LCLS MeV-UED Instrument Advisory Board Meeting

Introduction and Overview of MeV-UED

Alex Reid – MeV-UED Facility Director

11/18/2024

SLAC NATIONAL ACCELERATOR LABORATORY

Stanford University | U.S. DEPARTMENT OF ENERGY

Welcome and Charge

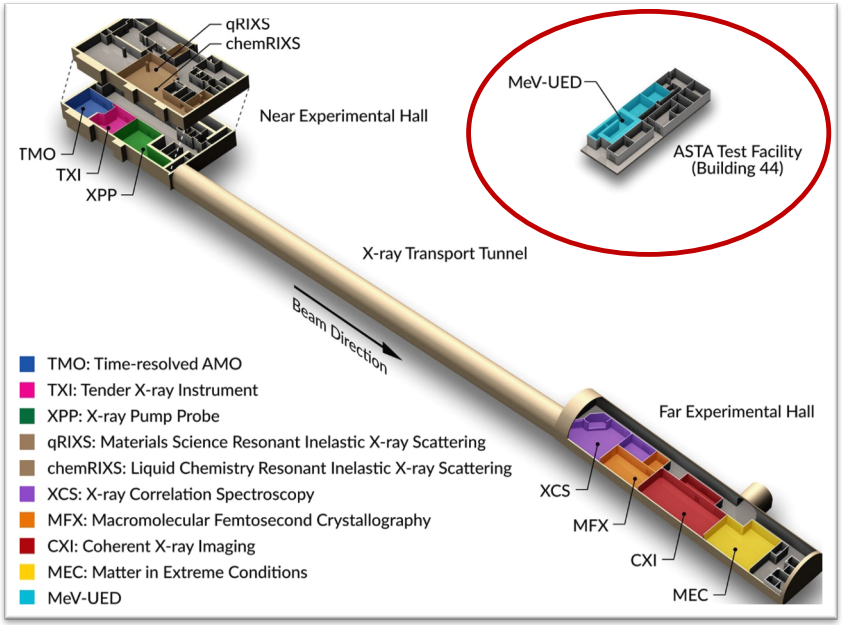
Charge Questions

1. Please evaluate the current state of the facility and the ongoing R&D projects. Will proposed/planned upgrades, if successfully implemented, substantially enhance the scientific impact of MeV-UED? Is the facility prioritizing these developments correctly?
2. Please evaluate the current scientific directions of the facility. Is the proposed user offering balanced? Are there other scientific directions that the committee would recommend MeV-UED to consider for the future?
3. What outstanding challenges do you foresee that must be addressed in order to meet the future needs of the facility?
4. For development over the next 5 to 10 years what does the committee see as the most complementary capabilities to implement in a prospective second UED beamline?
5. Please comment on idea of a MeV-UED workshop in the Spring to coincide with next AB meeting.

