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University of California, Davis, CA. N.C. Luhmann Jr.

Project overview and executive summary

The University of California, Davis is involved in a project to deploy and enhance an artificial intelligence (AI) system for predicting and preventing plasma disruptions on the DIII-D tokamak, under the funding from Department of Energy DE-SC0023500 (title: *AI/Deep Learning FRNN Software for Prediction & Real-Time Control of DIII-D Plasma Control System (PCS)*). The overarching goal is to demonstrate that real-time, AI-guided intervention can proactively modify the plasma state to avoid or mitigate disruptions—a critical challenge for the future of fusion energy.

This project builds upon the FRNN deep learning model, whose formidable predictive capability was previously established using archived data (Nature, 2019). A key milestone has been the successful integration of an optimized FRNN inference engine into the real-time Plasma Control System (PCS), achieving execution times under 1.7 milliseconds. This enables the system to not only forecast disruptions but also to test and execute control actions by engaging an array of plasma actuators.

To systematically progress toward robust control, we are addressing a central software challenge: the creation of a modern, high-performance computing (HPC) enabled "synthetic plasma simulator." This involves developing a deep learning framework to train a surrogate model ("SGTC") derived from the first-principles gyrokinetic code GTC. The role of SGTC is to provide accurate, real-time plasma instability information, creating a digital twin to complement and inform the control actions guided by experimental data.

A major leap forward in this project is the extension of the FRNN framework to incorporate high-dimensional, high-resolution data. We are moving beyond traditional 0D and 1D inputs by integrating experimentally measured 2D temperature fluctuation data from Electron Cyclotron Emission Imaging (ECEI) diagnostics. To fully leverage this capability, we have developed a sophisticated synthetic GTC-ECEI module. This tool generates realistic ECEI signals from GTC/SGTC simulations, establishing a valuable database for interpreting actual experimental data and validating theoretical models before live plasma discharges.

The successful upgrade of this synthetic diagnostic module to interface with SGTC has established a comprehensive SGTC-ECEI database, encompassing key instability models like fishbones. This closed-loop R&D platform, which fuses real-time experimental measurements with high-fidelity synthetic data, dramatically enhances FRNN's performance and our physical understanding. Overall, this integrated work provides a powerful foundation for validating control strategies and significantly advancing the real-

time measurement, analysis, and feedback control capabilities essential for stable fusion energy.

Throughout the project funding period, we published a total of 18 publications, gave 4 invited presentations, and presented 7 poster presentations [Appendix: Products], attracting significant attention from domestic and international fusion research communities.

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Accomplishments

Goal I: Build ECEI data module to interface with GTC numerical simulation results for establishing GTC/ECEI database.

ECE-Imaging visualizes 2-Dimensional electron temperature and electron temperature fluctuations. Synthetic diagnostics play a crucial role in the development of microwave imaging diagnostics. They provide a means to quantitatively compare experimental measurements with simulation outputs, allowing for a better understanding and interpretation of the observed experimental data. By utilizing synthetic diagnostics, researchers can gain insights into the underlying theoretical models and validate their accuracy. Moreover, synthetic diagnostics are valuable for the design of microwave diagnostic systems. In the context of microwave imaging reflectometry, 2D synthetic diagnostics have been successfully applied in numerous cases. Furthermore, the utilization of 2D synthetic diagnostics in electron cyclotron emission imaging has been successfully developed for ECE observation window analysis. In 2022, we improved the resonance depth calculation with different receiving bandwidth, and non-local radiation effect, which helps us to understand the fluctuation and profile evolution with numerical simulation.

The GTC-ECEI synthetic module was built in September 2022, to quantitatively list the response weight of radiation from different positions in the plasma, and different emission directions. The imaging plane was calculated without diffraction or refraction in the plasma. We need to consider it further with the equilibrium profiles of experimental plasma. The synthetic ECE Imaging module has been developed since March 2023, which contains the optics propagation in air and plasma. The synthetic ECE code calculates the ECE radiation along the optical beam path using a reciprocal theorem. The code launches the microwaves from the ECE receiver to the plasma through the optical system and calculates the absorption inside the plasma. Subsequently, the synthetic radiation temperature is derived by integrating the ECE emission along the beam path where the ‘launched radiation’ is absorbed.

The synthetic ECEI module testing has been conducted with preset equilibrium profiles corresponding to DIII-D experimental results. As shown in Fig. 1, the synthetic ECEI module successfully presents the 2D temperature information, which matches the preset result. It is important to quantitatively calculate the difference between synthetic output and numerical profiles. The error is less than 3%, which is acceptable for data interpretation and synthetic database establishment. The ECE signal originates from synthetic output with GTC simulation. A large amplitude fluctuation (500 eV) was set in a high temperature region (10 keV). It leads to a 5% fluctuation, which has been successfully measured from the synthetic module.

