

7/15/2017

**Final Scientific/Technical Report On**  
**AWARD NO. DE-SC0015635**  
**“Organization of the 17<sup>th</sup> Advanced Accelerator**  
**Concepts (AAC16) Workshop by the IEEE”**

The IEEE Council on Superconductivity  
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Period of time covered by the report: 5/1/2016 – 4/30/2017

## **Executive Summary**

The 2016 Workshop on Advanced Accelerator Concepts (AAC) was held at the Gaylord Hotel and Conference Center, National Harbor, Maryland, from July 31 through August 5, 2016. This workshop was the seventeenth in a biennial series that began at Los Alamos National Laboratory in 1982 with a workshop on laser acceleration of particles (see AIP Conf. Proc. 91). AAC16 was organized under the sponsorship of the IEEE Council on Superconductivity with financial support from the U. S. Department of Energy Office of High Energy Physics and the National Science Foundation.

The scope of the AAC Workshop has grown since 1982 to encompass a broad range of topics related to advancing accelerator science and technology beyond its current scientific and technical limits and is now an internationally acknowledged forum for interdisciplinary discussions on advanced accelerator and beam physics/technology concepts covering the widest possible range of applications. The Workshop continued the trend of growing worldwide participation, attracting world wide participation. The Workshop had a total of 256 attendees comprising (including the U.S.) representatives from 11 countries representing 65 different institutions.

Each day's schedule began with plenary sessions covering broad, cross disciplinary interests or general tutorial topics as selected by the Program Committee, followed by a break out into more narrowly focused working groups. The Workshop was organized into eight Working Groups each with a published statement of topical focus, scope of discussion and goals. A summary of the Working Group activities and conclusions is included in the American Institute of Physics' (AIP) Conference Proceedings now available as an on line open source document.

It has been a long tradition of the AAC workshops to encourage strong student participation. This is accomplished in part by subsidizing student attendance, done for this work shop by using funds from the DOE and National Science Foundation to significantly reduce student registration fees. As a result the registered student participation was 75 persons, or 29% of the total attendance of 256 persons, the highest percentage student enrollment the Workshop has ever had.

This is the final report for the DOE Office of Science/Office of High Energy Physics grant NO. DE-SC0015635, entitled "Organization of the 17th Advanced Accelerator Concepts Workshop by the IEEE."

## **Summary of Major Results**

Advanced Accelerator R&D covers long term research and development in accelerator physics and engineering. Since 1982, the community doing research in long-term Accelerator and Beam Physics R&D topics has met biennially at the Advanced Accelerator Concepts (AAC) Workshops to provide an overview of current progress in these topics, exchange ideas, promote research in the field and provide a forum for publication of new ideas and R&D progress. In the course of its development, the AAC Workshop has become the premier international forum for interdisciplinary discussions

on advanced accelerator and beam physics and technology concepts covering such a wide range of potential applications.

The 17th Advanced Accelerator Concepts (AAC) Workshop was held at the Gaylord Hotel and Conference Center, National Harbor, Maryland, near Washington D.C., from July 31 thru August 5, 2016. The meeting was devoted to cross-disciplinary discussion of advanced accelerator concepts, including progress in plasma acceleration methods, new methods of particle acceleration and high energy photon generation, techniques for production of ultra-high accelerating gradients, diagnostics and control of particle and photon beams and various associated particle beam, RF sources, advanced computational techniques, and the development of very high peak power and high repetition rate lasers. The specific technical topics were covered in the eight working groups described below and in a series of daily plenary session talks aimed at more general cross disciplinary and relevant tutorial topics.

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The results of the Workshop presentations and discussions have been published on line as an American Institute of Physics Conference Proceedings, AIP Proceedings, volume #1812, which has open access in perpetuity.

The Conference was organized by the IEEE under the sponsorship of the IEEE Council on Applied Superconductivity. The Chair Person was Dr. Daniel Gordon of the U.S. Naval Research Laboratory, and the day to day management for the Workshop was done by Centennial Conferences of Louisville, Colorado.

