



*... for a brighter future*

# *Undulator upgrade priorities*

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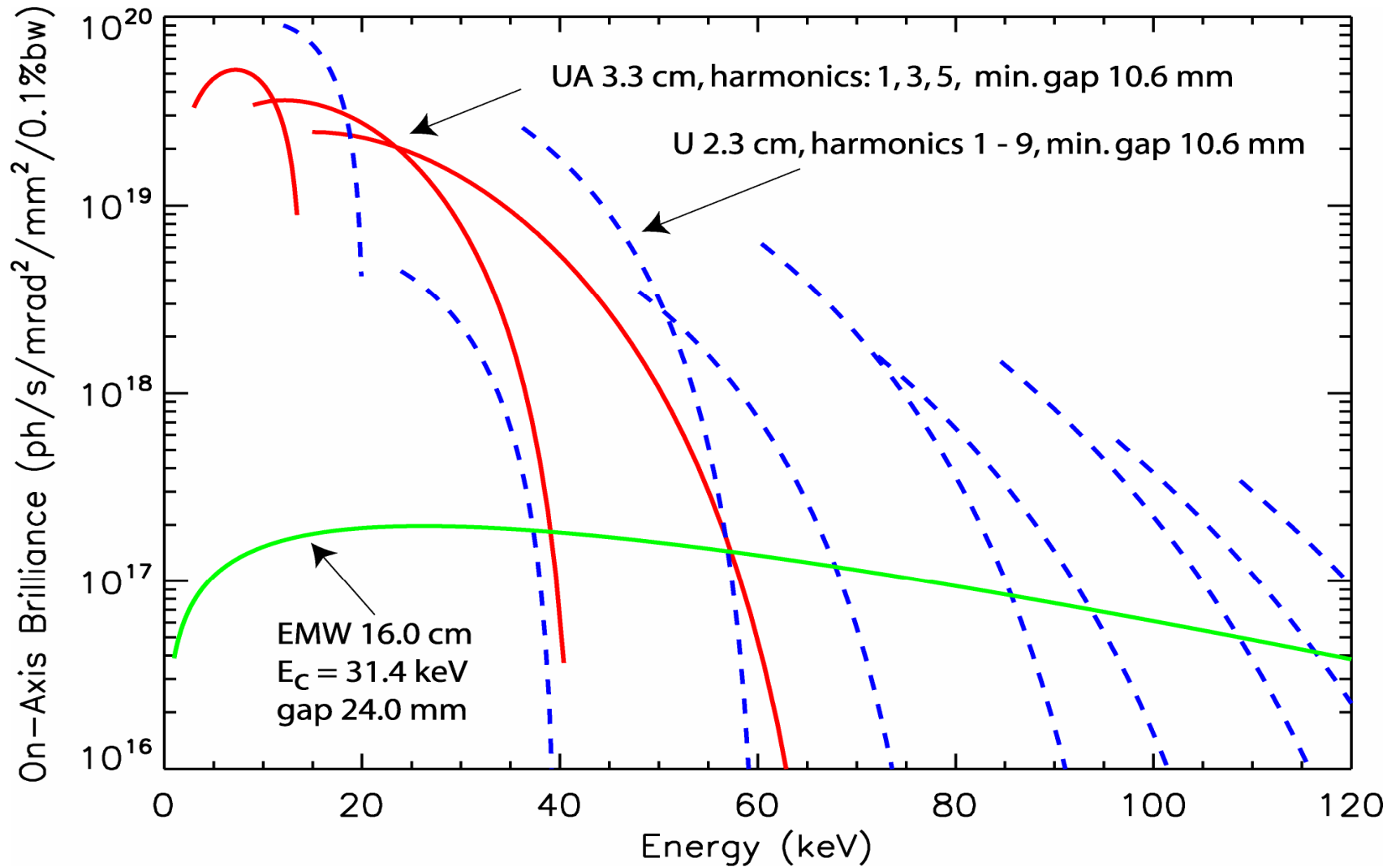
## *Letters of Intent and requests from XOR for new undulators*

- Canted undulator upgrade for GeoSoilEnviroCARS Sector 13
- Dual undulator operation in tandem mode at HPCAT Sector 16
  
- There are requests for more than a dozen new undulators over the next several years
  - Requests for an additional Undulator A on 9-ID, 12-ID, 20-ID, 34-ID
  - Request for in-line Undulator A and a shorter period (23 mm) undulator on 1-ID
  - Request for in-line Undulator A and a shorter period (23 mm) undulator on 11-ID
  - Request for tailored Undulator A and longer undulator (with a shorter period) on 8-ID
  - Request for superconducting undulators on 30-ID, 1-ID, and 3-ID
  - Request for a circularly polarized undulator for 4-ID.
  
- How do we propose to move forward?

