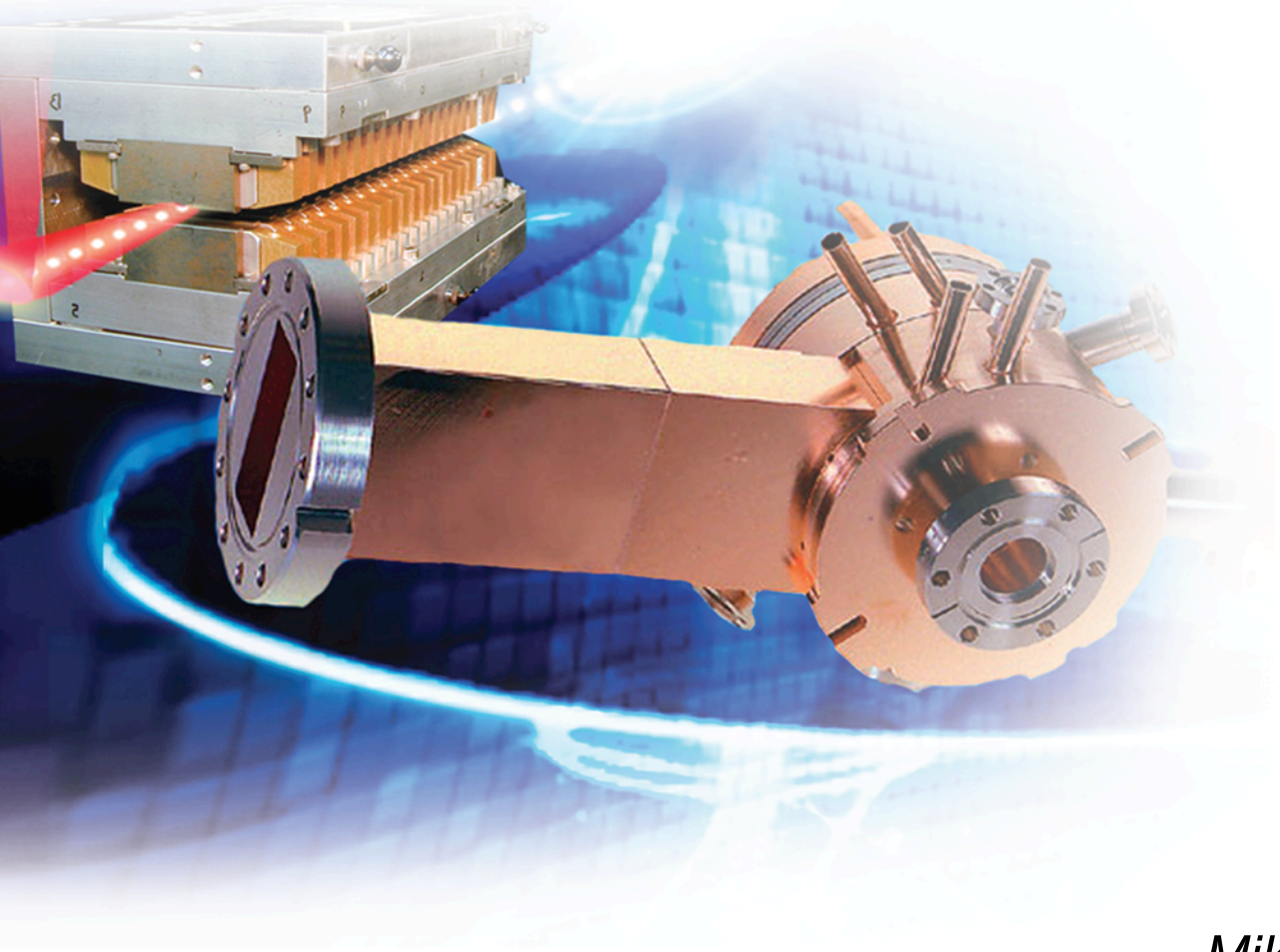


Mikhail Fedurin

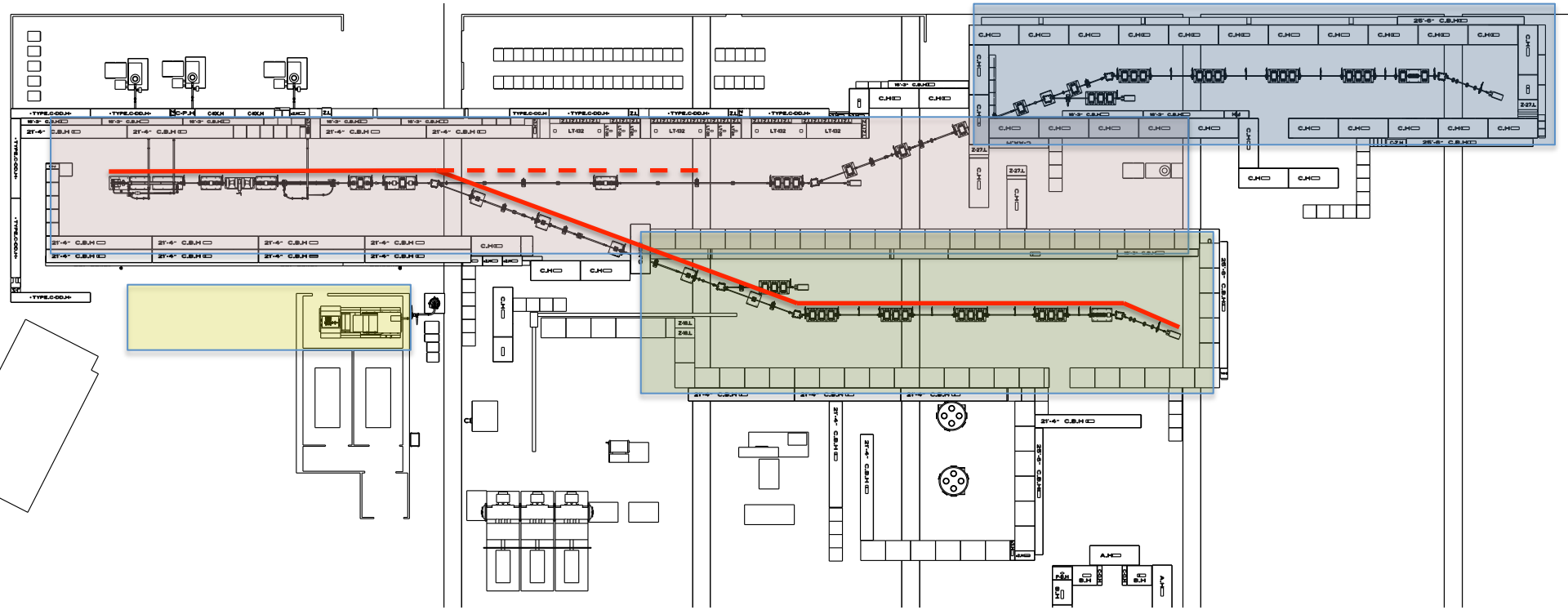
ATF II: Beamline and UED

BROOKHAVEN NATIONAL LABORATORY
a passion for discovery
U.S. DEPARTMENT OF ENERGY | Office of Science

ATF II beamlines. Design conception.