## **1. Organization**

The long term institutional responsibility for the AAC series of Workshops resides in the Core Committee. It has the responsibility for initiating each workshop organizational sequence, selecting and approving a Chair Person or persons from recommendations from the wider accelerator physics community and in working with the Chair Person(s) to

select a full Organizing Committee that has the specific responsibility for organizing the actual biennial workshop, establishing Working Group topics, selecting Working group leaders and co-leaders, and reviewing and approving Working Group scope of work statements. The Organizing Committee together with the Working Group Leaders and Co-Leaders comprises the Workshop Program Committee. It determines the overall schedule and the plenary topics and talks. Membership in the Organizing Committee includes ex officio members from the DOE Office of High Energy Physics and the National Science Foundation, the principal two federal funding agencies for R&D in advanced accelerator physics and technology. Selection of Organizing Committee members and Working Group leaders and co-leaders are done carefully to provide broad, equal and diverse representation from the relevant U.S. research institutions.

**Table 1: Membership of the AAC 2016 Organizing Committee**

Felice Albert	LLNL	LK Len**	DOE
Ralph Assman	DESY	Wei Lu	Tsinghua U.
Ilan Ben-Zvi*	BNL	Phillipe Piot	FNAL/NIU
Mike Downer,*	U. Texas	Igor Pogorelsky	BNL
Wei Gai*	ANL	Evgenya Simakov	LANL
Dan Gordon (Chair)	NRL	Dave Sutter*	U. Maryland
Mark Hogan	SLAC	Sami Tantawi	SLAC
Chan Joshi*	UCLA	Louise Willingale	U. Michigan
Wim Leemans*	LBNL	Slava Lukin	NSF**

\*AAC Core Committee members. \*\*Ex officio member of the Core Committee

The Local Organizing Committee was chaired by the Workshop Chairman, Daniel Gordon, and included members from the Naval Research laboratory Staff and the University of Maryland. The day to day business and financial management was the responsibility of a professional management company contracted by the IEEE, Centennial Conferences of Louisville, Colorado. The IEEE maintained budget overview and financial auditing responsibility through their Conference Services Organization.

## 2. Working Group Structure

The Working Groups form the Core of the scientific organization. Working Group topics are reviewed and selected anew for each AAC by the Organizing Committee which then selects Working group Leaders and Co-Leaders appropriate for each topic. The topics reflect the consensus of the Organizing Committee on what are the current areas in advanced accelerator R&D of broad and research of most interest world wide. Guidance is given to each Working Groups leadership on what the Organizing Committee thinks should be accomplished by each group. The Working Group leaders then prepare a “charge” document describing in detail what they plan to do. These charges are then reviewed, negotiated if need be, and approved by the Organizing Committee. Each Working Group’s leadership is then responsible for setting up the group’s agenda, soliciting speakers, accepting proposed talks, chairing the Working Group Sessions, recommending plenary session talks to the Program Committee for approval and, finally,

preparing a summary of the working groups presentations, discussions and conclusions for presentation on the last day of the Workshop and in written form for the Workshop Proceedings.

For AAC2016 the topics for the working groups were slightly altered from those of AAC2014 in order to reflect changes in the national High Energy Physics program structure resulting from the 2014 P5 HEPAP sub panel report. The AAC 2016 web site provides further details concerning each Working Group. The list of Group titles and the leaders and co-Leaders for AAC16 is below. This list is identical to the one in the proposal. The specific working Group charges were included in the proposal to DOE and are not reproduced here.

