

*Neutron and X-Ray Scattering Studies of  
New Green Cement, and Nanoconfined Water*

Award No. DE-FG02-90ER45429

**Final Report**

**Budget Period:** 9/01/1990 to 5/31/2017  
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**Principal Investigator:** Chen, Sow-Hsin  
Department of Nuclear Science and Engineering  
**Institution:** Massachusetts Institute of Technology, Cambridge, MA  
**Program Office:** DOE Office of Basic Energy Sciences (BES)  
**Program Manager:** Dr. Pappannan Thiyagarajan

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# Final Report

## *Neutron and X-Ray Scattering Studies of New Green Cement, and Nanoconfined Water*

### Executive Summary

This is the Final report on DE-FG02-90ER45429 for the time period from [September 1, 1990](#) to [May 31, 2017](#). The Principal Investigator is Sow-Hsin Chen, Department of Nuclear Science and Engineering, Massachusetts Institute of Technology (MIT), Cambridge, MA 02139 (email: [sowhsin@mit.edu](mailto:sowhsin@mit.edu)). The Administrative Point of Contact at MIT is Sarah Svenson, Senior Contract Administrator, Office of Sponsored Programs, Tel: 617-253-2495, [ssvenson@mit.edu](mailto:ssvenson@mit.edu). The DOE Program is the Office of Basic Energy Sciences (BES); Program manager is Dr. P. Thiyagarajan, Neutron Scattering SC-22.2/, Germantown Bldg., Germantown, MD 20874 <[Thiyagarajan@Science.DOE.GOV](mailto:Thiyagarajan@Science.DOE.GOV)>. During these 27 years, the scientific activities has had a number developing emphases, as reflected from the change of Project Title in 1990 as “*Construction of a Small Angle Neutron Scattering Spectrometer for Investigation of Microemulsions and Micellar Solutions in Bulk, in Porous Materials...*” to “*Neutron and X-Ray Scattering Studies of New Green Cement, and Nanoconfined Water*” in the last renewal period, 2015-2017, with many title changes in between. Progress Report for each sub-project period was reported to DOE with detailed activity and budgetary reports. It is fair to summary that the chief activity has been in the use neutron, x-ray and laser spectroscopy to investigate materials properties of complex fluids and soft condensed matter. It started with conducting neutron and X-ray scattering experiments to study the structure and dynamics of glass-forming liquids in general first, then more specifically in the case of supercooled water in confined geometry, and culminating in the final study of new green cement. Experiments were conducted at various DOE supported national neutron facilities including ORNL, ANL, BNL and Los Alamos, as well as at NIST/NCNR. Whenever possible, experiments were also performed at numerous world-class facilities, such as those at Saclay and the Institut Laue Langevin (ILL) in Grenoble, France, and at National Synchrotron Radiation Research Center (NSRRC) in recent years in Taiwan, etc. Leveraging on the large number of international collaborate activities, a substantial percentage of activities were supported with collaborators’ own funding sources. These have help to carry out DOE’s mission and produce impressive research products far beyond what was possible with only DOE funding supports. The chief product during this period, 1990-2017, includes (1) Three hundred and eight scientific articles published in peer-reviewed and high-impacted scientific journals during 1990-2017, and a dozen monographs including four books for scientists and graduate students, (2) Twenty-four scientific conferences organized and 209 papers presented at many national and international conferences, (3) educate and train 9 post-doctoral fellows and 28 students including 22 Ph.D. students, 3 M.S. students, and 3 in other categories by providing a research experience in neutron and X-Ray scattering techniques, most of them were supported wholly or in part in the scientific topic of this award during the funding period and (4) numerous high-visibility awards and honors. This final report summarizes and details these research activities and products. At the close of this funding period, the fund from DOE has been totally spent.

# *Neutron and X-Ray Scattering Studies of New Green Cement, and Nanoconfined Water*

## 1 Introduction and Summary

This is the Final report on DE-FG02-90ER45429 for the time period from [September 1, 1990](#) to [May 31, 2017](#). The Principal Investigator is Sow-Hsin Chen, Department of Nuclear Science and Engineering, Massachusetts Institute of Technology (MIT), Cambridge, MA 02139 (email: [sowhsin@mit.edu](mailto:sowhsin@mit.edu)). The Administrative Point of Contact at MIT is Sarah Svenson, Senior Contract Administrator, Office of Sponsored Programs, Tel: 617-253-2495, [ssvenson@mit.edu](mailto:ssvenson@mit.edu). The DOE Program is the Office of Basic Energy Sciences (BES); Program manager is Dr. P. Thiyagarajan, Neutron Scattering SC-22.2/, Germantown Bldg., [Germantown, MD 20874](#) <[Thiyagarajan@Science.DOE.GOV](mailto:Thiyagarajan@Science.DOE.GOV)>.

During these 27 years, the scientific activities has had a number developing emphases, as reflected from the change of Project Title in 1990 as “*Construction of a Small Angle Neutron Scattering Spectrometer for Investigation of Microemulsions and Micellar Solutions in Bulk, in Porous Materials...*” to “*Neutron and X-Ray Scattering Studies of New Green Cement, and Nanoconfined Water*” in the last renewal period, 2015-2017, with many title changes in between (see Section 1.1). Annual Progress Report for each years of each sub-project period was reported to DOE with detailed activity and budgetary reports. It is fair to summary that the chief activity and the major scientific goal of the PI’s research activity has been in the use neutron, x-ray and laser spectroscopy to investigate materials properties of complex fluids and soft condensed matter. It started with conducting neutron and X-ray scattering experiments to study the structure and dynamics of complex fluids in general first, then more specifically on supercooled water in confined geometry, and culminating in the final study of new green cement.

The PI has been conducting both quasielastic and inelastic neutron scattering spectroscopy work in earlier years using the world-class reactors at the high flux ones at Brookhaven (BNL), Oak Ridge National Laboratories (ORNL) and NIST/NCNR; at the Intense Pulse Neutron Source at Argonne National Laboratory; and also at those high flux ones at the Institut Laue-Langevin, Grenoble, France, and the Laboratoire Leon-Brillouin, CEN, Saclay, France. In the last decade, he has been a much more frequent user of Spallation Neutron Source (SNS) and High Flux Isotope Reactor (HFIR) at ORNL and the various neutron spectrometers at the Nuclear Center for Neutron Research (NCNR) at NIST. While NSLS-II at BNL is available to him now (was chosen as one of the very first users), but for his experiments, the Inelastic X-ray Scattering Spectrometer is still in the debugging stage. Internationally with the fast development of synchrotron facility capabilities in Asia, his group has collaborated and performed experiments at the Small-Angle-Wild-Angle X-ray Scattering (SAXS-WAXS) spectrometer at the National Synchrotron Radiation Research Center (NSRRC) in Taiwan. He has also fully utilized the NMR facility with fine oscillating disc viscometer for viscoelastic measurements at the University of Messina, Italy.

His research work during this project period includes the structure and dynamics of compressed hydrogen gas, rare gas liquids, and liquid metals; and more recently, structure and dynamics of water in supercooled states and near hydrophilic and hydrophobic surfaces, dynamics of proteins and other bio-macromolecules above and below the glass transition temperature. Highlights of these research activities are described in Section 2.3.

The scientific productivity during this period, 1990-2017, in terms of scientific papers published, conference presentations given, graduate students and post-doctoral fellows involved are

summarized in Section 2.2 and further elaborated in later sections. Some scientific highlights of the project are presented in Section 2.3, and recent highlights in 2.4. The chief products includes:

(1) Substantially large number, 308, of scientific articles published in peer-reviewed and high-impact-factor scientific journals, a dozen specialized monographs, including at least four highly utilized books for scientists and graduate students in the field (Sections 8.1 and 8.2 for details);

(2) Twenty-four national and international scientific conferences organized (Section 9.1) and 209 papers presented at many national and international conferences (Section 9.2);

(3) Professional services to various societies, such as the American Physical Society (APS), Neutron Scattering Society of America (NSSA), and the Materials Research Society (MRS), and the international neutron-related institutions and societies, as well as the wide-range of international outreach activities are described in Section 3;

(4) Educate and train 28 students including 22 Ph.D. students, 3 M.S. students, and 3 in other categories (Section 5.1) and 9 postdoctoral fellows (Section 5.2) by providing coveted research experience in neutron and X-Ray scattering techniques and thus contributed to the strength of scientific community;

(5) Cultivate, promote and expand the ever-growing number of both international and national collaborators to enhance the quality of research activities (Section 6); and finally,

(6) All these activities resulted in numerous high-visibility awards and honors naturally resulted from all these scientific activities and products (Section 4).

Expenditures and Cost Status is given in Section 7. DOE funds are highly capitalized by the accommodation and provision of neutron beam time, instrumentation, and technical support at all neutron scattering facilities where experiments are conducted. Supports for the collaborative Ph.D. students and post-doctoral fellows from some collaborators' own institutions, such as University of Florence and University of Messina, and the government of Taiwan have been invaluable (Section 5). It is clear that leveraging on the large number of international collaborate activities, a substantial percentage of activities were supported with collaborators' own funding sources as well as with their own high-level human resources. These have help to carry out DOE's mission and produce impressive research products far beyond what was possible with only DOE funding supports. The report ends with these quantifiable and qualified achievements.

At the close of the funding period, the fund from DOE has been totally spent.

## 1.1 Project Titles Changed over Time

Twenty-seven years is a long time. During this period, research activities have to change over time, and the available national facilities have also changed and upgraded in unimaginable ways. For example, the Spallation Neutron Source (SNS) at ORNL, and the upgraded facilities of NIST, to name just a couple, have given us such powerful facilities for experimental work. We expect that the NSLS-II at BNL will enhance our research capability as well. Our Project has utilized these facilities fully for the advancement of science in general areas of soft condensed matters physics using neutron and X-ray scattering methods, as reflected in the following title changes:

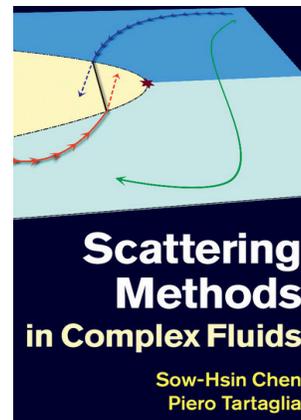
- *1990-1996: Construction of a Small Angle Neutron Scattering Spectrometer for Investigation of Microemulsions and Micellar Solutions in Bulk, in Porous Materials...*
- *1997-2001: Small-Angle Neutron Scattering Studies of Interfacial Curvatures in Bicontinuous Microemulsions and Viscoelasticity in Dense Micellar Solutions and Microemulsions*

- 2002-2005: *Neutron and X-Ray Scattering Studies of Kinetic Glass Transitions in Colloidal Systems with Short-Range Attractive Interactions and Dynamics of Supercooled Interfacial Water in Porous Materials and Lipid Bilayers*
- 2006-2012: *Neutron and X-Ray Scattering Studies of the Liquid-Liquid Transition in Supercooled Confined Water and the Slow Dynamics in Biomolecular Assemblies*
- 2012-2013: *Neutron and X-Ray Scattering Studies of the Liquid-Liquid Transition in Supercooled Confined Water and the Phonon-Like Collective Excitations in Globular Proteins*
- 2014: *Scattering Studies of the Liquid-Liquid Transition in Supercooled MCM41 Confined Water, Protein Hydration Water and Microstructure of New Green Cement*
- 2015: *Scattering Studies of Nanostructure of New Green Cement, Transverse Dynamics of Hydrated Proteins, and Phase Transition Phenomenon of Supercooled Water Confined in MCM-41 and OMC*
- 2015-2017: *Neutron and X-Ray Scattering Studies of New Green Cement, and Nanoconfined Water*

## 2 Progress Report: September 1, 1990 to May 31, 2017

### 2.1 Activities (including facilities used)

Some of the major scientific activities for this DOE funded research during 1990-2017 will be highlighted in Section 2.3. Yet, the major research results over the last two decades have been presented in various chapters in the PI's latest book jointly authored with Prof. Piero Tartaglia [*Scattering Methods in Complex Fluids*. Cambridge University Press, 2015.] We have highlighted some of these activities and research results in Section 2.3. We have also provide the activities of the last funding period, May 1, 2015 to May 31, 2017 in greater details to reflect the latest development that was not included in the 2015 book, in Section 2.4.



### 2.2 Productivity

During 1990 to 2017, research emphases have shifted from neutron reflectivity studies of surface geometry of bi-continuous microemulsions and colloids in the 1990s to the liquid-liquid phase transition phenomenon in supercooled confined water in the 2000's and ending with New Green Cement, and Nanoconfined Water. All enjoyed successful research results. For example, as shown in the highlights in Section 2.3, in 2004, this PI's group found a fragile-to-strong dynamic crossover phenomenon in deeply supercooled confined water by quasielastic neutron scattering experiments at ambient pressure. In 2006, his group discovered a density minimum in deeply supercooled water that further demonstrated the plausibility of the existence of the second critical point in supercooled water. This work was recognized with the PNAS's Cozzarelli Prize for "its outstanding scientific excellence and originality."

The scientific productivity in terms of scientific papers published, conference presentations

given, graduate students and post-doctoral fellows involved summarized has already been summarized in Section 1, with additional scientific highlights of the project presented in Section 2.3, and recent highlights in 2.4.

Despite of the quantities presented, it is important to stress the quality of the scientific productivity. For example, take journal publications for this discussion. In addition to the large quantity of 308 articles, the quality can be viewed from various angles, such as citations, the type of high-impact journals published in, etc. As shown in Google Scholar, the PI's publications have enjoyed some 30,000 citations, with the most cited ones include one article published in 1985 for about 800 times, and one in 2005 for over 560 times, and many others cited over 200 to 550 time. The annual citation pattern is another criterion. The Google Scholar shows that the annual citations have continued to increase from about 1300 in Year 2010 to over 2000 in Year 2016.

Furthermore, from the 308 papers published in peer-reviewed journals during 1990-2017 (Section 8.1), a rough count shows that over half of these papers were published in the following seven journals (over 22% in *Physical Reviews* and *Physical Review Letters*, and 5% in *PNAS*):

• Physical Review, A, B, C, E,	44
• Journal of Physics: Condensed Matter	26
• Physical Review Letters	25
• Journal of Physical Chemistry and Letters	24
• Journal of Chemical Physics	20
• Proceedings of National Academy of Sciences (PNAS)	18
• Nuovo Cimento	8

### 2.3 Scientific Highlights

As already mentioned, this PI's research work includes lattice dynamics of transition metals and molecular solids; structure and dynamics of compressed hydrogen gas, rare gas liquids, and liquid metals; and more recently, structure and dynamics of water in supercooled states and near hydrophilic and hydrophobic surfaces, dynamics of proteins above and below the glass transition temperature.