- ATF II beamline preserve present ATF advantages:
  - robust and flexible lattice for different beam optics
  - dispersion section for beam manipulation (chirped beam shape, mask technique)
  - small transverse size electron beam
  - compressed beam
- New features:
  - Three independent experimental halls
  - Multiple Interaction Points
  - Fine compressed beam (~10 fsec)

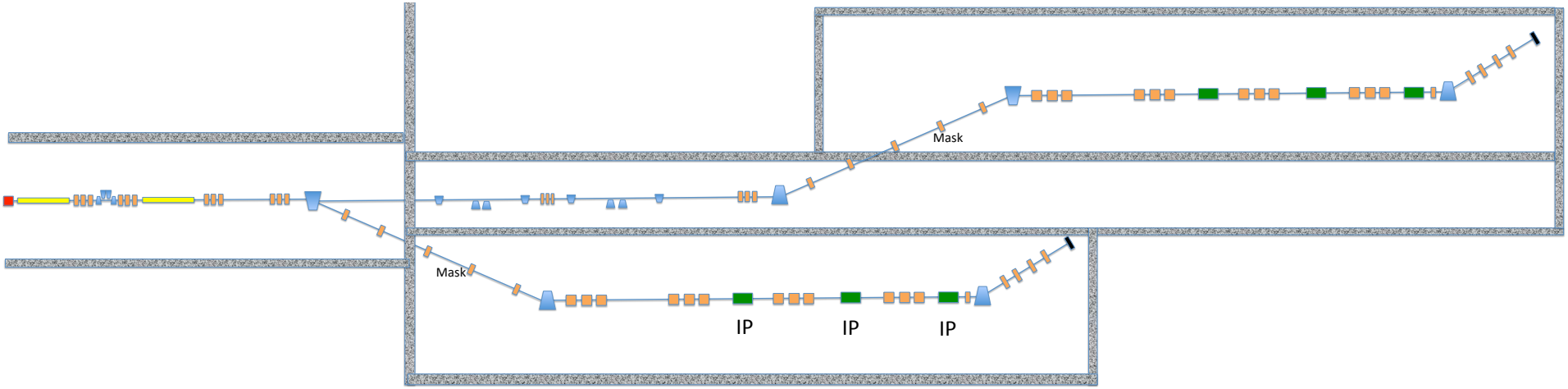
ATF II beamlines. Facility overview.



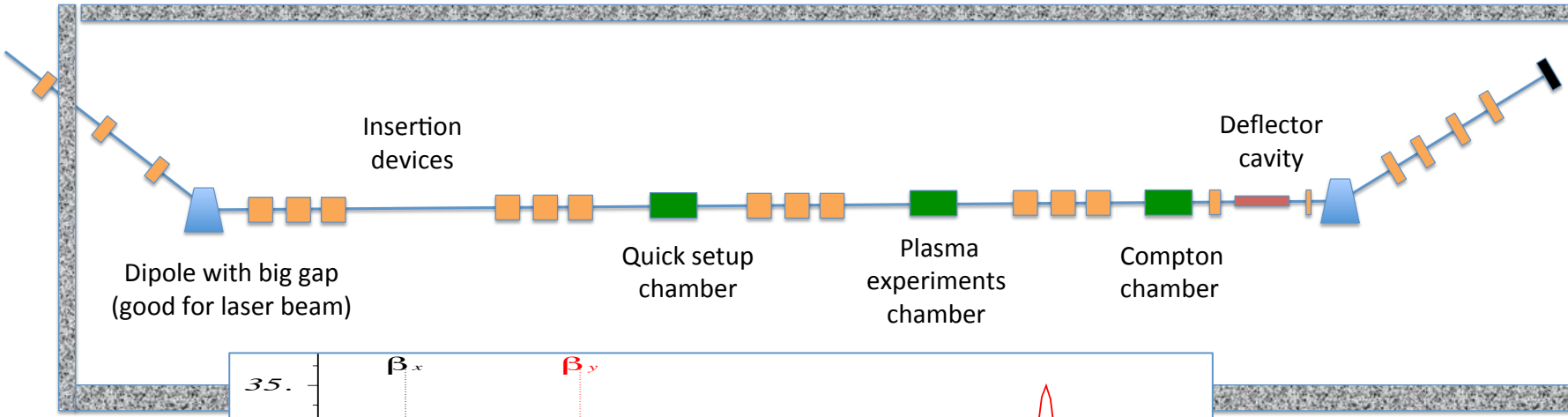
ATF II beamlines.
Multiple experimental stations

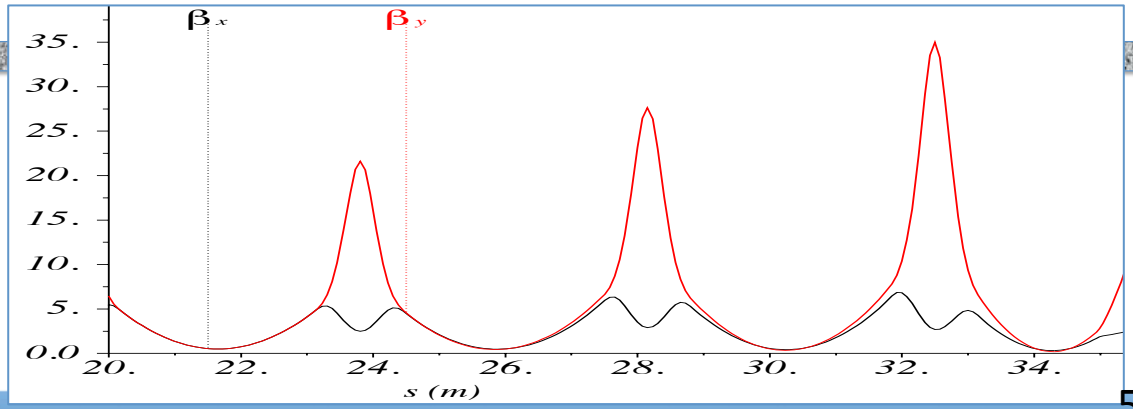
Beam line was designed to follow 2014 User Meeting recommendations: *"increase number of experimental stations on the beamline to allow experimental setup by multiple user groups with minimal interference"*

- Number of interaction points was increased.
- Extended beamlines may be used for small transverse beam size generation with progress to the last Interaction Point.