**WG 1: Laser-Plasma Wakefield Acceleration**

*Leader:* Tony Gonzales, LBNL; *Co-Leaders:* Wei Lu, Tsinghua U. and Brad Pollack, LLNL

**WG 2: Computations for Accelerator Physics**

*Leader:* Ben Cowan, Tech-X; *Co-Leader:* Carlo Benedetti, LLNL

**WG 3: Laser and High-Gradient Structure-Based Acceleration**

*Leader:* Evgenya Simakov, LANL; *Co-Leader:* Gerard Andonian, RadiaBeam

**WG 4: Beam-Driven Acceleration**

*Leader:* Chunguang Jing, Euclid Technologies; *Co-Leader:* Mike Litos, SLAC

**WG 5: Beam Sources, Monitoring and Control**

*Leader:* Manoel Conde, ANL; *Co-Leader:* Rafal Zgadzaj, U. of Texas

**WG 6: Laser-Plasma Acceleration of Ions**

*Leader:* Farhat Beg, UCSD; *Co-Leader:* Stepan Bulanov, LBNL

**WG 7: Radiation Generation and Advanced Concepts**

*Leader:* Bruce Carlston, LANL; *Co-Leaders:* Alex Murokh, RadiaBeam, Dmitri Kagonovich, NRL

**WG 8: Advanced Beams and Laser Facilities and Technology**

*Leader:* Almantas Galvanauskas, U. of Michigan; *Co-Leader:* Eduardo Granados, SLAC

**3. Workshop venue and schedule**

Meeting space and housing arrangements were contracted with the National Harbor and Conference Center at National Harbor, Maryland, a short distance south of Washington, D.C. on the Potomac River and across the river from Alexandria, Virginia. All conference activities including the Thursday evening Workshop dinner were held in the

Conference Center. A block of rooms at a special Workshop rate equivalent to the then effective local government rate (\$174/night) was reserved for this purpose.

The Plenary sessions were held in the Woodrow Wilson Ball rooms and breakout rooms for individual working groups with varying capacities were reserved on the same floor as the ballrooms for the entire week. Additional rooms were allocated for the workshop office and computer room. The schedule for AAC16 is shown below.

	Sunday July 31st	Monday August 1st	Tuesday August 2nd	Wednesday August 3rd	Thursday August 4th	Friday August 5th
7:00 am – 6:00 pm		7:00 am – 6:00 pm Registration Woodrow Wilson Registration Desk	7:30 am – 6:00 pm Registration Woodrow Wilson Registration Desk	7:30 am – 1:00 pm Registration Woodrow Wilson Registration Desk	7:30 am – 5:30 pm Registration Woodrow Wilson Registration Desk	7:30 am – 3:30 pm Registration Woodrow Wilson Registration Desk
8:15 am – 8:30 am		7:00 am – 6:00 pm Speaker Ready Room Annapolis Registration Desk	7:30 am – 6:00 pm Speaker Ready Room Annapolis Registration Desk	7:30 am – 1:00 pm Speaker Ready Room Annapolis Registration Desk	7:30 am – 5:30 pm Speaker Ready Room Annapolis Registration Desk	7:30 am – 3:30 pm Speaker Ready Room Annapolis Registration Desk
8:30 am – 10:00 am		Welcome Woodrow Wilson BCD	Announcements Woodrow Wilson BCD	Announcements Woodrow Wilson BCD	Announcements Woodrow Wilson BCD	8:00 am – 8:05 am Announcements Woodrow Wilson BCD
10:00 am – 10:30 am		Plenary 1 Woodrow Wilson BCD	Plenary 4 Woodrow Wilson BCD	Plenary 5 Woodrow Wilson BCD	Plenary 6 Woodrow Wilson BCD	8:05 am – 9:35 am Plenary 7 Woodrow Wilson BCD
10:30 am – 12:00 pm		Plenary 2 Woodrow Wilson BCD	Working Groups 2	Working Groups 5	Working Groups 6	9:35 am – 10:00 am Coffee Break Woodrow Wilson A
12:00 pm – 1:30 pm		Lunch On your own – hotel and nearby restaurants				10:00 am – 11:30 am Plenary: Student Poster Prize Winners Woodrow Wilson BCD
1:30 pm – 3:00 pm		Plenary 3 Woodrow Wilson BCD	Working Groups 3		Working Groups 7	11:30 am – 12:20 pm Working Group Summaries Woodrow Wilson BCD
3:00 pm – 3:30 pm		Coffee Break Woodrow Wilson A		Optional Tour to Air and Space Museum – Steven F. Udvar-Hazy Center *Ticket-only event! Buses leave Gaylord National at 2:00 pm & will return around 7:30 pm	Coffee Break Woodrow Wilson A	12:20 pm – 1:40 pm Lunch On your own – hotel and nearby restaurants
3:30 pm – 5:00 pm	3:00 pm – 7:00 pm Registration Woodrow Wilson Registration Desk	Working Groups 1	Working Groups 4		Working Groups 8	1:40 pm – 2:55 pm Working Group Summaries Woodrow Wilson BCD
5:00 pm – 6:00 pm		Student Tutorials Woodrow Wilson B and Woodrow Wilson CD				2:55 pm – 3:25 pm Coffee Break Woodrow Wilson A
5:30 pm – 7:30 pm			Posters & Reception Woodrow Wilson A			3:25 pm – 4:40 pm Working Group Summaries Woodrow Wilson BCD
6:00 pm – 8:00 pm	6:00 pm – 7:30 pm Welcome Reception Eastern Shore 1 & 2				6:00 pm – 8:00 pm Workshop Banquet Woodrow Wilson A	4:40 pm – 5:00 pm Closing Woodrow Wilson BCD

