AWANOW 2023 SESSION SCHEDULE

AWA Overview (chair John Power): AWA presents a short overview of the AWA program and plans THURSDAY 9 – 10:20 AM

Advanced Acceleration Concepts (chair Chunguang Jing) Presentations from researchers on AWA Theme 1 THURSDAY 10 AM - 2:20 PM

Beam Dynamics and Diagnostics (chair Philippe Piot) THURSDAY 3 PM - 5:10 PM Presentations from researchers on AWA Theme 2

Beam Sources and Applications (chair Eric Wisniewski) FRIDAY 9 – 11:10 AM Presentations from researchers on AWA Theme 3

AWA Wrap-up

FRIDAY 11:30 AM - 12 noon We want to hear what your priorities are for the AWA facility in Session 5.

Adjourn

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09:00	Welcome			Rik Yoshida	
	Virtual Meeting, Argonne			09:00 - 09:05	
	AWA facility overview			John Power	
	Virtual Meeting, Argonne			09:05 - 09:20	
-	AWA collaborator program			Scott Doran	
	Virtual Meeting, Argonne			09:20 - 09:40	
	AWA upgrades			Wanming Liu	
10:00	Virtual Meeting, Argonne			09:40 - 10:00	
10:00	LBL LLRF Upgrade for the AWA facility Virtual Meeting, Argonne			Larry Doolttle 10:00 - 10:20	
				Chunguang Jing	
	Overview Virtual Meeting, Argonne			10:20 - 10:30	
-	MTM Structures			Xueying Lu	
-	Virtual Meeting, Argonne			10:30 - 10:50	
	Structure Walkefield Accelerator Development Program	and Collat	oration with AWA	Seunghwan Shin	
11:00	Virtual Meeting, Argonne			10:50 - 11:10	
	Break				
	Virtual Meeting, Argonne			11:10 - 12:00	
12:00	Beam shaping using an ultrahigh vacuum multileaf coll	imator		Nathan Majemik	
	Virtual Meeting, Argonne	-		12:00 - 12:20	
	Experimental Studies and Simulations for an X-band Sh	Ses .	sion 3: Beam Dynamics and	Session 4: Beam Sour	rces and X
	Virtual Meeting, Argonne	_			
	Flat Beam + 1954	09:00	Potential implementation of a	Dopleg Bunch Compresso	r with Linearization Optics in Argonne Wakefield Accelerator F
12.02	Virtual Meeting, Argonne	09:00	Potential Implementation of a Shanyou Teng	Dogleg Bunch Compresso	r with Linearization Optics in Argonne Wakefield Accelerator F
13:00	Virtual Meeting, Argonne Wakefield Mapping	09:00			r with Linearization Optics in Argonne Wakefield Accelerator F Seongyeol Kim
13:00	Virtual Meeting, Argonne Wakefield Mapping Virtual Meeting, Argonne		Shanyou Teng		
13:00	Virtual Meeting, Argonne Wakefield Mapping Virtual Meeting, Argonne Demonstration of Transverse Stability in an Alternating		Shanyou Teng Round to Flat and Flat to Rou		Seongyeol Kim
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13:00	Virtual Meeting, Argonne Wakefield Mapping Virtual Meeting, Argonne Demonstration of Transverse Stability in an Alternating Vina Meeting, Argonne Multicell Dielection Disk Accelerator: Preliminary High P	-	Shanyou Teng Round to Flat and Flat to Rou Virtual Meeting, Argonne Model calibration		Seongyeol Kim 09:20 - 09:40 Helinekamp Sebastian
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16:30 - 16:50

16:50 - 17:10

Sergey Kuzik

17:00

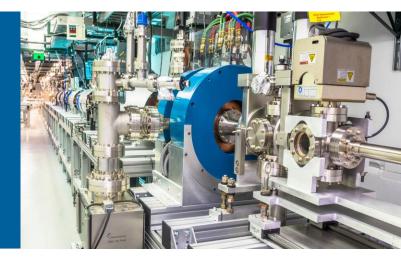
al Meeting, Argonn

leam Halo Measurement

irtual Meeting, Argonne



ARGONNE WAKEFIELD ACCELERATOR OVERVIEW



JOHN POWER

AWA Group Leader HEP Division Argonne National Laboratory



August 10, 2023 AWANOW Workshop via ZOOM

CHARTING THE FUTURE: AWA'S BLUEPRINT FOR NEXT-GENERATION ACCELERATORS

MISSION

VISION

Creating tomorrow's accelerators.

