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Possible Storage Ring Upgrades

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Advanced Photon Source

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Boundary Conditions

- Use existing storage ring tunnel
- All beamlines (sectors 1~35) will be preserved
  - Can continue operation with no change in performance if so desired
  - Bending magnet beamlines (sectors 1~35) may require realignment
- 7 GeV is target, 6 GeV is minimum energy
- Existing beam stability will be maintained
- Existing bunch patterns will be maintained
  - E.g., 24 bunch, 1296, hybrid mode
- Single bunch current limit will be maintained
  - E.g., 16 mA in hybrid mode.

Goal for the Upgrade

- Provide upgraded experimental capabilities on multiple fronts
  - Support for time-resolved studies requiring picosecond pulses
  - Improved transverse coherence
    - *E.g., coherent diffraction studies*
  - Improved imaging
    - *E.g., phase-contrast imaging*
  - Significantly longer straight sections, e.g.,
    - *Fast polarization switching*
    - *More canted devices*
  - Improved beam stability to match emittance reductions.

Promise of a Storage Ring Upgrade

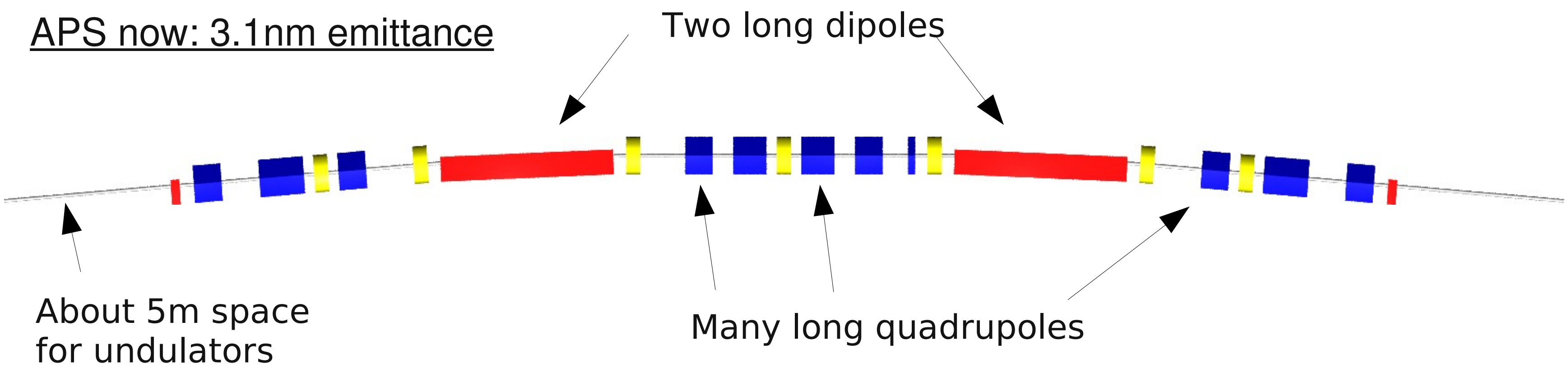
- Could upgrade the APS storage ring to provide
  - Longer straight sections
  - Lower emittance
  - Higher current
  - Short x-ray pulses
  - Novel insertion devices
  - Customized source properties
- Do nothing to preclude ERL upgrade in the future.