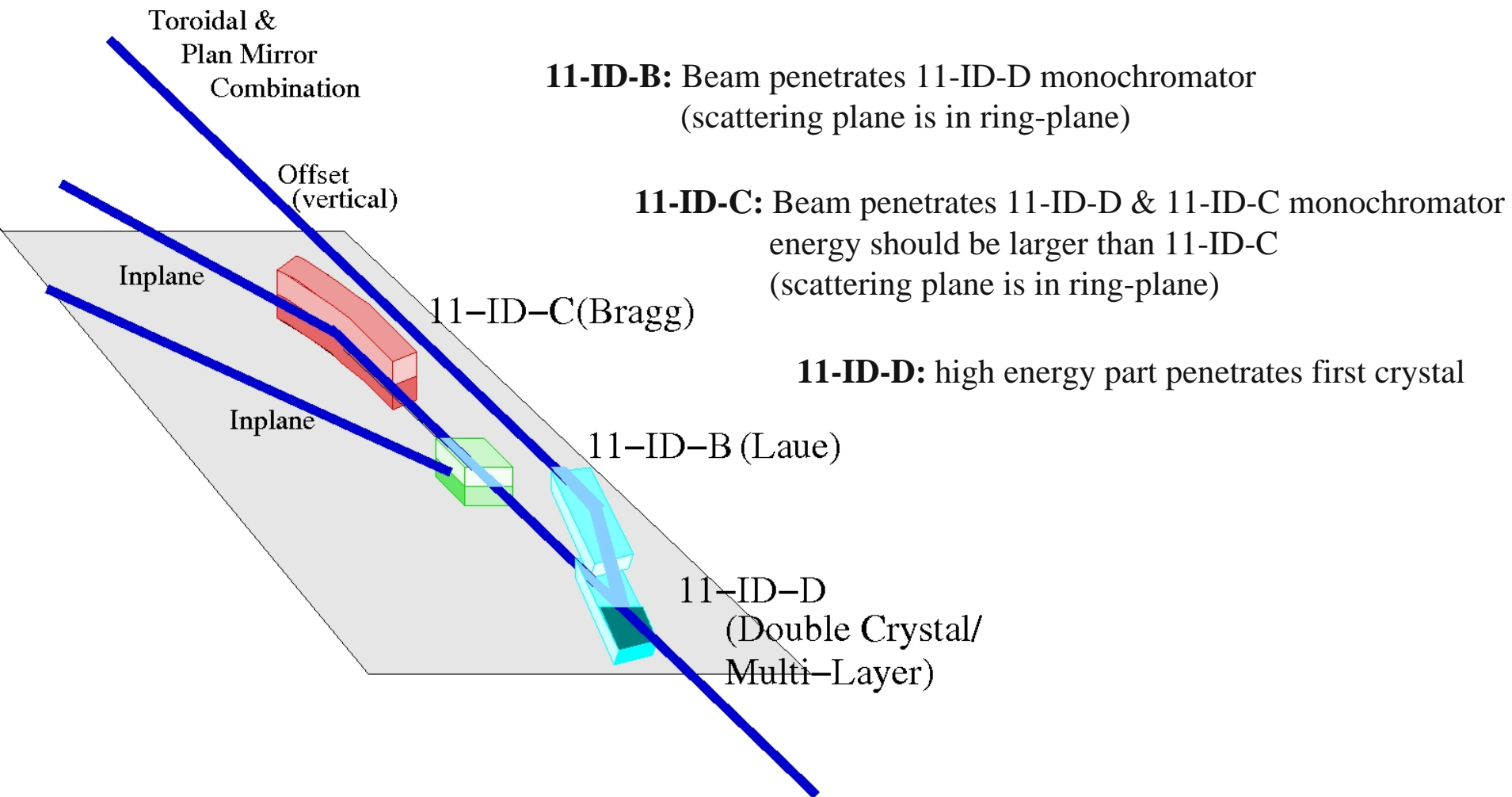
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# Tuning Curves Undulator U 2.3 cm, Undulator A (3.3 cm), and EMPW (16.0 cm) up to 120 keV



# General 11-ID beam line layout



# Goals of the 11-ID Upgrade

## 11-ID-B

- Dedicated to high energy scattering (low energy resolution and optimized flux)
- Various available energies with (very) limited scan range (60 keV / 90 keV / 120 keV)
- Flux:  $10^{13}$  -  $10^{14}$  photons/s in  $500 \times 500 \mu\text{m}^2$
- Optional: use of refractive lenses (horizontal/vertical focusing)