Developing the Accelerator Science & Technology (AS&T) of electron beam <u>generation</u>, <u>manipulation</u> and <u>acceleration</u> for beam-driven wakefield acceleration for a future Energy Frontier Linear Collider (LC) and other applications

STRATEGY

Basic research

developing near-term & mid-term applications as stepping-stones towards the long-term e+/e- LC through both in-house and collaborative research.

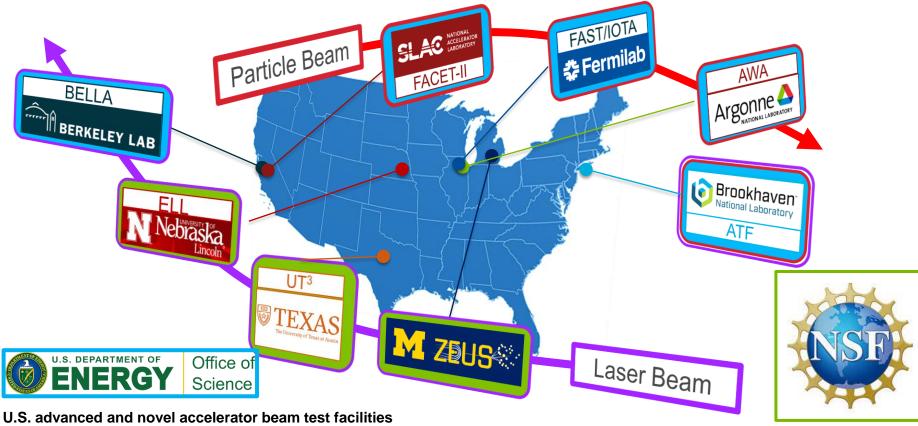
Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC. enabling GV/m STRUCTURE WAKEFIELD ACCELERATION to produce BRIGHT GeV-class ELECTRON BEAMS

> at the ARGONNE WAKEFIELD ACCELERATOR



PREMIER AMERICAN BEAM TEST FACILITIES

Demonstrating the viability of emerging accelerator science ultimately relies on experimental validation.



[C. Clarke et al 2022 JINST 17 T05009, https://iopscience.iop.org/article/10.1088/1748-0221/17/05/T05009]

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National Laboratories

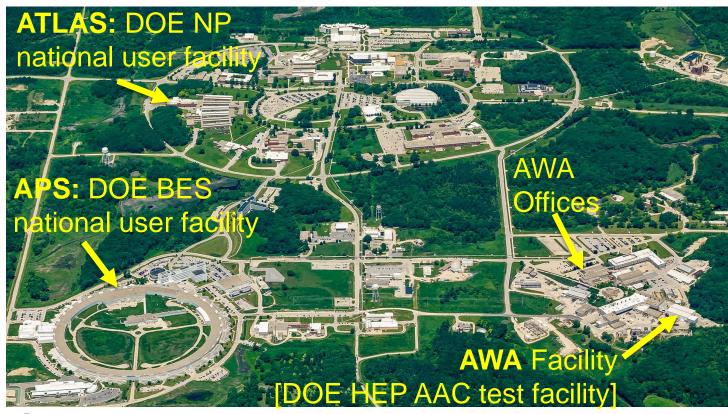


Universities

Argonne

ARGONNE WAKEFIELD ACCELERATOR (AWA)

