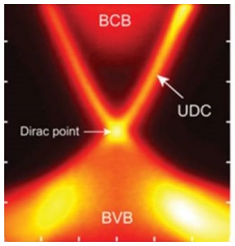
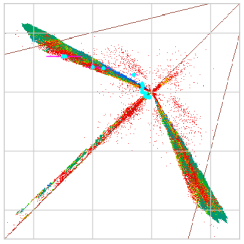
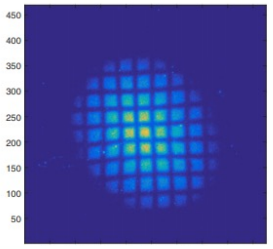
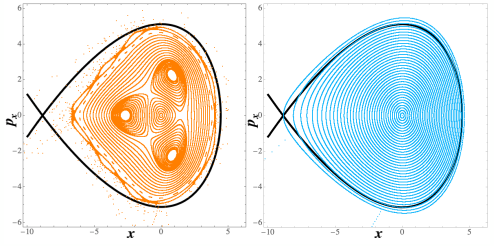
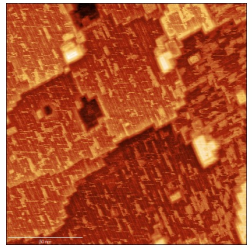
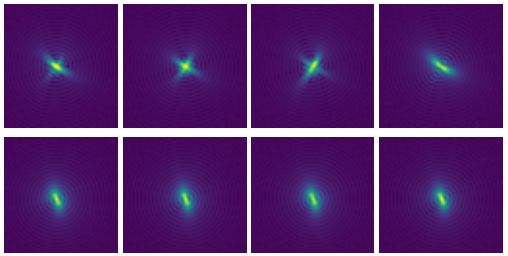
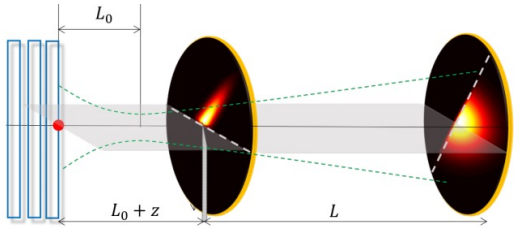
The Center for
BRIGHTBEAMS
A National Science Foundation Science & Technology Center

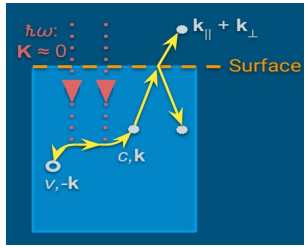
Overview
EAB Meeting 2024

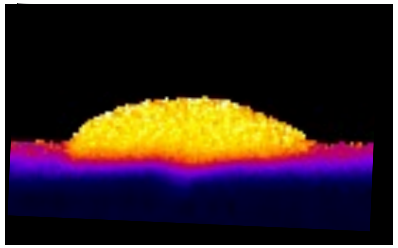
J. Ritchie Patterson
Center Director







EAB Charge

- Comment on Strategic Plan revisions, which are aimed at increasing legacy by focusing on deliverables that are achievable in the remaining 2.5 years.
- Advise on planning for CBB in the post-STC era
- Recommend improvements to presentations for the NSF Site Visit

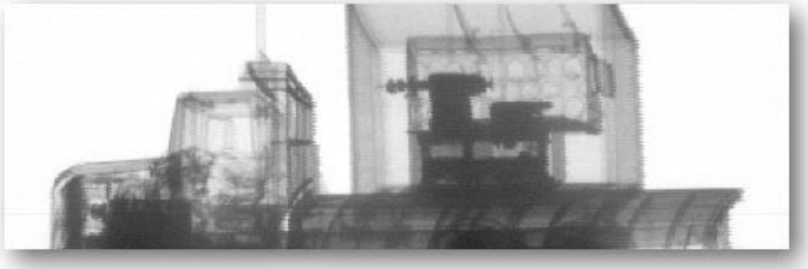
Code of Conduct

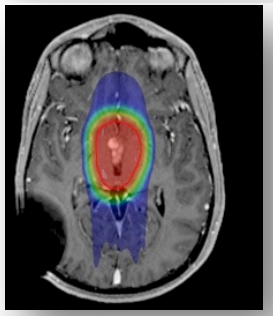
All participants are expected to conduct themselves professionally and create a welcoming environment free from discrimination, harassment, or retaliation.

- Disruptive or harassing behavior of any kind will not be tolerated, including inappropriate language or behavior, unwelcome jokes or comments, unwanted attention or touching, actions or statements based on personal characteristics, offensive images, and photography without permission.
- Respect one another.
- Report violations the director, managing director, or a theme leader.
- Witnesses are empowered to intervene and encouraged to report concerns.
- Personal safety and comfort is a top priority.

Why accelerators?

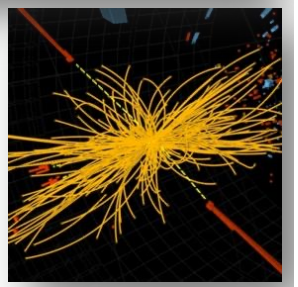
- Industry
  - Food & product safety
  - Contraband detection
  - Polymer cross-linking, eg tires
  - Semiconductor fabrication
- Medicine
  - Medical isotope production
  - Tumor treatment





~30,000 industrial and medical accelerators are in use, with annual sales of $3.5 B and 10% growth per year.

- Research
  - X ray sources and colliders for nuclear & particle physics
  - Electron microscopes



Since 1943, a Nobel Prize in **Physics** has been awarded to research benefiting from accelerators every 3 years.

Since 1997, the same has been true of **Chemistry**.

Center for Bright Beams - CBB

Center Vision:

Gain the fundamental understanding needed to transform the brightness of beams available to science, medicine and industry.

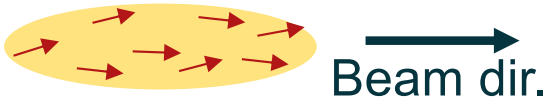
Center Mission:

- Increase beam brightness and reduce accelerator cost and size.
- Transfer key technologies to national labs and US industry.
- Prepare a diverse group of students for leadership.

  The annual demand for new Accelerator Science PhDs is 2-4x the number produced by US universities.

  HEPAP Subcommittee for Review of US Particle Accelerator School (2015).

