Status of PRAE beamline

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Task

• Design the entire beam line
  – Provide the proper beam for end user
  – Fit the geometry requirement

• Perform the realistic start-to-end simulation
ProRad Experiment Requirements:
- Energy: 30, 50 70 MeV
- $\sigma_x = 20 - 30 \mu m$
- $\sigma_y = 100 - 200 \mu m$
- $\sigma_{x',y'} < 50 \mu rad$
- $\sigma_E / E < 5 \times 10^{-4}$
- $Q = 10 - 100 \ pC$

Wide energy range

Need extremely small emittance

The most difficult requirement: we need the energy compressor system

Radiobiology Experiment Requirements:
- Mini Beam
  - $\sigma_{x,y} = 400 - 700 \mu m$ after 10 cm air + 3 cm water
  - Low divergence
- FLASH beam
  - $\sigma_{x,y} = 10 \text{ mm} \times 10 \text{ mm} , \Delta t = 100 \text{ ms}$
  - $\sigma_{x,y} = 26 \text{ mm} \times 18 \text{ mm} , \Delta t = 500 \text{ ms}$

Wide beam size range
Simulation Environment

Lattice design: Madx

Proton Radius
Dechirper
Collimator
Dipole
Quadrupole
Linac
RF Gun
RF-Track
Astra

Radiobiology + Instrumentation

22.2 m

6 m

Radiobiology simulation: BDSIM
Status:
• A beamline has been designed
• A simulation environment has been setup
• In ideal case:
  – The energy spread requirement for ProRad can be reached at 70 MeV beam
  – The requirement for radiobiology
    • Mini beam: can be met at 140 MeV beam
    • FLASH Beam: can be met with drift and defocusing quadrupole

Future:
• Reoptimize the RF injector
• start-to-end optimization for RF Gun and Linac
• Evaluate and simulate the CSR effect
• Study the misalignment and the imperfection of all components
• Investigate the passive dechirper structure