With the availability of small angle neutron scattering (SANS) facilities at ANL, BNL, ORNL, and NCNR, he has successfully developed new techniques to determine the structure and mutual interactions of self-assembled systems such as micelles, microemulsions and proteins surfactant complexes in solution with SANS technique. He also investigated extensively the coexistence of critical phenomena and percolation transition in three-component microemulsions and copolymer micellar solutions. Since 2000, together with a student C. Liao, they developed a theory for analyzing high-resolution inelastic x-ray spectra and have succeeded in the determination of the in-plane phonon dispersion relations in lipid bilayers in both the gel and liquid crystalline phases. In 2003, they have measured phonons propagating along the helical axis of B-DNA in a liquid crystalline phase. In 2006, they measured intra-protein phonons in many globular proteins for the first time. They found a strong correlation between the counter-ion valency and the phonon damping. In 2004, his group found a fragile-to-strong dynamic crossover phenomenon in deeply supercooled confined water by quasielastic neutron scattering experiments at ambient pressure. An extension of this experiment to a series of measurements under pressure further led to discovery of the existence of a second low-temperature critical point in water in 2005. In 2006, his group discovered a density minimum in deeply supercooled water that further demonstrated the plausibility of the existence of the second critical point in supercooled water. As early as 2008, a high-resolution Quasi-Elastic Neutron Scattering was used by his group to investigate the slow dynamics of hydration water

confined in calcium silicate hydrate gel in an aged cement paste at supercooled temperatures, and a super-Arrhenius to an Arrhenius dynamic crossover of the translational relaxation time  $\langle \tau \rangle$  as a function of inverse temperature is observed at  $T_L = 231 \pm 5 \text{K}$ . His more recent studies include slow dynamics of confined water in deeply supercooled states, in porous glasses, and near hydrophilic and hydrophobic surfaces such as those in MCM-41S porous silica, carbon nanotubes, in cement, and on the surfaces of proteins, DNAs and RNA. Most recently, his group discovered the strongest evidence so far for the existence of a Liquid-to-Liquid Phase Transition (LLPT) in low-temperature water.

In the areas of small angle scattering, he is considered as one of the major scientists that applied both SANS and SAXS to solve problems in colloid and complex fluid areas. In the aspect of techniques and methods of using SAS, he has made long-lasting contributions. Among which there are the most cited work with Dr. M. Kotlarchyk in the formulation of the so-called decoupling approximation to handle the calculation of the SANS intensity distribution of interacting nonspherical particles in solution and to correct for the effect of polydispersity (1983); in his development with Jose Teixeira on the fractal approach to calculate the scattering intensity distribution of protein-detergent complexes in solution (1986, 1990); in his successful development with Drs. Dan Lee and Sung-min Choi, for the first time in mid 1990's, of a contrast variation method to measure the average mean curvature of surfactant film in a bi-continuous microemulsion, and followed by the introduction of the Clipped Random Wave Model with Prof. T. Hashimoto of Kyoto, that enabled them to successfully measure the average Gaussian Curvature of the surfactant film as well; and with Dr. Wei-Ren Chen, for the first time around 2002, the introduction of the new method of the scaling plot of SANS intensity to determine the structural arrest phase boundary in L-64 copolymer micellar system and confirmed the mode-coupling theory prediction of the A3 singularity point of colloids with short-range attraction.

The research activity made possible by Award No. DE-FG02-90ER45429 has been summarized in the PI's 2015 Book with Prof. Piero Tartaglia [*Scattering Methods in Complex Fluids*. Cambridge University Press, 2015], as stated in Section 2.1.

## 2.4 Recent Scientific Highlights

Since the 2015 books covers materials to the date of publication around April 2015, the following include the latest scientific highlights with results reported in more than 15 scientific papers as reported in Section 8.1:

- 1) For the primary research in Green Cement on the kinetics of hydration process in cement paste, we collaborate extensively with the group of Prof. Piero Baglioni of Chemistry Department, University of Florence. Prof. Emiliano Fratini, a member of Prof. Baglioni's group, prepares all the needed cement samples as well as shares his expertise knowledge on the subject.
- 2) For light scattering and NMR measurements, we collaborate with Prof. Francesco Mallamace of Physics Department of University of Messina, Italy. Prof Mallamace also possesses a very fine oscillating disc viscometer for viscoelastic measurements.
- 3) We collaborate with Dr. U-Ser Jeng of the National Synchrotron Radiation Research Center (NSRRC) in Hsin-chu, Taiwan. The NSRRC, Taiwan has built a third generation 3 GeV synchrotron3, a powerful x-ray radiation source. NSRRC has also been operating a world class Small-Angle-Wild-Angle X-ray Scattering (SAXS-WAXS) spectrometer.
- 4) For SANS work, we mostly use NG-7 and NG-3 30-m SANS instrument at NIST Center for Neutron Research (NCNR). We receive the technical assistance of Dr. Paul Butler, Dr. Boualem

Hammouda and Dr. Yun Liu.

- 5) We also use SANS-I in HFIR and EQ-SANS at SNS, Oak Ridge National Laboratory (ORNL). Dr. Ken Littrell and Dr. William Heller provide technical assistance.
- 6) For QENS work, we use Disc-Chopper Time-of-Flight Spectrometer (DCS) and High-Flux Backscattering Spectrometer (HFBS) at NIST NCNR. Dr. John Copley, Dr. Antonio Faraone, Dr. Madhu Tyagi and Dr. Juscelino Leao provide long-time technical assistance. We also use the backscattering spectrometer BASIS at SNS, ORNL.
- 7) For INS work, we use DCS at NCNR and SEQUOYA, CNCS at SNS. We collaborate with Dr. Eugene Mamontov and Dr. Alexander Kolesnikov and receive technical assistance from Dr. Mark
- 8) We have been, throughout the years, the regular users of the high-resolution Inelastic X-ray Scattering Spectrometer in ID-3-C and ID-30 beamlines of APS, Argonne National Laboratory, for our IXS investigation of biological macromolecules. Dr. A. Alatas, Dr. A. Said, Dr. B. Leu and Dr. E. Alps of APS have provide technical assistance
- 9) During this last period, we have been selected to be one of the very first users to test use the brand new NSLS-II 10-ID Beamline Inelastic X-ray Scattering spectrometer with 1 meV resolution at Brookhaven National Lab. 24 days of beam time has been promised for the first two years. For our proposed study, we collaborate with Prof. Piero Baglioni group of the University of Florence. They will provide us with all the needed samples for hydrated protein studies. The equipment is still under refinement. Dr. Yong Cai of NSLS-II and Dr. Ahmet Alatas of APS provide their technical collaboration.

After May 31, 2017 at the end of DOE' funded project, the collaborative research activities with the University of Florence Group, University of Messina Group, and NSRRC in Taiwan are expected to continue, so is the research activity at BNL.

### 3 Professional Services and International Outreach

Aside from some of the contributions stated in Section 2.3, in earlier years, Sow-Hsin Chen has been active as an organizer of domestic and international symposia and the NATO Advanced Study Institute. He also has been active as a consultant to numerous developing countries with regard to their nuclear power development programs. He served as an advisor to the National Science Council and the Institute of Nuclear Energy Research of Republic of China (ROC), and the Korean Atomic Energy Research Institute (KAERI) of the Republic of Korea on the matter of nuclear power planning and development in the respective countries from 1972 for over twenty years. He has served as a consultant to Schlumberger-Doll Research of Ridgefield, Connecticut, on neutron molecular spectroscopy; to Exxon Research and Engineering Co., Annandale, New Jersey, on neutron small angle scattering; and to Texaco Research Center, Beacon, New York, on neutron scattering studies of aggregation behavior in Asphaltene. He was the US Chair of the ground-breaking *First U.S.-China Workshop on Neutron Science and Technology* (2006), and *Second US-China Workshop on Scientific and Industrial Applications Using Neutrons, Muons and Protons* (2008) sponsored by the US National Science Foundation. These two Workshops have set the foundation for all the active developments of the field in China ever since.

He was a Program Advisory Committee member for the U.S. National Pulse Neutron Sources, IPNS/LANSCE; a Program Review Committee member for the Solid State Division, Chemical Sciences and Chemical Technology Divisions of ORNL and member of various panels reviewing

proposals submitted to the U.S. National Science Foundation's Engineering Research Center. In March 2003, he was a member of a Committee of Visitors (COV) to Basic Energy Sciences Division of DOE to review the policy of all DOE funding in neutron and x-ray sciences in the U.S. He was the chairman of the review committee for the NIH Collaborative Instrumentation Block Grant in 1999. In the SANS area, he was the main invited lecturer at the IAEA Regional Workshop on SANS held at the Bhabha Atomic Energy Research Institute in Bombay, India in 1995, and co-Chaired with Dieter Schneider the *XI International Conference On Small Angle Scattering -SAS 99*, May 17-20, 1999, BNL. He was a member of the Editorial Board (Liquid Section) of the *Journal of Physics Condensed Matter* (U.K.) from 1992 to 1998. He is still active as a guest editor of some special issues of the *JPCM*. In the last three years, he has been a member of the Beamline Advisory Team of NSLS-II Inelastic X-ray Scattering (IXS) of the BNL. In 2014, he was a key member of the Organizing Committee of the 2<sup>nd</sup> cyber enabled collaborative graduate course, *Neutrons in Soft Matter Science: Complex Materials on Mesoscopic Scales*, taught by expert scientists and professor from 15 contributing institutions, offered jointly by ORNL and University of Tennessee.

He has worked tirelessly throughout his entire career to foster the international community of nuclear science and technology. As the graduate of the first Graduate School of Nuclear Science at the National Tsing Hua University (NTHU) in 1956, he has helped to establish a *Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Technology* at the NTHU and has brought world renown neutron scientist to the university each year since 2013. The four lecturers thus far are: Dr. John M. Carpenter of ANL (2013); H.E. Dr. Khaled Toukan, AEC Commissioner of Jordan (2014), Prof. Sunil K. Sinha of UC San Diego (2015), and Prof. Piero Baglioni of University of Florence (2016). Each *Lectureship* was participated by over 200 people. He has contributed to the creation of the Sow-Hsin Chen Fellowship in Neutron Science at M.I.T. to benefit needed and worthy neutron science graduate students to MIT. He has created collaborative projects with NSRRC in Taiwan on X-ray scattering research on green cement, and also developed a collaborative project between MIT and both NTHU and Tsinghua University in Beijing as well as NSRRC under the MIT's MISTI (MIT's International Science and Technology Initiatives) program.

## 4 Awards and Honors

Prof. Chen is a Fellow of the American Physical Society, the American Association for the Advancement of Science, and the Neutron Scattering Society of America. He is an Academician of the Academia Sinica, Taiwan.

He received the Alexander von Humboldt U.S. Senior Scientist Award from Germany during 1987-88, and the "revisit" award in the summer of 1995. In the spring of 1995, as a Fellow of the Japan Society for the Promotion of Science, he spent a month in Kyoto University in addition to conducting a lecture tour to many Japanese universities and research institutes. For his contribution and achievement, the Nuclear Science and Engineering Department of MIT awarded him a Career Achievement Award in May 2002. He received an Outstanding Alumni Award from National Tsing Hua University in Taiwan (2006) and the Distinguished Alumni Award by the Physics Department of National Taiwan University in Nov. 2012.

He and his co-authors received the 2006 *PNAS* Editorial Board *Cozzarelli Prize* for the paper "The violation of Stokes-Einstein relation in supercooled water" for its outstanding scientific excellence and originality. He is the recipient of the 2008 *Clifford G. Shull Prize*, the highest recognition given by the Neutron Scattering Society of America with the citation: "For seminal contributions to understanding the dynamical properties of supercooled and interfacial water using neutron scattering techniques, and for an exceptional record of training young scientists in the use of scattering techniques to solve topical interdisciplinary problems in complex fluids and soft matter."

Sow-Hsin Chen received the *Guinier Prize* at SAS2015, September 17, 2015, Berlin, Germany. “The Guinier prize recognizes either lifetime achievement, or a major breakthrough, or an outstanding contribution to the field of small-angle scattering... [Chen] met all three of these criteria,” as, stated by Prof. Jill Trehwelfa, Chair of the IUCr Commission on Small-Angle Scattering.

Sow-Hsin Chen received *Dottore di Ricerca* “*Honoris Causa*” in Fisica (Honorary Doctorate in Physics) from University of Messina, Italy on May 9, 2014. He was cited for his pioneering research on the existence of the Liquid-Liquid Phase Transition (LLPT) in supercooled water, part of which has been conducted in collaboration with Prof. Francesco Mallamace and his group at the University of Messina over the last 20 years [<http://web.mit.edu/nse/news/2014/chen-honorary-doctorate.html>]. On November 18, 2016, he was also awarded the Honorary Doctor of Science, *honoris causa*, from his alma mater, McMaster University, Hamilton, Ontario, Canada at the university’s November Convocation. He was cited for many of his “groundbreaking work” including specifically the “investigations into the properties of disordered materials and supercooled and interfacial water, using neutron scattering and other related scattering techniques” [<http://web.mit.edu/nse/news/2016/chen-honorary-doctorate.html>]

## 5 Graduate Students and Post-Doctoral Fellows

### 5.1 Graduate Students

During 1990-2017, the DE-FG02-90ER45429 award supported the following graduate students at MIT except those supported by their home organizations with \*\*:

	Name	Graduation Date	From	Degree	Current Affiliation
1	S. L. Chang	1991	Taiwan	Ph.D.	National Tsing Hua University, Taiwan and CEO, Radiation Protection Assoc.
2	Xuan Hui Guo	1991	China	Ph.D.	Wall Street
3	Xiao Lin Zhou	1992	China	Ph.D.	
4	K.F. Bradley	1993	U.S.A.	Ph.D.	U.S. industry
5**	Piero Lo Nostro	1995	Italy	Ph.D.	University of Florence, Assist. Professor
6	Daniel Lee	1995	U.S.A.	Ph.D.	University of Pennsylvania, Full Professor
7	Bruce L. Carvalho	1995	U.S.A.	Ph.D.	American industry
8	Chwen-Yuan Ku	1996	Taiwan	Ph.D.	Taiwan instrumental co. Engineer
9	Yingcun Liu	1997	China	Ph.D.	U.S. west coast industry
10	Sung-Min Choi	1998	South Korea	Ph.D.	KAIST, Nuclear & Quantum Engineering Department Chair, South Korea
11	Ciya Liao	2001	Taiwan	Ph.D.	Oracle, Senior Database Expert
12**	Emiliano Fratini	2002	Italy	Ph.D.	University of Florence, Associate Professor
13	Wen-Ren Chen	2004	Taiwan	Ph.D.	ORNL, Research Scientist
14	Li Liu	2005	China	Ph.D.	RPI, Associate Professor
15	Yun Liu	2005	China	Ph.D.	NIST, Research Scientist and University of Delaware, Research Professor
16	Dazhi Liu	2008	China	Ph.D.	Wall Street
17**	Marco Lagi	2009	Italy	Ph.D.	Start own company in Boston
18	Yang Zhang	2010	China	Ph.D.	University of Illinois, Assistant Professor
19	Xiang-Qiang Chu	2010	China	Ph.D.	Wayne State University, Assistant Professor
20	Wei-Shan Chiang	2014	Taiwan	Ph.D.	NIST, Post-Doctoral Fellow
21	Zhe Wang	2015	China	Ph.D.	Tsinghua Univ., Beijing China, Assist. Prof.
22	Peisi Le	2017	China	Ph.D.	Google, San Jose, CA, Network Scientist
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23	Darwan Choy	2001	Singapore	M.S.	Singapore government
24	Poe-Jou Chen	2002	Taiwan	M.S.	Taiwan industry
25	Chansoo Kim	2004	South Korea	M.S.	KIST, South Korea
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26	Mingda Li	China	MIT, Assistant Professor, January 18, 2018 (Paid by DOE grant under Prof. Chen for the first two years at MIT as Ph.D. graduate student, 2009-2011)
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27**	Jiayue Wang	China	MIT, Ph.D. candidate, Sept. 2015 on (Summer Visiting Student in 2014 from Tsinghua University, Beijing, China and supported by Tsinghua)
28**	Li-Li Zhang	China	McMaster Univ. Ph.D. candidate, Sept./16 on (Visiting Student from Jinan University, China from Sept. 2014-May 2015. First semester paid by Jinan and January to May 2016 supported by DOE grant.)

