UE81 – Phase 1 LDRD for UED

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Outline

- Research Goals
- Design, Manufacture and installation (Mechanical, Electrical, Vacuum, Diagnostics)
- Commissioning and current configuration
- Future work

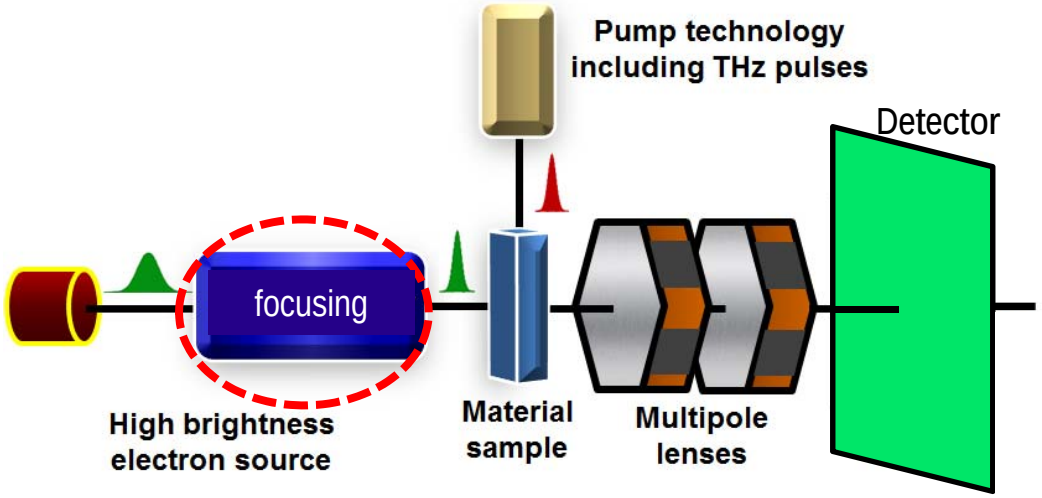
Research Goals

1. Gain control over beam size and divergence angle.
2. Focus electron bunch to 30 μm size in user sample chamber
3. Define specifications and design of UEM.
4. Design compressor for high charge short pulse (not currently funded)

Applications: UED/UEM are active core programs at BNL including a DOE Early Career Award at (CMPMS)

Phase I: focusing. Phase II: imaging. Phase III: compression

Accelerator based MeV electron microscopes,



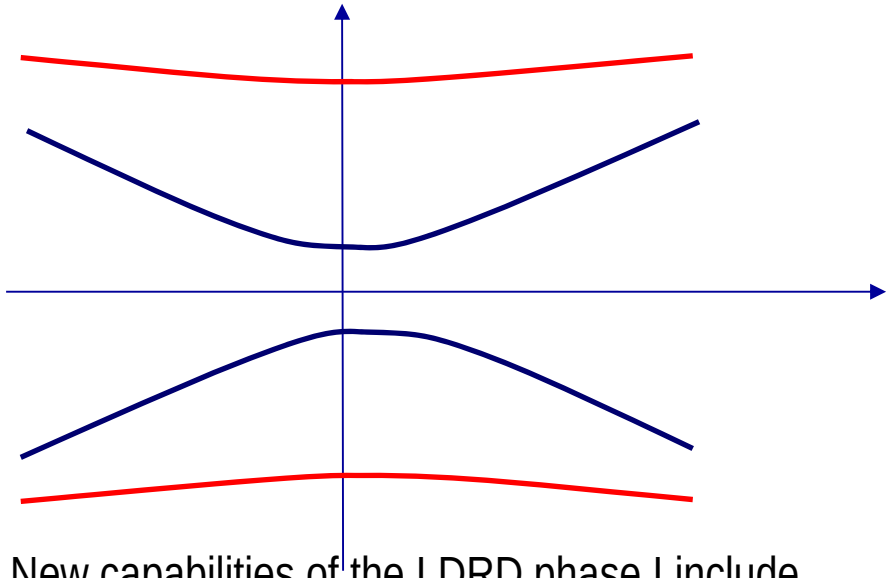
Physics design: optimizing Beam size and/or divergence angle at focal point

Phase I: To achieve experimental confirmation of electron bunch focusing to 30 μm in size from low to high charge, with a divergence angle between 0.1 and a few mrad.