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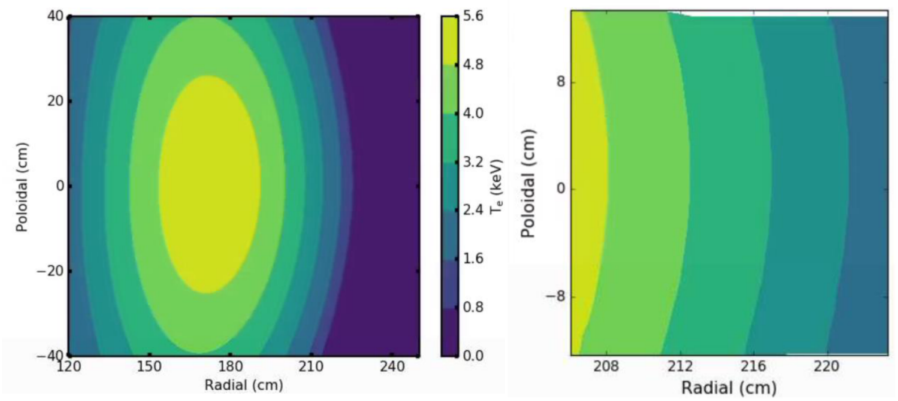
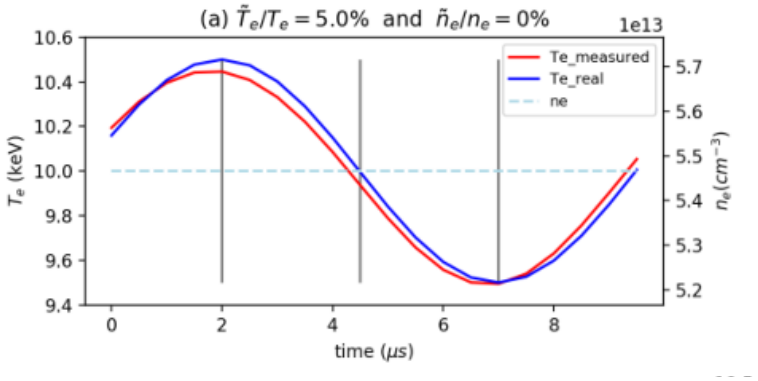


(a) (b)



(c)

Figure 1. (a) Preset equilibrium temperature profile (b) Synthetic ECE Imaging output 2D temperature profile (c) Synthetic output raw data with 5% temperature fluctuation, without any density fluctuation. The blue curve stands for preset temperature fluctuation. The red curve stands for synthetic output.

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Goal II: Run the synthetic GTC-ECEI module to generate the appropriate synthetic database for FRNN

The synthetic diagnostic code is optimized to have sufficient accuracy (~ 0.1 eV) in response to the MHD perturbations modeled by GTC. The synthetic ECE code calculates the overall ECE radiation from a bulk plasma at ~ 1-10 keV, while the perturbation level by GTC starts at the level of ~0.1 eV. The synthetic diagnostic must be able to resolve the 0.1 eV MHD perturbation from the bulk plasma ~1-10 keV before it can be used to generate the database. The accuracy is achieved by the careful and consistent meshing with ~1 mm grid size near the ECE resonance spot. Such an accuracy is demonstrated with the synthetic diagnostic simulation of a Reversed Sheared Alfven Eigenmode (RSAE) from GTC modeling. The RSAE is localized near the q=3 surface (red dash line). The electron density (temperature) fluctuation structure of the RSAE is shown in Fig 2a,2b. The ~ 0.1 eV temperature fluctuation 2D structure (Fig 2b) is well captured by the evenly spaced synthetic ECE receivers (Fig 2c) with a grid.