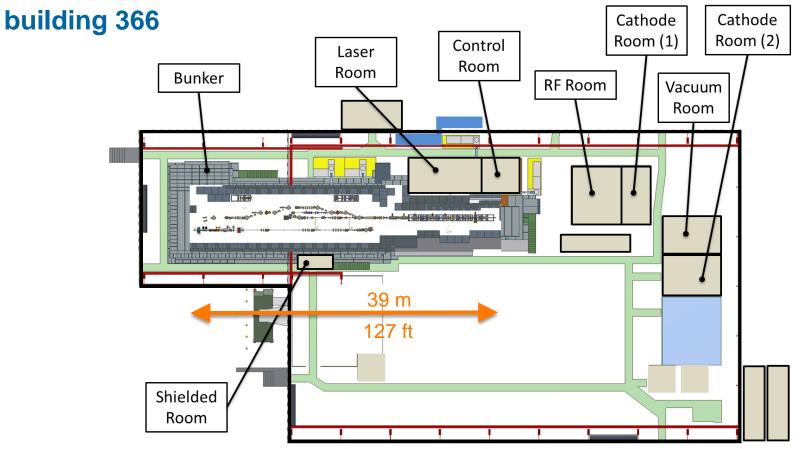
Located in Chicago Western Suburbs



• 5 accelerators at Argonne



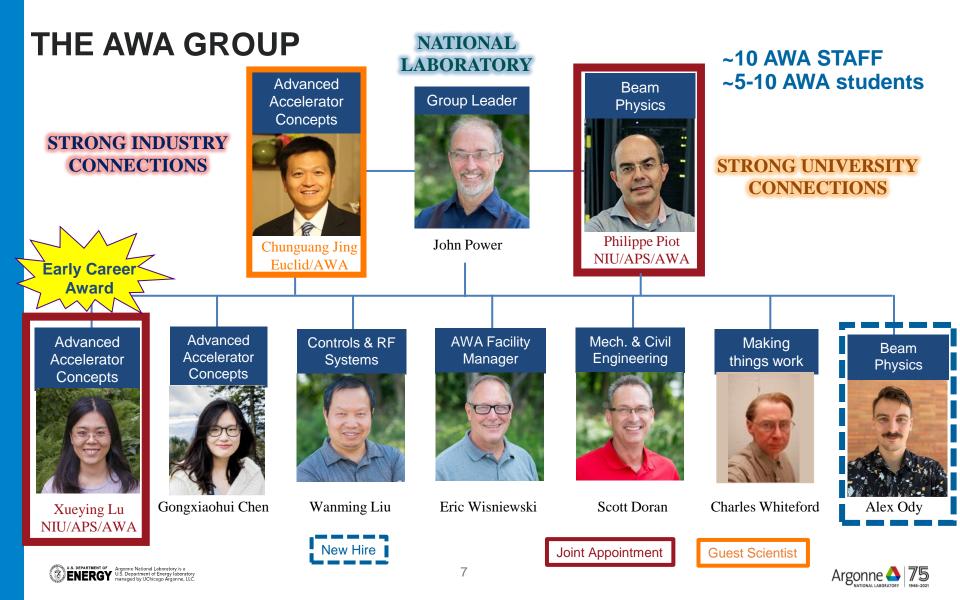
THE AWA FACILITY



Top view of building 366

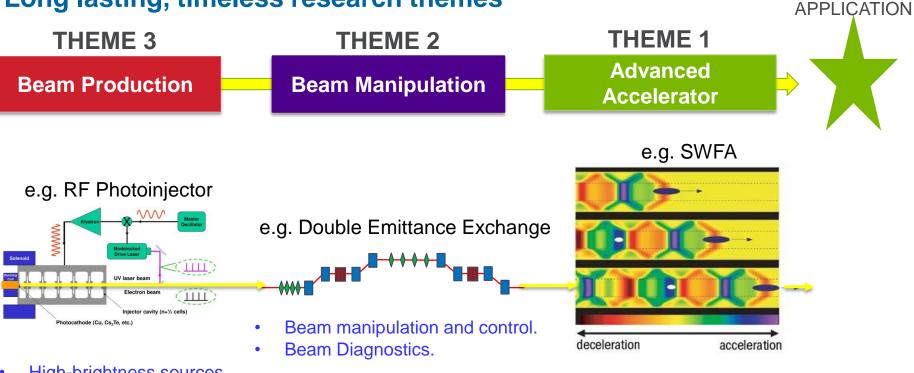






AWA RESEARCH THEMES

Long lasting, timeless research themes



- High-brightness sources
- High-charge sources

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Novel cathodes

8



High-gradient acceleration

SWFA PWFA

High-efficiency acceleration

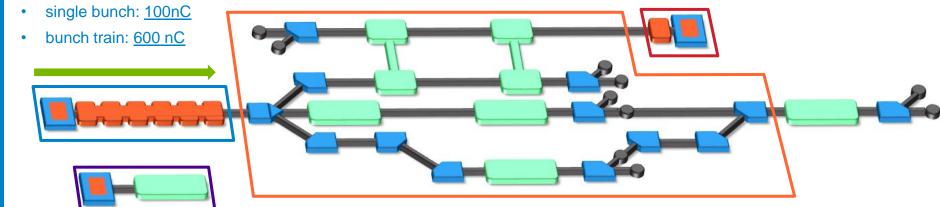
AWA CAPABILITIES

Drive RF Photoinjector (65 MeV)