ATF II beamlines.
Stage 1 beamlie population map

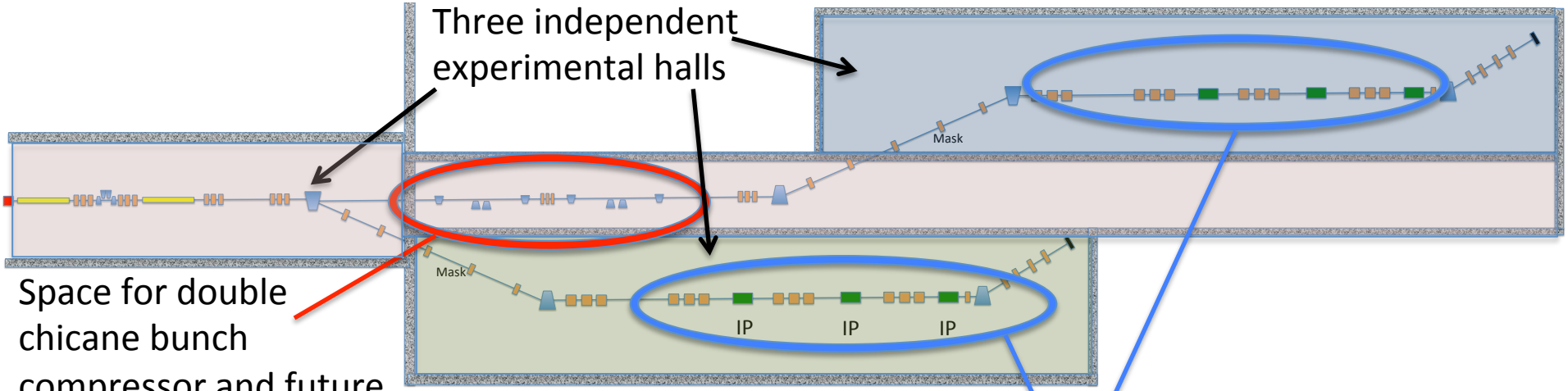




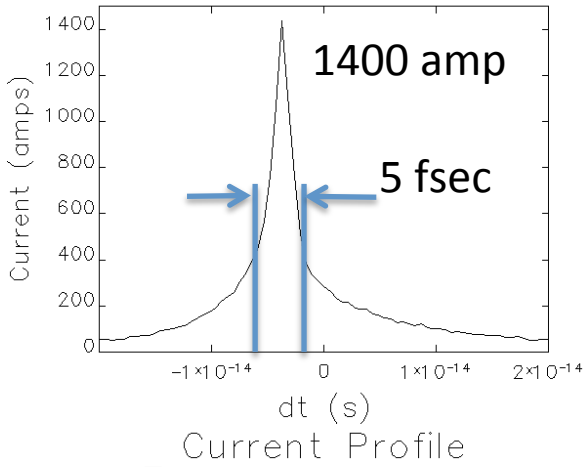
ATF II beamlines.
Other planned features on Stage 1)

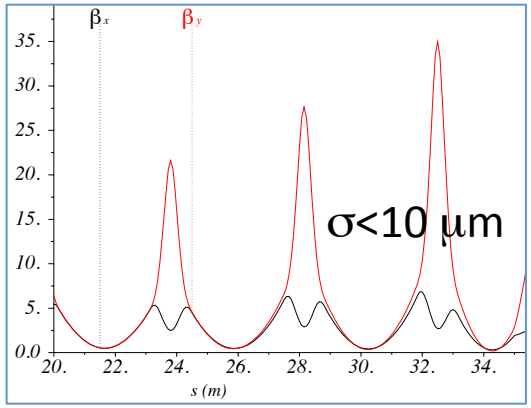
- Bunch compression:
  - Chicane magnet
  - Velocity compression
- Flat beam (beam will be magnetized at the cathode)

ATF II beamlines. Next stage.



Space for double chicane bunch compressor and future energy upgrade

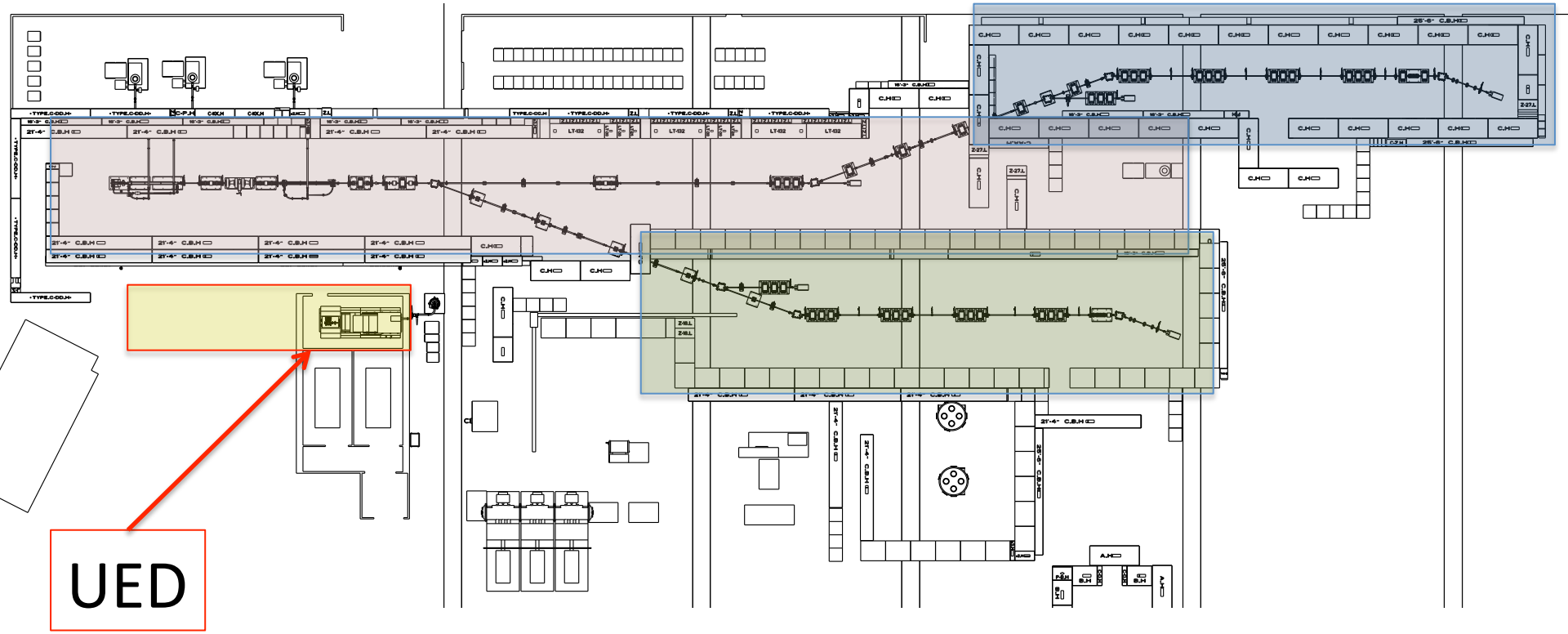




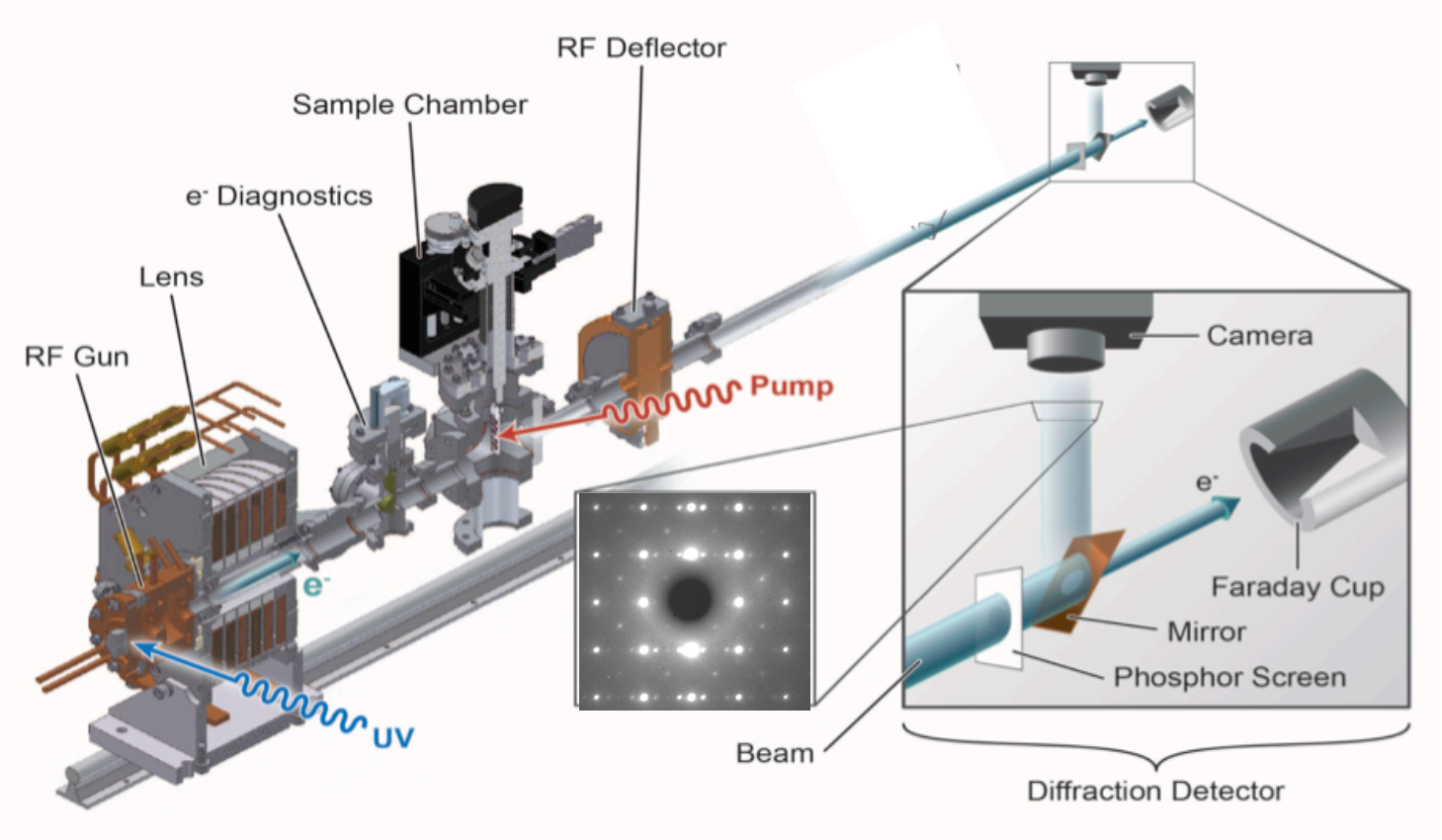
Multiple IP and experimental stations. Beam size progressively decrease to <10 micron