Challenges solved:

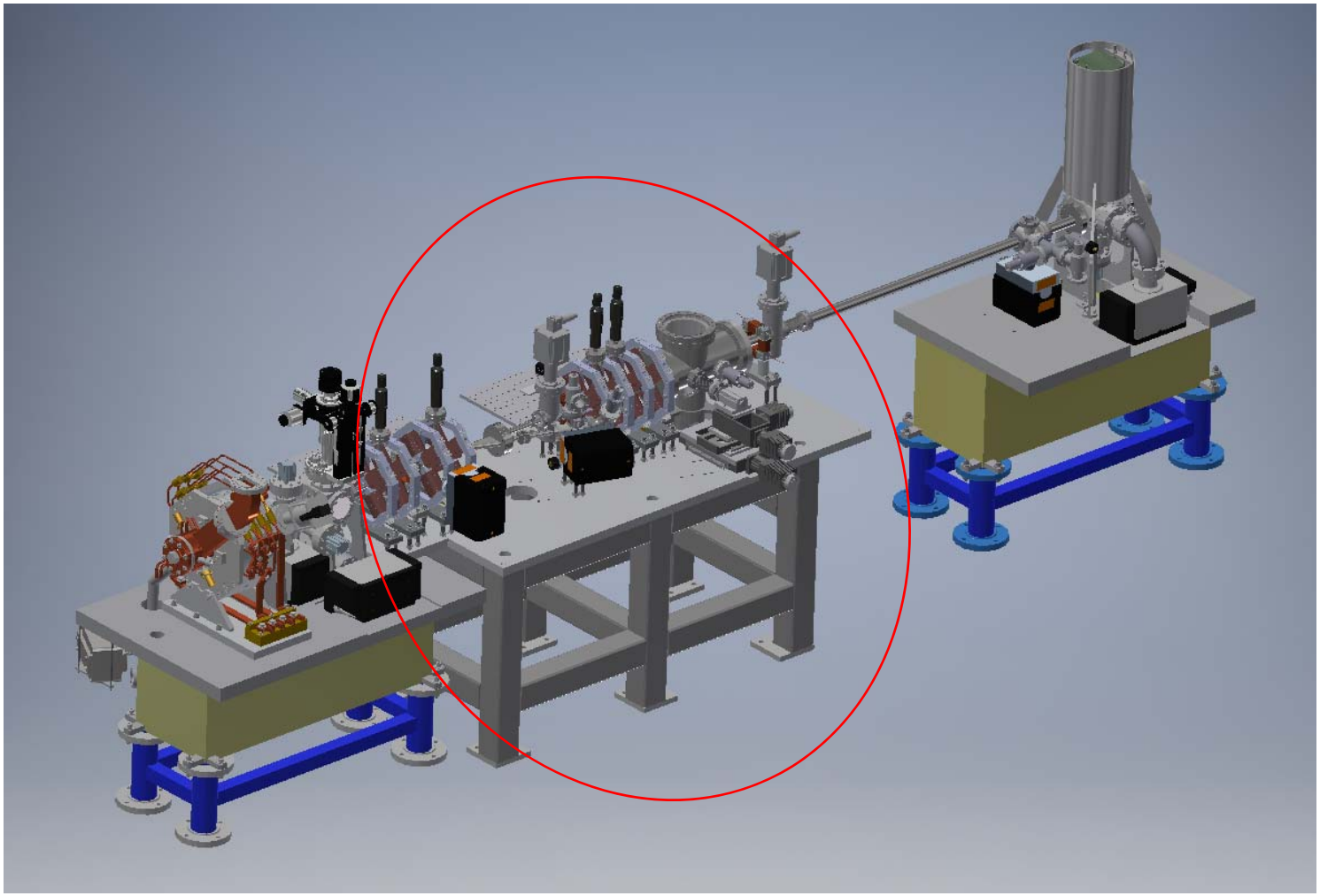
- Optimization of lattice to focus to 30 μm size in a compact configuration ✓
- Minimize cost ✓

- Optimized Beam size, or optimized divergence angle at sample may be applied for different type of experiments ✓



New capabilities of the LDRD phase I include variable beam size and divergence angle

Phase I LDRD for UED



Design/Manufacture, Installation

The Second year primarily involved the completion of mechanical and electrical designs, manufacturing and installation.

