

Photocathode Physics for Photoinjectors (P3)

October 15-17, 2018

Santa Fe, New Mexico

Hilton Buffalo Thunder Resort

Workshop Conclusion

Local Committee

Lucy Maestas
Shannon Perez
John Lewellen
Vitaly Pavlenko
Nathan Moody



Organizing Committee

Ivan Bazarov (Cornell University)
Luca Cultrera (Cornell University)
David Dowell (SLAC National Accelerator Laboratory)
Daniele Filippetto (Lawrence Berkeley National Laboratory)
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Carlos Hernandez Garcia (Thomas Jefferson National Accelerator Facility)
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Siddharth Karkare (Arizona State University)
John Lewellen (Los Alamos National Laboratory)
Nathan Moody (Los Alamos National Laboratory)
Pietro Musumeci (UCLA)
Howard Padmore (Lawrence Berkeley National Laboratory)
John Smedley (Brookhaven National Laboratory)
Theo Vecchione (SLAC National Accelerator Laboratory)



Workshop Action Items

- **Deliverable: Draft a digestible, compact R&D Roadmap**
 - POC: Nathan and Theo first draft (Kathy Karkay volunteered to help); editor model; executive summary available for PMs
 - ROI argument / rationale for cathode research across application areas; use DOE report template (send links around)
- **Deliverable: New review paper updating status and priorities of photocathode R&D**
 - POC: Jared M.; Siddharth K., Theo V.
 - Engage wide participation
 - Email: p3_2018_participants@lanl.gov
- **Workshop discussion: Understanding and responding to challenges in photocathode funding**
 - Edit shared document: https://docs.google.com/document/d/15IyoL_47Z2N3Uq9LVxuUSu-2e0PmSDh5mT4pFYwoGbw/edit?usp=sharing
- **Engage senior program managers to study their photocathodes needs and program risks**
 - POC: Bruce Dunham (suggested)
 - Organize delegations to periodically visit DOE and the relevant program managers
- **Drive toward standardized architectures and components to leverage the limited funds (e.g., common puck, transfer, etc.). In practice this has been difficult, but worth pursuing.**
 - Coordinate test of BNL (John Smedley) cathodes at SLAC to fast-track a high-impact demonstration
 - Repository of common-puck designs (Eric M.)

New review paper published today

Review Article

<https://doi.org/10.1103/PhysRevApplied.10.047002>

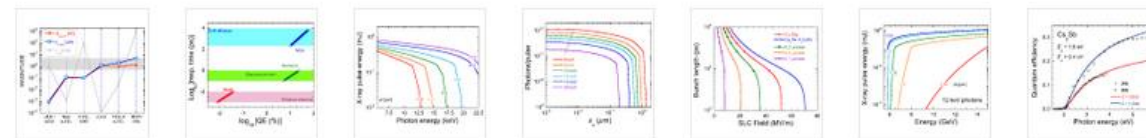
Perspectives on Designer Photocathodes for X-ray Free-Electron Lasers: Influencing Emission Properties with Heterostructures and Nanoengineered Electronic States

Nathan A. Moody, Kevin L. Jensen, Andrew Shabaev, Samuel G. Lambrakos, John Smedley, Daniel Finkenstadt, Jeffrey M. Pietryga, Petr M. Anisimov, Vitaly Pavlenko, Enrique R. Batista, John W. Lewellen, Fangze Liu, Gautam Gupta, Aditya Mohite, Hisato Yamaguchi, Mark A. Hoffbauer, and István Robel

Phys. Rev. Applied **10**, 047002 – Published 17 October 2018

ABSTRACT

The development of photoemission electron sources to specifically address the competing and increasingly stringent requirements of advanced light sources such as x-ray free-electron lasers (XFELs) motivates a comprehensive material-centric approach that integrates predictive computational physics models, advanced nanosynthesis methods, and sophisticated surface-science characterization with *in situ* correlated study of photoemission performance and properties. Related efforts in material science are adopting various forms of nanostructure (such as compositionally graded stoichiometry in heterostructured architectures, and quantum features) allowing for tailored electronic structure to control and enhance optoelectronic properties. These methods influence the mechanisms of photoemission (absorption, transport, and emission) but have not, as yet, been systematically considered for use in photocathode applications. Recent results and near-term opportunities are described to exploit controlled functionality of nanomaterials for photoemission. An overview of the requirements and status is also provided.



Research Areas

Beam injection, extraction & transport Optoelectronics Photoemission
Semiconductors X-ray beams & optics

Physical Systems

Electron sources **Free-electron lasers** X-ray lasers

Accelerators & Beams

Interdisciplinary Physics

Particles & Fields

Handoff for P3 2020

- **Successful 2020 proposal:**
 - SLAC National Accelerator Laboratory and Arizona State University
 - Chair: Theodore Vecchione tvecchio@slac.stanford.edu
 - Co-chair: Siddharth Karkare karkare@asu.edu
- **Coming in 2020:**
 - Changes to workshop format and organization to



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