ATF II: Ultrafast Electron Diffraction (UED)

ATF II beamlines. Facility overview.



MeV-Ultrafast Electron Diffraction



Electron Beam	
Bunch charge	~1 pC
Electron Beam Energy	2-3 MeV
Relative energy spread (rms)	9.5×10^{-4}
Pulse width (rms)	100 fs
Divergence (rms)	59 μrad
Spot size (rms)	200 μm

by Junji Li

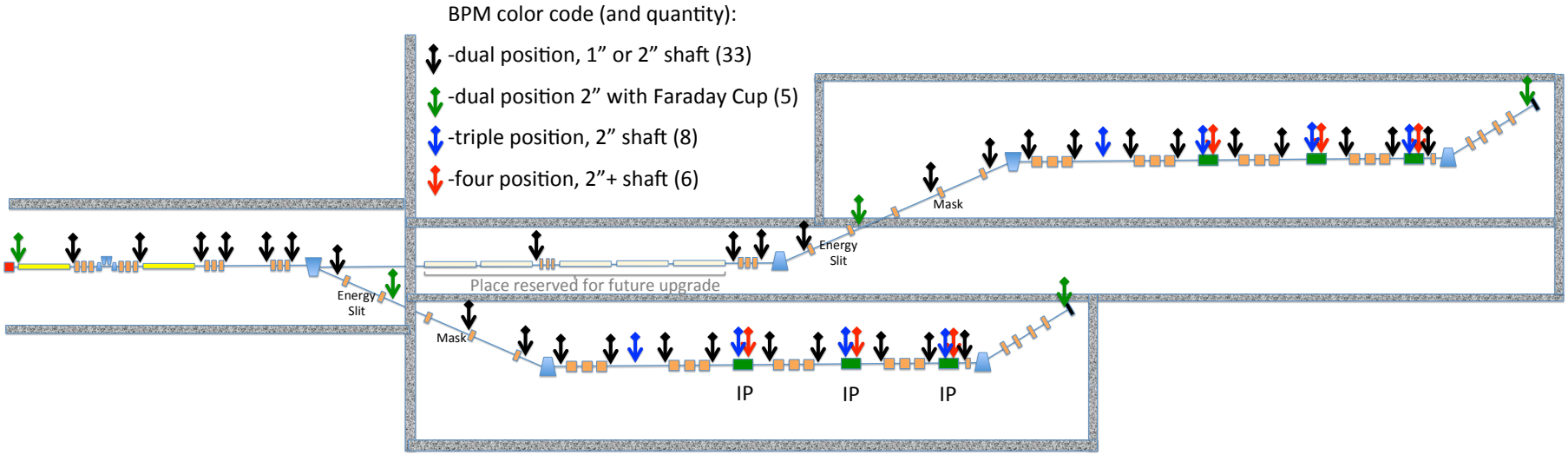
ATF UED, improvements plan:

- Improve probe brightness
- Time jitter free UED beamline (2015 LDRD by Li Hua Yu, BNL)
- Increase rep rate

Thank you!

Support material:

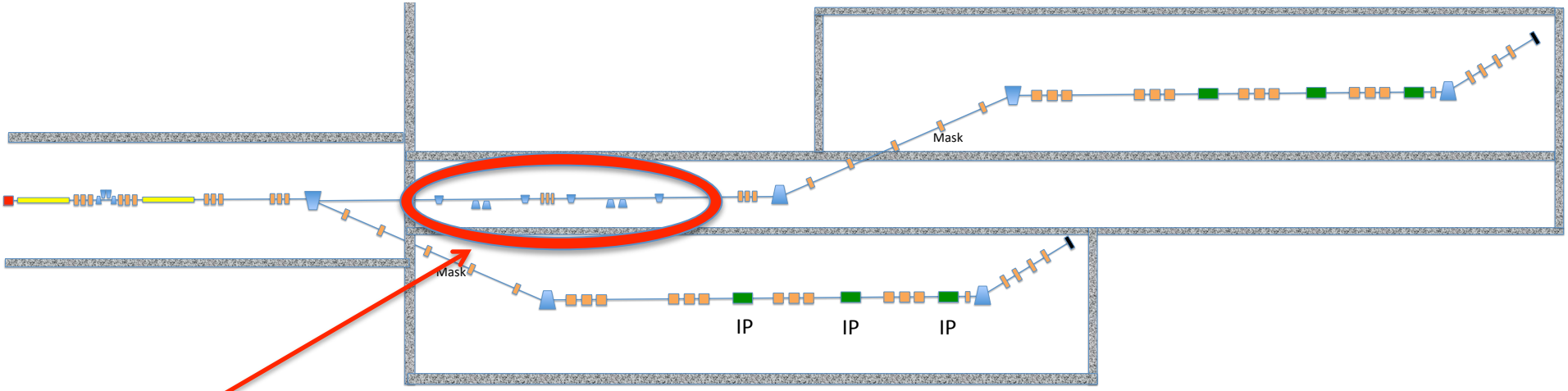
ATF II beamlines map



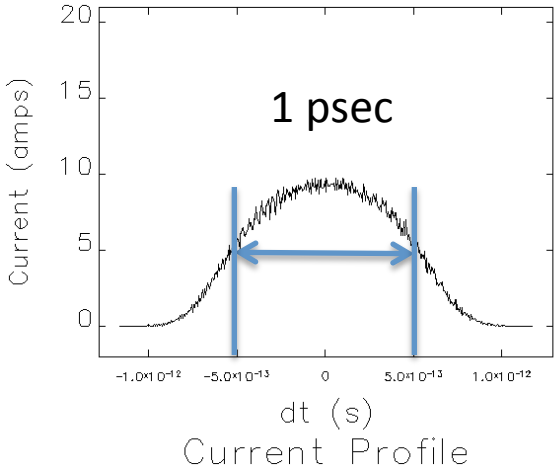
Dual-position: 1) beam clear 2) YAG
Triple-position: 1) beam clear 2)YAG 3) OTR mirror or Ge (laser sync)
Four-position: 1) beam clear 2)YAG 3) OTR screen 4) Pinhole (laser alignment) or Ge (laser sync)