Beam Test Facility to enable novel acceleration

Witness RF photoinjector (15 MeV)

- Provides two-beam capability
- Bright beams for low-energy experiments



Argonne Cathode Test Stand (2-4 MeV)

- Cathode research and diagnostics
- Physics of high-gradient breakdown

Experimental Switchyard

- Highly reconfigurable
- 6D phase space manipulation





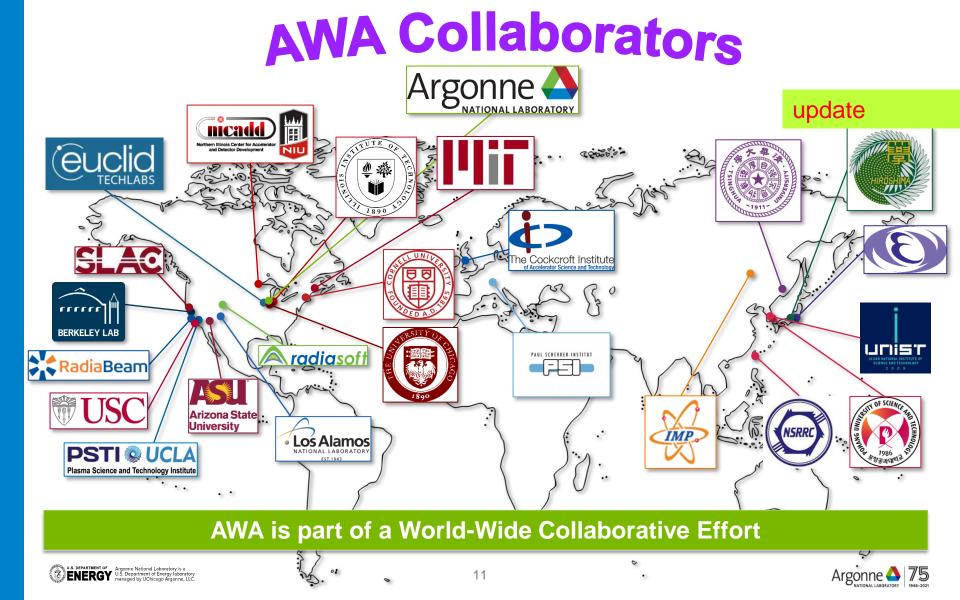
AWA COLLABORATOR PROGRAM

see talk by Scott Doran (ANL) next



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AWA Traineeship Program

Unique student experience due to AWA's small group size

- Provides a hands-on experience.
- Well prepared for research at universities, laboratories and industry.

On-going educational support

- Education at all levels: graduate (MS & PhD), undergraduate students, summer interns.
- A yearly average of graduating <u>three Ph.D.'s per year</u>

Chicagoland Accelerator Science Traineeship (CAST)

- Program established between IIT-NIU to train MS students.
- AWA is actively participating in CAST

HEP Accelerator Traineeship Program

A number of studies indicate a shortfall in the number of domestically trained accelerator physicists and engineers employed at DOE labs (including HEPAP study in 2014)

- Shortfalls are expected to occur in four major areas:
- Physics of large accelerators and systems engineering
- Superconducting RF accelerator physics and engineering
 Radiofrequency power system engineering
- Cryogenics systems engineering

U.S. DEPARTMENT OF Office of Science

Drivoto

Graduate-level traineeship program created to address these needs

Glen Crawford HEPAP, August 2023

August 2023



HEP Research Program - HEPA

									Private					
LBL	IASF	NIU	SLAC	SLAC	Tsinghua	a SLAC	NIU	SLAC	Sector	AWA	SpaceX	SLAC	SLAC I	POSTEC
Tsinghua	Tsinghua	Pohang	NIU	IIT	Tsinghua	UCLA	MIT	MSU	Tsinghua	IIT	MIT	NIU	NIU	UNIST
											Q			
Dan Wang	Jiahang Shao	Gwanghui Ha	Alex Halavanau	Nicole Neveu	Lianming Zheng	Ryan Roussel	Xueying Lu	Mitchell Schneider	Maomao Peng	Chen Gongxiaohui	Julian Picard	Tianzhe Xx	Wei Hou Tan	Jimin Seok
2016	2016	2017	2017	2018	2018	2019	2019	2019	2020	2020	2022	2022	2022	2022