## 5.2 Post-Doctoral Fellows

During 1990-2017, the DE-FG02-90ER45429 award supported three Post-Doctoral Fellows at MIT – Dr. Jianlan Wu (2007-2008), Dr. Christopher E. Bertrand (2012-2013), and Dr. Kanae Ito (2014-16). Yet, the project benefited substantially from six additional full-time post-doctoral fellows supported by their home-base institutions for multi-years and one visiting scholar. These include Dr. Paolo Gallo supported by Italian funding source from University of Rome III (1995-1997), Dr. Emiliano Fratini supported by University of Florence (2002-2003), Dr. Antonio Faraone supported by University of Messina, Italy (2003-2004), and Dr. Matteo Broccio also supported by University of Messina, Italy (2007-2009); Dr. C.S. Tsao supported by the Institute of Nuclear Research, Longtan, Taiwan (2009-2011), and Dr. Kao-Hsiang Liu from Academia Sinica, Taiwan and supported by the National Science Council of Taiwan (2012-2015). Prof. Li-Hua of Jinan University, China was supported by Jinan from 2011-2012 as visiting scholar to MIT.

## 6 Research Collaborators

When recent scientific highlights were mentioned in Section 2.4, many international and national research collaborators were mentioned in relation to each type of experiments. Throughout the years, the PI has been extremely fortunate to cultivate long and close collaborations with over 80 collaborators all over the world throughout the years. Before 1990, most collaborators came from Europe, and some of them have continued to collaborate for over 30 years, even long before this 27-year project. It is impossible to list all of them, but all of them are listed as co-authors of the research publications with their institutional affiliations clearly indicated as listed in Section 8. In the following, only a few are highlighted.

### 6.1 International Collaborators

Of all the international collaborators, two stands out as the most active and persistent ones in this project period. They are Prof. Piero Baglioni of the University of Florence, Italy, and Prof. Francesco Mallamace of the University of Messina, Italy. Both started their collaboration with this PI in the early 1990 and have continued ever since, and have had over 60-70 joint papers respectively with Chen. They both sent their student(s) and post-doc(s) to MIT to learn and work under S.H. Chen's supervision during this project period, and all of them have become close collaborators as well, such as Prof. Piero Lo Nostro, Prof. Emiliano Fratini, and Dr. Marco Lagi from Florence; and Dr. Antonio Faraone and Dr. Mateo Broccio from Messina. Prof. Baglioni's group collaborates with Chen's ground in the area of charged colloids and cement research, and most recently on green cement area. Prof. Emiliano Fratini provides the experimental samples as well as much of his expertise knowledge

in cement. Prof. Mallamace's group including Dr. Carmero Corsaro and others collaborates with Chen's group in the broad areas of photon-correlation spectroscopy of complex liquids, and the dynamic crossover transition in glass forming liquids, including supercooled water. It is expected that these Florence and Messina activities will continue actively.

In addition, there are many other long-time collaborators from Europe. They include Prof. Piero Tartaglia of University of Rome, starting from 1972 and published 54 joint papers on photon-correlations spectroscopy of complex fluids (1972 to 2010), and co-authored the 2015 book, *Scattering Methods in Complex Fluids: Selected Topics*, Cambridge University Press; Dr. Marie-Claire Bellisant-Funel of Laboratoire Léon Brillouin, CEA-CNRS, Saclay, France (1982-2014) with over 25 joint papers on quasielastic neutron scattering experiments in supercooled water, protein solution, etc.; Dr. Jose Teixeira of CNRS, Saclay, France (1980-2000) with 18 joint papers on neutron scattering experiments in the detection of high-frequency sound wave in supercooled water and fractal scattering from denatured protein systems; Prof. Francesco Sciortino of University of Rome I with 15 joint papers (1994-2005) and Prof. Paola Gallo of University of Rome III with 12 joint papers from 1995 to 2014 on the applications of mode-coupling theory for explaining the dynamics of supercooled water; Prof. A. Coniglio (2004-2006); Prof. Antonio Cupane of University of Palermo (joint international conference in 2015); Prof. Jacques Rouch of University of Bordeaux (with 38 joint papers from 1976-1996); Profs. Heinz Hoffman and Jurgen Kalus of University of Bayreuth, Bayreuth, and Prof. Rudolph Kline of University of Konstanz, Germany (1987-1995); Prof. R. Strey of University of Cologne, Germany (7 joint papers during 1990-2002); Prof. Kenneth A Dawson of UCD, Ireland and Prof. Otto Glatter of Graz University of Technology, Austria for joint activities with the EU's Marie Curie Research and Training Network from 2004-2008; Dr. Jon Samseth of Norway (1986-1993); and Dr. K. Mortensen of Riso National Laboratory, Denmark (1990-1992).

In Asia, most of the collaboration started after 1990. The earliest was the collaboration with Prof. T. Hashimoto of University of Kyoto in 1995 for a few years, and with Prof. Michio Tokuyama of Tohoku University in Sendai since early 2002, and became one of the key speakers of Tokuyama's series of *International Symposium on Slow Dynamics in Complex Systems* from the first in 2003 to 4<sup>th</sup> in November 2012. But, the most scientifically significant and long lasting collaboration is that with Prof. C.Y. Mou of National Taiwan University. From 2002 to the present, more than 20 joint publications have resulted because Mou's lab has provided Chen's group the samples created for nanoconfined water and has opened up a new chapter of water research on the liquid-liquid phase transition of supercooled water. Mou also sent his post-doc, Dr. Kao-Hsiang Liu, to spend three years (2012-2015) at MIT, and Chen has also linked him to his European network including collaboration with Profs. Baglioni and Mallamace. From 2010, in relation to Chen's activities (see Section 3) with the National Tsing Hua University, more substantive collaboration with the National Synchrotron Radiation Research Center has materialized starting with Prof. S.L. Chang, and more substantively with Dr. U-Ser Jeng's group (2012-2017) with experimental work using NSRRC's Small-Angle-Wild-Angle X-ray Scattering (SAXS-WAXS) spectrometer. Section 3 will show considerable outreach work in China and Korea. There is strong collaboration with Prof. Sung-Min Choi, Chair of the Nuclear & Quantum Engineering Department, KAIST, South Korea, after his graduation from MIT in 1998 with 11 joint papers, and with Prof. Li-Mei Xu of Peking University, collaboration with who started from her Ph.D. time at Boston University in 2005 to the present with almost 10 joint papers. Others include Dr. C.S. Tsao as post-doc from Institute of Nuclear Energy Research, Longtan, Taiwan, with 4 joint papers (2008-9), and Prof. Li Hua as visiting scholar from Jinan University, Guangzhou, China with 3 joint papers (2011-2012).

In the Latin America, most collaboration has been with Mexican physicist, including Prof. Magdaleno Medina Noyola of the San Luis Potosi University and Dr. Marcelo Lozada-Cassou. They

are frequent participants of each other's international conferences. Prof. Noyola and his post-doc also spent time at MIT in 2008-2009 while S.H. Chen lectured at the summer school at San Luis Potosi University in June 2007.

## 6.2 National Collaborators

The division of “international” and “national” or “country” collaborators is rather artificial, but more for convenience sake. In reality, like a real network diagram, the collaborative graphic is like a spider web. Having said that, the national collaborative activities can be categorized as:

(1) Scientists and some long-time “invisible college” professionals – such as Dr. Chun Loong, formerly of Argonne National Laboratory (ANL) with 7 joint papers (1984-2006) but substantial joint international out-reach activities (Section 3), Dr. David Price also formerly of ANL and Dr. Marie-Louise Saboungi. Dr. P. Thiyagarajan, formerly of ANL with 4 joint papers (1990-2004), Dr. Jack Carpenter of ANL (Section 3), Dr. John Huang formerly of Exxon Research Center, NJ (1990-1996) with more than 5 joint papers, and Prof. Huey W. Huang of Rice University (2001-2002). Yet, Prof. E.H. Stanley and his research group at Boston University should be singled out. The collaboration with the Stanley group was long before 1990, but since 1997-2017, there were 33 joint papers, and many of his former Ph.D. students also became collaborators as they moved on to their new affiliations both nationally and internationally.

(2) Former doctoral students or post-docs – such as Dr. Eric Sheu with 4 joint papers after 1990 (1990-1999); Dr. Yun Liu of NIST and Delaware University with 24 joint papers (1994-2011); Prof. Sung-Min Choi of KAIST with 11 papers; Dr. W.R. Chen of ORNL with 14 papers (2002-2006); Prof. M. Broccio of University of Pittsburgh with a dozen joint paper (2003-2010); Dr. Antonio Faraone of NIST with 25 joint papers (2002-2012); Dr. M. Lagi with 9 joint papers (2008-2010); Dr. C.E. Bertrand (2012-2013) with 4 joint papers; Dr. M. Li (2010-2014) with 4 joint papers; Dr. K. Ito (2014-2016) with 5 joint papers; Prof. Y. Zhang of University of Illinois with over 20 joint papers (2006-2013); Prof. Z. Wang, formerly with ORNL and now with Tsinghua University, Beijing, China with more than 10 joint papers (2013-2016). Much of their collaborative work continue after their time at MIT.

(3) Scientists and instrument scientists at national laboratories – Section 2.4 is a microcosm of how the project collaborates with scientists in this group each year. They are all listed as co-authors in Section 8.1, thus those not list in the above Section 6.2(2) are highlighted here. At ORNL: Drs. A. I. Kolesnikov, K.C. Littrell, Eugene Mamontova, William Heller, A. Podlesnyak; and J.S. Lin; at NIST/NCNR: Drs. Juscelino B. Leão, Madhu Tyagi, Leland Harriger, William A. Kamitakahara and Sung Chang, J.R.D. Copley, C.F. Majkrzak and S.K. Satija; APS/ANL: Drs. Ahmet Alatas. E. E. Alp, B. Leu, A. Said, A. P. Moravsky, and Gian P. Felcher; and at BNL/ NSLS-II: Dr. Yong Cai.

## 7 Expenditures and Cost Status

Throughout the years, the main expenditures are stipends and overhead support for graduate students and salary and operation support for post-docs when applicable, as well as a portion of the summer salary for the PI. Since all experiments have been carried out at major neutron facilities in the US, travel cost related to these experiments has been also a significant part of the annual award. All these funds for experiments have been highly leveraged by support from national and international neutron facilities that fund experiments once requested beam time has been awarded on a competitive base. When experiments are collaborated with international collaborators, they have been responsible for expenses related to their students and post-docs. In addition, some collaborators, specifically those

from University of Florence and University of Messina, have provided needed human resources such as students and post-doctoral fellows, as well as samples for experiments and necessary scientific equipment. Small amount of funds have also been requested for the attending and presenting scientific results at national and international meeting, for necessary computer equipment for data analyses at MIT. At the end of May 3, 2017, all DE-FG02-90ER45429 funds have been completely spent.

## 8 Publications, 1990 – 2017

### 8.1 Journal Articles

[308 papers, Nos. 168-476 taken from <http://http://globalcc.org/shc/journals/> for 1990-2017, are listed]

476. Corsaro, Carmelo, Francesco Mallamace, Sebastiano Vasi, Sow-Hsin Chen, H. Eugene Stanley, and Domenico Mallamace, **“Contrasting microscopic interactions determine the properties of water/methanol solutions,”** *Front. Phys.*, 12 (x): xx; DOI 10.1007/s11467-017-0685-7 (2017).

475. Mallamace, Francesco, Carmelo Corsaro, Sveva Longo, Sow-Hsin Chen and Domenico Mallamace, **“The evaluation of the hydrophilic-hydrophobic interactions and their effect in water-methanol solutions: a study in terms of the thermodynamic state functions in the frame of the transition state theory,”** *Colloids and Surfaces B: Biointerfaces - Special Issue celebrating Prof. P. Baglioni’s 65th birthday*, Submitted (2017).

474. Le, Peisi and S.-H. Chen, **“Hydration-dependent dynamics of water in calcium-silicatehydrate: A QENS study by global model,”** *Colloids and Surfaces B: Biointerfaces - Special Issue celebrating Prof. P. Baglioni’s 65th birthday*, Ms. Ref. No.: COLSUB-D-17-01797 (2017).

473. Ridi, Francesca, E. Fratini, M. Toneli, S.-H. Chen, P. Baglioni, **“Water as a probe of the colloidal properties of cement,”** *Langmuir (Accepted for publication as an Invited Review Article)*, Manuscript ID: la-2017-02304r.R2 (2017).

472. Le, Peisi, Emiliano Fratini, Lili Zhang, Kanae Ito, Eugene Mamontov, Piero Baglioni, and Sow-Hsin Chen, **“Quasi-elastic neutron scattering study of hydration water in synthetic cement: an improved analysis method based on a new global model,”** *Journal of Physical Chemistry C*, 121 (23):12826–12833. DOI: 10.1021/acs.jpcc.7b03233 (2017).

471. Rezhdo, O., S. Di Maio, Peisi Le, K.C. Littrell, R.L. Carrier, S.-H. Chen, **“Characterization of colloidal structures during intestinal lipolysis using small-angle neutron scattering,”** *J. Colloid Interface Sci.*, 499: 189-201 (2017).

470. Wang, Zhe, Kanae Ito, and Sow-Hsin Chen, **“Detection of the liquid-liquid transition in the deeply-cooled water confined in MCM-41 with elastic neutron scattering technique,”** *Il Nuovo Cimento*, 39C: 299 (2016), (Presented at the *Int’l Workshop on The Structure and Dynamics of Supercooled Water & Other Glassy Materials*, Palermo, Italy, October 10-13, 2015. (2016).