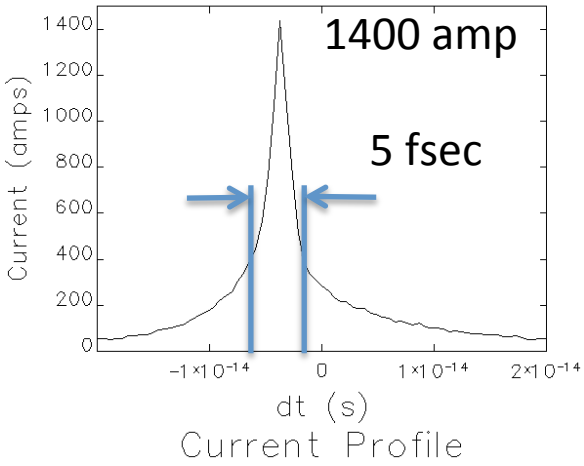
ATF II beamlines. Fine beam compression

scheme proposed by Yichao Jin (C-AD)



Double chicane
bunch compressor

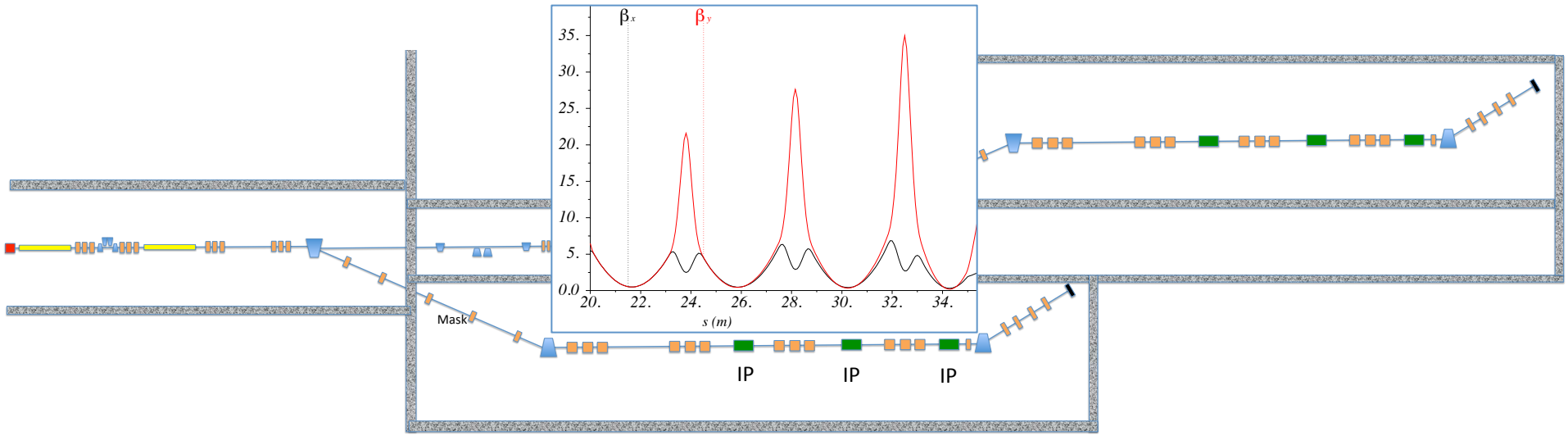




ATF II beamlines.
Multiple experimental stations

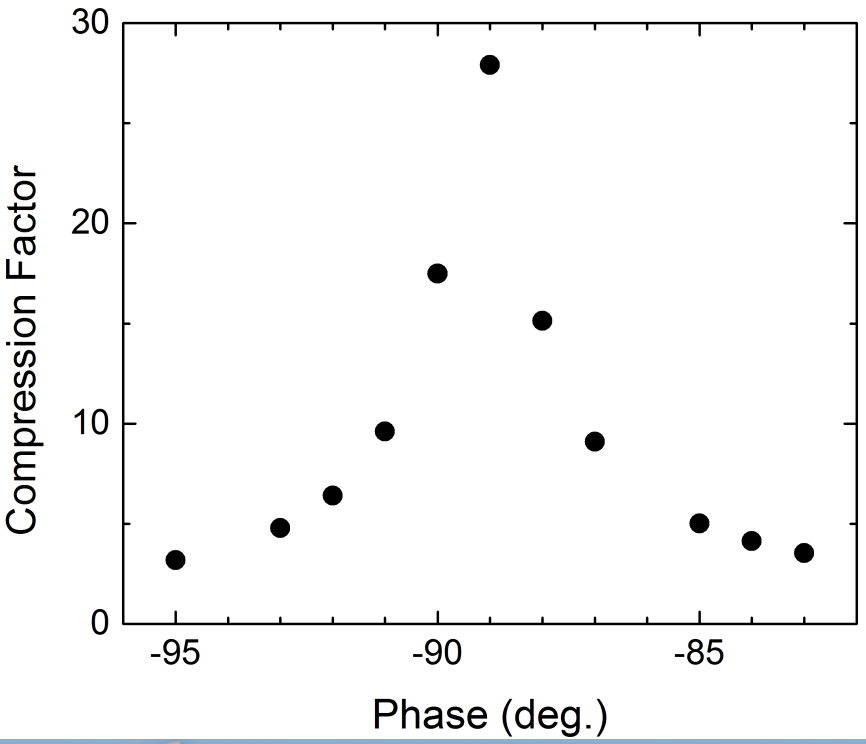
Beam line was designed to follow 2014 User Meeting recommendations: *"increase number of experimental stations on the beamline to allow experimental setup by multiple user groups with minimal interference"*

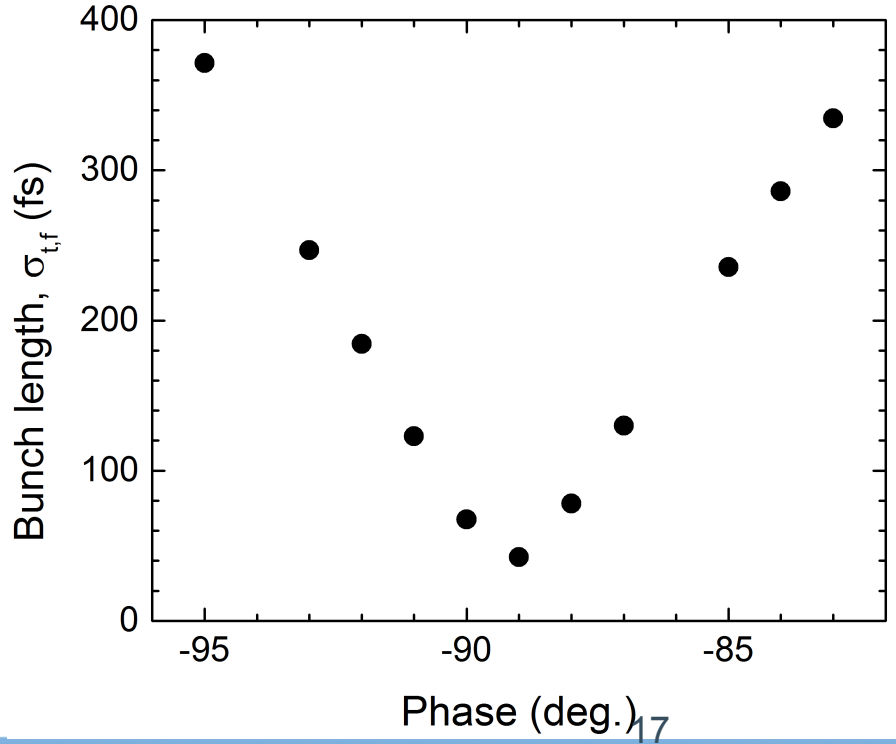
- Number of interaction points was increased.
- Extended beamlines may be used for small transverse beam size generation with progress to the last Interaction Point.