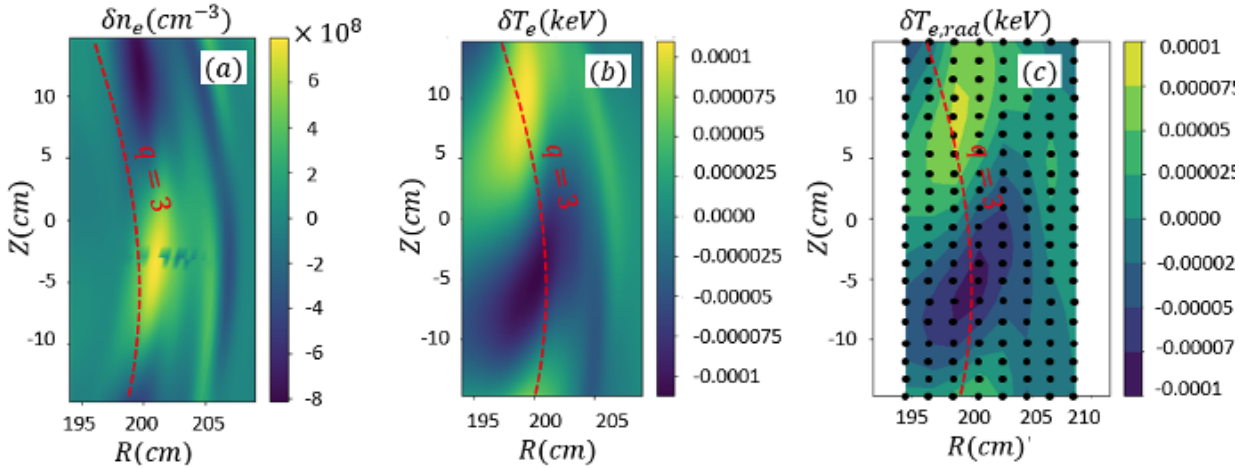

Figure 2. The synthetic diagnostic has sufficient accuracy (~ 0.1 eV) in response to the MHD perturbation from GTC output (a) The electron density fluctuation of the RSAE from GTC simulation (b) The electron temperature fluctuation of the RSAE from GTC simulation (c) The synthetic ECE fluctuation.

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Goal III: Iteratively further optimize a synthetic platform with currently available experimental ECEI data from DIII-D

At the edge of the plasma, the ECE radiation intensity is not solely related to the electron temperature at the cold resonance spot. The insufficient optical depth of the edge plasma makes the radiation intensity sensitive to both the electron density and temperature. In other words, the measured radiation intensity and fluctuation cannot be simply interpreted as the local electron temperature and temperature fluctuations. At DIII-D, ECEI is frequently arranged at the edge of the plasma for H-mode and L-mode MHD/turbulence measurements. Thus, it is important for the synthetic ECEI platform to provide sensitivity studies of the ECE radiation temperature in response to different density and temperature fluctuation structures for arbitrary experimental profiles.

The synthetic platform is applied to model the radiation fluctuation in response to different temperature and density fluctuations near an H-mode pedestal, shown in Fig 3. The pedestal profile assumes a hyperbolic tangent (tanh) shape and the separatrix is at R=226.5 cm, shown in Fig 3a,3b. A T_e (n_e) blip is separately added to the pedestal profile from R=220 cm to R=226 cm. The amplitudes of the blip are both ~1% of the temperature and density value at R=220 cm. The corresponding radiation fluctuation for the perturbation at each radial location is then modeled by the synthetic ECEI platform, as shown in Fig 3 (c, d). As can be seen in Fig 3 (c, d), the ~17 eV T_e blip can excite a similar level of $T_{e,rad}$ blip at the same radial location, while the n_e blip can actually reduce the radiation by ~4.5 eV. Thus, the synthetic modeling informs that the radiation is ~4-5 times more sensitive to electron temperature than density at the H-mode pedestal, and the radiation is negatively correlated with the electron density. The negative correlation is due to the additional radiation absorption by more electrons.

The synthetic ECEI platform also informs that the radiation responds linearly to small-scale mixed density and temperature fluctuations. Figure 3e shows the linear sum of the radiation fluctuation due to the T_e blip in Fig 3c and the radiation fluctuation due to the n_e blip in Fig 3d. Figure 3f shows the synthetic simulation result of both the n_e and T_e blips on the original H-mode profile. Comparing Fig 3e,3f, it is found that the radiation changes due to the mixed T_e and n_e blip is equal to the linear superposition of that due solely to density and temperature fluctuation. One important application of the linear response is the measurement of MHD poloidal wave number with ECEI at the plasma edge. Though ECE radiation is a mixed result of density fluctuation and temperature fluctuation, the poloidal wave number measured by ECEI is still valid as the poloidal structure is the linear combination of the density and temperature fluctuation poloidal structure.