ANL community

Scientific collaboration inside ANL (multipurpose lab)

- Argonne Accelerator Institute (John Byrd)
 - 1. APS (Advanced Photon Source): https://www.aps.anl.gov/
 - 2. ATLAS (Argonne Tandem Linac Accelerator System) in PHYS: https://www.anl.gov/atlas
 - 3. AWA (Argonne Wakefield Accelerator) in HEP: https://www.anl.gov/awa
 - 4. LEAF (Low Energy Accelerator Facility) in Nuclear Engineering: <u>https://www.ne.anl.gov/facilities/leaf/</u>
 - 5. EXM (Electron and X-ray Microscopy) in CNM: <u>https://www.anl.gov/cnm/electron-and-xray-microscopy</u>
- Math & Computer Science: efficient optimization, machine learning, ...
- "User" Applications: MSD (beam irradiation of samples), APS (radiation for medical therapy studies)

Technical expertise inside ANL (multipurpose lab)

- HEP: Electronics Group, Mechanical Group, Safety
- ANL Central Shops: machining, brazing, welding, metrology
- APS: Vacuum Shop (UHV cleaning), Ju Wang (high-voltage test of beam kicker, and bipolar supplies), Alex Cours (klystron modulator circuits), Jeff Dooling (laser diagnostics),
- PHY: (radiation shielding calculations for AWA bunker);
- Other ANL divisions: CNM (Ultrananocrystalline Diamond for cathodes); ES and CSE: (atomic layer deposition (ALD) to prevent multipacting); ES (tribology and metrology for ILC positron source) CNM (SEM for surface inspection)



AWA UPGRADES

AWA'S PHILOSOPHY OF CONTINUOUS IMPROVEMENTS

see talks by Wanming Liu (ANL) and Larry Doolittle (LBL) next



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ONGOING UPGRADES Opportunities for collaborations

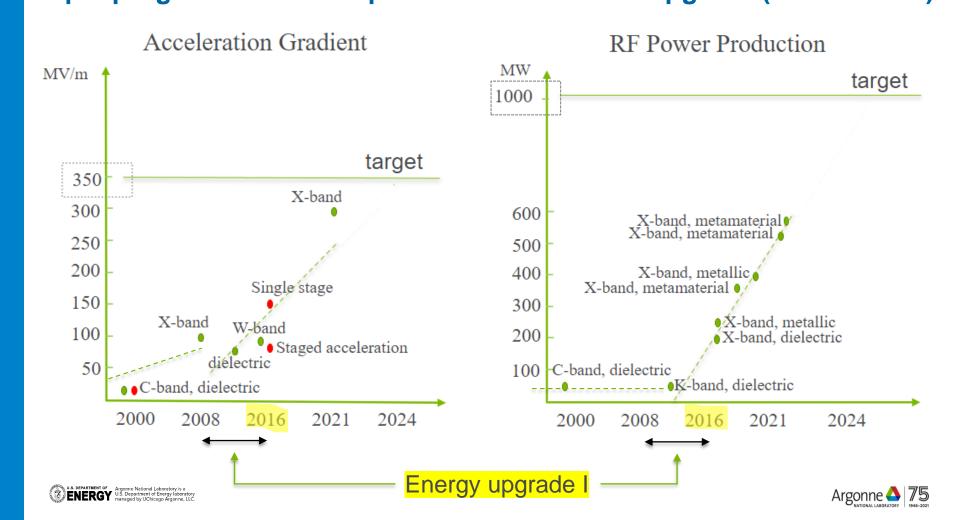
I	Beam Reliability		Beam Quality	Beam Stability	Beam Capabilities				
S	TART	PROJE	CT		FINISH				
•	FY2018	Photoca	thode laser (Vitara oscilla	tor)	completed 2020				
•	FY2019	RF Phot	RF Photocathode Gun: winter 2023						
	FY2019	RF Acce	RF Accelerating Cavity: winter 2024						
	FY2020	Photoca	thode Laser Room Temp	Ctrl:	completed 2022				
	FY2020	Digital L	LRF hardware:		spring 2023				
•	FY2021	Digital L	LRF controls w/ APS and v	w/LBL	winter 2023				
•	FY2021	EPICS co	ontrol system w/ APS cont	rols group	completed 2023				
•	FY2021	High Pov	wer RF system w/ APS RF	group (Klsytron1)	2024				
•	FY2021	High Pov	wer RF system w/ APS RF	group (Klsytron2)	2025				
•	FY2022	Photoca	thode laser (Amplitude C	ontinuum MPA pump)	completed 2023				
•	FY2022	Multilea	f Collimator w/ UCLA		spring 2024				
A	U.S. DEPARTMENT OF Argonne National Lab	oratory is a							