By D.Stratakis, Velocity Bunching (50 pC)

- Vary phase of first linac (L1)
- Keep L2 on crest ($\varphi=0^0$)
- Turn off magnetic bunch compressor (BC)



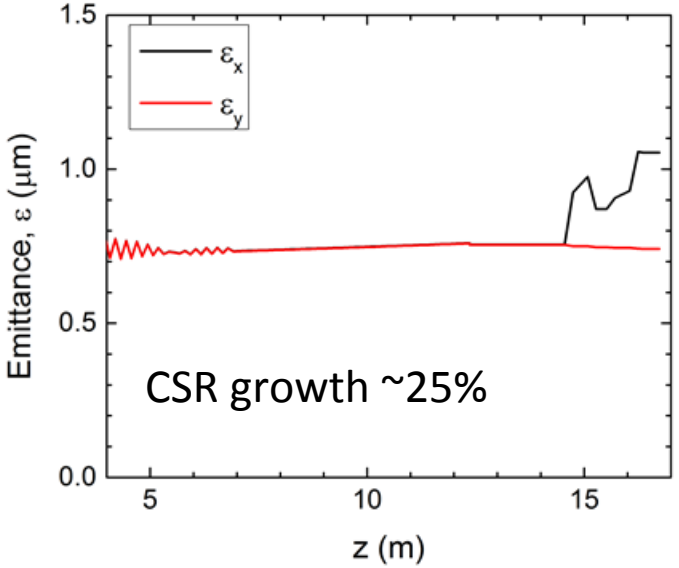


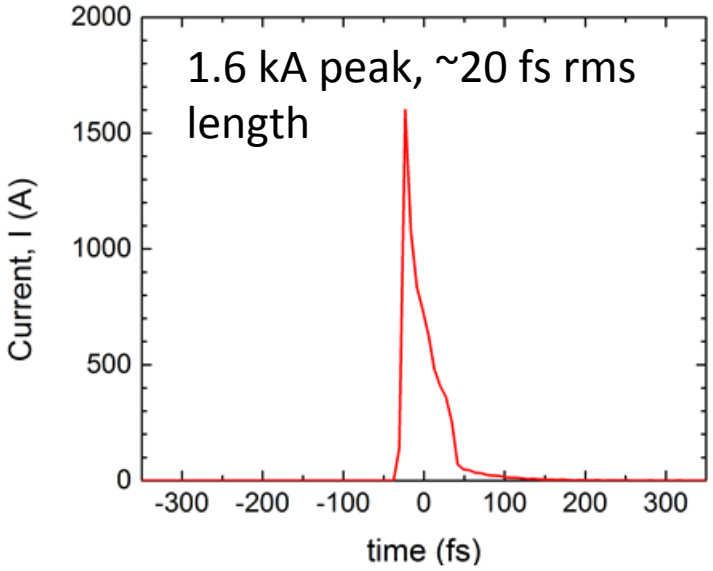
D.Stratakis proposal: Two stage compression

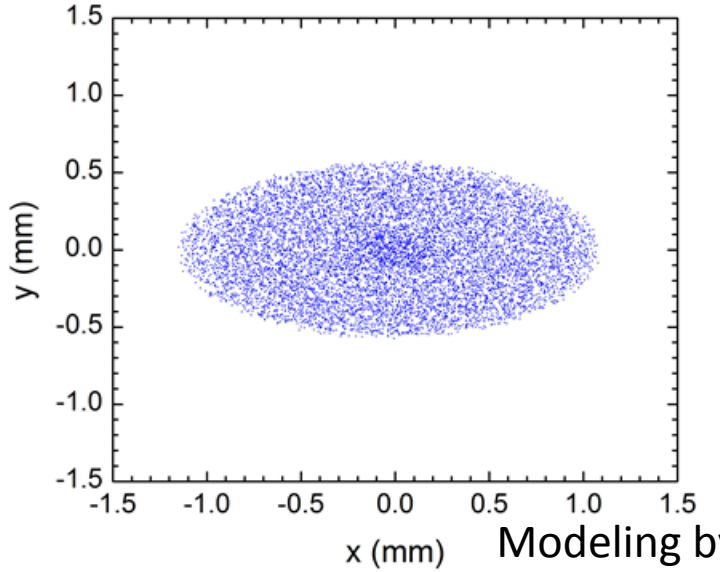
- Asymmetric profiles and emittance growth if compression factor C is greater than 4. Thus, keep C~4
- Then, use a magnetic bunch compressor (BC) to provide additional compression
- Simulation with a round beam
- Simulation with a flat beam
- Results for a 50 pC show that such scheme can produce ~20 fs beams (see next slide)
- Can be tested at the present ATF

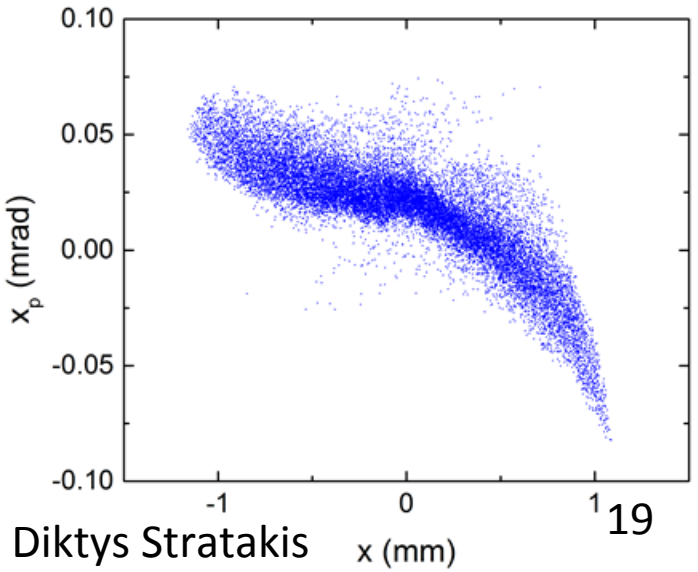
Velocity compression at ATF.