Long Straight Sections Very Important

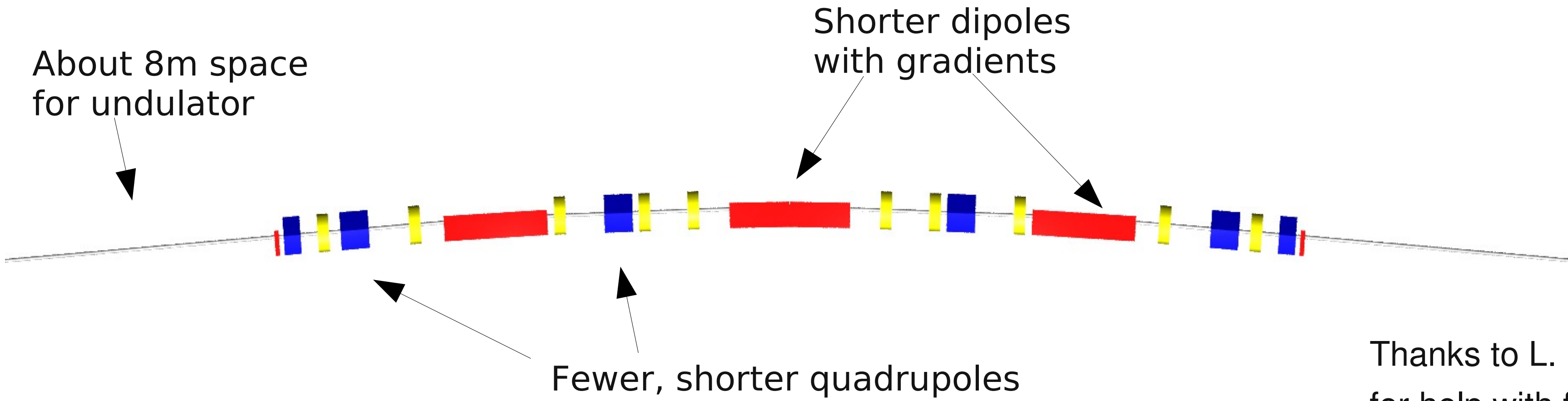
- APS straight sections now allow 4.8 m for insertion devices
- Longer straight sections interesting for many reasons
  - Flux-starved experiments
  - Long devices for reduced x-ray bandwidth
  - Getting more from expensive end station equipment by having several IDs
  - Canted devices to increase number of simultaneous experimental stations
  - Provides more space for cryostats for superconducting crab cavities.

Triple-Bend Design (APS1nm)

APS now: 3.1nm emittance



Possible upgrade: 1nm emittance

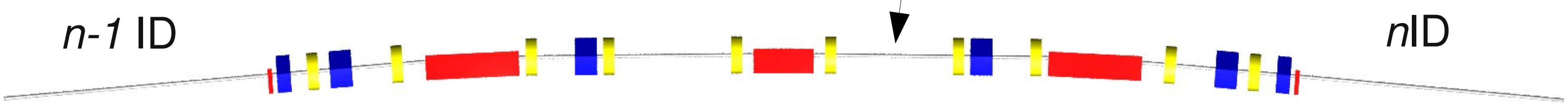


Thanks to L. Emery
for help with figures.

Another Option: APSx3

- This is an evolution of the 1nm lattice
- Offers three times as many ID beamlines
- Could provide a three-pole wiggler for beamlines that still want bending-magnet-like source
- Downside: Emittance doesn't improve much

<u>APSx3: ~1.5nm</u>



2.1m magnet-to-magnet
in new straight sections.