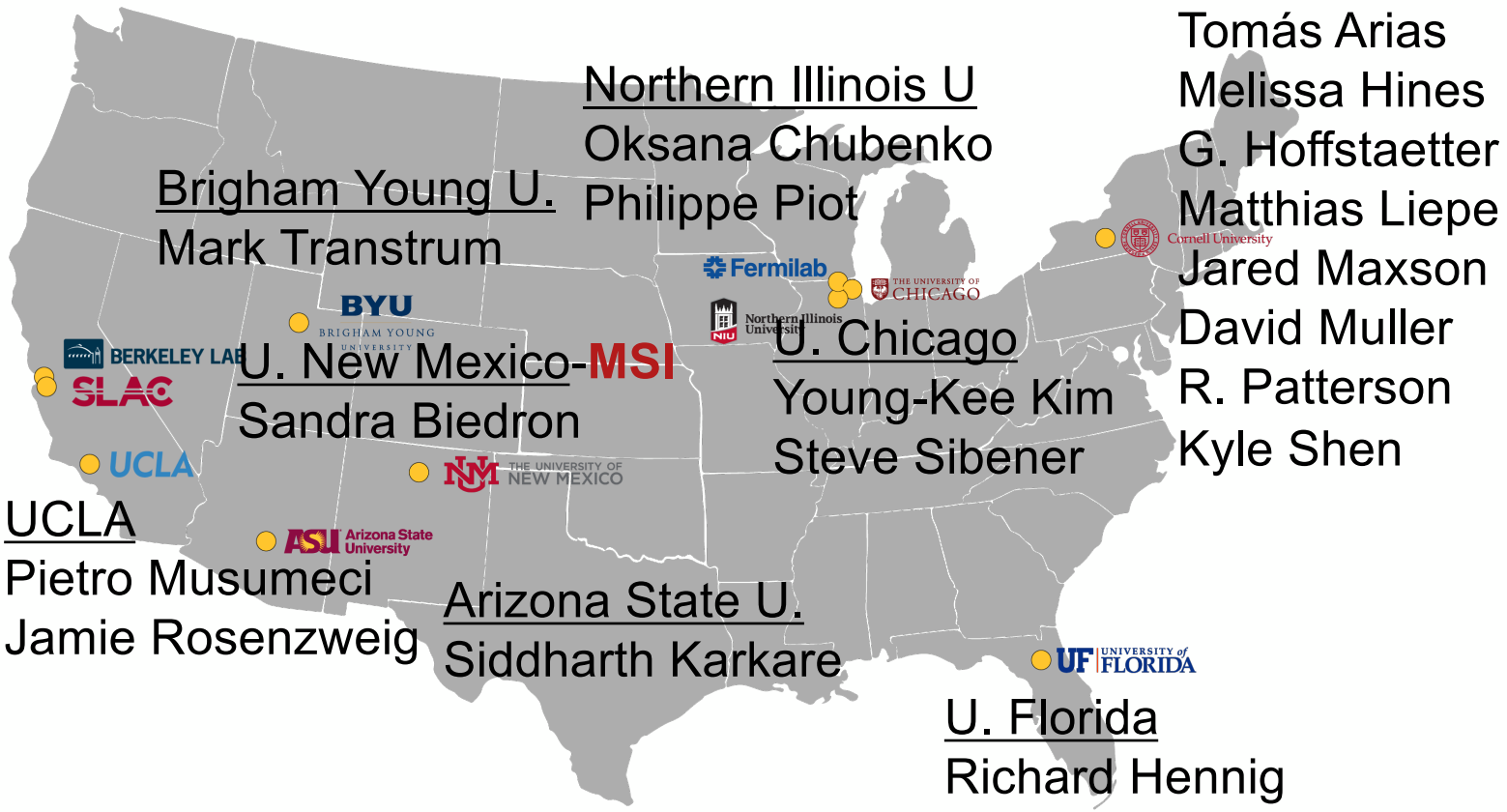
What is brightness?



Low brightness bunch

High brightness bunch

CBB institutions



Brigham Young U.
Mark Transtrum

Northern Illinois U
Oksana Chubenko
Philippe Piot

U. New Mexico-MSI
Sandra Biedron

U. Chicago
Young-Kee Kim
Steve Sibener

Cornell
Tomás Arias
Melissa Hines
G. Hoffstaetter
Matthias Liepe
Jared Maxson
David Muller
R. Patterson
Kyle Shen

UCLA
Pietro Musumeci
Jamie Rosenzweig

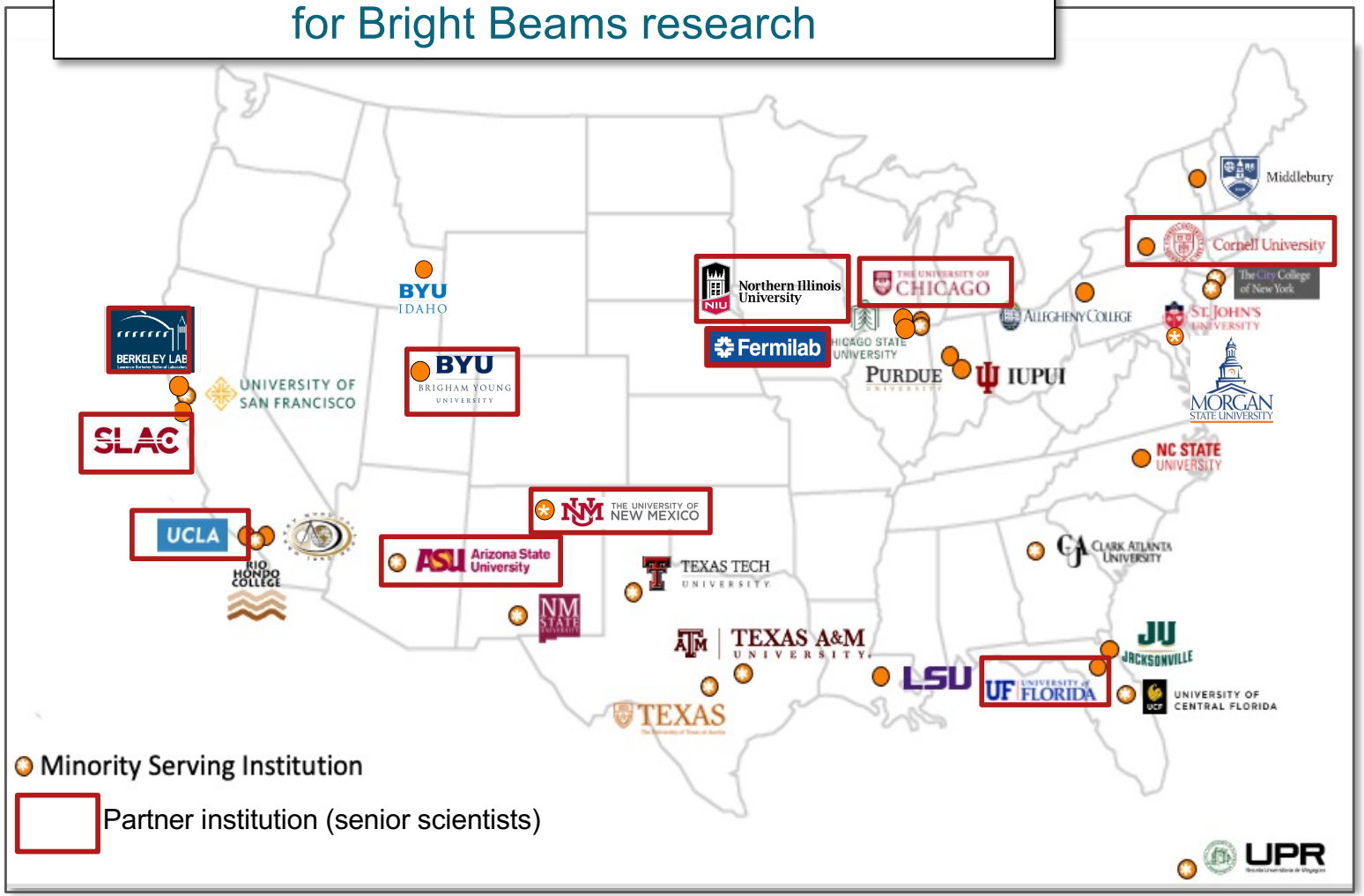
Arizona State U.
Siddharth Karkare

U. Florida
Richard Hennig

CBB joins chemists, surface scientists, condensed matter physicists, ab initio physicists, electron microscopists, and accelerator scientists

Center for Bright Beams

Institutions of students participating in Center for Bright Beams research



Brianna Harris Davis
MS, Clark Atlanta
Now a HS Physics teacher

Zeinab Ismail, St Johns U
REU 2021

Frank Ikponmwen
PhD, Clark Atlanta
Now Analytical Chemist at US FDA

Pubs/proceedings 6/22-3/23

Colors show the univ. **departments/institutions** of the authors.