Case of a round beam: VB & BC



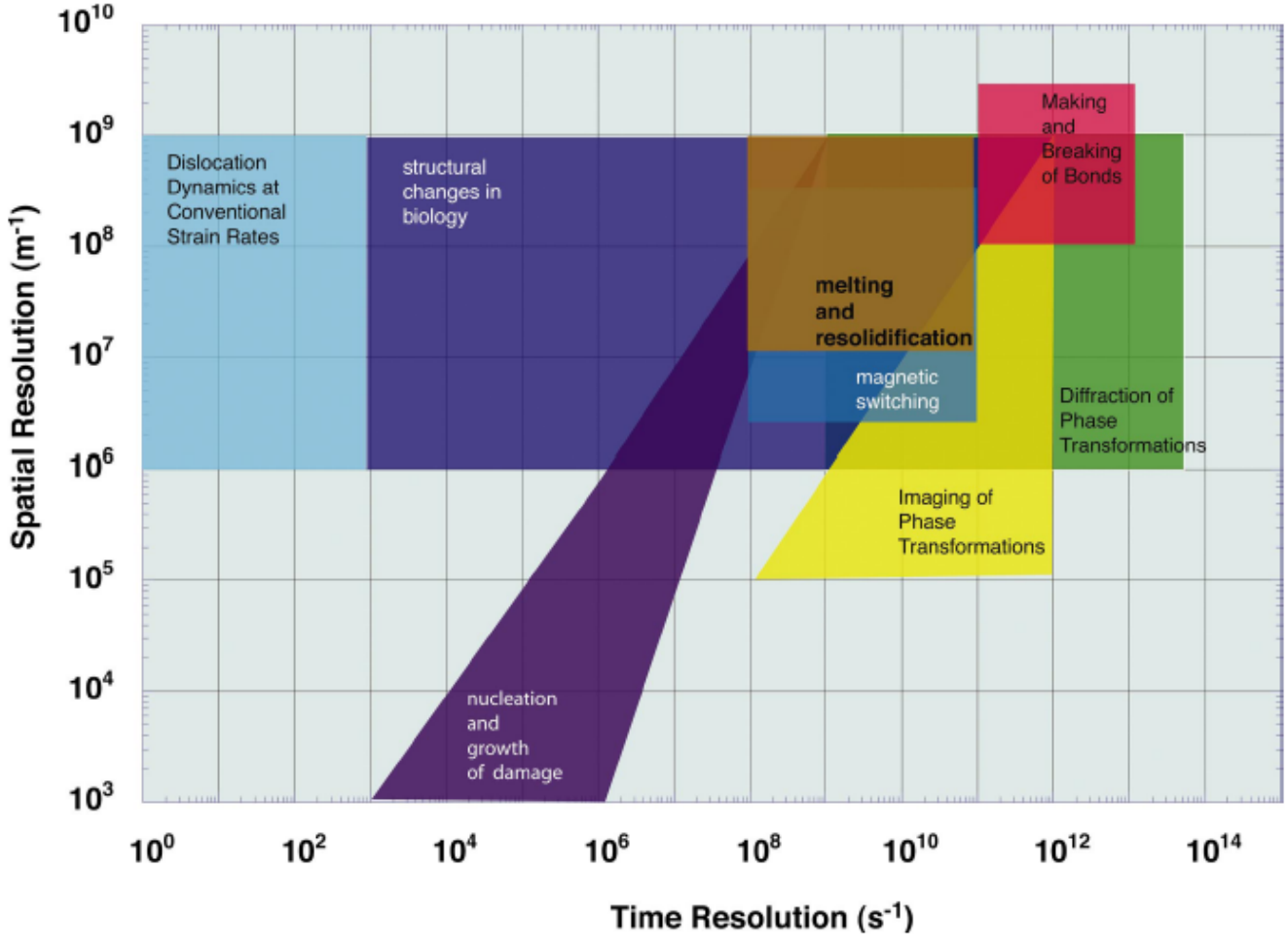






Modeling by Diktys Stratakis

Structural changes in nature

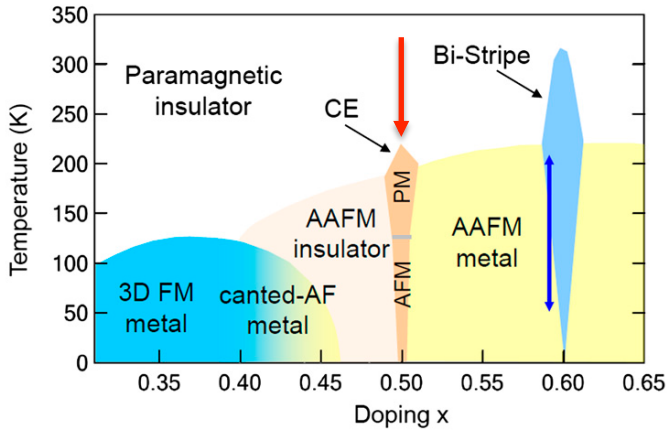


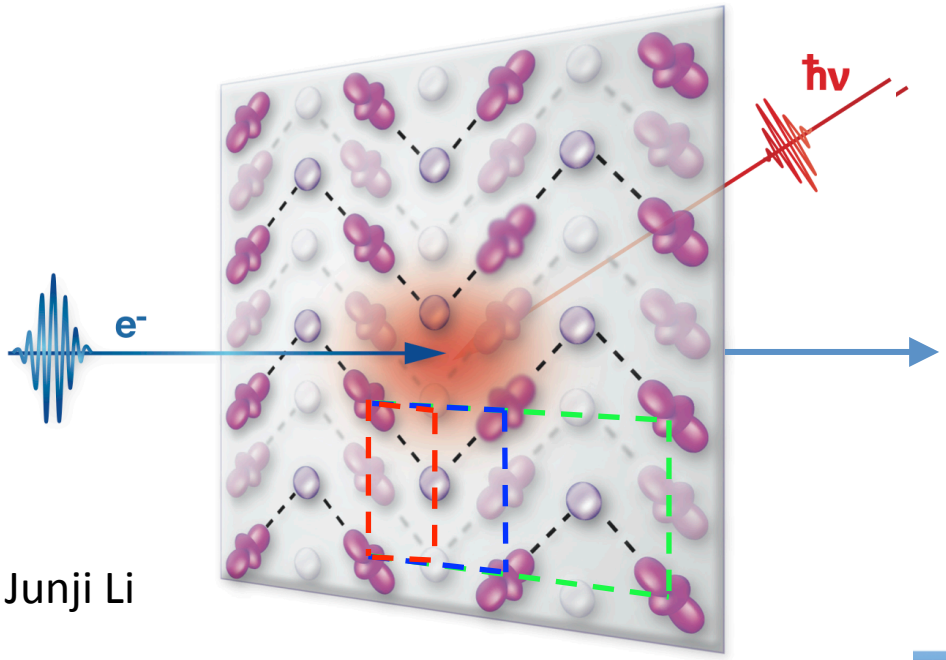
by Junji Li

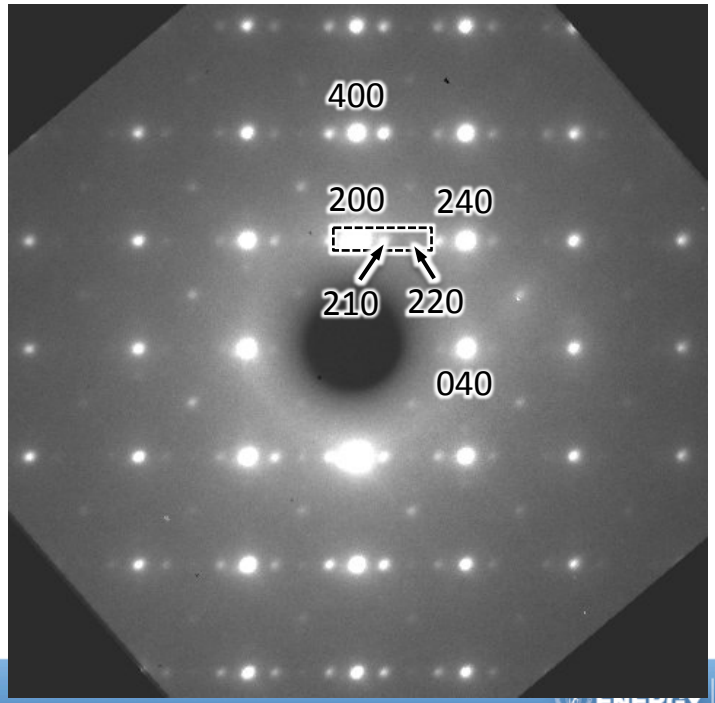
$LaSr_2Mn_2O_7$

$La_{2-2x}Sr_{1+2x}Mn_2O_7$