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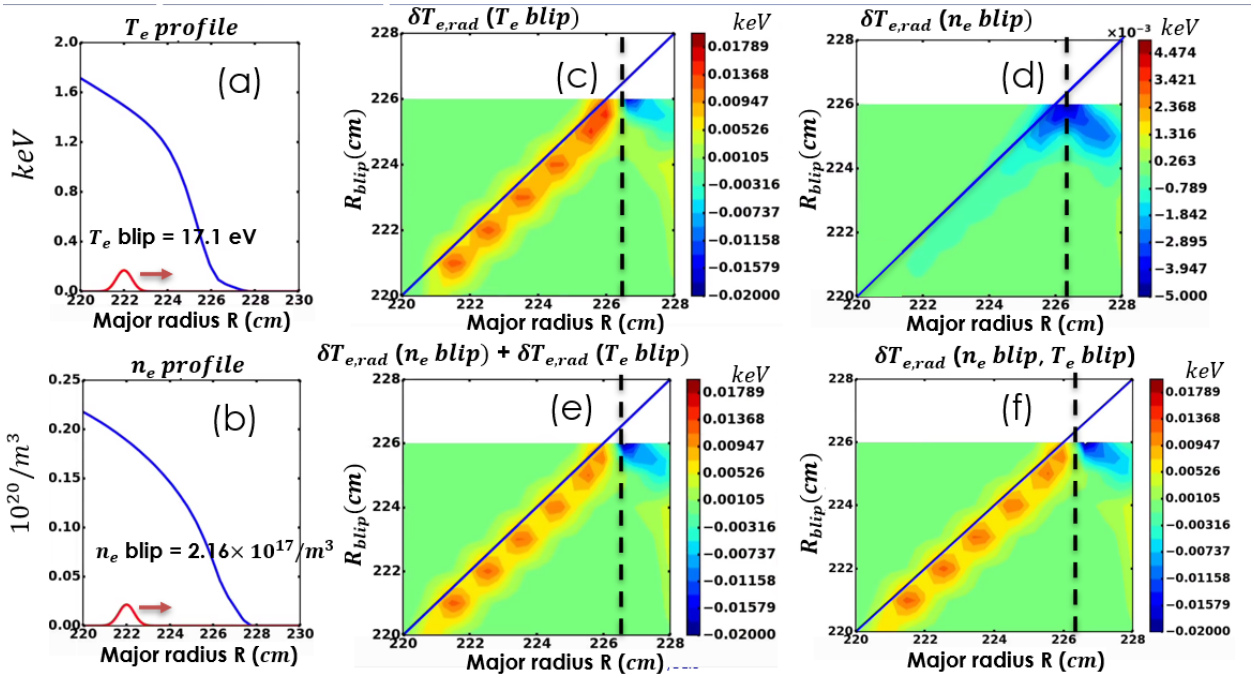

Figure 3. Synthetic ECEI module is applied to model the radiation fluctuation in response separately to density and temperature fluctuations at an H-mode pedestal (a) The H-mode electron temperature profile (b) The H-mode electron density profile (c) The radiation fluctuation in response to temperature fluctuation at different radial locations (d) The radiation fluctuation in response to density fluctuation at different radial locations (e) The linear sum of (c) and (d) (f) The radiation fluctuation in response to both the density and temperature fluctuations at different radial locations

The resonance spot is the birthplace of the ECE radiation. Thus, the thickness of the resonance spot is related to the radial resolution of the ECE diagnostic. At the core plasma where the ECE optical depth is sufficient, the ECE radiation birthplace is near the cold resonance location determined by the magnetic field strength. However, at the Scrape-off Layer (SOL), the local plasma is optically thin, so the radiation is not born from the local SOL electrons by the hot electrons at the pedestal. As a result, the radiation intensity is quite strong at the SOL region, shown as the green in Fig 4a. The corresponding resonance spot, modeled using the synthetic ECEI platform, is shown in Fig 4b. As can be seen, the resonance spot (yellow area) aligns with the cold resonance (red line) at higher ECE frequencies (f > 85.5 GHz), which is consistent with the general understanding of ECE radiation in the core plasma. At the lower ECE frequencies (f < 85.5 GHz), of which the cold resonance is outside the separatrix, the resonance spot is non-locally inside the plasma and has a significant broadening compared to that of the higher frequency radiations.

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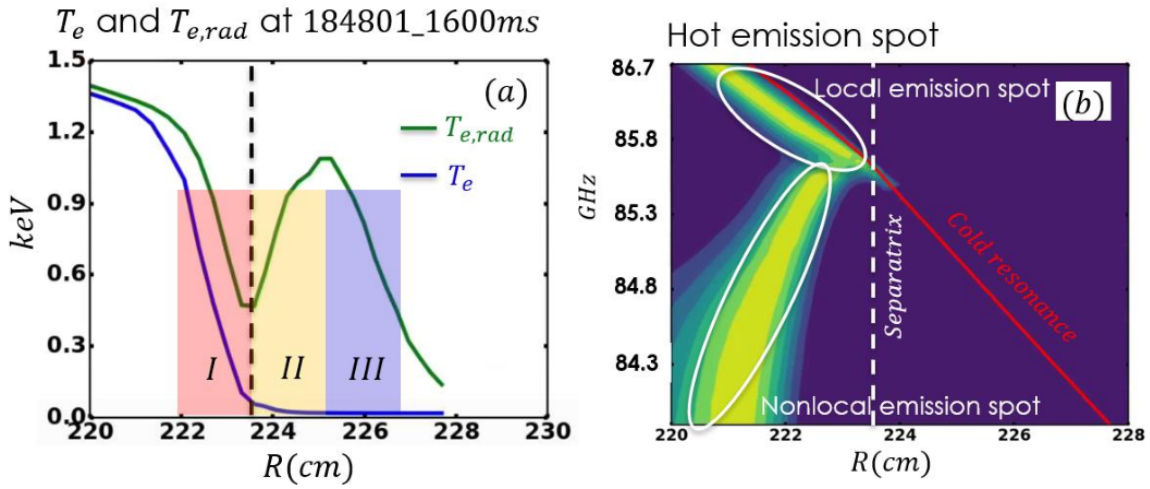

Figure 4. The resonance spot is large due to the non-local radiation effect (a) The electron temperature and the simulated radiation temperature (b) The resonance spot for ECE frequencies inside and outside the last closed flux surface.