469. Mallamace, Francesco, Carmelo Corsaro, Domenico Mallamace, Sebastiano Vasi, Cirino

- Vasi, Piero Baglioni, Sergey V. Buldyrev, Sow-Hsin Chen, and H. Eugene Stanley, **“Energy landscape in protein folding and unfolding: A 1H NMR study,”** *Proc. Natl. Acad. Sci. USA*, 113, 3159-3163; [[www.pnas.org/cgi/doi/10.1073/pnas.1524864113](http://www.pnas.org/cgi/doi/10.1073/pnas.1524864113)] (2016).
468. Le, Peisi, Emiliano Fratini, Kanae Ito, Zhe Wang, Eugene Mamontov, Piero Baglioni, and Sow-Hsin Chen, **“Dynamical behaviors of structural, constrained and free water in calcium- and magnesium-silicate-hydrate gels,”** *Journal of Colloid and Interface Science*, 469, 157–163 [<http://dx.doi.org/10.1016/j.jcis.2016.01.071>] (January 2016).
467. Wang, Zhe, A. I. Kolesnikov, K. Ito, A. Podlesnyak, and S.-H. Chen, **“Pressure effect on Boson peak in deeply cooled confined water: Evidence of a liquid-liquid transition,”** *Phys. Rev. Lett.*, 115, 235701; DOI: 10.1103/PhysRevLett.115.235701 (Dec. 4, 2015).
466. Wang, Zhe, Alexander I. Kolesnikov, and Sow-Hsin Chen, **“Wang et al. Reply to Comments by F. Formisano and S. De Panfilis, preceding Comment, Phys. Rev. Lett. 115, 149801 (2015).”** *Phys. Rev. Lett.*, 115, 149802 (October 2, 2015).
465. Mallamace, F., C. Corsaro, D. Mallamace and S.-H. Chen, **“Erratum to: The fragile-to-strong dynamical crossover and the system viscoelasticity in attractive glass forming colloids,”** *Colloid and Polymer Science*, pp. 293:3351; [<http://dx.doi.org/10.1007/s00396-015-3713-6>] (2015).
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461. Mallamace, Francesco, Carmelo Corsaro, Domenico Mallamace, Sebastiano Vasi, Cirino Vasi, H. Eugene Stanley, and Sow-Hsin Chen, **“Some thermodynamical aspects of protein hydration water,”** *Journal of Chemical Physics*, 142, 215103; [<http://dx.doi.org/10.1063/1.4921897>] (2015).
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458. Mallamace, F., P. Baglioni, C. Carmelo, S.-H. Chen, D. Mallamace, C. Vasi, and E.H. Stanley, **“The influence of water on protein properties,”** *J. Chem. Phys.*, 141, 165104; DOI: 10.1063/1.4900500 (2014).
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## 8.2 Books and Monographs

1. Sow-Hsin Chen and Piero Tartaglia. *Scattering Methods in Complex Fluids*. Cambridge University Press, 2015.

2. Chen, S.H. and M. Kotlarchyk. *Interaction of Photons and Neutrons With Matter -- An Introduction*. Singapore: World Scientific Pub., 2007. 2nd edition.

3. Chen, S.H. and M. Kotlarchyk. *Interaction of Photons and Neutrons With Matter -- An Introduction*. Singapore: World Scientific Pub., 1997. 1st edition.

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M8 Chen, S.H., Guest editor. *Dynamically Slow Process and Near-arrest Phenomena in Soft Matter*. Published as a special section in *J. Phys. Condensed Matter*, vol. 21, no. 50, Dec. 16, 2009.

M7 Chen, S.H. and P. Baglioni, eds. Special Issue: *International Workshop on Topics in Application of Scattering Methods to Investigation of Structure and Dynamics of Soft Condensed Matter*. Published as *J. Phys. Condensed Matter*, August 2006.

M6 Chen, S.H., F. Mallamace, and F. Sciortino, eds. Special Issue: *Structural Arrest Transitions in Colloids With Short-Range Attractive Interaction*. Published as *J. Phys. Condensed Matter*, vol. 16, no. 42, Oct. 27, 2004.

- M5 Chen, S.H. and M.C. Bellissent-Funel, eds. Special Issue: *Topics on Scattering Studies of Structure and Dynamics in Complex Fluids*. Published as *J. Phys. Condensed Matter*, v. 13, no. 41, Oct. 15, 2001.
- M4 Mallamace, Francesco, Sow-Hsin Chen, and Piero Tartaglia, eds. *The Morphology and Kinetics of Phase Separating Complex Fluids*, Proceedings of the International Conference in Messina (Italy), June 24-28, 1997. Published as *Il Nuovo Cimento*, v. 20, D. N. 12 bis, Dec. 1998.
- M3 Chen, S.H., ed. *Topics in Complex Fluids*. Special issue of *J. Phys. Condensed Matter*, v. 8, no. 25A, 17 June, 1996.
- M2 Blum, L. and S.H. Chen, eds. *Colloid and Interface Science: Trends and Applications*. Proceedings of the Workshop held on the occasion of the 60th birthday of Sow-Hsin Chen at Guanica, Puerto Rico, 2-5, May, 1995, appears in *Physica A*, v. 231, no. 1-3, Sept.15, 1996.
- M1 Chen, S.H., J.S. Huang, and P. Tartaglia, eds. *Structure and Dynamics of Strongly Interacting Colloids and Supramolecular Aggregates in Solution*. *NATO Advanced Study Institute Series A: Physics*, v. 369. 1992.

## 9 Conferences Organized and Presentations, 1990 – 2017

### 9.1 Conferences Organized

June 27-July 1, 2016

*2016 Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Technology*, National Tsing Hua University, Hsin-chu, Taiwan, June 27-July 1, 2016. Invited Lecturer: Piero Baglioni.

October 10-13, 2015

*International Workshop on The Structure and Dynamics of Supercooled Water and Other Glassy Materials*, Palermo, Italy, October 10-13, 2015. Organizers: A. Cupane, Piero Baglioni, S.H. Chen, Francesco Mallamace, and C.Y. Mou.

April 29-30, 2015

*2015 Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Technology*, National Tsing Hua University, Hsin-chu, Taiwan, April 29-30, 2015. Invited Lecturer: Sunil K. Sinha.

September 3 – December 5, 2014

*Neutrons in Soft Matter Science: Complex Materials on Mesoscopic Scales*. Courses jointly offered by ORNL and Joint Institute for Neutron Science of University of Tennessee and coordinated by Meiyun Chang-Smith. S.H. Chen, Tekeshi Egami and Sunil Sinha on Organizing Committee.

June 26-27, 2014

*2014 Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Technology*, National Tsing Hua University, Hsin-chu, Taiwan, June 26-27, 2014. Invited Lecturer: H.E. Khaled Toukan.

May 22-23, 2013

*2013 Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Technology*, National Tsing Hua University, Hsin-chu, Taiwan, May 22-23, 2013. Invited Lecturer: John M. Carpenter.

November 11-13, 2010

*International Workshop on Dynamic Crossover Phenomena in Water and Other Glass-forming Liquids*, Nov 13, 2010, Florence, Italy. Organizers: P. Baglioni and S.H. Chen.

August 6-7, 2009

*The 9th Emerging Information & Technology Conference*, MIT, August 6-7, 2009. Chairman: Lou-Chuang Lee, Co-Chair: Sow-Hsin Chen.

November 7-9, 2008

*The 2nd US-China Workshop on Scientific & Industrial Applications Using Neutrons, Muons & Protons, Dongguan, Guangdong, China*, November 7-9, 2008. US Chair: Sow-Hsin Chen, Co-chair: Chun Loong, China Chair: Jie Wei, Co-Chair: Dongfeng Chen.

November 16-19, 2006.

*International Meeting on Neutrons and Grand Challenges of Nanoscience, Energy Research and Computation*, November 16-19, 2006, Xian, China. Chairman: Sow-Hsin Chen, Co-chair: Chun Loong.

November 12-15, 2006

*The 1st US-China Workshop on Neutron Science and Technology*, Beijing, China, Nov 12-15, 2006, sponsored by NSF and Chinese AEC. Chairman: Sow-Hsin Chen, Co-chair: Chun Loong.

November 11-13, 2005

*International Workshop on Topics in Application of Scattering Methods to Investigation of Structure and Dynamics of Soft Condensed Matter*, Florence, Italy, Nov.11-13, 2005. Organizers: Piero Baglioni and Sow-Hsin Chen.

December 17-21, 2003

*International Workshop on Physics of Structural Arrest Transitions in Colloidal Systems with Short-Range Attraction*, Messina, Italy, Dec.17-21, 2003. Organizers: Sow-Hsin Chen, Francesco Mallamace, and Francesco Sciortino.

October 29-31, 2001

*Workshop on Neutron and X-Ray Scattering: Applications to Biological and Industrial Problems*, Institute of Nuclear Energy Research (INER) in Taiwan on October 29-31, 2001. Honorary Chair: S.H. Chen.

June 2001

*5<sup>th</sup> Steering Committee of TRR-II Project, INER, Taiwan*

January 17-18, 2001

*4<sup>th</sup> Technical Review Committee of TRR-II Project, INER, Taiwan.*

November 22-25, 2000

*International Conference on Scattering Studies of Mesoscopic Scale Structure and Dynamics in Soft Matter*, Messina, Italy, November 22-25, 2000. Organizers: F. Mallamace and Sow-Hsin Chen.

March 30-April 1, 2000

*Workshop on Neutron Scattering in Soft Matter,*” March 30-April 1, 2000, at INER, Taiwan. Honorary Chair: S.H. Chen.

May 17-20, 1999

*XI International Conference on Small Angle Scattering-SAS 99*, May 17-20, 1999, Brookhaven National Laboratory. Co-Chairs: Sow-Hsin Chen and Dieter Schneider.

Nov. 17-21, 1998

*1998 Workshop of Neutron and X-ray Scattering*, SRRC, Hsin-chu, Taiwan, Nov. 17-21, 1998. Co-Chair: S.H. Chen.

June 24-28, 1997

*International Conference on The Morphology and Kinetics of Phase Separating Complex Fluids*, Messina, Italy, June 24-28, 1997. Organizers: F. Mallamace, Sow-Hsin Chen and P. Tartaglia.

May 2-5, 1995

*EPSCOR-NSF Workshop on Colloid and Interface Science: Trends and Applications*, Copamarina Beach Resort, Guanica, Puerto Rico, May 2-5, 1995. Co-organized by S.H. Chen of MIT and Lesser Blum of University of Puerto.

April 10-13, 1994

*10<sup>th</sup> International SAS Conference*, April 10-13, 1994, NIST, Gaithersburg, MD. Co-organized by S.H. Chen of MIT and Charles C. Han, NIST.

June 11-21, 1991

*NATO Advanced Study Institute on Structure and Dynamics of Supramolecular Aggregates and Strongly Interacting Colloids*, Maratea (Italy), June 11-21, 1991. Director: Sow-Hsin Chen, S. Huang, and P. Tartaglia.

## 9.2 Paper Presentations, Invited Speeches, etc.

2017.06.24 Sow-Hsin Chen gave an Invited Lecture entitled “Hydration-dependent Dynamics of Water in Calcium-Silicate-Hydrate: A QENS Study by Global Model,” at MIT via WebEx for the *International Symposium "40 years of Soft Matter Science in Florence"* held in Florence, Italy, June 22-24, 2017 celebrating Prof. Piero Baglioni’s 65<sup>th</sup> birthday.

2016.11.17-8 On the occasion of receiving the Honorary Doctor of Science, *honoris causa*, from McMaster University, Sow-Hsin Chen gave an informal talk to the graduate students and faculty of the Physics Department together with Drs. Mike Rowe and Eric Svendsen on their days as the first graduate students of Prof. B.N. Brockhouse.

- 2016.07.22 Sow-Hsin Chen presented an invited talk, "Evidence of Liquid-to-Liquid Phase Transition in Deeply Cooled Confined Water Shown by Neutron and X-Ray Scattering Studies," at MIT via WebEx for the *Course on Water and Water Systems*, Centre Ettore Majorana in Erice, Sicily, Italy, July 22-31, 2016.
- 2016.06.26 *2016 Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Engineering*. Introduction of Prof. Piero Baglioni, the invited Lecturer. The Lectureship, National Tsing Hua University, Hsin-chu, Taipei, June 26-July 1, 2016.
- 2015.12.01 An Invited Lecture entitled "Evidence of Liquid-to-Liquid Phase Transition in Deeply Cooled Confined Water Shown By Neutron Scattering Studies" was presented at the *Symposium BBB on Liquids and Glassy Soft Matter-Theoretical and Neutron Scattering Studies, session 3: Water I, MRS Fall Meeting*, Boston, 2015.
- 2015.10.10 Sow-Hsin Chen delivered a plenary talk entitled "Low Temperature Liquid-Liquid Phase Transition and Dynamic Crossover of Water Confined in Different Geometry," at the *International Workshop on The Structure and Dynamics of Supercooled Water and Other Glassy Materials*, Palermo, Italy, October 10-13, 2015, This workshop was organized also to celebrate Sow-Hsin Chen's 80<sup>th</sup> birthday. [<https://sites.google.com/site/chenunipa/home>]
- 2015.09.17 As a Guinier Prize recipient, Sow-Hsin Chen delivered a keynote speech entitled "Fascinating and Sustained Applications of Small Angle Scattering Method for Studying Current Topics in Soft Matter Science" at the *SAS2015* meeting in Berlin, Germany, September 14-18, 2015.
- 2015.07.01 Sow-Hsin Chen gave an informal talk on the research in topical areas related to complex fluids and water at the Physics Department of University of Macau, Macau. July 1, 2015.
- 2015.06.23 Sow-Hsin Chen delivered an invited plenary speech entitled "Evidence of Liquid-to-Liquid Phase Transition in Deeply Cooled Confined Water" at the *First Gordon Conference on Neutron Scattering on the Effect of Disorder and Disordered Materials*, June 21-26, 2015, The Chinese University of Hong Kong, Hong Kong, China.
- 2015.04.29 Sow-Hsin Chen gave an introduction of Prof. Sunil K. Sinha, the invited Lecturer. *2015 Sow-Hsin Chen Distinguished Lectureship on Neutron Science and Technology*, National Tsing Hua University, Hsinchu, Taiwan, April 29-30, 2015.
- 2014.07.28 Chen, S.H., "Scattering Studies of the Liquid-Liquid Transition in Supercooled Confined Water, Protein Hydration Water, Phonons in Protein and Microstructure of New Green Cement," A talk presented at the 2014 Neutron Scattering Principal Investigators' Meeting, Hilton Washington DC North/Gaithersburg, July 28-30, 2014, Sponsored by the U.S. Department of Energy, Office of Science. [DOE-PI Meeting Agenda](#), [Cement Poster](#), [Water Poster](#)
- 2014.07.16 Chen, S.H., "Evidence of the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," a Keynote Lecture given at

ORNL *International Workshop on "Structure and Dynamics of Confined Fluids*, ORNL, TN, July 16, 2014. [Abstract of the Talk](#)