C. M. Pierce, D. B. Durham, F. Riminucci, S. Dhuey, I. Bazarov, J. Maxson, A. M. Minor, and D. Filippetto, "Experimental Characterization of Photoemission from Plasmonic Nanogroove Arrays," Phys. Rev. Appl., vol. 19, no. 3, p. 034034, Mar. 2023, doi: 10.1103/PhysRevApplied.19.034034.	Chicago LEPP
A. Kachwala, O. Chubenko, D. Kim, E. I. Simakov, and S. Karkare, "Quantum efficiency, photoemission energy spectra, and mean transverse energy of ultrananocrystalline diamond photocathode," Journal of Applied Physics, vol. 132, no. 22, p. 224901, Dec. 2022, doi: 10.1063/5.0130114.	ASU Chicago NIU
C. J. Knill, H. Yamaguchi, K. Kawahara, G. Wang, E. Batista, P. Yang, H. Ago, N. Moody, and S. Karkare, "Near-Threshold Photoemission from Graphene-Coated Cu(110)," Phys. Rev. Appl., vol. 19, no. 1, p. 014015, Jan. 2023, doi: 10.1103/PhysRevApplied.19.014015.	ASU
C. J. R. Duncan, M. Kaemingk, W. H. Li, M. B. Andorf, A. C. Bartnik, A. Galdi, M. Gordon, C. A. Pennington, I. V. Bazarov, H. J. Zeng, F. Liu, D. Luo, A. Sood, A. M. Lindenberg, M. W. Tate, D. A. Muller, J. Thom-Levy, S. M. Gruner, and J. M. Maxson, "Multi-scale time-resolved electron diffraction enabled by high repetition rate, high dynamic range direct electron detection." arXiv, Jun. 16, 2022	LEPP Chicago AEP
C. M. Pierce, D. B. Durham, F. Riminucci, S. Dhuey, I. Bazarov, J. Maxson, A. M. Minor, and D. Filippetto, "Experimental characterization of photoemission from plasmonic nanogroove arrays." arXiv, Oct. 10, 2022	LEPP Chicago AEP BNL
C. Zhang, Y.-T. Shao, Z. Baraissov, C. J. Duncan, A. Hanuka, A. L. Edelen, J. M. Maxson, and D. A. Muller, "Bayesian Optimization for Multi-dimensional Alignment: Tuning Aberration Correctors and Ptychographic Reconstructions," Microsc Microanal, vol. 28, no. S1, pp. 3146–3148, Aug. 2022, doi: 10.1017/S1431927622011692.	LEPP AEP SLAC
F. Bosco, O. Camacho, M. Carillo, E. Chiadroni, L. Faillace, A. Fukasawa, A. Giribono, L. Giuliano, N. Najernik, A. Mostacci, L. Palumbo, B. Spataro, C. Vaccarezza, J. B. Rosenzweig, and M. Migliorati, "A fast tracking code for evaluating collective effects in linear accelerators." arXiv, Aug. 12, 2022	UCLA
F. Cropp, L. Moos, A. Scheinker, A. Gilardi, D. Wang, S. Paiagua, C. Serrano, P. Musumeci, and D. Filippetto, "Virtual-Diagnostic-Based Time Stamping for Ultrafast Electron Diffraction." arXiv, Feb. 09, 2023	UCLA LNL BNL
J. Gibson, A. Hire, and R. G. Hennig, "Data-augmentation for graph neural network learning of the relaxed energies of unrelaxed structures," npj Comput Mater, vol. 8, no. 1, pp. 1–7, Sep. 2022, doi: 10.1038/s41524-022-00891-8.	Florida
J. Jarvis, V. Lebedev, A. Romanov, D. Broemmelsiek, K. Carlson, S. Chattopadhyay, A. Dick, D. Edstrom, I. Lobach, S. Nagaitsev, H. Piekarz, P. Piot, J. Ruan, J. Santucci, G. Stancari, and A. Valishev, "Experimental demonstration of optical stochastic cooling," Nature, vol. 608, no. 7922, pp. 287–292, Aug. 2022, doi: 10.1038/s41586-022-04969-7.	NIU FNAL
J. Lim, S. Sinha, A. C. Hire, J. S. Kim, P. M. Dee, R. S. Kumar, D. Popov, R. J. Hemley, R. G. Hennig, P. J. Hirschfeld, G. R. Stewart, and J. J. Hamlin, "Suppression of superconductivity in Nb-substituted MoB2 at high pressure." arXiv, Feb. 27, 2023	Florida
K. Howard, Z. Sun, and M. U. Liepe, "Thermal annealing of sputtered Nb3Sn and V3Si thin films for superconducting radio-frequency cavities," 2023, doi: 10.48550/ARXIV.2301.00756.	LEPP
L. Faillace, R. Agustsson, M. Behtouei, F. Bosco, D. Bruhwiler, O. Camacho, M. Carillo, A. Fukasawa, I. Gadjev, A. Giribono, L. Giuliano, S. Kutsaev, N. Majernik, M. Migliorati, A. Mostacci, A. Murokh, L. Palumbo, B. Spataro, S. Tantawi, C. Vaccarezza, O. Williams, and J. B. Rosenzweig, "High field hybrid photoinjector electron source for advanced light source applications," Phys. Rev. Accel. Beams, vol. 25, no. 6, p. 063401, Jun. 2022, doi: 10.1103/PhysRevAccelBeams.25.063401.	UCLA
M. Gordon, W. H. Li, M. B. Andorf, A. C. Bartnik, C. J. R. Duncan, M. Kaemingk, C. A. Pennington, I. V. Bazarov, Y.-K. Kim, and J. M. Maxson, "Four-dimensional emittance measurements of ultrafast electron diffraction optics corrected up to sextupole order," Phys. Rev. Accel. Beams, vol. 25, no. 8, p. 084001, Aug. 2022, doi: 10.1103/PhysRevAccelBeams.25.084001.	Chicago LEPP
N. Majernik, G. Andonian, W. Lynn, S. Kim, C. Lorch, R. Roussel, S. Doran, E. Wisniewski, C. Whiteford, P. Piot, J. Power, and J. B. Rosenzweig, "Beam shaping using an ultra-high vacuum multileaf collimator and emittance exchange beamline." arXiv, Oct. 05, 2022	UCLA NIU
N. Majernik, G. Andonian, W. Lynn, S. Kim, C. Lorch, R. Roussel, S. Doran, E. Wisniewski, C. Whiteford, P. Piot, J. Power, and J. B. Rosenzweig, "Beam shaping using an ultrahigh vacuum multileaf collimator and emittance exchange beamline," Phys. Rev. Accel. Beams, vol. 26, no. 2, p. 022801, Feb. 2023, doi: 10.1103/PhysRevAccelBeams.26.022801.	UCLA NIU
N. S. Sitaraman, Z. Sun, B. Francis, A. C. Hire, T. Oseroff, Z. Baraissov, T. A. Arias, R. Hennig, M. U. Liepe, D. A. Muller, and M. K. Transtrum, "Theory of Nb-Zr Alloy Superconductivity and First Experimental Demonstration for Superconducting Radio-Frequency Cavity Applications," Aug. 2022, doi: 10.48550/arXiv.2208.10678.	LEPP BYU Florida LASSP AEP
P. Saha, O. Chubenko, J. Kevin Nangoi, T. Arias, E. Montgomery, S. Poddar, H. A. Padmore, and S. Karkare, "Theory of photoemission from cathodes with disordered surfaces," Journal of Applied Physics, vol. 133, no. 5, p. 053102, Feb. 2023, doi: 10.1063/5.0135629.	ASU LASSP BNL
R. Roussel, A. Edelen, C. Mayes, D. Ratner, J. P. Gonzalez-Aguilera, S. Kim, E. Wisniewski, and J. Power, "Phase Space Reconstruction from Accelerator Beam Measurements Using Neural Networks and Differentiable Simulations." arXiv, Sep. 09, 2022	SLAC Chicago ANL
S. A. Willson, R. G. Farber, A. C. Hire, R. G. Hennig, and S. J. Sibener, "Submonolayer and Monolayer Sn Adsorption and Diffusion Behavior on Oxidized Nb(100)," J. Phys. Chem. C, Jan. 2023, doi: 10.1021/acs.jpcc.2c08458.	Chicago Florida
T. Paschen, R. Roussel, L. Seiffert, B. Kruse, C. Heide, P. Dienstbier, J. Mann, J. Rosenzweig, T. Fennel, and P. Hommelhoff, "Ultrafast Strong-Field Electron Emission and Collective Effects at a One-Dimensional Nanostructure," ACS Photonics, Feb. 2023, doi: 10.1021/acsphotonics.2c01551.	UCLA
Z. Sun, M. Ge, J. T. Maniscalco, V. Arrieta, S. R. McNeal, and M. U. Liepe, "Electrochemical Polishing of Chemical Vapor Deposited Niobium Thin Films." arXiv, Jan. 02, 2023 [Online]. Available: http://arxiv.org/abs/2301.00788	LEPP
Z. Sun, T. Oseroff, Z. Baraissov, D. K. Dare, K. Howard, M. O. Thompson, D. A. Muller, and M. U. Liepe, "ZrNb(Cx) RF superconducting thin film with high critical temperature in the theoretical limit." arXiv, Feb. 28, 2023	LEPP AEP
Z. Sun, Z. Baraissov, L. Shpani, R. D. Porter, Y.-T. Shao, T. Oseroff, M. O. Thompson, D. A. Muller, and M. U. Liepe, "Smooth, homogeneous, high-purity Nb3Sn RF superconducting films by seed-free electrochemical synthesis." arXiv, Feb. 03, 2023 [Online]. Available: http://arxiv.org/abs/2302.02054	LEPP AEP