Appendix: Product

Journal articles

1. Title: Electron Cyclotron Emission–Based Separatrix Identification in ITER with OMFIT Synthetic Modeling
Journal: Fusion Science and Technology

Peer reviewed: Yes

Publication status: Published

Volume: NA

Issue: NA

First page number or eLocation ID: NA

Publication date: 2025

Publication location: Westmont, IL

Authors: Xiaoliang Li, Guanying Yu, Yilun Zhu, Neville Luhmann Jr. William Tang.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1080/15361055.2025.2580012

University of California, Davis, CA. N.C. Luhmann Jr.

Acknowledgement of DOE support: Yes

2. Title: The dual-electron cyclotron emission based measurement of 3D structures on DIII-D tokamak
Journal: Plasma Physics and Controlled Fusion

Peer reviewed: Yes

Publication status: Published

Volume: 67

Issue: 11

First page number or eLocation ID: 115009

Publication date: 2025

Publication location: United Kingdom

Authors: Xiaoliang Li, Guanying Yu, Yilun Zhu, Gerrit Kramer, Yanzheng Jiang, Edward Strait, Max Austin, Laszlo Bardoczi, Neville Luhmann, Evdokiya Kostadinova, Dmitri M Orlov, William Tang

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1361-6587/ae163d

Acknowledgement of DOE support: Yes

3. Title: Design of the High-Q Approach Notch Filter for 60 GHz Collective Thomson Scattering System
Journal: Plasma Science and Technology

Peer reviewed: Yes

Publication status: Published

Volume: NA

Issue: NA

First page number or eLocation ID: NA

Publication date: 2025

Publication location: China

University of California, Davis, CA. N.C. Luhmann Jr.

Authors: Chen Luo, Peng Shi, Xiaoliang Li, Yilun Zhu, Shasha Qiu, Logan G Himes and Neville Luhmann Jr.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1088/2058-6272/ae1a2f

Acknowledgement of DOE support: Yes

4. Title: Development and preliminary results of 270 GHz microwave forward scattering diagnostic system on the experimental advanced superconducting tokamak (EAST)
Journal: Plasma Physics and Controlled Fusion

Peer reviewed: Yes

Publication status: Published

Volume: 67

Issue: 8

First page number or eLocation ID: 085029

Publication date: 2025

Publication location: United Kingdom

Authors: Pengjun Sun, Xiaoliang Li, Yang Ren, Xiaofeng Han, Xianzi Liu, Jing Qian, Yilun Zhu, Calvin Domier, Ke Yao, Xinhang Xu, Jon Dannenberg, Ran Chen, Guosheng Xu, Neville Luhmann Jr

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1361-6587/adfa41

Acknowledgement of DOE support: Yes

5. Title: Design of a 170GHz quasi-optical notch filter for microwave-based diagnostics protection on the burning plasma device

Journal: Fusion Engineering and Design

Peer reviewed: Yes

Publication status: Published

Volume: 214

University of California, Davis, CA. N.C. Luhmann Jr.

Issue: NA

First page number or eLocation ID: 114925

Publication date: 2024

Publication location: Amsterdam, Netherlands

Authors: Chen Luo, Xiaopin Tang, Calvin Domier, Xiaoliang Li, Ang Ti, Pengjun Sun, Shasha Qiu, Xinhang Xu, Xianzi Liu, Yilun Zhu, Neville Luhmann

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1016/j.fusengdes.2025.114925

Acknowledgement of DOE support: Yes

6. Title: First observations of edge instabilities in strongly shaped negative triangularity plasmas on DIII-D

Journal: Plasma Physics and Controlled Fusion

Peer reviewed: Yes

Publication status: Published

Volume: 67

Issue: 3

First page number or eLocation ID: 035033

Publication date: 2025

Publication location: Bristol, UK

Authors: T Cote, G Yu, AO Nelson, N Leuthold, N Richner, S Stewart, F Khabanov, Y Zhu, F Ebrahimi, J King, C Paz-Soldan, L Schmitz, KE Thome, ME Austin, F Scotti

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1361-6587/adb5ba

Acknowledgement of DOE support: Yes

7. Title: Design of a 170 GHz Quasi-optical Notch Filter for Microwave-based Diagnostics Protection on the Burning Plasma Device

University of California, Davis, CA. N.C. Luhmann Jr.