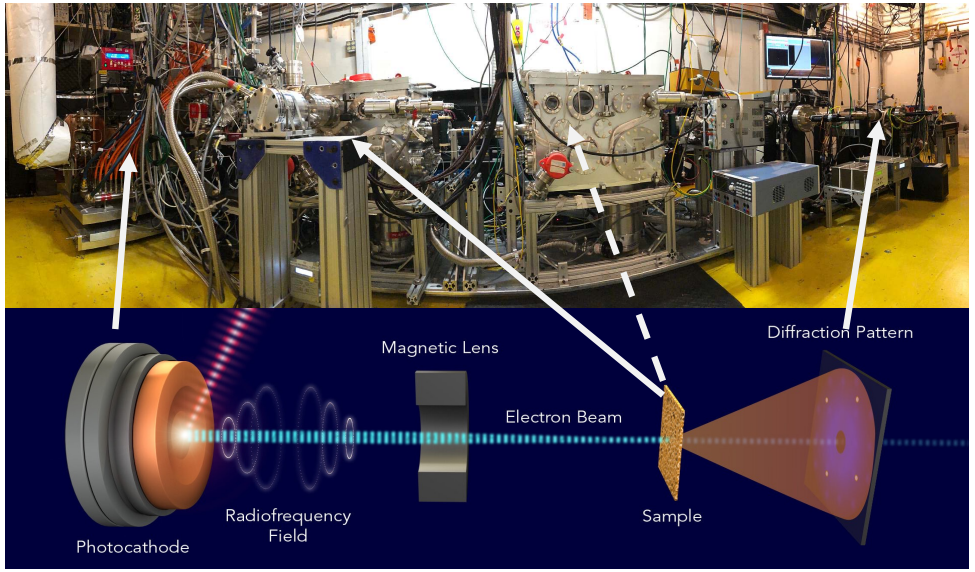
LCLS MeV-UED

Instrument is formally part of the LCLS Facility

- Mandate for 2700 hrs of user science per year
- 60 % external proposals, 40 % other user science

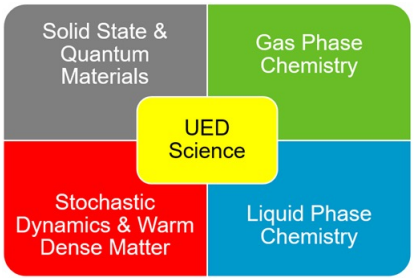


The LCLS Facility



Key capabilities

- 2-4 MeV electrons
- Single-shot – **1080 Hz**
- Transmission geometry diffraction to >12 $Å^{-1}$
- 150 fs time resolution
- Multiple Science Programs (and user offerings)
  - > 7 separate sample delivery options
- Laser pumps from THz to deep UV
- User access with typical 30-50% acceptance rate



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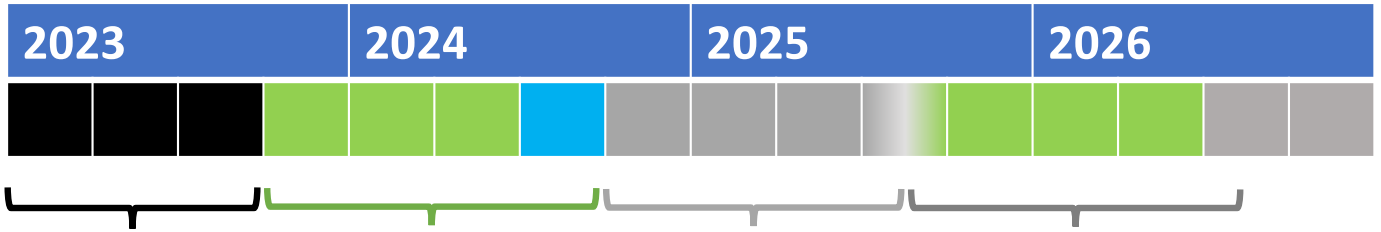
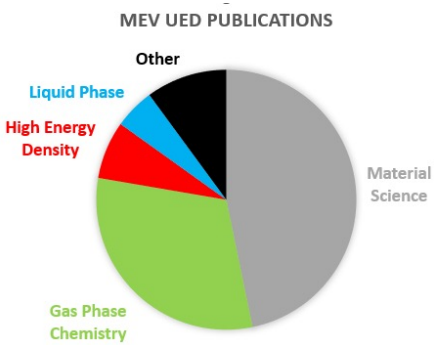
Current Program at the MeV-UED facility

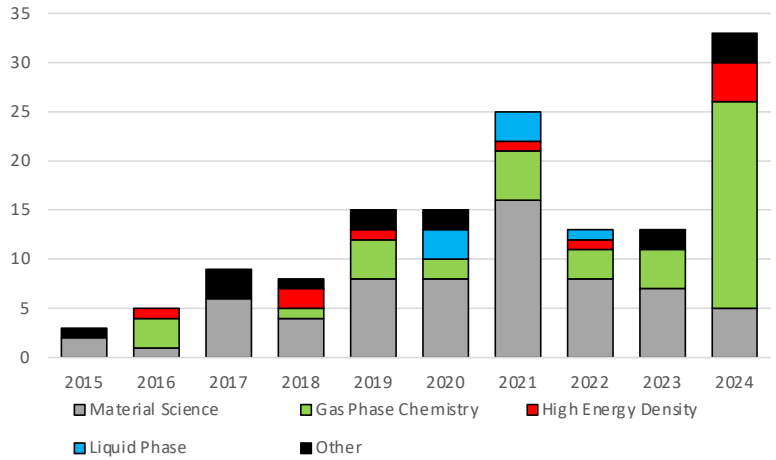


Safety Shutdown Run 4: GUED (& LUED) Run 5: SUED Run 6 (Chem.)