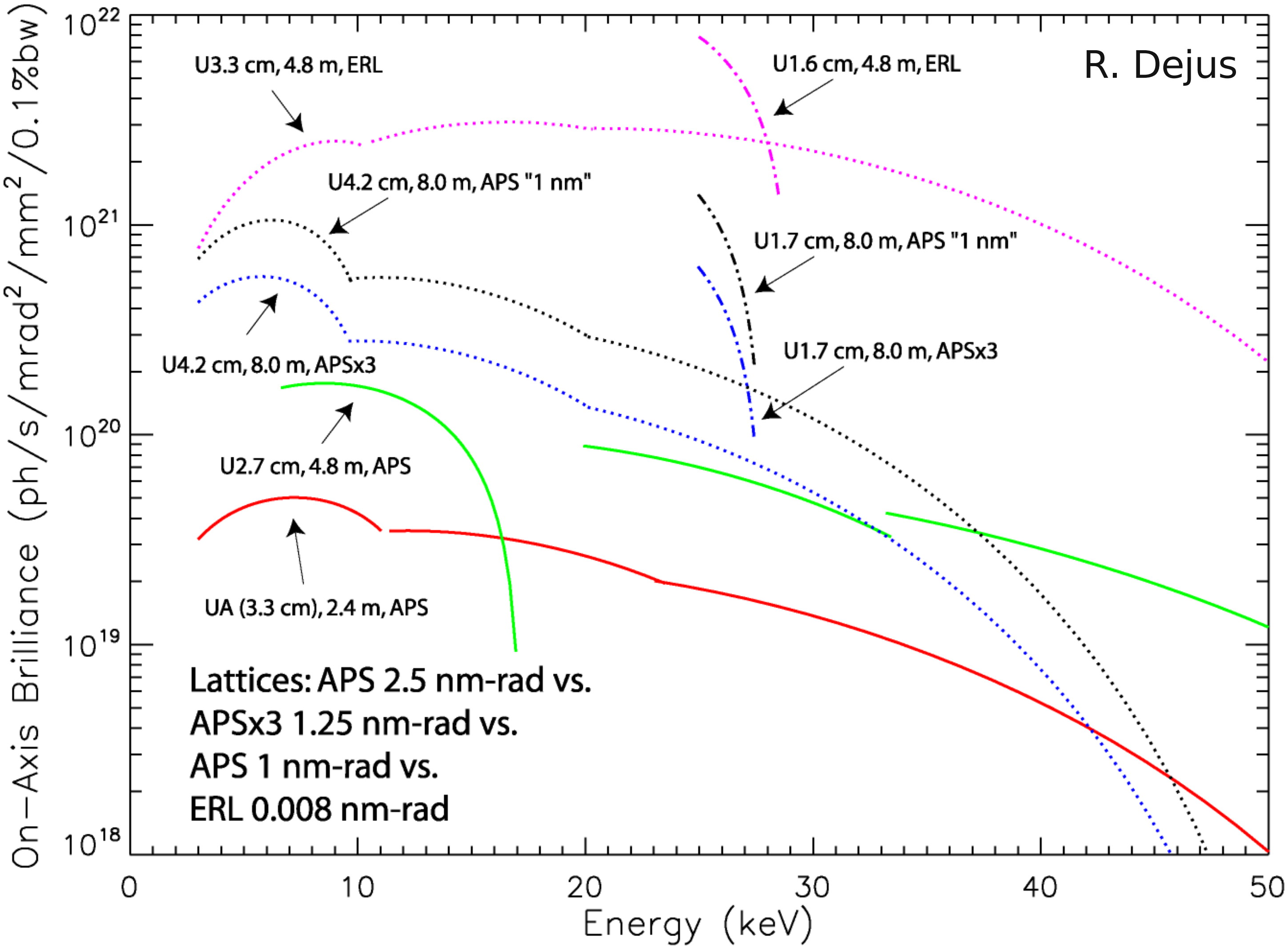
Thanks to L. Emery
for help with figures.

Source Parameters Compared to APS Now

Case	*# of Sectors*	*x rms (microns)*	*x' rms (microrad)*	*y rms (microns)*	*y' rms (microrad)*
Today	40	275	11.4	8.5	3
APS 1nm	40	~120	~10	~7	~1
APSx3	40	~120	~14	~13	~1