Journal: Fusion Engineering and Design

Peer reviewed: Yes

Publication status: Published

Volume: 214

Issue: NA

First page number or eLocation ID: 114925

Publication date: 2025

Publication location: Amsterdam, Netherlands

Authors: Chen Luo, Xiaopin Tang, Calvin Domier, Xiaoliang Li, Ang Ti, Pengjun Sun, Shasha Qiu, Xinhang Xu, Xianzi Liu, Yilun Zhu, Neville Luhmann, Jr.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1016/j.fusengdes.2025.114925

Acknowledgement of DOE support: Yes

8. Title: Quasi-optical beam tracing module development for millimeter-wave high-wavenumber collective scattering on the NSTX-U and EAST tokamaks

Journal: Fusion Engineering and Design

Peer reviewed: Yes

Publication status: Published

Volume: 212

Issue: NA

First page number or eLocation ID: 114826

Publication date: 2024

Publication location: Amsterdam, Netherlands

Authors: Xianzi Liu, Yang Ren, Yilun Zhu, Neville C Luhmann Jr

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1016/j.fusengdes.2025.114826

Acknowledgement of DOE support: Yes

University of California, Davis, CA. N.C. Luhmann Jr.

9. Title: Scaling law for defining the relativistic shift of the high field side electron cyclotron emission diagnostics on the tokamak device

Journal: Review of Scientific Instruments

Peer reviewed: Yes

Publication status: Published

Volume: 96

Issue: 2

First page number or eLocation ID: 023503

Publication date: 2024

Publication location: Melville, NY

Authors: X. Yu, Z. B. Shi, W. Chen; M. Jiang, G. Y. Yu, Y. L. Zhu.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1063/5.0231756

Acknowledgement of DOE support: Yes

10. Title: Modelling of the electron cyclotron emission burst from a laboratory tokamak plasma with loss-cone maser instability

Journal: Journal of Plasma Physics

Peer reviewed: Yes

Publication status: Published

Volume: 90

Issue: 6

First page number or eLocation ID: 985900601

Publication date: 2024

Publication location: United Kingdom

University of California, Davis, CA. N.C. Luhmann Jr.

Authors: Guanying Yu, Gerrit Kramer, Yilun Zhu, Max Austin, Severin Denk, Min-Gu Yoo, Xiaoliang Li, Bingzhe Zhao, Ruifeng Xie, Zeyu Li, Ying Chen, Xianzi Liu, Shasha Qiu, Xinhang, N. C. Luhmann Jr.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1017/s0022377824001430

Acknowledgement of DOE support: Yes

11. Title: Electron cyclotron emission quasi-optical transmission system on the HL-3 tokamak

Journal: Review of Scientific Instruments

Peer reviewed: Yes

Publication status: Published

Volume: 95

Issue: 11

First page number or eLocation ID: 113510

Publication date: 2024

Publication location: Melville, NY

Authors: X. Yu; Z. B. Shi; Z. C. Yang; M. Jiang; W. Chen; G. Y. Yu; Y. L. Zhu; W. C. Deng; Y. Zhou; Y. Q. Shen; J. Wen; P. W. Shi; K. X. Han.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1063/5.0231756

Acknowledgement of DOE support: Yes

12. Title: Gyrokinetic simulation of pedestal degradation correlated with enhanced magnetic turbulence in a DIII-D ELMy H-mode discharge
Journal: Plasma Physics and Controlled Fusion

Peer reviewed: Yes

Publication status: Published

Volume: 66

Issue: 4

University of California, Davis, CA. N.C. Luhmann Jr.

First page number or eLocation ID: 045008

Publication date: 2024

Publication location: United Kingdom

Authors: X Jian, J Chen, C Holland, V S Chan, X R Zhang, G Yu and Z Yan

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1361-6587/ad268e

Acknowledgement of DOE support: Yes

13. Title: Density fluctuation statistics and turbulence spreading at the edge of L–mode plasmas

Journal: Nuclear Fusion

Peer reviewed: Yes

Publication status: Published

Volume: 64

Issue: 12

First page number or eLocation ID: 126056

Publication date: 2024

Publication location: Bristol, UK

Authors: FO Khabanov, R Hong, PH Diamond, GR Tynan, Z Yan, GR McKee, C Chrystal, F Scotti, G Yu, SA Zamperini, Y Zhu

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1741-4326/ad820d

Acknowledgement of DOE support: Yes

14. Title: The 140 GHz notch filter development for millimeter-wave diagnostics protection on the stellarator Wendelstein 7-X

Journal: Journal of Instrumentation

Peer reviewed: Yes

University of California, Davis, CA. N.C. Luhmann Jr.