- Completion of Run 4 on Gas Phase Photo Chemistry – 15 user experiments delivered
- Completion of Liquid Phase R&D: Data taken for four experiments
- Completion of Switch to new RF source and commissioning of 1080 Hz operation
- Run 5 operations, 17 experiments planned + in-house R&D
- Run 6 planning beginning

LCLS MeV-UED Publication



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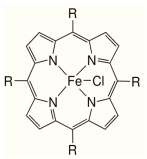
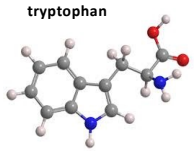
Chemical Sciences Highlights & Developments

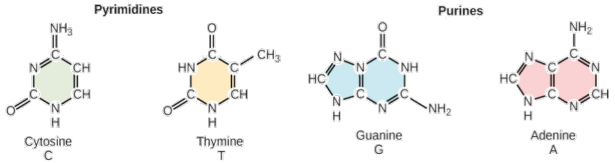
Talks by Yusong Liu & Mianzhen Mo

Core program on Photo Chemistry

- Goal: Delivery of larger organic molecules that need evaporation to gas phase without thermal decomposition (DNA bases, amino acids, peptides, coordination complexes etc.)



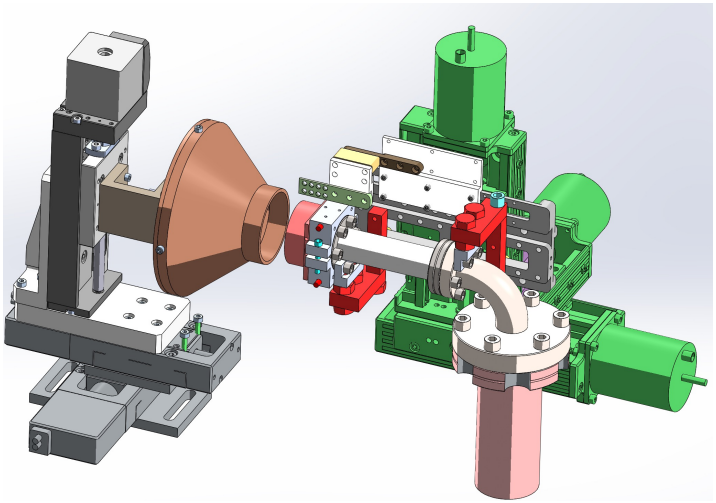




Goals of Liquid Phase Early Science

1. Demonstrate the scientific capabilities and utilities of liquid-phase UED

2. Build knowledge and experience with liquid phase delivery to allow a future user offering



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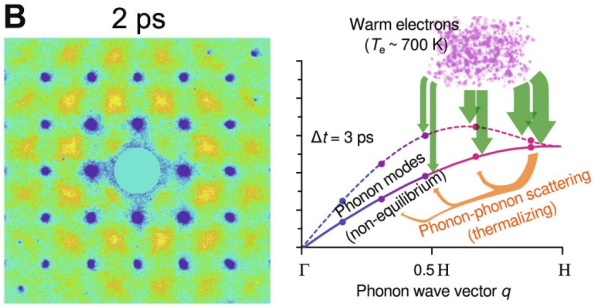
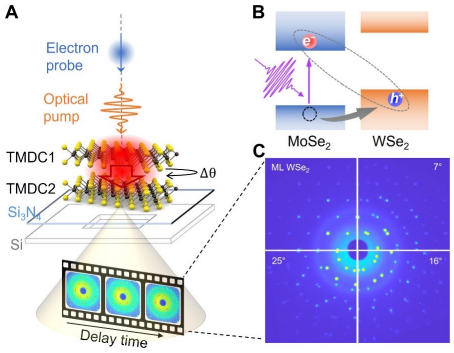
Material Science Highlights & Developments