CBB Diversity

	Total	%Female & Nonbinary		% URM	
		Achieved	US Avg.*	Achieved	US Avg.*
Undergraduates	17	53%	21%	24%	12%
Grad. Students	37	30%	20%	16%	3%
Postdocs	6	67%	20%	17%	3%
Senior Scientists	20	20%	14%	10%	5%

*Data from AIP and APS, 2019.

URM includes African American/Black, Hispanic, and Native American/Pacific Islander.

CBB is sharing its best practices for team science and diversity:

- Monthly meetings of STC managing directors
- Direct mentorship of three new NSF STCs (CROPPS , LEAP, and COMPASS) and one NIH center (PORTENT)

2023 Awards

David Muller
2023 John Cowley Medal
Int'l Microscopy Congress

Young-Kee Kim
2023 APS Chair

Steven J. Sibener
2023 Remsen Award
American Chemical Society

James Rosenzweig
2023 Hannes Alfven Prize
in Plasma Physics
European Physical Society

In addition, 11 students and postdocs won a prize, fellowship or award (2022)

Strategic Plan

- Guides CBB activities and budgeting
- Evolves to reflect world accelerator priorities, progress, lessons learned
- Seeks to maximize impact and **legacy**

Center for BRIGHT BEAMS
A National Science Foundation Science & Technology Center

Strategic Plan, 2021-2026

Vision and Mission

Vision

Gain the fundamental understanding needed to transform the brightness of electron beams available to science, medicine, and industry.

Mission

Transform the reach of electron beams by advancing fundamental knowledge and applying it to increase beam brightness x100 and reduce the cost and size of key enabling technologies. Ensure that these new approaches are realized in operating accelerators by transferring the best of them to national labs and industry. Educate and inspire a diverse generation of students to prepare them for a broad set of career paths including leadership in interdisciplinary team science.

CBB's scientific advances are extending the capabilities of the approximately 15,000 U.S. researchers who rely on large particle accelerators to advance the frontiers of physics, chemistry, materials science, biology, and medicine [1]. CBB's research will reduce the cost and improve the performance of small laboratory instruments and industrial tools, as well as large colliders and X-ray sources. CBB will help realize university-scale X-ray FELs capable of femtosecond imaging; ultrafast electron diffraction set-ups that can image not only nanoscale, but also molecular assemblies; and electron microscopes equipped with bright sources that directly investigate phonon-coupling dynamics, opening new pathways for quantum materials [2]. Brighter beams in future electron-ion colliders will unlock the secrets of the "glue" that binds the building blocks of visible matter in the universe; and simpler, cheaper designs may enable an electron-positron collider that glimpses closer to the big bang. CBB will also extend the capabilities of beams available to medicine and industry, which currently operate 30,000 accelerators and add 10 new ones each day [3]. Areas of growth include semiconductor fabrication, metrology, and new green technologies. These advances are CBB's *outcome legacy* and realizing them depends on effective Knowledge Transfer to national labs and industry.