Publication status: Published

Volume: 19

Issue: 10

First page number or eLocation ID: P10024

Publication date: 2024

Publication location: Bristol, UK

Authors: Logan Himes, Shasha Qiu, Calvin Domier, Xiaoliang Li, Yilun Zhu, Neville Luhmann Jr

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1748-0221/19/10/P10024

Acknowledgement of DOE support: Yes

15. Title: Frontier system-on-chip (SoC) technology for microwave diagnostics

Journal: Review of Scientific Instruments

Peer reviewed: Yes

Publication status: Published

Volume: 95

Issue: 9

First page number or eLocation ID: 093516

Publication date: 2024

Publication location: Melville, NY

Authors: Ying Chen, Pin-Jung Chen, Robert Hu, Yilun Zhu, Jo-Han Yu, A-V Pham, Omeed Momeni, Calvin Domier, Jon Dannenberg, Xiaoliang Li, Guanying Yu, Neville Luhmann

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1063/5.0219545

Acknowledgement of DOE support: Yes

University of California, Davis, CA. N.C. Luhmann Jr.

16. Title: Millimeter-wave high-wavenumber scattering diagnostic developments on EAST and NSTX-U

Journal: Review of Scientific Instruments

Peer reviewed: Yes

Publication status: Published

Volume: 95

Issue: 8

First page number or eLocation ID: 083553

Publication date: 2024

Publication location: Melville, NY

Authors: Pengjun Sun, Xianzi Liu, Yang Ren, Guosheng Xu, Ran Chen, Jing Qian, Xiaoliang Li, Calvin Domier, Jon Dannenberg, Ke Yao, Yilun Zhu, Neville Luhmann

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1063/5.0219393

Acknowledgement of DOE support: Yes

17. Title: Modeling the electron cyclotron emission radiation signature from suprathermal electrons in a tokamak

Journal: Review of Scientific Instruments

Peer reviewed: Yes

Publication status: Published

Volume: 95

Issue: 7

First page number or eLocation ID: 073505

Publication date: 2024

Publication location: Melville, NY

Authors: Guanying Yu, Yilun Zhu, Gerrit Kramer, Max Austin, Severin Denk, Min-Gu Yoo, Xiaoliang Li, Bingzhe Zhao, Ruifeng Xie, Zeyu Li, Ying Chen, Xianzi Liu, Shasha Qiu, NC Luhmann

University of California, Davis, CA. N.C. Luhmann Jr.

Publication identifier type: DOI

Publication identifier: https://doi.org/10.1063/5.0217728

Acknowledgement of DOE support: Yes

18. Title: Isotope impact on Alfvén eigenmodes and fast ion transport in DIII-D

Journal: Nuclear Fusion

Peer reviewed: Yes

Publication status: Published

Volume: 64

Issue: 5

First page number or eLocation ID: 056033

Publication date: 2024

Publication location: Bristol, UK

Authors: M.A. Van Zeeland, E. Bass, X.D. Du, W.W. Heidbrink, C. Chrystal, C. Crocker, G. DeGrandchamp, S. Haskey, D. Liu, J. Gonzalez-Martin, K.E. Thome, G. Yu, Y. Zhu

Publication identifier type: DOI

Publication identifier: https://doi.org/ 10.1088/1741-4326/ad38cc

Acknowledgement of DOE support: Yes

Conference and Workshop Presentations

1. Type: Invited Presentation

Title: Frontier System-on-Chip (SoC) Technology for Microwave Diagnostics

Authors: Chen, Y., Chen, P. J., Hu, R., Zhu, Y., Yu, J. H., Pham, A. V., Momeni, O., Domier, C., Dannenberg, J., Li, X., Yu, G. and Luhmann, N.

Conference Location: Asheville, North Carolina, U.S.

Conference Date: April 21-25, 2024

Publication Status: Published

Conference Name: 25th Topical Conference on High-Temperature Plasma Diagnostics

Acknowledgement of DOE support: Yes

2. Type: Invited Presentation

Title: First Observation, Identification, and Implication of Edge Instabilities in Strongly Shaped Negative Triangularly Plasmas on DIII-D

Authors: Cote, T., Yu, G., Nelson, A., Leuthold, N., Richner, N., Stewart, S., Khabanov, F., Schmitz, L., Paz-Soldan, C., Thome, K. and Austin, M.

Conference Location: Atlanta, Georgia, U.S.

Conference Date: October 7–11, 2024

Publication Status: Published

Conference Name: 66th Annual Meeting of the APS Division of Plasma Physics

Acknowledgement of DOE support: Yes

3. Type: Invited Presentation

Title: System-on-Chip Technology Application on Millimeter Wave Reflectometers (Invited)

Authors: Yilun Zhu, Ying Chen, Pin-Jung Chen, Robert Hu, Calvin Domier, Guanying Yu, Xiaoliang Li, Jon Dannenberg, Neville Luhmann Jr.

Conference Location: Greifswald, Germany

Conference Date: May 13-16, 2024

University of California, Davis, CA. N.C. Luhmann Jr.