Detailed content of the Plenary and working sessions is available on the aac2016 workshop website.

#### **4. Website**

The AAC16 Website is at <http://aac2016.org>.

The website was launched in 2015 and contains extensive information about the workshop. It will remain on line for the foreseeable future as a resource to the advanced accelerator community, future workshop organizers and the general public. It contains detailed information about the agendas for both plenary sessions and working groups, links to plenary presentations, participant lists, and links to previous workshop websites.

#### **5. AAC Prize**

Since 2008 each AAC workshop has awarded the “AAC Prize” to an individual or individuals for outstanding contributions to the science and technology of advanced accelerator concepts. The AAC Prize for 2016 was awarded to Professor Warren Mori of UCLA for his leadership and pioneering contributions to the theory and particle-in-cell simulations of plasma-based acceleration. The Prize included a plaque and a monetary award of \$5,000 made possible by generous donations from industrial sponsors Euclid Techlabs and RadiaBeam Technologies.

The committee members for the AAC 2016 prize were: Chan Joshi (UCLA, Chair), Philip Sprangle (U. Maryland), Wei Gai (ANL), Wim Leemans (LBNL), Bob Palmer (BNL), and Dave Sutter (U. Maryland). A solicitation for nominations was sent out in early 2016 and the prize was awarded at the Workshop’s Thursday night dinner.

#### **6. Proceedings**

The proceedings of the AAC16 workshop were published on line on March 6, 2017 as American Institute of Physics (AIP) Proceedings, Volume #1812, and are available as “open access” at <http://aip.scitation.org/toc/apc/1812/1> to any interested person. The prompt publishing was possible through the intense efforts of the AAC16 joint editors: Dr. Gregory Nusinovich (University of Maryland) and Dr. Steve Gold (U.S. Naval Research Laboratory, retired)

#### **7. Student Poster Competition**

As in prior years, a student Poster competition was held, and a “best poster” for a presentation related to each working group was awarded. Each winner received a framed certificate and the opportunity to make a short oral presentation of their work at the Friday morning plenary session.

The winners were (numbering corresponds to their working group’s number):

1. Kelley Swanson, LBNL
2. Manuel Kirchen, Hamburg University
3. Nicholas Sudar, UCLA

4. Ligia Diana Amorim (Instituto Superior Technico, Lisbon)
5. Neils Delbos (University of Hamburg, CFEL(
6. Peter Kordell (University of Michigan)
7. Joseph Shaw (University of Texas, Austin)
8. Eric Welch (UCLA)

## **8. AAC18**

At its meeting during AAC16, the Organizing Committee approved Co-Chairpersons for AAC18. They are Evgenya Simakov, LANL, and Ben Cowan, Tech-X Corporation.