Large-scale colliders, intense X-ray sources, and electron microscopes are essential tools for science and industry, yet the U.S. educates few students to understand the bright electron beam

Center for Bright Beams Strategic Plan 2021-2026

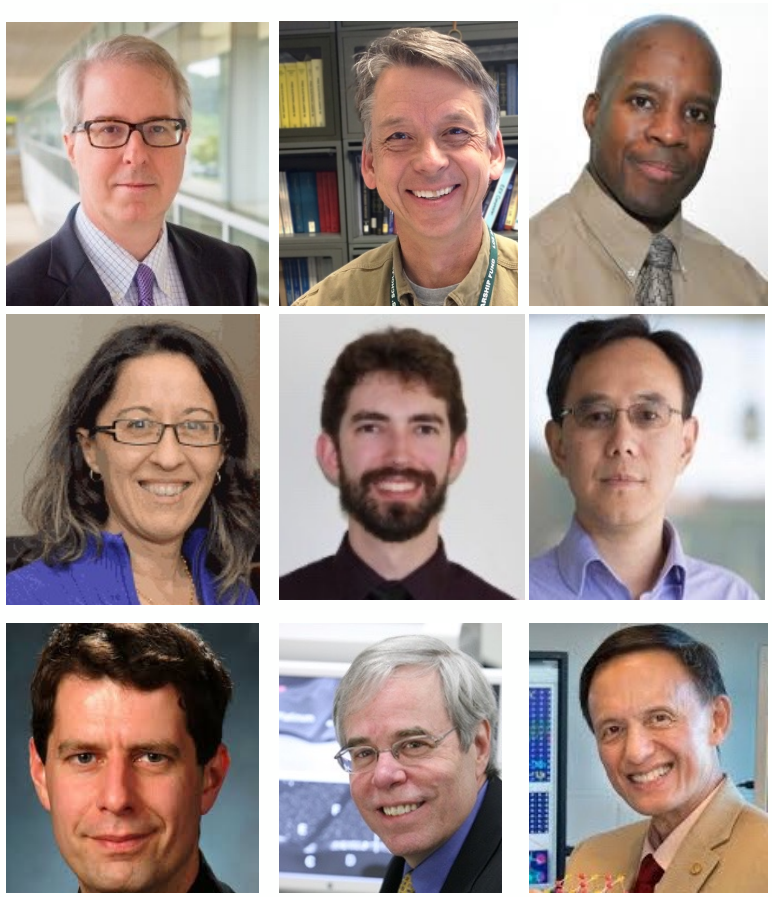
This year's changes:

- **Added** Demo of 100pC bunches with 100nm emittance (BDC 1.3) (priority)
- **Dropped** four deliverables that are out of reach or make little use of teamwork
  - 10 meV photocathode PHC 1.4,
  - Optical Stochastic Cooling BDC 2.2, 2.3
  - Bounds of ML for tuning BDC 3.4
- **Relaxed** two targets
  - Robust photocathode will be tested at 10mA rather than 50mA
  - Most ambitious single electron photocathode will have MTE < 25 meV (and emittance ~10 pm) rather than emittance <0.2 pm

See research talks for details

External Advisory Board

Stuart Henderson (ch.)	Jefferson Lab
Bruce Carlsten	Los Alamos Nat'l Lab
Paul Gueye	Michigan State U.
Kathy Harkay	Argonne Nat'l Lab
Erik Hosler	PsiQuantum, Inc.
Zhirong Huang	SLAC
Bryan Reed	Integrated Dynamic Electron Solutions/JEOL
Peter Voorhees	Northwestern U.
Yimei Zhu	Brookhaven Nat'l Lab



One-day in-person meeting, March 15, 2024

Strong lab representation, consistent with NSF guidance.

CBB budget allocation

Strategic Plan guides budgeting

- CBB research consists of a **package of projects**, which are developed and funded annually.
- Each project supports one student or postdoc and addresses a **specific deliverable** in the Strategic Plan.
- Funding is open to anyone and is our mechanism for welcoming new members.
  Examples:
  Sandra Biedron (UNM) 2020
  Oksana Chubenko (NIU) 2022

Project development and selection:

Faculty talk through project ideas for the coming year at a full day meeting.

Yesterday

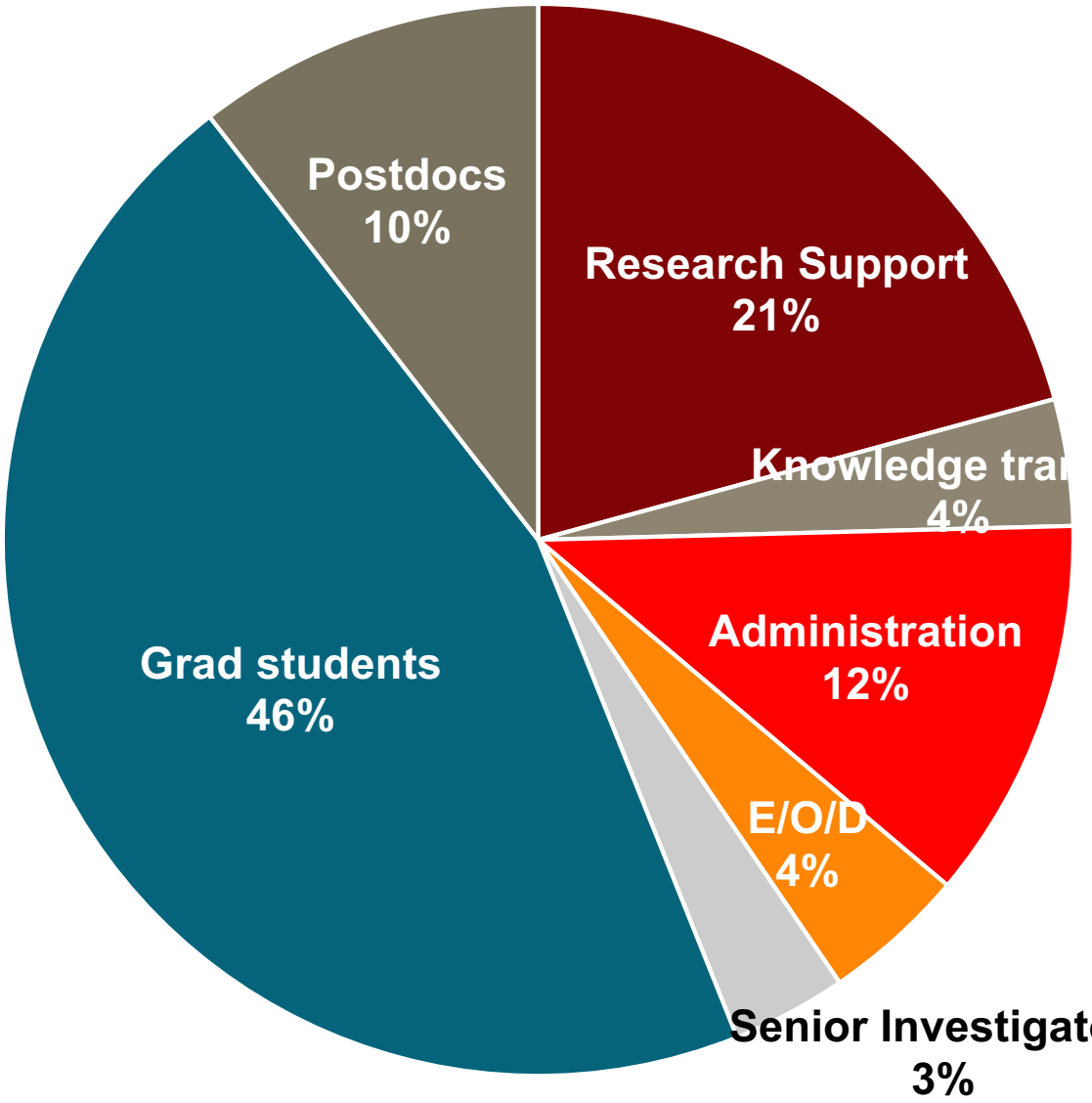
Faculty then submit brief, written proposals for their project(s)

Given the prior discussion and vetting, the vast majority of projects are aligned with the Strategic Plan and well-planned and are awarded funding.