- 2014.06.28 Chen, S.H., "Evidence of the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," an invited Plenary Lecture given at the *StatPhys-Taiwan-2014*, Institute of Physics, Academia Sinica, June 28, 2014.
- 2014.06.26 Chen, S.H., "Introduction to H.E. Dr. Khaled Toukan, The *2014 Sow-Hsin Chen Distinguished Lecturer on Neutron Science and Technology*." This Lectureship was held on June 26, 2014 in conjunction with *FoTEL 2014* at the College of Nuclear Science, National Tsing Hua University.
- 2014.06.24 Chen, S.H., "Multiscale Structure of Calcium-Silicate-Hydrate (C-S-H) and Magnesium-Silicate-Hydrate (M-S-H) Gels," an invited lecture given at NSRRC, Hsinchu, Taiwan on June 24, 2014.
- 2014.05.09 Chen, S.H., "Evidence of the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," A special lecture (Lectio Magistralis) given at a special ceremony for the Professional Doctorate Honoris Causa in Physics, University of Messina, May 9th, 2014 when receiving the Dottore di Ricerca "Honoris Causa" in Fisica (Honorary Doctorate in Physics). [Abstract of the Talk](#). Prof. Chen was cited for his pioneering research on the existence of the Liquid-Liquid Phase Transition (LLPT) in supercooled water, part of which has been conducted in collaboration with Prof. Francesco Mallamace and his group at the University of Messina over the last 15 years. [News at MIT](#)
- 2014.05.08 Chen, S.H., "Hydration Water in Protein is Crucial to the "Softening" of the Short Time Intra-protein Collective Vibrations of Specific Length Scale," an invited talk given at a *Workshop on Water*, IPCF-CNR, Messina, Italy on May 8, 2014.
- 2014.04.14 Chen, S.H., "Evidence of the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," an invited Plenary Lecture given at the *International Conference on Water Sciences* at Peking University on April 14, 2014.
- 2013.10.01 Chen, S.H., "Hydration Water in Protein Is Crucial to the "Softening" of the Short time Intra-protein Collective Vibrations of Specific Length Scale," an invited Lecture given at *BNL-NSLS-II Early Science Workshop* on October 1, 2013
- 2013.08.02 Chen, S.H., "Search for the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," a talk given at the Pre-Gordon Conference at Boston University, August 2, 2013
- 2013.05.24 Chen, S.H., "Phonons in Proteins Studied by High Resolution Inelastic X-Ray Scattering at Advanced Photon Source (APS)," an invited Lecture given at College of Nuclear Science, National Tsing Hua University, Hsinchu, Taiwan, on May 24, 2013.
- 2013.05.22 Chen, S.H., "Introduction to Jack Carpenter, The *2013 Sow-Hsin Chen Distinguished Lecturer on Neutron Science and Technology*." This Lectureship was held on May 22, 2013 at the College of Nuclear Science, National Tsing Hua University. [An "Impression" write-up on the Lectureship](#)

- 2013.05.21 Chen, S.H., "Phonons in Proteins Studied by High Resolution Inelastic X-Ray Scattering at Modern Synchrotron Sources," an invited Lecture given at NSRRC, Hsinchu, Taiwan, on May 21, 2013.
- 2012.12.03 Chen, S.H., "Search for the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," an invited Lecture given at given at *4th International Symposium on Slow Dynamics in Complex Systems*, Tohoku University, Sendai, Japan, Dec.2-7, 2012.
- 2012.11.28 Chen, S.H., "Search For the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," a Plenary Lecture given at *Workshop on Structure and Dynamics of Water in Gas, Liquid and Solid Phases*, Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei, Taiwan, Nov.28-30, 2012
- 2012.11.26 Chen, S.H., "Phonons in Biomaterial Studied by High Resolution Inelastic X-Ray Scattering at a Modern Synchrotron Source," an invited Lecture given at the Physics Department of National Taiwan University, Taipei, November 26, 2012 by the Distinguished Alumnus Awardee.
- 2012.11.23 Chen, S.H., "Memory of my days at Physics Department of Taida (1952-1956)," Remarks given at the occasion of the Taida Physics Department's *Annual Alumni Meeting*, Taipei, November 23, 2012 – Prof. S.H. Chen was given the Department's Distinguished Alumnus Award
- 2012.07.28 Bertrand, Christopher E. and Sow-Hsin Chen (PI), "Micro-structure of Portland Cement Paste and Time Evolution of Dynamic Properties of Its Hydration Water during the Curing Process," a Talk given at the DOE/PI Meeting, Gaithersburg, MD, July 28, 2012
- 2012.07.11 Chen, S.H., "Micro-structure of Portland Cement Paste and Time Evolution of Dynamic Properties of Its Hydration Water during the Curing Process," an invited Lecture given at National Dong-Hwa University, Hua-Lian, Taiwan, July 11, 2012.
- 2012.06.21 Chen, S.H., "Search For the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," an invited Lecture given at the *American Conference on Neutron Scattering-2012*, Georgetown University Conference Center, June 21, 2012.
- 2012.05.21 Chen, S.H., "Search for the First-Order Liquid-to-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering," an invited Lecture given at the Center for BioNano Interactions, School of Chemistry and Chemical Biology, University College Dublin, Ireland, May 21, 2012.
- 2012.02.15 Chen, S.H., "Micro-structure of Portland Cement Paste and Time Evolution of Dynamic Properties of Its Hydration Water during the Curing Process," A lecture given at NSRRC, Hsinchu, Taiwan on Feb 15, 2012.
- 2012.02.14 Chen, S.H., "Micro-structure of Portland Cement Paste and Time Evolution of Dynamic Properties of Its Hydration Water during the Curing Process," an invited Lecture given at College of Nuclear Science, NTHU, Taiwan, Feb 14, 2012.

- 2011.07.20 Chen, S.H., "Experimental Evidence of a Dynamic Crossover at  $T_X = 225$  K in Confined Low-Temperature Water and Its Possible Biological Effects," an invited Keynote Lecture given at *the 9th International Plant Cold Hardiness Seminar*, July 17-22, 2011, Luxembourg City, G.-D. Luxembourg.
- 2011.04.25 Chen, S.H., "The Effect of Additives on the Time Evolution of the Properties of Hydration Water during the Curing Process of Portland Cement Pastes," an invited Lecture given at Taiwan Cement Company, Taipei, Taiwan, April 25, 2011.
- 2011.04.20 Chen, S.H., "High-Resolution Inelastic X-ray Scattering Study of Phonon-like excitation in Globular Proteins," an invited lecture given at the Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan, April 20, 2011.
- 2011.04.19 Chen, S.H., "Phonons in Biomaterial Studied by High Resolution Inelastic X-Ray Scattering at a Modern Synchrotron Source," an invited Lecture given at the NSRRC, Hsinchu, Taiwan on April 19, 2011.
- 2010.11.27 Chen, S.H., "Search for the First-Order Liquid-Liquid Phase Transition in Low-Temperature Confined Water by Neutron Scattering – SANS, QENS, and INS," an invited talk given at a Mini-workshop on Aqueous Interfaces in Physics, Chemistry and Biology, National Taiwan University, Taipei, Nov. 27, 2010.
- 2010.11.22 Chen, S.H., "Investigation of Dynamics of a Protein and Its Hydration Water by Scattering Techniques," An invited lecture to be given at *College of Nuclear Science, National Tsing-Hua University*, Hsinchu, Taiwan, Nov 22, 2010.
- 2010.11.13 Chen, S.H., "Search For the First-Order Liquid-Liquid Phase Transition in Low Temperature Confined Water by Neutron Scattering--SANS, QENS and INS," an invited talk given at *International Workshop on Dynamic Crossover Phenomena in Water and Other Glass-forming Liquids*, Nov 13, 2010, Florence, Italy
- 2010.10.04 Chen, S.H., "Dynamic Crossover Phenomena in Confined Water and Its Relation to the Liquid-Liquid Critical Point: Experiments and MD Simulations," an invited talk given at the Joint Institute for Neutron Sciences (JINS) Seminar Series, University of Tennessee, Oct 4, 2010
- 2010.08.19 Chen, S.H., "Dynamics of Biopolymers and Their Hydration Water Studied by Neutron and X-ray Scattering," an invited talk given at the China Institute of Atomic Energy, Beijing, China, August 19, 2010
- 2010.08.15 Chen, S.H., "A Room Temperature Reversible Hydrogen Storage Materials Studied by SANS," a talk given at the First Meeting of the "Union for Compact Accelerator-Driven Neutron Source (UCANS) at Tsinghua University, Beijing, China, August 16-18, 2010. [Meeting Announcement](#), [Abstract of the Talk](#)
- 2010.08.07 Chen, S.H., "Dynamic Crossover Phenomena in Confined Water and Its Relation to the Liquid-Liquid Critical Point," a talk given at the Pre-Gordon Conference at Boston University, August 7. 2010.
- 2010.07.19 Chen, S.H., "Dynamic Crossover Phenomena in Confined Water and Its Relation to

the Liquid-Liquid Critical Point," a talk given at the *Neutron Scattering Contractor's Meeting*, organized by Department of Energy, Office of Basic Energy Section at the Airlie Conference Center, Virginia, July 19-21, 2010.

- 2010.07.13 Chen, S.H., "A Room Temperature Reversible Hydrogen Storage Material Studied by SANS," an invited talk given at the *Workshop on Accelerator-Based Neutron Source and Applications*, NTHU, July 12-14, 2010.
- 2010.06.30 Chen, Sow-Hsin and Xiang-qiang Chu and Marco Lagi, "Dynamics of Biopolymers and Their Hydration Water Studied by Neutron Scattering," an invited Lecture given at the *International School of Physics "Enrico Fermi," Varenna, Lake Como, Italy*, on June 30th 2010. Lecture Notes taken by Dario Corradini.
- 2010.06.29 Chen, Sow-Hsin and Yang Zhang, "Dynamic Crossover Phenomenon in Confined Water and Its Relation to the Liquid-Liquid Critical Point: Experiments and MD Simulations," an invited Lecture given at the *International School of Physics "Enrico Fermi," Varenna, Lake Como, Italy*, on June 29th 2010. Lecture Notes taken by Dario Corradini (corradini@fis.uniroma3.it).
- 2010.06.29 Chen, Sow-Hsin and Yang Zhang, "Dynamic Crossover Phenomenon in Confined Water and Its Relation to the Liquid-Liquid Critical Point: Experiments and MD Simulations," an invited Lecture given at the *International School of Physics "Enrico Fermi," Varenna, Lake Como, Italy*, on June 29th 2010. Lecture Notes taken by Dario Corradini.
- 2010.06.26 Chen, S.H., "Evidence of the enhanced hydrogen storage capacity by spillover effect in Pt-impregnated activated carbon using SANS and INS methods," A paper presented at the *American Conference on Neutron Scattering-2010*, Ottawa, Canada. June 26- 30, 2010.
- 2010.04.09 Chen, S.H., "Recollection on Some Aspects of My Academic Career," *A talk given on the kick off meeting of the Monte Jade Leadership Development Forum*, April 9, 2010.
- 2010.03.11 Chen, S.H., "Neutron Scattering Studies of Glassy Dynamics of a Protein and Its Hydration Water and Their Coupling," A lecture to be given at the Center For Condensed Matter Sciences (CCMS), National Taiwan University, March 11, 2010.
- 2010.03.09 Chen, S.H., "Dynamic Crossover Phenomena in Confined Water and Its Relation to the Liquid-Liquid Critical Point: Experiments and MD Simulations," an invited talk presented at the *Taiwan-Japan Workshop on Neutron and X-ray Scattering*, Yilan, Taiwan, March 8-9, 2010.
- 2009.11.04 Chen, S.H., " $\alpha$  and  $\beta$  Relaxations in Proteins at Physiological Temperature - Its Implication for Neutron Spin-Echo Spectroscopy," an invited lecture given at the *Workshop on Neutron Spin Echo Spectroscopy*, 2009, Nov 4-5 2009, SNS, Oak Ridge, TN
- 2009.09.03 Chen, S.H., "Evidence of Dynamic Crossover Phenomena in Water and Its Relation

to the Liquid-Liquid Critical Point: Experiments and MD Simulations," an invited lecture given at the *IDMRCs-2009 Meeting*, Sept. 3, 2009, Rome, Italy

- 2009.08.30 Chen, S.H., "Neutron Scattering Studies of Low Temperature and High Temperature Dynamic Crossovers in Lysozyme Hydration Water and Their Effects on the Conformational Dynamics of the Protein," a Plenary Lecture given at the *European Conference on the Spectroscopy of Biological Molecules*, Aug 30 2009, Palermo, Italy.
- 2009.08.06 Chen, S.H., "Welcoming remark as a co-Conference Chair" and "Remarks on the world-wide interest in Neutron Scattering as a powerful tool for characterization of energy related advanced materials," given at the *9th Emerging Information & Technology Conference (EITC)*, MIT, August 6-7, 2009.
- 2009.08.01 Chen, S.H., "Evidence of Dynamic Crossover Phenomena in Water and Other Glass-Forming Liquids: Experiments, MD Simulations and Theory," a lecture given at the Pre-Gordon Meeting at Boston University, Aug 1, 2009
- 2009.07.22 Chen, S.H., "The Dynamic Crossover Phenomenon and Its Relation to the Existence of a Liquid-Liquid Critical Point in Supercooled Water," an invited lecture given at the China Institute of Atomic Energy, Beijing, China, July 22, 2009
- 2009.07.20 Chen, S.H., "The Dynamic Crossover Phenomenon and Its Relation to the Existence of a Liquid-Liquid Critical Point in Supercooled Water," an invited lecture given at the Department of Engineering Physics, Tsinghua University, Beijing, China, July 20, 2009
- 2009.07.06 Chen, S.H., "The Dynamic Crossover Phenomenon and Its Relation to the Existence of a Liquid-Liquid Critical Point in Supercooled Water," an invited lecture given at the College of Physical Science, Sichuan University, Chengdu, China, July 6, 2009
- 2009.05.11 Chen, S.H., "Observation of low-temperature and high-temperature dynamic crossover in lysozyme hydration water and their effect on the conformational dynamics of the protein," a plenary lecture given at the *Workshop on Protein and Water*, May 10-13 2009, Tempe (AZ).
- 2009.03.05 Chen, S.H., "The Dynamic Crossover Phenomenon and Its Relation to Anomalous Properties of Supercooled Water," an invited lecture given at the *WPI-AIMR Annual Workshop*, March, 2009, Miyagi-Zao, Japan.
- 2009.02.11 Chen, S.H., "Pressure Dependence of the Dynamic Crossover Phenomenon in Confined Supercooled Water and Its Relation to the Existence of a Liquid-liquid Critical Point," a plenary lecture given at the *QENS-2009*, PSI, Switzerland, Feb. 10-13, 2009.
- 2008.11.22 Chen, S.H., "Observation of a Dynamic Crossover Phenomenon in Confined Water and Its Relation to the Existence of a Liquid-liquid Critical Point," An invited lecture given at the *Final Conference of the EU RTN Arrested Matter on Dynamical Arrest of Soft Matter and Colloids*, Taormina, Italy, 22-26 November 2008.
- 2008.11.07 Chen, S.H., "Neutron Scattering Study of Cement Hydration Kinetics and Additive Effects," a keynote Lecture given at the *Second US-China Workshop on Scientific and Industrial Applications Using Neutrons, Muons and Protons*, Dongguan, China,