Measurement of momentum-dependent electron-phonon coupling in Tungsten



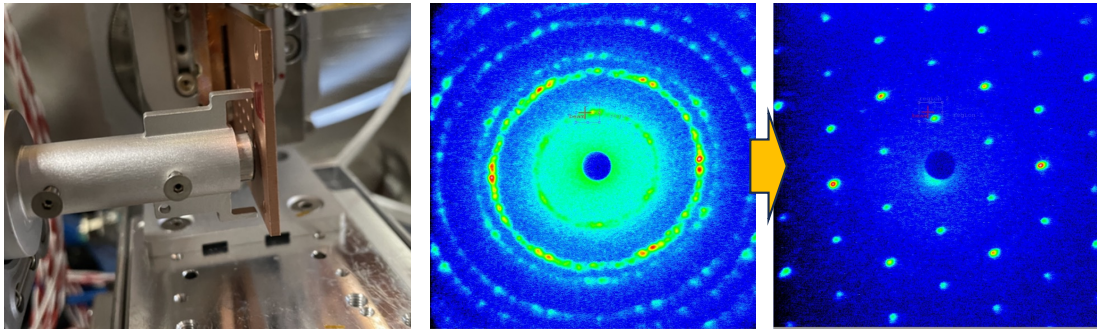
M. Mo *et al.*, *Science Advances* **10**, eadk9051(2024).

Hidden phonon highways promote photoinduced interlayer energy transfer in twisted transition metal dichalcogenide heterostructures



A. C. Johnson et al., *Science Advances* **10**, eadj8819 (2024).

Micro diffraction using a pinhole to select diffraction region



A selection of apertures can be place behind the sample to select the diffraction region allowing single crystal domains be selected within multi domain samples.

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Run Organization: Grouping Science Areas?

Material Science Program

Solid-State & Quantum Mat.

Runs: 1,3,5

Run 5 Proposals:

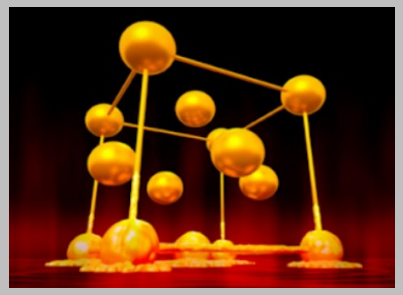
14 experiments/39 proposals

Stochastic Dynamics & Warm Dense Matter

Runs 1,3,5 (offered with mat. sci.)

Run 5:

3 experiments/4 proposals



Chemical Science Program

Gas-Phase Chemistry

Runs: 2,4

Run 4:

15 experiments/30 proposals

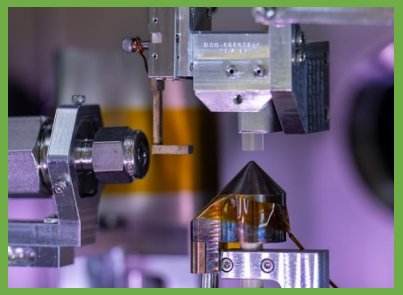
Liquid-Phase Chemistry

Early Science only

Run 4: **4 experiments**

Strong user interest

>50 E.S. Participants



LCLS MeV-UED Team

U.S. DEPARTMENT OF ENERGY | Office of Science

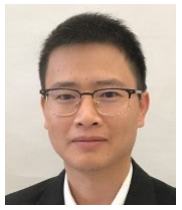

Joel England


Stephen Weathersby


Ming-Fu Lin

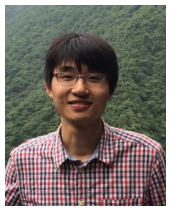

Yusong Liu


Patrick Kramer

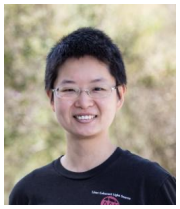

Mianzhen Mo


Linh Phan


Mike Minitti


Fuhao Ji


Tianzhe Xu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Randy Lemons


Eric Konzelmann


Sam Eisenberg


Xiaozhe Shen

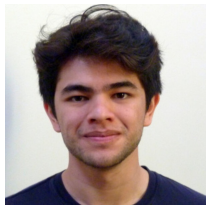

Sharon Philip


Jake Koralek


Christina Hampton


Martin Grassl


Thomas Wolf


Ian Roque


Brian Kaufman


Alice Green

SLAC

And many others at LCLS, AD, TID divisions of SLAC