Upshot

CBB provides stable support for students and postdocs, while delivering a research program that is coordinated and dynamic.

CBB Budget Allocation Year 8

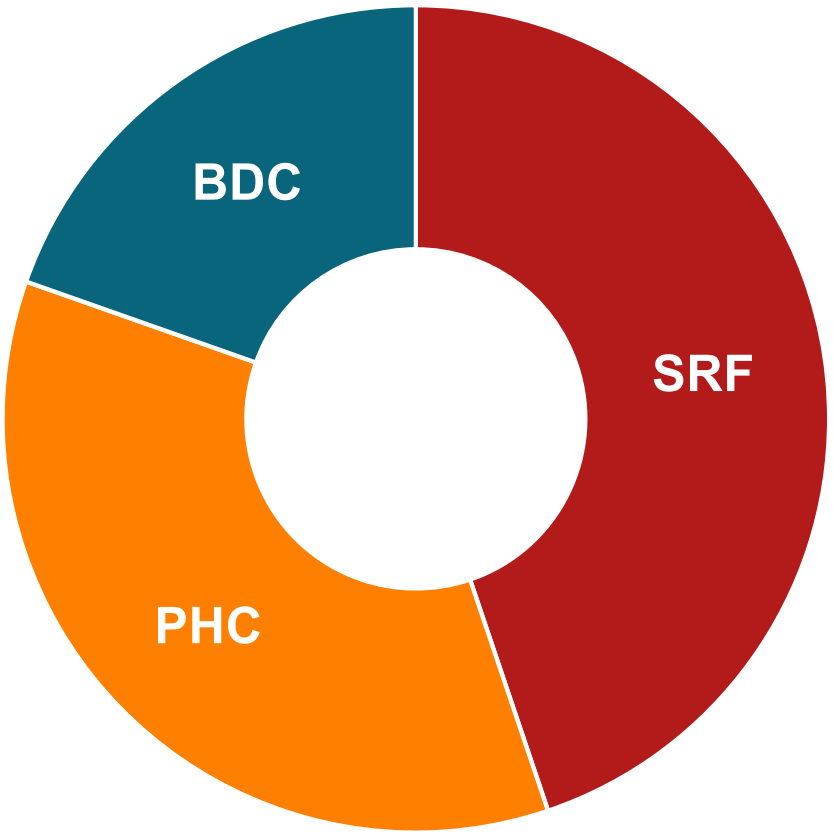


Grand total $5.5M
(incl. F&A)

Fractions exclude F&A

Shared facilities
CBB manages no shared facilities.

Allocation by Theme

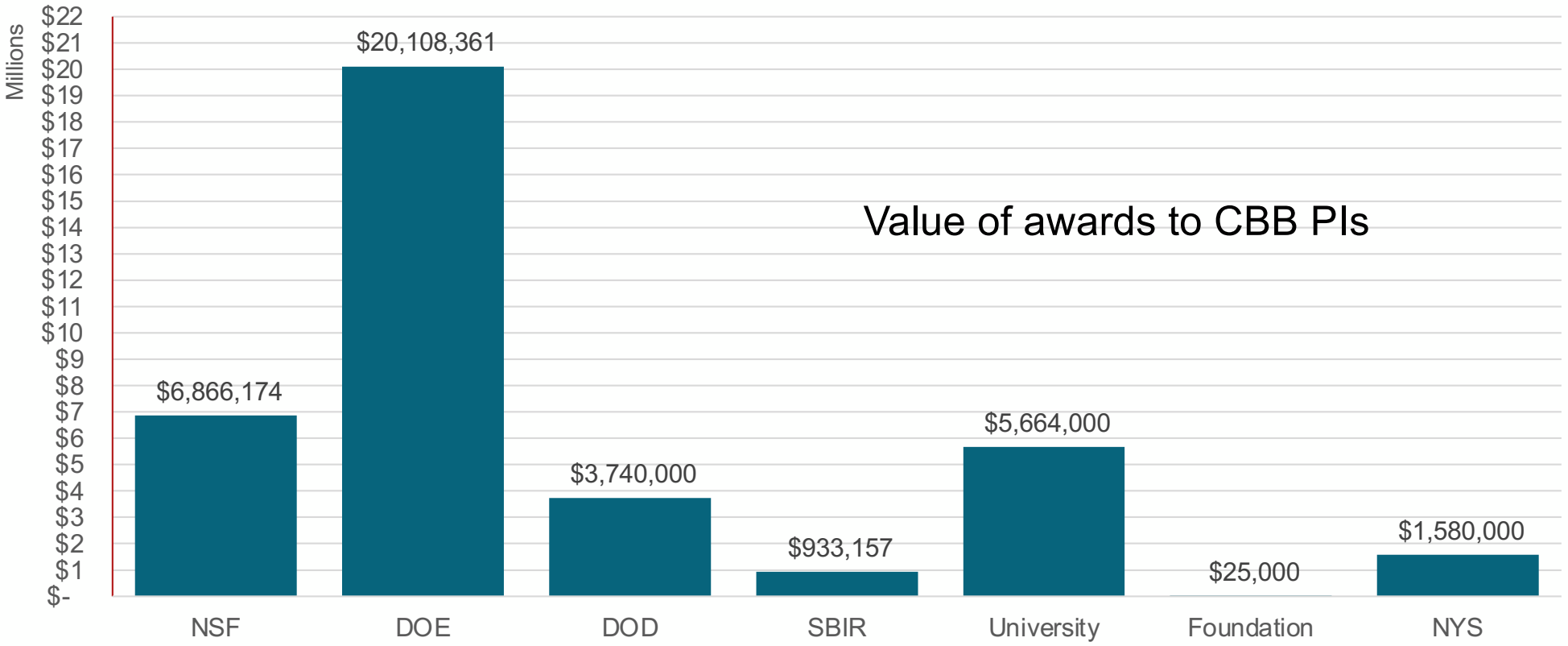


PHC = 35% BDC = 20% SRF = 45%

This split is the result of bottoms up planning and the proposal process.

Cornell accounts for about 3/5 of CBB by any metric (leadership, meeting host, students, etc.)

Leveraged Funding Years 1 - 7



CBB Legacy

54 highly-trained scientists to date with more in the pipeline, trained in materials in extreme conditions, accelerators, and interdisciplinary team science.
42% academia/education, 33% national lab or govt, 22% industry

CBB Legacy: PHC and SRF

Accelerator expertise, combined with Accelerator Materials, is transformative

High performance photocathodes

- CBB is widely recognized as a world leader – perhaps *the* world leader
- Today most photoinjector designs incorporate an advanced photocathode

  Before CBB, copper photocathodes were the norm and in many communities, alkali-antimonide and nano-structured photocathodes were viewed with skepticism.