Nov 7-9, 2008. [Article on the Workshop on Neutron News, v. 20, 2009](#)

- 2008.11.05 Chen, S.H., "Brief Introduction to the Nuclear Science and Engineering Department at MIT, and Introduction to the Activities and Achievements of Chen's Group at MIT," a talk given at Zhuhai before the *2nd US-China Workshop* in Dongquan, China on November 5, 2008
- 2008.09.11 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Confined Water and Its Relation to the Existence of a Liquid-Liquid Critical Point in Supercooled Water," an invited lecture given at the *International Workshop on Current Problems in Soft Condensed Matters* at KAIST, Daejeon, South Korea, September 7 ~ 11, 2008.
- 2008.07.28 Chen, S.H., "Pressure and Temperature Dependences of the Dynamic Crossover and Density of Supercooled Confined Water and Their Relations to the Existence of a Liquid-Liquid Critical Point," a invited talk given at the *Gordon Conference on Water & Aqueous Solutions*, Holderness School. July 27-August 1, 2008
- 2008.07.26 Chen, S.H., "Neutron Scattering Studies of Dynamic Crossover Phenomena in Water Confined in Various Geometries," a talk given at a Pre-Gordon Meeting at Boston University, July 26, 2008
- 2008.07.13 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Confined and Hydration Water and Its Relation to the Liquid-Liquid Critical Point in Supercooled Water," a plenary lecture given at the 9th *International Bologna Conference on Magnetic Resonance in Porous Media*, Schlumberger-Doll Research, Cambridge, MA, July 13-16, 2008.
- 2008.07.06 Chen, S.H., "Neutron Scattering Studies of Liquid-Liquid Phase Transition and the Associated Second Critical Point in Deeply Supercooled Confined Water," an invited lecture given at the *Workshop on Critical Phenomena and Complex Systems*, Chung-Yuan Christian University, Taiwan on July 6, 2008.
- 2008.05.13 Chen, S.H., "Density Measurement of 1-D Confined Water by Small Angle Neutron Scattering Method," an invited lecture given at the *ACNS-2008 Meeting*, Santa Fe, NM, May 13, 2008.
- 2008.05.12 Chen, S.H., "Supercool Water: Its Weird Properties and Fascination," an Invited Special Lecture presented on the occasion of receiving the Clifford G. Shull Prize of the Neutron Society of America at the *American Conference on Neutron Scattering 2008 Meeting*, Santa Fe, NM, May 12, 2008. [Press Release of the NSA of the Clifford G. Shull Award on Feb. 4, 2008](#)
- 2008.03.21 Chen, S.H., "Observation of a Fragile-to-Strong Dynamic Crossover Phenomenon in Confined Water and Its Relation to the Existence of a Liquid-Liquid Critical Point in Supercooled Water," an invited Special Lecture given at the *Session on Recent Advances in Soft Complex Materials Using Neutron Scattering, APS March Meeting*, March 13, 2008, New Orleans.
- 2008.02.07 Chen, S.H., "Inelastic X-Ray Scattering Studies of Phonon Propagation and Damping in Biomolecular Assemblies," an invited lecture given at *NSLS-II Workshop on IXS*, BNL, Feb. 7th-8th, 2008.

- 2007.12.10 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Confined and Hydration Water and Its Relation to The Liquid-Liquid Critical Point in Supercooled Water," An invited Lecture presented at *ESF-FWF Conference on Water Interfaces in Physics, Chemistry and Biology: A Multi-Disciplinary Approach*, Universitätszentrum Obergurgl, Austria, 8-13 December 2007.
- 2007.11.30 Chen, S.H., "Investigation of Hydration Water Induced High-T Dynamic Crossover in Lysozyme," a talk presented at Boston University, Nov 30, 2007
- 2007.11.26 Chen, S.H., "Applications of Neutron Scattering to Bio-Sciences," Possible UROP Projects, Presented on November 26, 2007 at the Nuclear Science and Engineering Department, MIT
- 2007.10.08 Chen, S.H., "Investigation of Hydration Water Induced Dynamic Transitions in Lysozyme," a talk presented at the *SNS/HFIR User Meeting*, ORNL, October 8-10, 2007
- 2007.09.26 Chen, S.H., "Dynamic Crossover Phenomenon in Confined Supercooled Water and Its Relation to the Existence of a Liquid-Liquid Critical Point in Water," an Invited Lecture presented at the *5th International Workshop on Complex Systems*, September 25-28, 2007, Sendai, Japan
- 2007.09.07 Chen, S.H., "Dynamic Crossover Phenomenon in Nano-confined Supercooled Water and Its Relation to the Existence of the Second Critical Point of Water," Discovery Lecture given at the Center for Nano-phase Materials Sciences, ORNL, on September 7, 2007.
- 2007.07.24 Chen, S.H., "Observation of a Dynamic Crossover in Water Confined in Double-wall Carbon Nanotubes," a talk given at Prof. Stanley's group, Boston University, July 24, 2007
- 2007.06.28 Chen, S.H., "Neutron and Light Scattering Studies of the Liquid-to-Glass and Glass-to-Glass Transitions in a Copolymer Micellar System," an invited lecture given at the *Meeting on Science and Technology of Complex Fluids*, June 28, 2007, San Luis Potosi, Mexico
- 2007.06.27 Chen, S.H., "Effective Protein-Protein Interaction and Clustering Phenomenon in Solution Studied by Small-Angle Neutron Scattering," an invited lecture given at the *Meeting on Science and Technology of Complex Fluids*, June 27, 2007, San Luis Potosi, Mexico
- 2007.06.26 Chen, S.H., "The Second Critical Point of Water and Its Effects on Conformational Flexibilities of Biopolymers," an invited lecture given at the *Meeting on Science and Technology of Complex Fluids*, June 26, 2007, San Luis Potosi, Mexico.
- 2007.06.25 Chen, S.H., "Pressure Dependence of Fragile-to-Strong Dynamic Crossover in Supercooled Confined Water and Its Relation to the Second Critical Point of Water," an invited lecture given at the *Meeting on Science and Technology of Complex Fluids*, June 26, 2007, San Luis Potosi, Mexico
- 2007.04.24 Chen, S.H., "The Second Critical Point of Water and Its Effects on Conformational Flexibilities of Biopolymers," a Talk given at NIST Center For Neutron Research,

Panel of Assessment, April. 24, 2007

- 2007.03.26 Chen, Sow-Hsin "Inelastic X-Ray Scattering Studies of Phonon Propagation and Damping in Biomolecular Assemblies," a talk given at the *IXS-CDT Inauguration and Workshop*, APS, ANL, March 26th, 2007
- 2007.02.19 Chen, Sow-Hsin "Measurement of Density Minimum in Confined Supercooled Water by SANS," a talk given at 24-213, MIT to Prof. Stanley group of Boston University on Feb. 19, 2007
- 2007.02.16 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the Glass Transition of Biopolymers," a lecture presented at MSD, ANL, Feb. 16, 2007
- 2007.02.05 Chen, Sow-Hsin, "Observation of Fragile-to-Strong Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the Glass Transition of Biopolymers," a lecture presented at School of Chemistry, University of Sydney, Sydney, Australia, Feb. 5, 2007.
- 2007.01.21 Liu, Dazhi and Sow-Hsin Chen, "Measurement of Density Minimum in Confined Supercooled Water by SANS," a lecture presented at the *Winter Discussion Workshop 2007 on Dynamical Arrest of Soft Matter and Colloids of the Marie Curie Research and Training Network*, Bad Gastein, Austria, Jan. 20-24, 2007.
- 2006.12.08 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the Glass Transition of Biopolymers," An invited talk presented at the *NSF-IMI Meeting* at the University of Tennessee, Knoxville, December 8, 2006.
- 2006.11.28 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the Glass Transition of Biopolymers," An invited talk presented at the Institute of Science and Technology, University of Maryland, Nov. 28, 2006.
- 2006.11.27 Chen, S.H., "Observation of Fragile-to-Strong Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the Glass Transition of Biopolymers," An invited talk presented at the *Physical and Chemical Properties Division Seminar*, NIST, Maryland, Nov. 27, 2006.
- 2006.11.18 Chen, S.H., "Measurement of Average Density of Confined Supercooled Water: SANS Method," A lecture presented at the *International Meeting on Neutrons and Grand Challenges of Nano-science, Energy Research and Computation*, November 16-19, Xian, China. [Xian Workshop Poster](#), [News on Xian Workshop](#),
- 2006.11.14 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein Hydration Water and Its Relation to the 'Glass Transition' of Proteins," A Plenary talk presented at the *1st US-China Workshop on Neutron Science and Technology*, Nov.12-15, 2006, Beijing, China. [1st US-China Workshop Poster](#), [1st US-China Workshop Program](#), [1st US-China Workshop Welcome](#), and [Neutron News \(2008\) on the First US-China Workshop](#).
- 2006.10.20 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in

Biomacromolecules," An invited talk presented at the Frank Laboratory of Neutron Physics, JINR, Dubna, Russia.

- 2006.09.12 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," An invited talk presented at Department of Physics, University of Florence, September 12, 2006.
- 2006.08.25 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," An invited talk presented at the Department of Nuclear, Seoul National University, South Korea, August 25, 2006.
- 2006.08.24 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," An invited talk presented at the Department of Nuclear and Quantum Engineering, KAIST, South Korea, August 24, 2006.
- 2006.07.29 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," A talk given at the Pre-Gordon Conference Discussion at Boston University on July 29, 2006.
- 2006.07.18 Chen, S.H., "SNS and Taiwan – the thoughts and boundary conditions," An invited talk presented at the ORNL, TN.
- 2006.07.11 Chen, S.H., "The Effective Pair-Potential of Charged Proteins in Solution and Its Relation to the Equilibrium Cluster Formation," An invited talk presented at the *International Conference on SAS-2006*, July 9-13, 2006, Kyoto, Japan.
- 2006.06.19 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein Hydration Water and Its Relation to the 'Glass Transition' in Proteins," A lecture given at the *American Conference on Neutron Scattering-2006* on June 19, 2006 at St. Charles, Illinois.
- 2006.05.29 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," An invited talk presented on May 29th, 2006 at the Institute of Physics, University of Zagreb, Croatia
- 2006.05.24 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," An invited talk presented on May 24th, 2006 at the Center for Condensed Matter Physics, National Taiwan University, Taipei.
- 2006.05.22 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water and Its Relation to the 'Glass Transition' in Biomacromolecules," An invited talk presented on May 22nd, 2006 at the Institute of Physics, Academia Sinica, Taiwan.
- 2006.05.16 Chen, S.H., "Observation of Pressure Dependence of Fragile-to-Strong dynamic Crossover and its Relation to the Second Critical Point of Water," An invited talk

presented on May 16th, 2006 at the National Tsing Hua University Distinguished Alumnus Award given to Prof. Sow-Hsin Chen. [Abstract of the Talk](#), [Lectureship Poster](#)

- 2006.04.08 Chen, S.H., "Neutron Scattering Studies of the Dynamic Crossover in Protein and DNA Hydration Water," A talk presented on April 8, 2006 at *Marie-Curie Research and Training Network Workshop*, Lugano, Switzerland.
- 2006.01.26 Chen, S.H., "Quasi-Elastic Neutron Scattering Studies of Molecular Dynamics of Hydration Water in Lysozyme and DNA," a talk given on Jan. 26, 2006 at the Nuclear Science and Engineering Department, MIT
- 2005.11.30 Chen, S.H., "Observation of Pressure Dependence of Fragile-to-Strong Dynamic Cross-over in Deeply Supercooled Confined Water and a Possible Second Critical Point of Water," A talk presented at the *Symposium in Celebration of Prof. Sidney Yip's 70th Birthday*, MIT, November 30, 2005. The first 5 preliminary slides were given with personal remarks
- 2005.11.29 Liu, Li and Sow-Hsin Chen, "Quasi-Elastic Neutron Scattering Studies of Molecular Dynamics of Hydration Water in Lysozyme," a talk presented on Nov. 29, 2005 at a Discussion Meeting with Prof. Stanley's group at Boston University
- 2005.11.11 Chen, S.H., "Observation of Pressure Dependence of Fragile-to-Strong Dynamic Cross-over in Deeply Supercooled Confined Water by Quasielastic Neutron Scattering," an lecture presented at *Workshop on Topics in Application of Scattering Methods for Investigation of Structure and Dynamics of Soft Condensed Matter*, November 11-13, 2005, Florence, Italy (Organizer: P. Baglioni and S.H. Chen). The Workshop Banquet also celebrated the 70th Birthday of Prof. Sow-Hsin Chen. [Workshop Program](#)
- 2005.10.31 Chen, S.H., "Effective Protein-Protein Interaction and Clustering Phenomenon in Solution Studied by Small-Angle Neutron Scattering," A talk presented at the *Symposium on Bio-Materials and Neutron*, AVS Meeting in Boston, October 31, 2005
- 2005.10.11 Chen, S.H., "Pressure Dependence of Fragile-to-Strong Dynamic Cross-over Transition in Deeply Supercooled Confined Water Studied by Quasielastic Neutron Scattering," a talk given at the *SNS/HFIR User Meeting* at Oak Ridge in QENS session on October 11, 2005
- 2005.08.25 Chen, S.H., "Inelastic X-Ray Scattering Studies of Phonon Propagation and Damping in Biomolecular Assemblies," a lecture given at *DOE Biomolecular Materials Program Meeting*, Airlie Center, Warrenton, VA, August 25-28, 2005.
- 2005.08.05 Chen, S.H., "Pressure Dependence of Fragile-to-Strong Dynamic Transition in Deeply Supercooled Confined Water Studied by Quasielastic and Inelastic Neutron Scattering," A talk given to the Boston University Group on August 5, 2005 at MIT.
- 2005.07.29 Chen, S.H., "Study of New Effective Protein-Protein Interaction Potential in Solution by Small-Angle Neutron Scattering," an invited talk presented at the *Second Neutron User Meeting of CSNS* at IoP, CAS, Beijing, July 28, 2005.