Design and manufacture

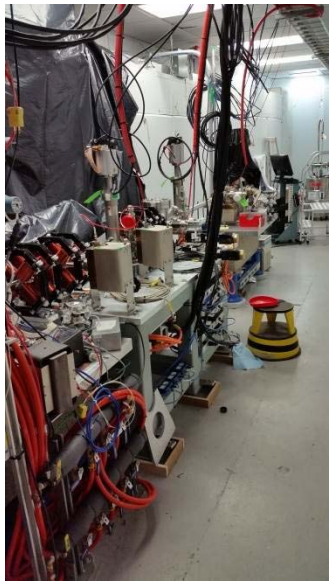
- –Develop the Lattice.
- –Generate models, manufacturing and assembly drawings
- –New components included:
  - Vacuum chambers, quadrupole and corrector magnets, flags, diagnostics chamber, corrector power supplies and stand Installation

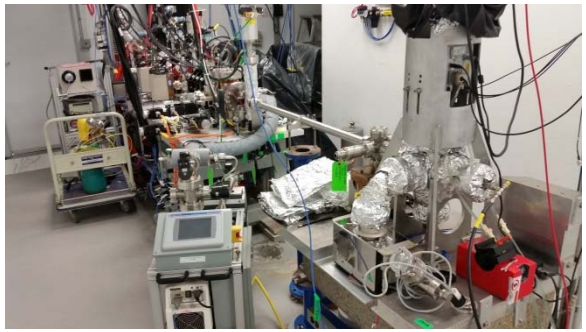
Installation and testing

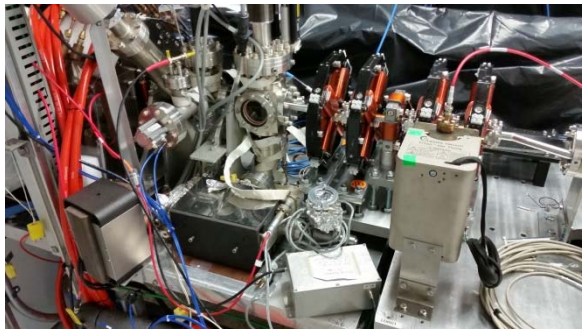
- –Assembly of all magnets, diagnostics and vacuum components were completed
- –All components were surveyed and positioned
- –The girder assembly was installed, surveyed and grouted in the UED room of building 912
- –The completed vacuum system was leak checked, pumped down and baked.
- –All systems were wired to the control system and associated power supplies
- –All subsystem integration tests were completed

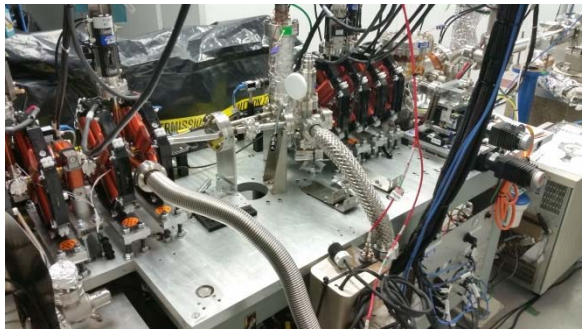
Current configuration

Before LDRD installation









Commissioning

NSLS-II staff worked closely with ATF staff and UED users to characterize this new mode of operation.

- Initial commissioning identified the system's sensitivity to remnant magnet fields.
- Multiple steps were installed and tested to remove remnant fields.

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Estimated Experiments Time Required

step 1. 1 week

- Test control system, flag, power supplies, programs – G. Wang,
- Check magnet polarities – done, double-check with beam – G. Wang, X. Yang, Y. Hidaka,
- Send beam through system, check monitors, check charge, quad centering – G. Wang, X. Yang, Y. Hidaka,

Step 2. 1-3 weeks

- Calibrate monitor for beam profile measurement, beam size and displacement – D. Padrazo, V. Smalyuk
- Compare quads tuning range and beam size variation – X. Yang, G. Wang, Y. Hidaka,
  Study resolution of beam profile measurement – D. Padrazo, V. Smalyuk, X. Yang, G. Wang,