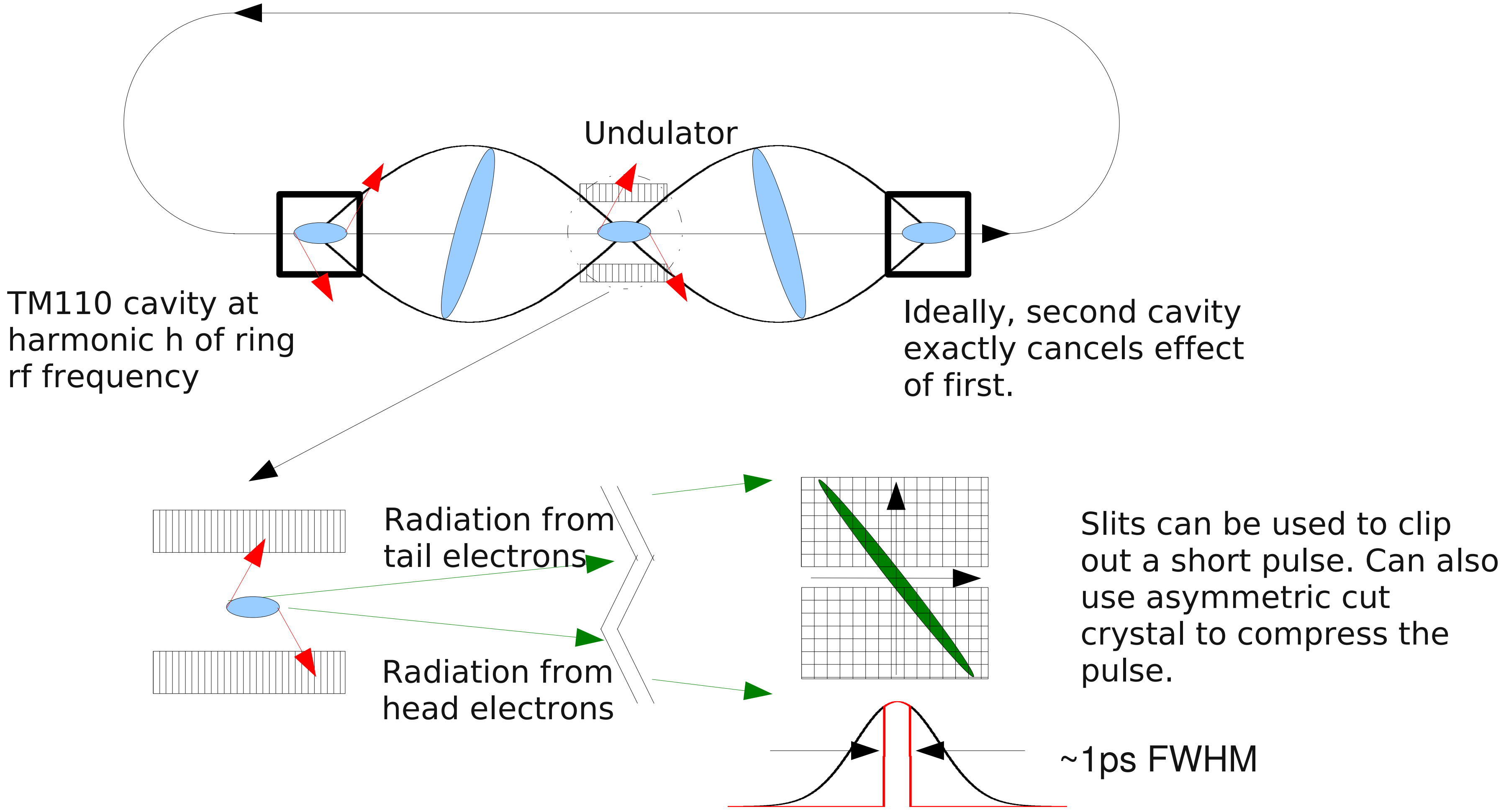
- Upgraded ring would run at 200 mA, 7 GeV
- Insertion devices would be customized to, e.g., maximize brightness consistent with power limitations of front ends.

Spectral Brightness Predictions



- 100 mA (APS), 200 mA (APSx3, APS 1 nm-rad), 25 mA (ERL)