- 2005.07.28 Chen, S.H., "Pressure Dependence of Fragile-to-Strong Dynamic Transition in Deeply Supercooled Confined Water Studied by Quasielastic and Inelastic Neutron Scattering," an invited talk presented at the *Second Neutron User Meeting* of CSNS at IoP, CAS, Beijing, July 28, 2005
- 2005.04.16 Chen, S.H., "Temperature and Pressure Dependences of Fragile-to-Strong Liquid-Liquid Transition in Deeply Supercooled Confined Water Studied by Quasielastic and Inelastic Neutron Scattering," A talk presented at *Frontiers in Squishy Physics, American Physics Society New York State Section Spring 2005 Symposium*, Rochester NY, on April 16, 2005.
- 2005.03.27 Chen, Sow-Hsin and Li Liu, "Temperature and Pressure Dependences of Fragile-to-Strong Liquid-Liquid Transition in Deeply Supercooled Confined Water," Presented at the Department of Nuclear Science, MIT, March 27, 2005.
- 2005.01.24 Chen, S.H., "Quasi-elastic Neutron Scattering Study of Fragile-to-Strong Liquid-Liquid Transition in Deeply Supercooled Water Confined in Pores of MCM-41," A talk given at the *Dynamical Arrested State of Soft Matter and Colloids Meeting*, the Marie Curie Network's Workshop Meeting, March 1-4, 2004, Bad Gastein, Austria, Jan. 24, 2005.
- 2004.12.21 Chen, S.H., "Observation of Fragile-to-Strong Liquid-Liquid Transition in Deeply Supercooled Water Confined in MCM-41-S Using Quasi-elastic Neutron Scattering," An invited talk presented at Institute of Materials Structure Science, KEK, Tsukuba, Japan on Dec. 21, 2004
- 2004.12.19 Chen, S.H., "Applications of Neutron and Photon Scatterings to Bio- and Nano-Sciences," A lecture given at Hainan University, Haikou, Hainan, China, Dec. 19, 2004.
- 2004.12.14 Chen, S.H., "Inelastic X-Ray Scattering Study of Phonons in A Liquid Crystalline Phase of Na-DNA," An invited talk presented at the Physics Department of Fudan University, Shanghai, China on December 14, 2004.
- 2004.11.02 Chen, S.H., "Observation of Fragile-to-Strong Transition in Deeply Supercooled Water Confined in MCM-41-S Using Quasi-elastic Neutron Scattering," An invited talk presented at the Institute of Atomic and Molecular Science Nov. 2, 2004, Taipei, Taiwan
- 2004.10.28 Chen, S.H., "Inelastic X-Ray Scattering Study of Phonons in A Liquid Crystalline Phase of Na-DNA," An invited lecture given at *The NSRRC Tenth Users' Meeting & Workshops*, Oct.28-29, 2004, Hsinchu, Taiwan.
- 2004.09.22 Chen, S.H., "Inelastic X-Ray Scattering Study of Phonons in A Liquid Crystalline Phase of Na-DNA," An invited lecture presented at *5th International Conference on Inelastic X-ray Scattering*, ANL, IL, Sept. 19-24, 2004.
- 2004.09.14 Chen, S.H., "Inelastic X-Ray Scattering Study of Phonons in A Liquid Crystalline Phase of Na-DNA," An invited lecture given at the Physics Department, Zhongshan University, Guangzhou, China, Sep. 14, 2004.

- 2004.09.07 Chen, S.H., "Neutron and Light Scattering Studies of the Liquid-to-Glass and Glass-to-Glass Transitions in a Copolymer Micellar System, "An invited lecture given at the CIAE, Beijing, Sept. 7, 2004.
- 2004.09.06 Chen, S.H., "Inelastic X-Ray Scattering Study of Phonons in A Liquid Crystalline Phase of Na-DNA," An invited lecture given at the Engineering Physics Department, Tsinghua University, Beijing, China, Sept. 6, 2004.
- 2004.08.02 Chen, S.H., "Observation of Fragile-to-Strong Transition in Deeply Supercooled Water Confined in MCM-41-S Using Quasielastic Neutron Scattering," An invited talk given at the *Gordon Research Conference on Physics and Chemistry of Water*, Aug. 1-6, 2004, Holderness School, New Hampshire
- 2004.06.07 Chen, S.H., "Quasielastic Neutron Scattering Investigation of the Translational and Rotational Dynamics of Supercooled Water Confined in Nanoporous Silica Matrices," An invited talk presented at the *ACNS meeting* on June 7, 2004, College Park, MD.
- 2004.03.03\_2 Chen, S.H., "Inelastic X-Ray Scattering Study of Collective Modes in A Liquid Crystalline Phase of Na-DNA," An invited lecture given at the Department of Nuclear and Quantum Engineering, KAIST, South Korea, March 3, 2004.
- 2004.03.03\_1 Chen, S.H., "The translational dynamics of water in curing cement phases: A QENS study," An invited lecture given at the Department of Nuclear and Quantum Engineering, KAIST, South Korea, March 3, 2004.
- 2004.03.01 Chen, S.H., "Small-Angle Neutron Scattering and Rheological Studies of Salt-Induced Gelation in Concentrated Cytochrome C Solution," A talk given at the *Dynamical Arrested State of Soft Matter and Colloids Meeting*, the Marie Curie Network Kick off Workshop Meeting, March 1-4, 2004, Bonn, Germany.
- 2004.02.22 Chen, S.H., "Quasielastic neutron scattering investigation of the translational and rotational dynamics of supercooled water confined in nanoporous silica matrices," An invited talk presented at *International Conference "Dynamics of Disordered Materials on the Nanometer Scale"* in Hanoi, Vietnam, Feb. 22-27, 2004.
- 2003.12.18 Baglioni, Piero and Sow-Hsin Chen, "Concentrated solutions of Cytochrome C: volume fraction, pH and salt effect," An invited talk presented at the *Structural Arrest Transitions in Colloidal Systems with Short-Range Attractions*, Messina, Italy, December 17-20, 2003.
- 2003.12.18 Chen, S.H., "Neutron and Light Scattering Studies of the Liquid-to-Glass and Glass-to-Glass Transitions in a Copolymer Micellar System," An invited lecture given at the *Structural Arrest Transitions in Colloidal Systems with Short-Range Attractions*, Messina, Italy, December 17-20, 2003.
- 2003.11.05 Chen, S.H., "Neutron and Light Scattering Studies of the Liquid-to-Glass and Glass-to-Glass Transitions in a Copolymer Micellar System," an invited lecture given at the *International Symposium on Slow Dynamics in Complex Systems*, November 2-8, 2003, Sendai, Japan.

- 2003.11.03 Chen, S.H., "Observation of Novel Liquid-to-Glass and Glass-to-Glass Transitions in a Copolymer Micellar System with a Very Short-Range Attractive Interaction," A paper presented for MIT's ILP in Tokyo, Japan on November 3, 2003.
- 2003.09.22 Chen, S.H., "Inelastic X-Ray Scattering Study of Collective Modes in A Liquid Crystalline Phase of Na-DNA," An invited lecture given at *17th European Colloid & Interface Science Society*, Sept. 21-26, 2003, Florence, Italy.
- 2003.08.25 Chen, S.H., "Neutron and Light Scattering Studies of the Liquid-to-Glass and Glass-to-Glass Transitions in Dense L64 Copolymer Micellar System," Invited Lecture One presented at *ASTATPHYS-2003*, August 25-30, 2003, Puerto Vallarta, Mexico.
- 2003.08.26 Chen, S.H., "Inelastic X-Ray Scattering Study of Phonons in Liquid Crystalline DNA," Invited Lecture Two presented at *ASTATPHYS-2003*, August 25-30, 2003, Puerto Vallarta, Mexico.
- 2003.08.12 Chen, S.H., "Models of Translational and Rotational Dynamics of Water in Porous Materials," An invited lecture given at the *NIST Workshop on Theory, Modeling and Neutron Scattering, TMNS03*, NIST, August 12-14, 2003.
- 2003.07.14 Chen, S.H., "Glassy Dynamics of Interfacial Water in Porous Materials," An invited lecture presented at the *Workshop on Scientific Opportunities for Cold Neutron Spectroscopy*, July 14-16, at NIST, Bethesda, MD.
- 2003.07.03 Chen, S.H., "Study of the Liquid-to-Glass and Glass-to-Glass Transitions in Dense L64 Copolymer Micellar Solutions with Scattering Experiments," an Invited Lecture given at *The International School of Physics: Physics of Complex Systems- New Advances and Perspectives* in Varenna, Italy, July 1-11, 2003.
- 2003.01.27 Chen, S.H., "Collective Chain Dynamics in Lipid Bilayers by Inelastic X-ray Scattering," was presented at the *IXS Workshop, SAS-02*, ANL, Argonne, IL, January 27-28, 2003.
- 2003.01.18 Chen, S.H. presented his work as a member at the *Winter Workshop on Attractive Interaction in Colloidal Systems*, January 18-23, 2003, Bad Gastein, Salzburg, Austria. Workshop Chair: Otto Glatter.
- 2002.11.28 Chen, S.H., "Applications of Neutron and Photon Scatterings to Bio- and Nano-Sciences," an invited lecture given at the *MIT-KAIST Workshop on Quantum Engineering*, KAIST, Korea, Nov. 28, 2002.
- 2002.10.12 Chen, S.H., "Observation of Liquid-to-Glass and Glass-to-Glass Transitions in L64/D2O Triblock Copolymer Micellar System," an invited talk presented at the *Yangtze conference on Fluids and Interfaces, Nanjing-Chongqin, China, October 12-18, 2002*
- 2002.08.18 Chen, S.H., "Collective Dynamics In Lipid Bilayers Studied By Inelastic X-ray

Scattering,” An invited lecture to be presented at *the Symposium on Biological Applications of Neutron Scattering* organized by D. Tobias and M. Tarek at the *American Chemical Society National Meeting* in Boston, MA, August 18-22, 2002.

- 2002.07.12      Chen, S.H., “Kinetic Glass Transition in a Co-polymer Micellar System With Temperature-Dependent Short-Range Attractive Interaction,” A lecture given at the Physics Department of Xiamen University in July 12, 2002.
2002. 06.17      Chen, S.H., “Translational and Rotational Dynamics of Bulk Supercooled and Interfacial Water,” An invited lecture given at *the ICTP-INFM School & Workshop on “Spectroscopic Investigation of the Collective Dynamics in Disordered Systems,”* 17-28 June 2002, Miramare - Trieste, Italy.
- 2002.04.21      Chen, S.H., “Kinetic Glass Transition in a Co-polymer Micellar System with Temperature-Dependent Short-Range Attractive Interaction,” An invited lecture presented at the meeting “*Self-Assembly-the Future,*” *Massa Marittima, Tuscany, Italy, April 21-24, 2002,* organized by Brian Robinson.
- 2001.12.14      Chen, S.H., “High-Resolution Inelastic X-ray Scattering Study of In-Plane Collective Dynamics of Lipid Bilayers,” An invited talk presented at the *Stony Brook Symposium on Complex Matter* In honor of Professor Benjamin Chu on his 70<sup>th</sup> Birthday, Stony Brook, NY, December 14, 2001.
- 2001.10.30      Chen, S.H., “In-Plane Collective Dynamics in Lipid Bilayers Studied by IXS and MD,” Invited Seminar presented at the *Workshop on Neutron and X-ray Scattering: Applications to Biological and Industrial Problems,* INER, Taipei, Taiwan, October 29-30, 2001.
- 2001.09.02      Chen, S.H., “Structure and Dynamics Near the KGT in a Co-polymer Micellar System with Short-range Attractive Interaction,” An invited lecture presented at the *DYPROSO XXVIII,* Rolduc, Netherland, September 2, 2001.
- 2001.07.24      Chen, S.H., “Kinetic Glass Transition in a copolymer micellar system with a temperature-dependent short-range attraction,” An invited paper presented at the *Conference on Molecular Engineering, ASTATPHYS-MEX-2001,* Cancun, Mexico, July 23-27, 2001.
- 2001.06.21      Chen, S.H., “Collective dynamics in lipid bilayers and globular proteins studied by Inelastic x-ray scattering,” An invited paper presented at the *INFM meeting,* University of Rome, Italy, June 21, 2001.
- 2001.06          Chen, S.H., Chair of TRC, 5<sup>th</sup> Steering Committee of TRR-II Project, INER, Taiwan.
- 2001.05.28      Chen, S.H., “Structure, Interaction and Phase Transitions in L-64 Co-polymer Micellar Solution Studied by Scattering Techniques,” An invited lecture to be given

- at the China Institute of Atomic Energy, Beijing, on May 28, 2001.
- 2001.05.21 Chen, S.H., "Diffusion," the topical areas discussed at the proposed *Cold Neutron Chopper Spectrometer for the Spallation Neutron Source Meeting* taken place at the NCNR at NIST on May 21 and 22, 2001 coordinated by Paul Sokol at PSU then.
- 2001.01.17 Fourth Meeting of TRR-II Technical Review Committee, January 17-18, 2001, INER, Tao-Yuan, Taiwan. Chaired by S.H. Chen.
- 2000.12.02 Chen, S.H., "Collective dynamics in phospholipid bilayers by high resolution inelastic x-ray scattering spectroscopy," Invited presentation at the *Energy Recovery Linac (ERL) Science Workshop* at Cornell University, Ithaca, NY, December 2-3, 2000.
- 2000.11.27 Chen, S.H., "Study of Collective Excitation in Fully Hydrated Phospholipid Bilayers by High Resolution Inelastic X-ray Scattering Spectroscopy," A lecture is given at the Physics Department of University of Palermo on Nov.27, 2000.
- 2000.11.23 Chen, S.H., "Study of Collective Excitation in Fully Hydrated Phospholipid Bilayers by High Resolution Inelastic X-ray Scattering Spectroscopy," a talk presented at the *International Conference on Scattering Studies of Mesoscopic Scale Structure and Dynamics in Soft Matter*, Messina, Italy, November 22-25, 2000. Organizers: F. Mallamace and Sow-Hsin Chen.
- 2000.06.29 Chen, S.H., "Studies of Collective Dynamics of Fully Hydrated Phospholipid Bilayers by High Resolution Inelastic X-ray Scattering Spectroscopy," presented his x-ray results at a *NIST Seminar* on June 29, 2000.
- 2000.05.29 Chen, S.H., "Structure, Interaction, Critical and Percolation Transitions in Pluronic Micellar Solutions," An invited lecture given at the *5th World Surfactants Congress-CESIO 2000*, May 29-June 2, Florence, Italy, (2000).
- 2000.05.04 Chen, S.H., "IXS of dynamics in proteins and lipid bilayers," An invited paper presented at The *6<sup>th</sup> Biophysical Society Annual Symposium on "Frontiers in Biophysics,"* at the National Tsing Hua University, Hsinchu, Taiwan, May 3-6, 2000.
- 2000.04.27 Chen, S.H., "Slow Dynamics in Supercooled Bulk and Interfacial Water Probed by CMD and Neutron Scattering," a lecture delivered at the Physics Department of the National University of Singapore, April 27, 2000.
- 2000.03.31 Chen, S.H., "Critical, Percolation and Kinetic Glass Transition in a Micellar System with a Short Range Attractive Interaction," a plenary talk presented at the *Workshop on Neutron and X-ray Scattering in Soft Matter,* March 30-April 1, 2000, at INER, Lungtan, Taiwan.
- 1999.06.29 Chen, S.H., "Single Particle and Collective Dynamics of Supercooled and Interfacial Water," an invited paper presented at the *Adriatico Research Conference on "Liquid*

*State of Matter: Opportunities from Advanced Radiation Sources,*” Trieste, Italy, June 28-July 2, 1999.