SRF cavities

- First successful Nb_3Sn in 2015 (CBB PI Liepe)
  Performance similar to Nb, but at 4K rather than 2K
- Nb_3Sn growth methods and understanding of the impact of defects.
  Labs and industry use CBB know-how for Nb_3Sn growth.
- Alternative Nb_3Sn growth: pioneering chemical vapor deposition
- NbZr as the next direction in SRF cavities

Accelerator Materials

Photoemission and Photocathodes

- Coherent, three-body electron-phonon-photon scattering
  *Nangoi, Karkare, Sundararaman, Padmore, and Arias, Phys. Rev. B, **104**, 115132 (2021)*
- Light-induced, non-equilibrium electron distributions
  *Maxson et al, NIM-A **865**, pp. 99–104 (2017)*
- Multi-photon processes
  *Maxson et al, NIM-A **865**, pp. 99–104 (2017); Nangoi, PhD Thesis, Cornell University (2022); Bae et al, J. Appl. Phys. **124**, no. 24, p. 244903 (2018)*
- *Ab initio* plane-wave, truncated Green's function approach to electron scattering states
  Wu, in preparation

Superconductivity and SRF cavities

- Defect formation and impact on the Fermi-level density of states (related to Tc)
  *Sitaraman et al, Phys. Rev. B **103**, 115106 (2021); Kelley, Sitaraman, and Arias, Supercond. Sci. Technol., **34**, no. 1, p. 015015 (2021).*
- Experimentally-validated *ab initio* theory of Helium Atom Scattering (HAS)
  *McMillan, Thompson, et al, J. Chem. Phys. **156**, no. 12, 124702 (2022); Thompson, Tuinen, Kelley, et al. J. Phys. Chem, in review (2024); Kelley, et al., PRL **132** 016203 (2024) (inelastic); Mendez et al, in preparation.*
- Zr-doped Nb: T_c limitation and a solution using ordered alloys
  Sitaraman et al., arXiv.2208.10678, PR Appl. (2023); Z. Sun et al., Adv.Electr.Mat. (2023) https://doi.org/10.1002/aelm.202300151
- Multi-scale description of SRF materials, combining experiment, ab initio calculations and mesoscopic, continuum modeling
  *Carlson et al., Phys. Rev. B **103**, 024516 (2021); Pack et al., Phys Rev B **101**, 144504 (2020)*

CBB Legacy: BDC

Very low emittance beams

- For a range of applications, showed that low emittance photocathodes improve the beam at the target.
  XFELs, UED, Terahertz lasing, compact XFELs

Machine Learning for Accelerators

- At one international accelerator workshop, every ML talk was given by a CBB participant or affiliate.

Automated tuning of electron microscopes

- For better, cheaper operation with less reliance on company experts.

Contributions to Optical Stochastic Cooling

- Provided the IOTA optical delay line and simulation
- Developed a delay line design suitable for a larger-scale demonstration

SLAC Feature
*Roussel et al, PRL **130**, 145001 (2023)*

Over the next 2 1/2 years, this legacy will expand and mature
CBB has much more to come

NSF SV Recommendations 2023

Post 2026 planning

- CBB should provide NSF with a milestone identifying the formation of a strategic task force with the explicit purpose of mapping the transition to beyond 2026. The task force should consider future activities which could be conducted under a significantly different award portfolio.
- CBB should engage with the program offices who are developing opportunities that overlap with CBB interests, such as DOE Office of Accelerator Research Development and Production.
- CBB should ensure that its plans for the future beyond 2026 include education, training and outreach even if, at this stage of planning, they are not explicitly funded.
- CBB should identify future opportunities for funding relevant education, training and outreach activities where possible.
- CBB should provide NSF with a milestone that defines when they will begin to work in earnest with the SRC to plan for future collaborative activities that will extend CBB thrusts beyond 2026.
- CBB should engage with the EAB in strategic discussions regarding the CBB future.
- **CBB should identify alternative funding avenues now to ensure interdisciplinary, convergent research continues past 2026.**
- **CBB should find ways to continue the training, professional development, and outreach efforts as these are key to continue and support the productive collaborative efforts among institutions developed under the CBB framework.**

Research

- CBB should keep pushing on the very productive research fronts, being mindful of broader discussions taking place and of literature produced in the broad material science community.
- CBB should work more strongly with the knowledge transfer team to ensure that legacies can be preserved to the greatest extent possible.

Workforce Development/Diversity

- CBB activities should be advertised broadly within each institution and seek out institutional partners to expand and continue CBB educational and outreach activities.
- CBB should tap into each institution's resources further to continue the improvement [in diversity].

Summary recommendations

1. CBB should identify alternative funding avenues now to ensure interdisciplinary, convergent research continues past 2026.

2. CBB should find ways to continue the training, professional development, and outreach efforts as these are key to continue and support the productive collaborative efforts among institutions developed under the CBB framework.

New Award: DOE Traineeship

Tigner Traineeship

Matthias Liepe (**PI**), Georg Hoffstaetter,
Jared Maxson Cornell

Jamie Rosenzweig, Pietro Musumeci UCLA

Siddharth Karkare Arizona State U.

Young-Kee Kim U. Chicago

The Traineeship program addresses DOE accelerator workforce needs

Program (starts this Fall)

- Funds students in Years 2 and 3 of PhD program
  14 students per year
- Professional development
- Weekly seminars
- Annual meeting
- Inclusive practices

Modeled largely on CBB

New Award: Morgan State U. (HBCU)

Advancing s**C**ientific ex**CEL**lence by **E**mpowering **R**esearch in **A**ccelerators Through **E**ducation

ACCELERATE

Prof. Willie Rockford
Chair of Physics
Morgan State U.

Prof. Paul Gueye
Michigan State University
CBB EAB

Prof. C. Santamaria
Visiting Asst. Prof.
Morgan State U.

Dominic Davis

Supports 4 Morgan undergrads in CBB related research

Dominic Davis and Joshua Marshall

Proposal in review: Morgan St. U.

NSF: Partnerships for Research and Education in Physics

Collaboration between Morgan faculty and CBB

Materials and Photonic Structures (MAPS) for brighter beams

Substrates
for photocathode growth

Prof. Michael Spencer
Morgan State U.

Photonic crystals as
photocathodes

Prof. Birol Ozturk
Morgan State U.

Morgan graduate students will prepare materials at Morgan
and test them in Jared Maxson's lab

Training Summary

- Tigner Traineeship award
- Morgan State U. ACCELERATE award
- Morgan State U. MAPS proposal

CBB has made significant progress on expanding and sustaining its training, professional development, and outreach efforts

Research Grants?

CBB faculty plan to self-organize submission of targeted collaborative proposals

What about a new Research Center?

DOE BES Energy Frontier Research Center?
Spoke with program officers in advance of the FOA, but there was no match between CBB research and the call.