Publication Status: Published

Conference Name: 16th International Reflectometry Workshop

Acknowledgement of DOE support: Yes

4. Type: Invited Presentation

Title: New Measurement Capabilities Addressing the Key Physics of Edge and SOL Transport with the System-on-Chip ECE Imaging system

Authors: Guanying Yu, Yilun Zhu, Gerrit Kramer, Patrick Diamond, Raffi Nazikian,

Filipp Khabanov, Zeyu Li, Calvin Domier, Neville Luhmann Jr.

Conference Location: Madison, Wisconsin, U.S.

Conference Date: May 2-5, 2023

Publication Status: None

Conference Name: 32nd US Transport Task Force Workshop

Acknowledgement of DOE support: Yes

Oral/Poster Presentation

1. Type: Academic Seminar

Title: MILLIMETER-WAVE TECHNOLOGY APPLICATIONS FOR NUCLEAR FUSION ENERGY DEVELOPMENT

Authors: Yilun Zhu, Neville Luhmann Jr.

Conference Location: National Yang Ming Chiao Tung University, Taiwan

Conference Date: March 7, 2023

Publication Status: Published

Conference Name: NA

Acknowledgement of DOE support: Yes

University of California, Davis, CA. N.C. Luhmann Jr.

2. Type: Poster Presentation

Title: The ECE radiation signature of runaway electrons in optically thick and thin plasmas

Authors: Yu, Guanying ; Kramer, Gerrit ; Zhu, Yilun ; Li, Xiaoliang ; Xu, Xinhang ; Austin, Max ; Xie, Ruifeng ; Li, Zeyu ; Zhao, Bingzhe ; Chen, Ying ; Liu, Xianzi ; Qiu, Shasha

Conference Location Atlanta, Georgia

Conference Date: October 7–11, 2024

Publication Status: Published

Conference Name: 66th Annual Meeting of the APS Division of Plasma Physics
Acknowledgement of DOE support: Yes

3. Type: Poster Presentation

Title: Development of ECE-I and ECE Synthetic Diagnostics in NIMROD

Authors: Khavin, V., Orlov, D., Howell, E., Yu, G., Li, X. and Ebrahimi, F.

Conference Location: Atlanta, Georgia, U.S.

Conference Date: October 7-11, 2024

Publication Status: Published

Conference Name: 66th Annual Meeting of the APS Division of Plasma Physics

Acknowledgement of DOE support: Yes

4. Type: Poster Presentation

Title: High-wavenumber Collective Scattering Diagnostic System for EAST and NSTX-U Tokamaks and Synthetic Diagnostic System Development

Authors: Liu, Xianzi ; Ren, Yang ; Sun, Pengjun ; Domier, Calvin ; Dannenberg, Jon ; Xu, Xinhang ; Zhu, Yilun ; Luhmann, Neville

Conference Location: Atlanta, Georgia

Conference Date: October 7–11, 2024

Publication Status: Published

University of California, Davis, CA. N.C. Luhmann Jr.

Conference Name: 66th Annual Meeting of the APS Division of Plasma Physics

Acknowledgement of DOE support: Yes

5. Type: Poster Presentation

Title: Modeling the Electron Cyclotron Emission radiation signature from suprathermal electrons in a tokamak

Authors: Guanying Yu, Yilun Zhu, Gerrit Kramer, Max Austin, Severin Denk, Min-Gu Yoo, Xiaoliang Li, Bingzhe Zhao, Ruifeng Xie, Zeyu Li, Xianzi Liu, Shasha Qiu, and N.C. Luhmann, Jr.

Conference Location: Asheville, North Carolina, U.S.

Conference Date: April 9-12, 2024

Publication Status: Published

Conference Name: Transport Task Force Conference 2024

Acknowledgement of DOE support: Yes

6. Type: Poster Presentation

Title: Recent advancements of microwave imaging diagnostic at the DIII-D tokamak

Authors: Domier, Calvin ; Yu, Guanying ; Chen, Ying ; Li, Xiaoliang ; Hong, Suk-Ho ; Kramer, Gerrit ; Zhu, Yilun ; Luhmann, Neville

Conference Location: Denver, CO

Conference Date: October 30-November 3, 2023

Publication Status: Published

Conference Name: 65th Annual Meeting of the APS Division of Plasma Physics

Acknowledgement of DOE support: Yes

7. Type: Poster Presentation

Title: ECE-Imaging characterization of edge magnetic islands affecting pedestal transport and stability in a net-zero torque plasma

University of California, Davis, CA. N.C. Luhmann Jr.

Authors: Domier, Calvin ; Yu, Guanying ; Li, Zeyu ; Cote, Tyler ; Kramer, Gerrit ; Zhu, Yilun ; Luhmann, Neville

Conference Location: Denver, CO

Conference Date: October 30-November 3, 2023

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Conference Name: 65th Annual Meeting of the APS Division of Plasma Physics

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