- 1999.05.18 Chen, S.H., “SANS Study of the Structure and Interaction of L64 Triblock Copolymer Micellar Solution in the Critical Region,” An invited paper presented at the *XI International Congress On Small Angle Scattering (SAS-99)* at BNL, NY, May 17-20, 1999.
- 1999.05.18 Chen, S.H., “Curvature and Morphology of 3-component Isometric Microemulsions in the Lamellar Phase,” An invited paper presented at the *XI International Congress On Small Angle Scattering (SAS-99)* at BNL, NY, May 17-20, 1999.
- 1998.11.17 Chen, S.H., “Studies of Single Particle and Collective Dynamics in Interfacial and Supercooled Water,” an invited talk presented at the *Workshop on X-ray and Neutron Scattering*, November 17-18, 1998, SRRC, Hsinchu, Taiwan.
- 1998.08.21 S.H. Chen, “Analysis of the Structure, Interaction and Viscosity of Pluronic Micelles in Aqueous Solutions by Combined Neutron and Light Scattering,” **A paper presented** at the *Scattering Symposium: Scattering from Polymers: Characterization by X-rays, Neutrons, and Light* of the *216th ACS Meeting* in Boston, Aug. 21-27, 1998.
- 1998.03.20 Chen, S.H., “Applications of Quasi-Elastic Neutron Scattering to the Study of Dynamics of Hydration Phenomena,” an invited talk given at the Institute of Nuclear Energy Research (INER) sponsored by Epoch Foundation and INER, Lungtan, Taoyuan, Taiwan, March 20, 1998.
- 1998.01.26 Chen, S.H., “Elastic Neutron Scattering Studies of A Model and Real Water at Deeply Supercooled States,” an invited talk presented at the Laboratoire Leon Brillouin, CEA Saclay, France, January 26, 1998.
- 1997.12 Chen, S.H., “Neutron Scattering Studies of the Structure and Interaction of Tri-Block Co-Polymer Micelles in Aqueous Solution,” an invited talk presented at the Symposium L: Complex Fluids and Biomaterials” at the *MRS Meeting*, Boston, December 1997.
- 1997.11.12 Chen, S.H., “Small Angle Neutron Scattering Studies of the Structure and Interaction of Tri-Block Co-Polymer Micelles in Aqueous Solution,” an invited talk presented at the *ACS Meeting* in Cancun, Mexico, Nov. 12, 1997.
- 1997.11.05 Chen, S.H., “Mesoscopic Scale Structures in Self-Organized Surfactant Solutions Determined by Small Angle Neutron Scattering,” an invited lecture given at the *11th Toyota Conference on Nanostructured Materials in Biological and Artificial Systems*, November 5-8, Mikkabi, Shizuoka, Japan. November 5, 1997.
- 1997.08.25 Chen, S.H., “SANS Studies of the Interfacial Curvatures and Morphology in Bicontinuous Porous Materials,” An invited lecture presented at *Materials*

*Research Using Cold Neutrons at Pulsed Neutron Sources,*” ANL, Argonne IL, August 25-26, 1997.

- 1997.08.05 Chen, S.H., “Characterization of the Aggregation and Percolation Behavior in Polymer and Surfactant Solutions by Small Angle Neutron and Light Scattering,” an invited paper given at Raychem Corporation, Menlo Park, August 5, 1997.
- 1997.08.03 Chen, S.H., “Neutron Scattering Studies of the Structure, Interaction and Viscoelasticity of Tri-Block Co-Polymer Micelles in Aqueous Solution,” an invited talk presented at the *LANSCE User’s Meeting*, August 3, 1997.
- 1997.06.24 Chen, S.H., “Measurements of Interfacial Curvatures in Micro-phase-separated Bicontinuous Structures Using Small-angle Neutron Scattering,” *An invited paper* presented at the *International Conference on the Morphology and Kinetics of Phase Separating Complex Fluids*, Messina, Italy, June 24-28, 1997.
- 1997.03.18 Chen, S.H., “Measurements of the Curvatures of Random Surfaces by Scattering Experiments: the Case of Bicontinuous Microemulsions,” *An invited lecture* presented at the *Symposium on Contemporary Physics*, Taipei, Taiwan, in celebration of the 50th anniversary of the founding of the Department of Physics, National Taiwan University, March 18, 1997.
- 1996.12.13 Chen, S.H., “A New Scattering Method for the Measurement of the Interfacial Curvature in Bicontinuous Microemulsions and in Phase-Separated Polymer Blend,” A paper presented at the DuPont Center of Research and Development, Wilmington, DE, December 13, 1996.
- 1996.12.02 Chen, S.H., “Measurement of the Gaussian Curvature of surfactant film in an Isometric Bicontinuous One-Phase Microemulsions,” A paper presented at the *MRS Symposium*, Boston, December 2, 1996.
- 1996.10.14 Chen, S.H., “The Relationship Between the Interfacial Curvatures and the Phase Behavior in Bicontinuous Microemulsions,” *An invited lecture* presented at the *International Symposium on Colloids and Polymer Science*, Nagoya, October 14, 1996.
- 1996.08 Chen, S.H., “Measurement of the Gaussian Curvature of the Interface in the Isometric Bicontinuous Microemulsion and a Phase-Separated Polymer Blend,” A paper presented at the *ACS Meeting*, Orlando, Florida, August 1996.
- 1996.08.17 Chen, S.H., “Slow Dynamics of Water Near Hydrophilic Surfaces,” A review paper presented at the *Jingshin Physics Symposium in Memory of Professor Wolfgang Kroll* at the Physics Department, University of Massachusetts, Dartmouth, Aug. 17, 1996.
- 1996.08.03 Chen, S.H., “Cage Effect in Supercooled Water and Its Implications in Incoherent Quasi-Elastic Neutron Scattering,” A paper presented at the *Gordon Conference on*

*Water and Aqueous Solutions* – 96, August 3, 1996.

- 1996.07.21 Chen, S.H., “Measurement and Interpretation of Curvatures of the Oil-Water Interface in Isometric Bicontinuous Microemulsions,” An invited lecture given at a micro symposium *Applications to Complex Liquids*, the *10th International Conference on Small-Angle Scattering*, July 21-25, 1996, Campinas, Brazil.
- 1996.07.09 Chen, S.H., “Effects of Surface Adhesion on the Phase Behavior of Water-in-Oil Microemulsions and Viscosity in Co-polymer Micelles,” A Lecture delivered at the *International School of Physics, Enrico Fermi: The Physics of Complex Systems*, July 9-19, 1996,
- 1996.07.09 Chen, S.H., “Measurements of curvatures of the Oil-Water Interface in Isometric Bicontinuous Microemulsions by Scattering Experiments,” A Lecture delivered at the *International School of Physics, Enrico Fermi: The Physics of Complex Systems*, July 9-19, 1996.
- 1996.01.24 Chen, S.H., “Measurement of the Gaussian Curvature of the Interfaces in an Isometric Bicontinuous Microemulsions and a Phase-Separated Polymer Blend,” A paper presented at NIST, January 24, 1996.
- 1996 Chen, S.H., “Slow Dynamics in a Model and Real Supercooled Water,” a paper presented at the *ACS Symposium Series No. 676*, Washington, DC.
- 1996.01.03 Chen, S.H., “The Gaussian Curvature of the Oil-Water Interface in an Isometric Bicontinuous Microemulsion,” A talk presented at a meeting in Oaxaca, Mexico. January 3, 1996.
- 1995 Chen, S.H., “Interfacial Scattering from Surfactant Monolayers in Microemulsions,” An invited paper presented in the *4th International Conference on Surface X-ray and Neutron Scattering*, 1995.
- 1995.11.30 Chen, S.H., “Direct Measurement of Ion Correlations in Ionic Micella Solutions and the Physical Origin of the Renormalized Charge,” A paper presented at the *Workshop on Colloid Physics*, organized by R. Klein, University of Konstanz, Germany, Nov. 30-Dec.2, 1995.
- 1995.09.25 Chen, S.H., “Slow Dynamics of Interfacial Water in Supercooled States in Bulk and Near Hydrophilic Surfaces,” An invited paper presented at the *Workshop on Non-equilibrium Phenomena in Supercooled Fluids, Glasses and Amorphous Materials*, Pisa, Italy, September 25-29.1995.
- 1995.09.25 Chen, S.H., “Clustering in Dense Three-Component Water-Based Microemulsion System,” An invited paper presented at the *Workshop on Non-equilibrium Phenomena in Supercooled Fluids, Glasses and Amorphous Materials*, Pisa, Italy, September 25-29.1995.

- 1995.06.14 Chen, S.H., "Statics and Dynamics Properties of Water-in-Oil Microemulsions Near the Critical and Percolation Point," A talk given at the Physics Department, University of Tokyo, Japan, June 14, 1995.
- 1995.06.13 Chen, S.H., "Structural Inversion Bicontinuous Microemulsions AOT/Water/Decane Three-Component Microemulsion Systems," A talk given at the Ochanomizu University, Tokyo, Japan, June 13, 1995.
- 1995.06.06 Chen, S.H., "Statics and Dynamics Properties of Water-in-Oil Microemulsions Near the Critical and Percolation Point," A lecture given at the Department of Applied Physics, Nagoya University, June 6, 1995.
- 1995.05.03 Chen, S.H., "General introduction of the workshop," presented at the *Workshop on Colloid and Interface Science: Trends and Applications*, Guanica, Puerto Rico, May 2-5, 1995.
- 1995.04.24 Chen, S.H., "**Slow Dynamics of Interfacial Water**," An invited paper presented at the *Symposium in Honor of Professor B.N. Brockhouse for receiving 1994 Nobel Prize in physics*, April 24, 1995, McMaster University.
- 1995.04 Chen, S.H., "SANS Studies of the Structure and Interaction in Protein, Micelle, and Microemulsion Systems," a paper presented at the *RCA/IAEA Workshop-SANS*, April 1995.
- 1994.11.28 Chen, S.H., "Spinodal Decomposition of the Three Component Microemulsion System: AOT-Water-Decane," A paper presented at the *MRS Meeting*, Boston, MA, November 28 – December 9, 1994.
- 1994.11.14 Chen, S.H., "Bulk and Surface Structure of a Ternary Microemulsion," A talk presented at the *Symposium on Neutron Scattering in Materials Science, Fall Meeting of MRS*, Boston, MA, Nov. 14, 1994.
- 1994.10.18 Chen, S.H., "Radioactivity and Health: Hazard versus Benefits," A lecture given at the Epoch Foundation, Taipei, Taiwan, October 18, 1994.
- 1994.10.11 Chen, S.H., "Structure of Microemulsions and Measurement of the Mean Curvature of Surfactant Film: Observation of an Ordered-to-Disordered Bicontinuous Transition," A Lecture delivered at KAO Corporation, Tokyo, Japan, October 11, 1994.
- 1994.10.04 Chen, S.H., "Dynamics of Water in Confined Geometry," A talk presented at the *Yamada Conference*, Sendai, Japan, October 4, 1994.
- 1994.07.04 Dan D. Lee and S.H. Chen, "Direct Measurement of the Mean Curvature of Surfactant Films in a Ternary Microemulsion System: Observation of a Structural Inversion," A lecture presented at the *International Conference on Scaling Concepts and Complex Fluids*, Catanzaro, Italy, July 4-8, 1994.

- 1994.06.23      Chen, S.H., "Structure and Dynamics of Water-in-Oil Microemulsions Near the Critical and Percolation Points," An invited paper at the *12th Symposium on Thermophysical Properties*, Boulder, Colorado, June 19-25, 1994.
- 1994.04.13      Chen, S.H., "Counterion Condensation on Spherical Micelles Studied by Combined Small Angle Neutron and X-Ray Scattering," A talk presented at the *ACS Meeting*, Washington DC.
- 1994.01.17      Chen, S.H., "Introduction to Small Angle Neutron Scattering," Two lectures presented at the *Workshop on Neutron and Synchrotron X-ray Beam Applications*, AEC, Taipei, Taiwan, January 17-18, 1994.
- 1993.11.26      Chen, S.H., "Structure and Dynamics of Water-in-Oil Microemulsions near the Critical and Percolation Points," A lecture presented at Eniricerche Spa, Milan, Italy, November 26, 1993.
- 1993.08          Chen, S.H., "Structure and Dynamics of Water in Confined Geometry," One of the two lectures given by S.H. Chen at *NATO ASI on Hydrogen-Bond Networks*, August 1993.
- 1993.06.28      Chen, S.H., "Applications of Thermal Neutron Scattering in Colloid and Surface Sciences," An invited talk presented at Texas Research Center, Beacon, NY on June 28, 1993.
- 1993.04.27      Chen, S.H., "Measurement and Interpretation of Counterion Distributions around Cylindrical Micelles," An invited talk presented at the *IX International Congress on Small Angle Scattering*, Saclay, France, April 27-30, 1993.
- 1992.09.21      Chen, S.H., "Inverse Problems in Neutron and X-ray Reflectivity Studies," An invited plenary lecture given at the *6th European Colloid and Interface Science Society Meeting*, Graz, Austria. September 21-25, 1992.
- 1992              Chen, S.H., "Structure and Aggregation of Lithium dodecyl sulfate micelles in the Presence of a Macrocylic Cage: A SANS Study," An invited paper presented at the *International Conference on Small Angle Scattering*, 1992.
- 1992              Chen, S.H., "Visualization of 3D microstructure of Bicontinuous microemulsions by combined SANS experiments and simulations," An invited paper presented at the *7th Conference of the Liquids Section of the European Physical Society on Neutron Scattering from Liquids*, Giardini Naxos (Taormina, Sicily), Italy, 1992.
- 1991.04.15      Chen, S.H., "Inverse Problem in Neutron Reflection," An invited lecture to the *NATO ASI on Inverse Problems in Scattering and Imaging*, Cape Cod, MA, April 15-19, 1991.
- 1991              Chen, S.H., "Dynamic Slowing-Down in Dense Microemulsions Near the

Percolation Threshold,” An invited paper presented at the *Workshop on Slow Dynamics in Condensed Matter*. Organized by Kawasaki, K., M. Tokuyama, and T. Kawakatsu, 1991.

- 1991      Chen, S.H., “Light Scattering from Polydispersed Fractal Clusters in Solution,” An invited paper presented at an *European Chemical Conference* in Zagreb, Croatia, 1991.
- 1990      Chen, S.H., “Mixed Short-Chain Lecithin/Long-Chain Lecithin Aggregates Studied by Small-angle Neutron Scattering,” An invited paper presented at the *Workshop on Trends in Colloid & Interface Science*, 1990.
- 1990      Chen, S.H., “Measurement and Interpretation of Counterion Distribution around Cylindrical Polyelectrolytes,” An invited paper presented at the *Workshop on Trends in Colloid & Interface Science*, 1990.
- 1990      Chen, S.H., “Quasielastic and Inelastic Neutron Scattering and Molecular Dynamics of Water at Supercooled Temperature,” An invited paper presented at a *NATO Conference on Hydrogen - Bonded Liquids*. 1990.