Z. Sun, *et al.*, *PNAS* **108**, 11799 (2011)

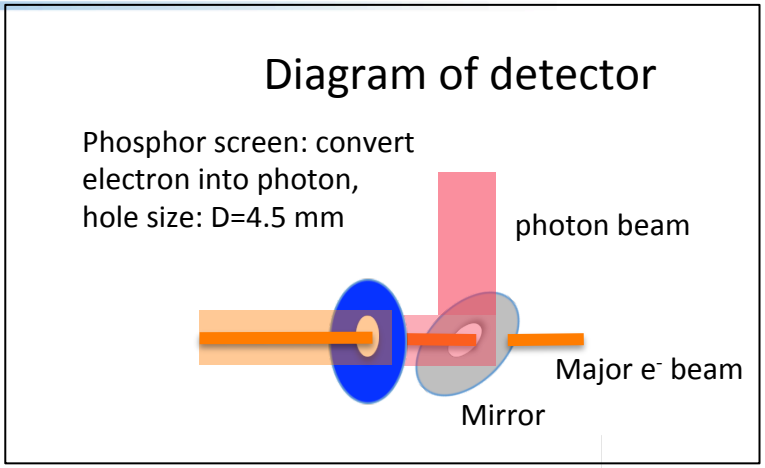


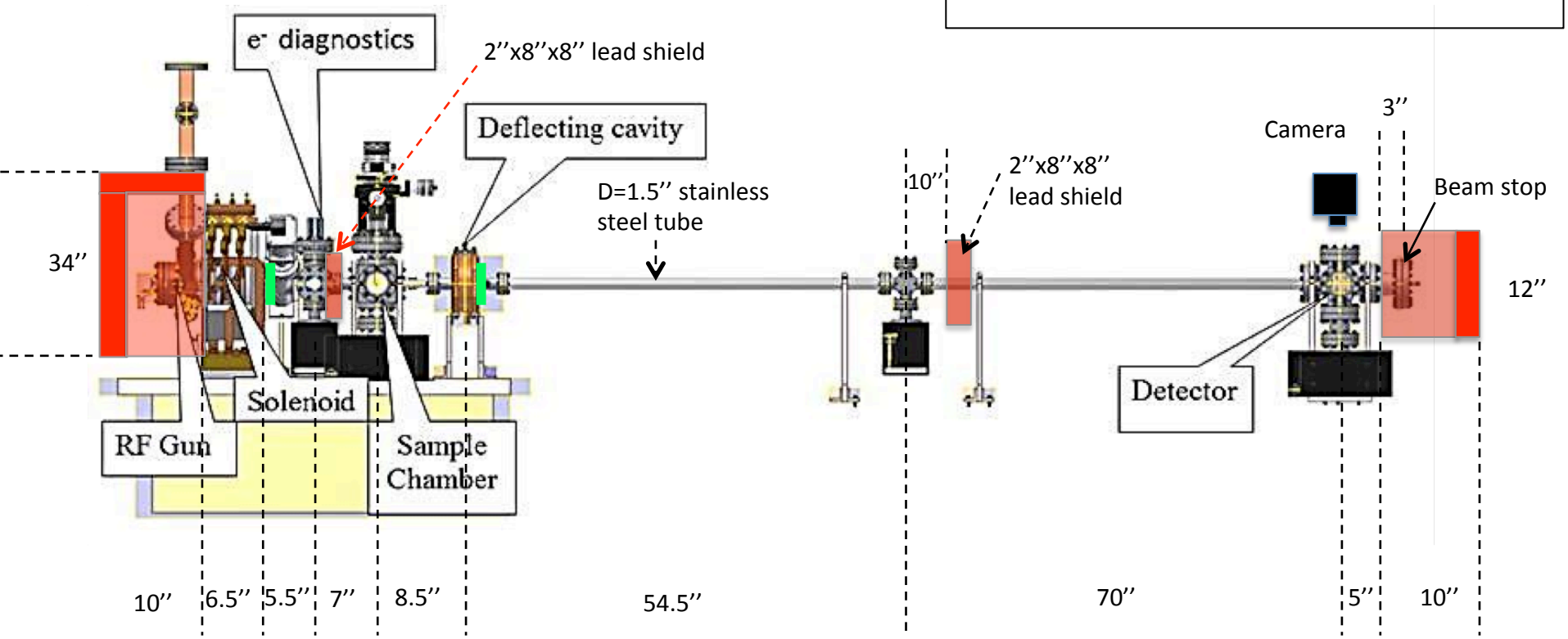




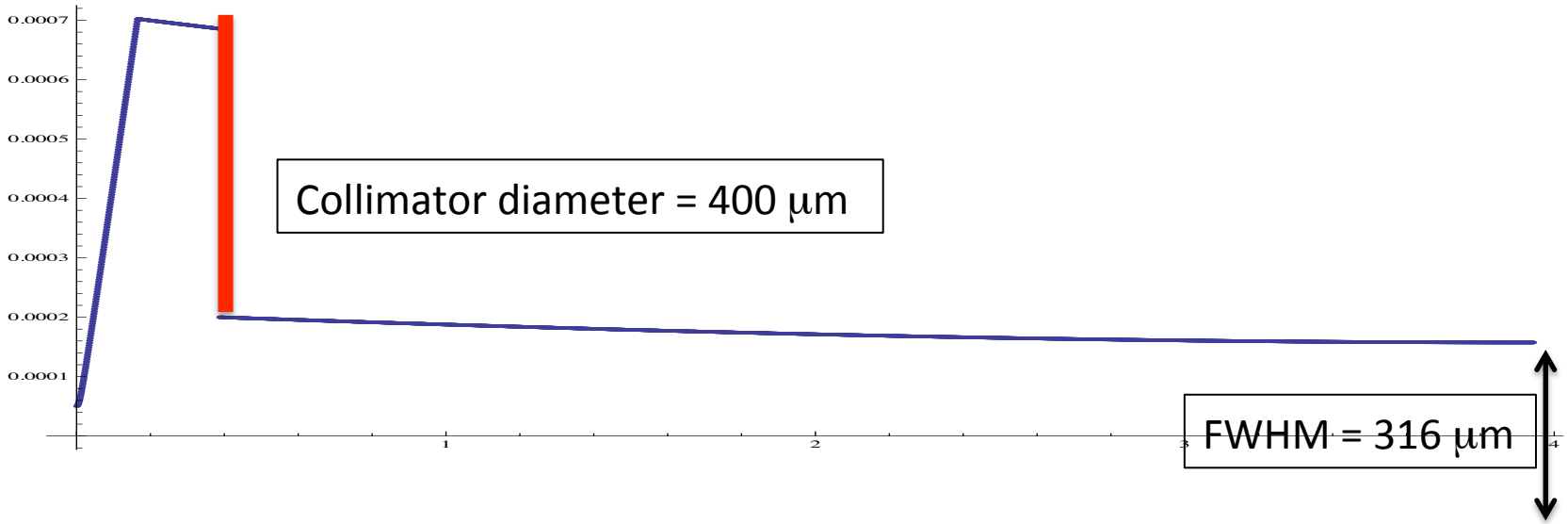
by Junji Li

UED beamline configuration





UED. Operational beam shape, collimator IN



Operational current in solenoid (130 A)