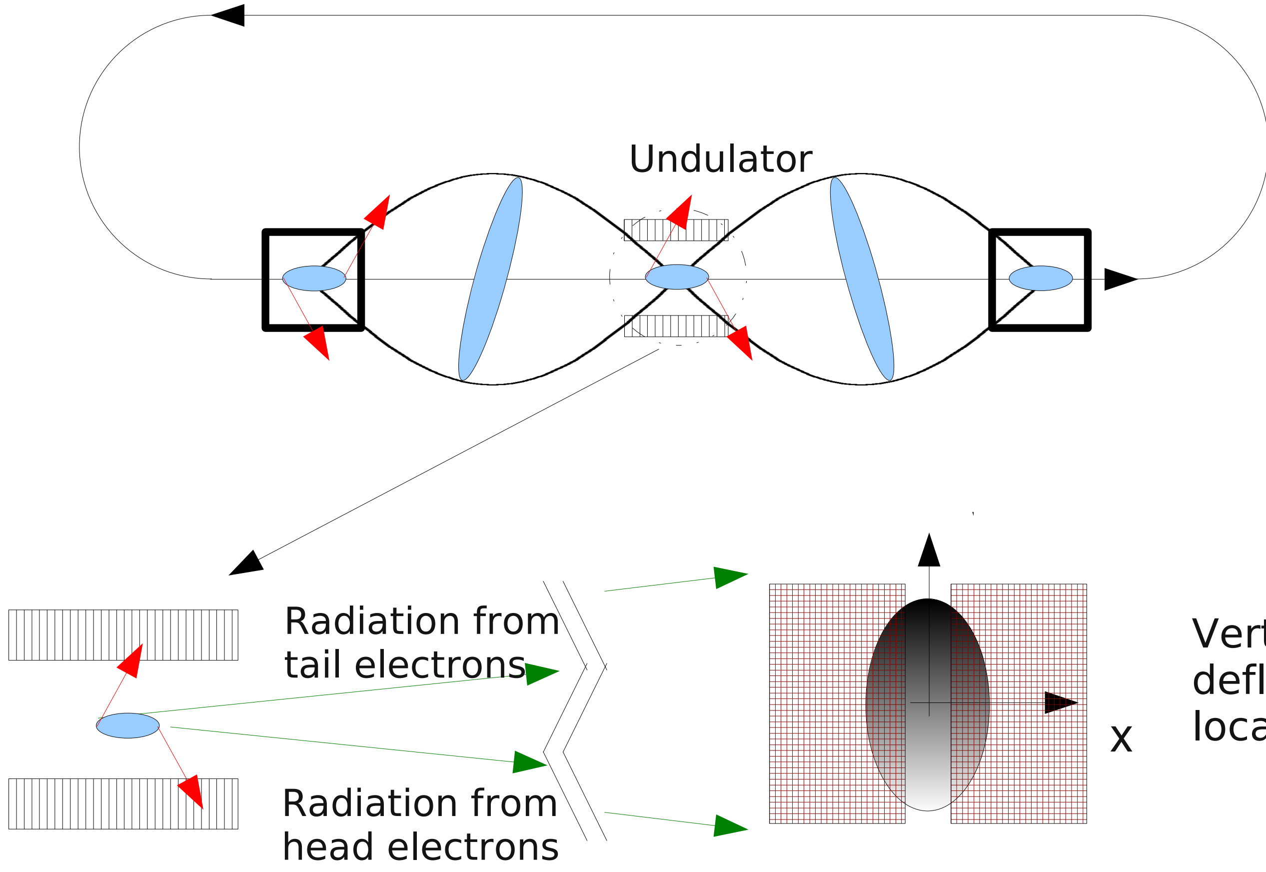
Zholents' Transverse Rf Chirp Concept



~1ps FWHM possible for existing APS
(K. Harkay *et al*., PAC 05, p. 668.)

Large Area Coherent Imaging

This is another concept[1] for using a crabbed beam.



Vertical *time-dependent* deflection doesn't change local coherence properties.

[1]E. Gluskin

Summary: Ring Upgrade

- Pros
  - Well-known technology, should deliver as promised
  - Long straight sections, possibly 3x number of IDs
  - Smaller horizontal beamsize (~120 microns)
  - Improved brightness (10~100x)
  - Support for ps pulses, large-area coherent imaging
- Cons
  - Lattice flexibility very difficult to achieve
  - Considerable dark time required for installation
  - Brightness improvement is disappointing relative to
    - *Detector/beamline improvements*
    - *ERL projections.*

Acknowledgements

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