## 11-ID-C

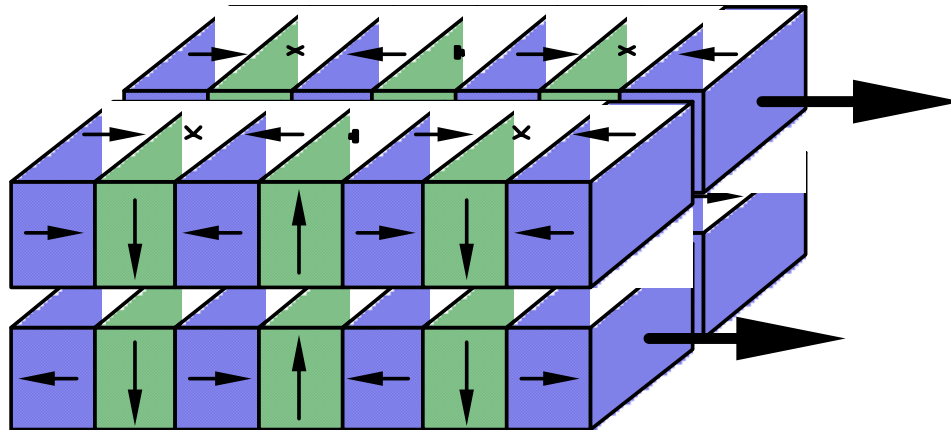
- Dedicated to high energy scattering (medium energy resolution and moderate focusing)
- “fixed” energy with (very) limited scan range (115 keV)
- Flux:  $10^{13}$  photons/s in  $200 \times 500 \mu\text{m}^2$
- Optional: use of refractive lenses (horizontal/vertical focusing)

## 11-ID-D

- Dedicated to medium energy spectroscopy & scattering (focus on time dependent effects) medium to low energy resolution and well focused
- Energy range: 4 - 25keV (.01% bandwidth) / 11keV/33keV (1% bandwidth)
- Flux:  $10^{13}$  -  $10^{14}$  photons/s in  $50 \times 400 \mu\text{m}^2$  (.01% bandwidth) /  $\sim 10^{15}$  -  $10^{16}$  photons/s in  $50 \times 400 \mu\text{m}^2$  (1% bandwidth)
- Optional: use of zone plates

## The 4-ID-D hard-x-ray magnetic spectroscopy beam line

- Require fast (10 - 20 Hz) changing of x-ray helicity because this allows lock-in detection of magnetic dichroism
- This is currently done with phase-retarder optics, but the unequal transmitted x-ray intensities for opposite helicities are a source of errors.
- Proposal is to replace Undulator A with an Apple II undulator.
- An Apple II has a set of horizontal and a set of vertical magnets that are displaced relative to one another to produce elliptical x radiation.
- The mechanical motion makes switching slow (0.5 Hz), which limits the possibility of lock-in detection.

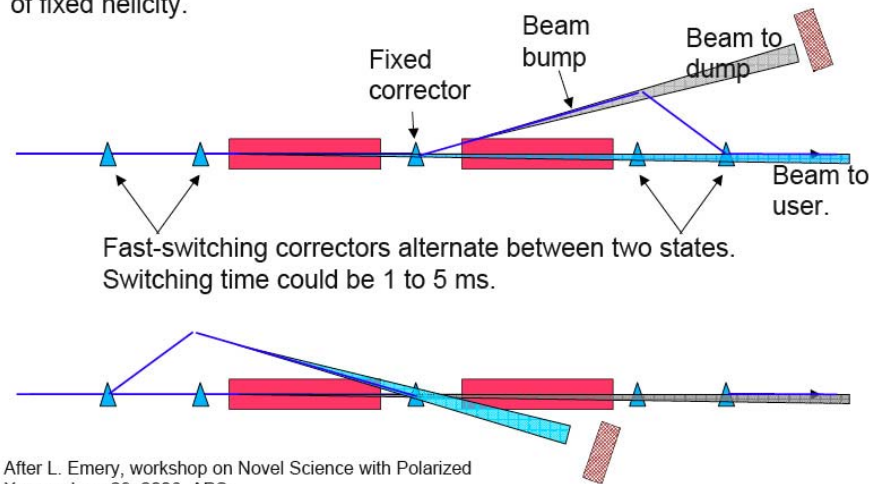


## ... the double Apple II for 4-ID-D

- In the first stage, one Apple II to replace the current Undulator A.
- In the second stage, replace CPU with a second Apple II, where the first and second are preset for the generation of left or right polarization.
- 5 kicker magnets cause the particle beam to alternate between the preset undulators at a specified frequency.
- This allows the sensitive lock-in detection, extending the range of dichroic signals into the  $10^{-6}$  range.

### Fast Polarization Switching from a Long Straight Section

Use corrector magnets to switch the beams from two undulators of fixed helicity.



After L. Emery, workshop on Novel Science with Polarized X-rays, June 29, 2006, APS.



# Conclusions

- Highest priority would be the upgrade insertion devices for 1-ID and 11-ID
- Propose starting R&D for circular polarization undulator
- Propose starting R&D for superconducting undulators as funding becomes available
- Tailored undulators and additional undulators A would be scheduled to tie in appropriately with the relevant beamline upgrades.