NSF Physics Frontier Center?
Requires a shift in NSF practices

NSF Industry University Cooperative Research Centers?
Funding is ~1/10 CBB

NSF Technology Innovation and Partnership Directorate?
2 CBB proposals failed miserably

DOE GARD and ARDAP?
The program officers know CBB and have expressed interest in the center approach.

Maybe: CBB at DOE?

The DOE Office of Science Funding Opportunity allows for collaborative proposals

- Funding levels comparable to CBB are allowed (in principle)
- 3 - 5 year award period

Target program:

Office of High Energy Physics (OHEP) General Accelerator R&D (GARD)
"*Develops the next generation of particle accelerators and related technologies that are essential for discoveries in HEP.*"

Recent High Energy Physics planning process report (P5) recommends GARD budget increases starting in ~2027

Office of Science Accelerator R&D and Production (ARDAP) is also a match, but funding there is very tight.

CBB at DOE?

CBB adaptations to meet GARD program priorities

- **Continued high impact interdisciplinary research** (SRF, PHC)
- **Greater emphasis on HEP needs: ILC, FCC-ee, Muon collider**
  - Possible topics: SRF, polarized electron sources, nanobeams, cold copper
- **Training: scientific leaders with expertise in accelerator science and related fields**
  - Professional development, USPAS
  - Team science
- **Increased hands-on accelerator training**
  - Full cavity tests (SRF)
  - Beam line experience (BDC)
    MEDUSA (Cornell), PEGASUS (UCLA)
    FAST/IOTA (FNAL), AWA (ANL), RHIC cooler (BNL), etc.

Research projects for Tigner trainees

Center for Bright Beams Network

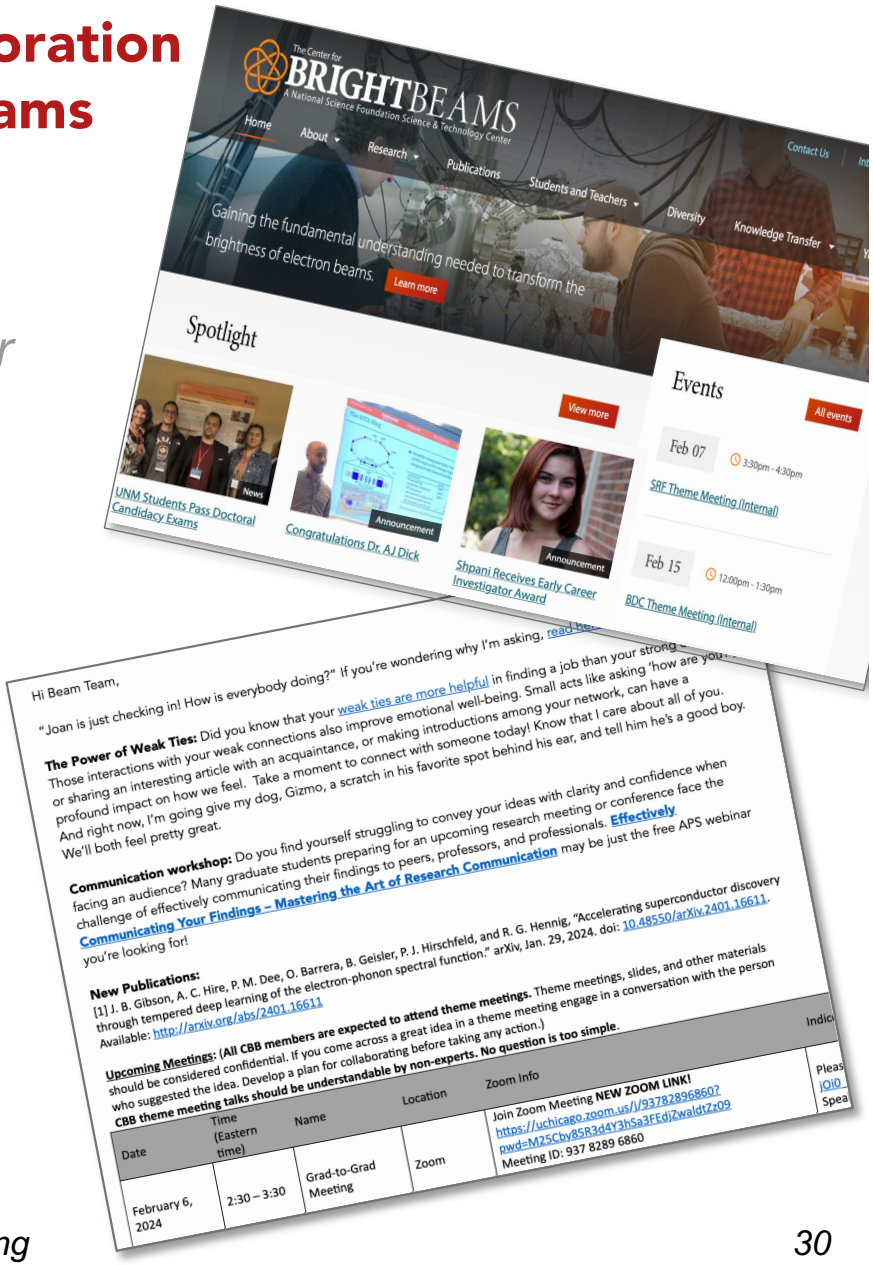
Solution if center proposals fail

Network to foster interdisciplinary collaboration and university training for brighter beams

Program elements

- Professional development for students
  2 online workshops or pedagogical lectures/year
- Grad-2-grad meetings for networking
- INDICO for meeting agendas and slide archival
- Annual poster session (virtual)
- Website and *Weekly News* with
  - Publications
  - Pointers to resources
  - Seminar and meeting listings
  - Job or internship opportunities
  - REU/SULI program portal

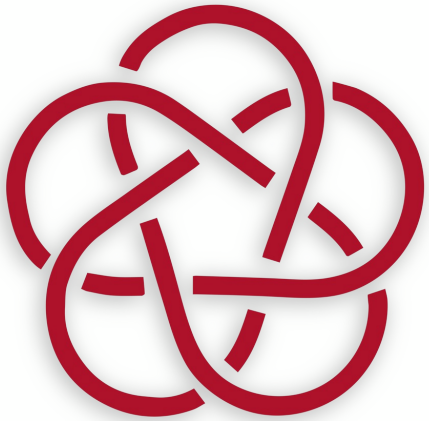
The network will serve as a core with research grants arrayed around it.



CBB Network

Subscription-based financial model

Membership	Benefits	Impact
University $4k/yr/faculty member *or* free for MSIs *Initially paid by Research Offices and later assumed by grants*	• Professional development program • Networking • Science communication • DEI best practices and mentoring plans	• New collaborative research opportunities, including for center proposals • Access to effective professional development, simplifying proposal preparation • Contact with faculty at minority-serving institutions
National Lab or Company $20k/year?	Access to students via poster session, advertisements of their jobs and internships, seminar publicity	• Support university accelerator science • Reach scientists-in-training



Gaining the fundamental understanding needed to transform the brightness of electron beams available to science, medicine and industry.