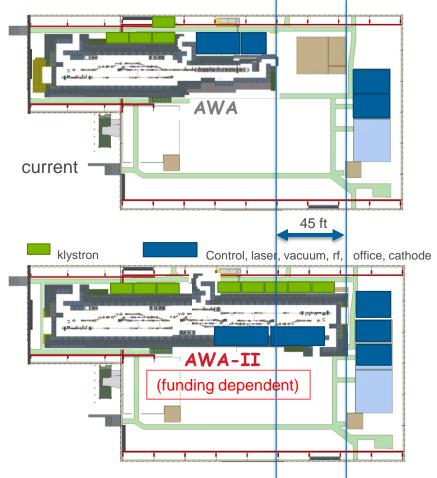


POTENTIAL UPGRADES	Beam Qua	lity	Reliability		
Near term	Beam Stab	oility	Capabilities		
Diagnostics and Equipment	_				
 BPM electronics & BPM vacuum hardware Online bunch length diagnostic, and Bunch arrival monitor 33 GHz oscilloscope Laser diagnostics 					
Beam control					
 Beam shaping with multileaf collimator Laser shaping with SLM 					
ACT Gun		Moderate funding ar			
 Solid state cathode compatibility (improve vacuum, add loa 	ad-lock)		effort required		
− Upgrade energy from 2 MeV \rightarrow 6 MeV					
 Upgrade beamline linac, add TDC for bunch length, add W 	iFEL spectrometer				
Witness Gun					
 Solid state cathode compatibility (add load-lock) 					
 Relocation for TBA 					
Mid term					
 Collinear Wakefield Accelerator based energy doubler 					
 500 MeV Two Beam demonstrator beamline (AWA top 	research priority)		Substantial funding		
Far term			and effort required		
 AWA-II energy upgrade (AWA top operations priority) 					
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WHY DOES AWA NEED AWA-II? Energy upgrade II Rapid progress with short pulse TBA since 2016 upgrade (started 2008)



UPGRADES: FAR TERM → AWA-II



(funding dependent)

UPGRADE PATH

AWA: Ongoing upgrades

Quality upgrades

- <u>Brightness.</u> Emittance improvement by RF symmetrized gun (AWA) & RF symmetrized cavities (LBNL)
- <u>Stability.</u> New RF synchronization system (LBNL BACI), RF Station stability project (APS RF group)

Capabilities upgrades

- <u>Extended Bunch shaping.</u> (SLM based Laser shaping, TDC shaping, EEX multi-leaf Collimator, etc.)
- <u>Machine Learning</u>. For machine control, virtual diagnostics and physics (EPICS upgrade w/ APS Controls group)

AWA-II: High energy version of AWA

- 65 MeV → ~150 MeV
- Tighter focus for acceleration research
 - High-quality ~1 GeV TBA demonstrator (roadmap)
 - Allows SWFA to enter GV/m regime
 - High beam density needed for PWFA
- Increase the size the experimental switchyard





FY21-26

FY26

SUMMARY: WE WANT YOUR FEEDBACK

Collaborations

• A mix of in-house and collaborative research towards future accelerators

Traineeship

AWA welcomes and supports students

Upgrades

Beam Reliability	Beam Quality	Beam Stability	Beam Capabilities
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The 10,000-foot view of AWANOW

STEP 1: AWA updates you on facility (Session 1, this one)
STEP 2: You tell AWA how your concept or project could be tested at the AWA (Sessions 2,3,4)
STEP 3: wrap up discussion (close-out on Friday)

• Give us comments on ELD, computer support, mechanical support, traineeship, upgrades, equipment, etc.



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