Step 3 4 weeks

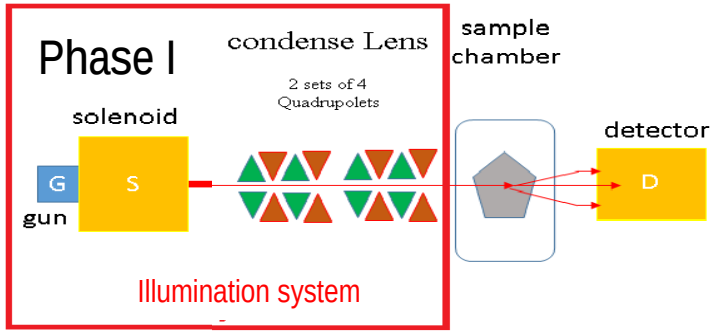
- Find the minimum beam size achievable at the sample – L. H. Yu, G. Wang, X. Yang, Y. Hidaka, D. Padrazo, V. Smalyuk, 4 weeks over 6 months

Step 4 4 weeks

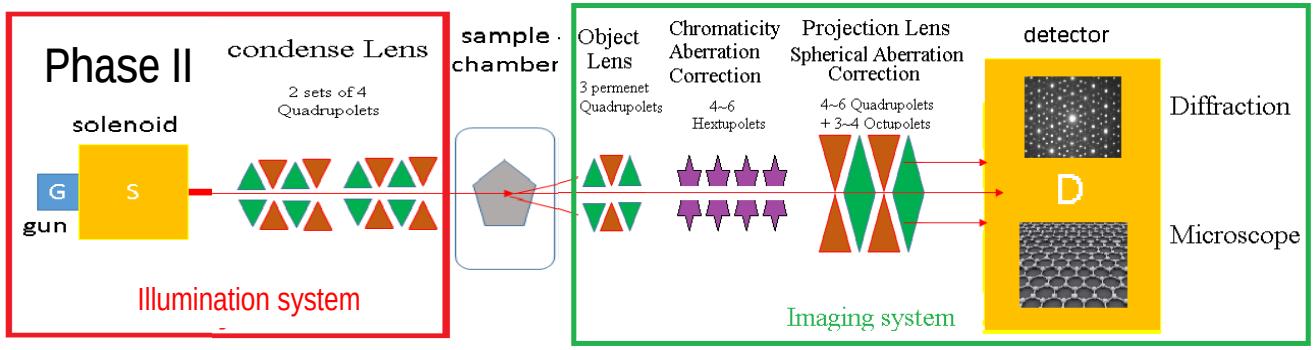
- Assess bunch length measurement system– L. H. Yu,, 4 weeks over 6 months

Road map from UED to UEM

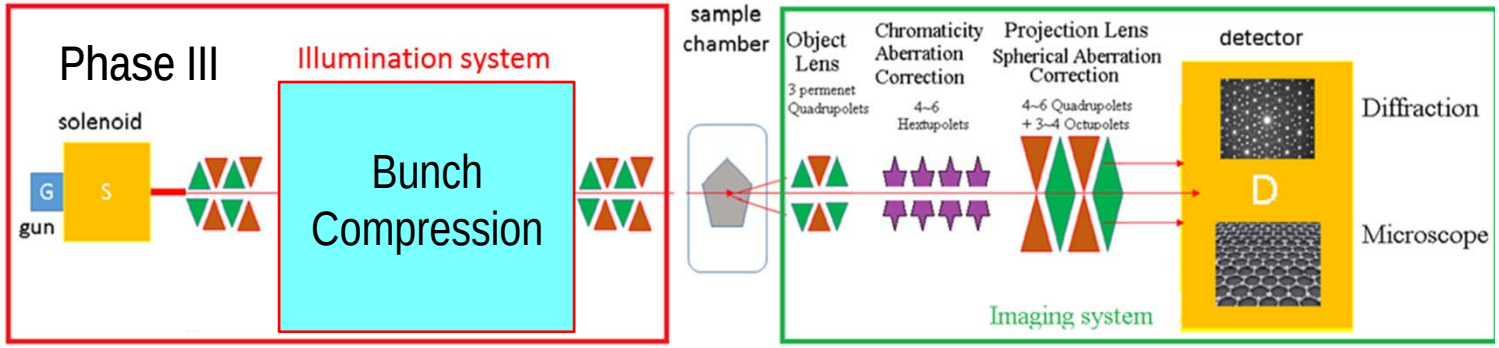
Control beam size and divergence at the sample



UEM capability



Control bunch length



Future

- Many user applications are driving development
- Teams that have expressed interest in the UED/UEM system are:
  - NSLS-II users
  - Material Sciences
  - Detector development programs
  - Instrumentation and Physics

Thank you