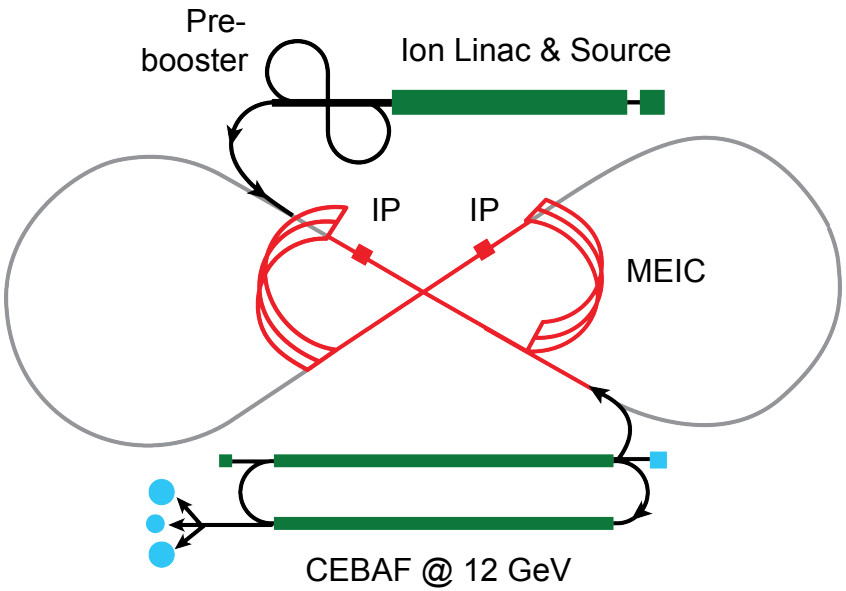
IR work update

- Preliminary design of extended IR (±100 m around IP) presented at meeting with Mike Sullivan Feb 2013.

- Goal is to have (semi-)final iteration ready before DIS conference (April 22), including:
  - Straight electron straight as per design report spec with only soft wiggles in CCB upstream of detector.
  - Adjust strength of „big“ ion dipole to put beams in parallel after IP.
  - Dual function electron low-Q^2 tagger also including compensation features.
  - Additional low-t ion detection point downstream of secondary focal point but before crab cavity to further improve near-beam tracking.
    - See separate slide
  - Additional compensation elements downstream of all detection points?

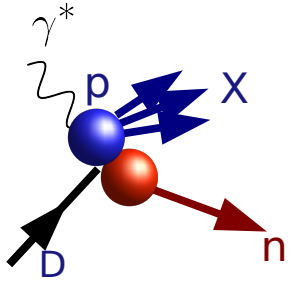


- Asymmetric IR optics for the full-acceptance detector optimized for low chromaticity and high luminosity
  - 2 identical IR:s in lattice
  - Upstream ion FFB at minimum distance (4 m) from IP.
  - Location of downstream FFB can be adjusted, but since both IR:s use the same CCB, the total contribution to the chromaticity has to remain the same.
    - Detailed study by Vasiliy for Mike Sullivan's last visit in Nov 2012

Ultra-forward hadron detection – requirements

1. Good acceptance for ion fragments (rigidity different from beam)

- Large downstream magnet apertures
- Small downstream magnet gradients (realistic peak fields)

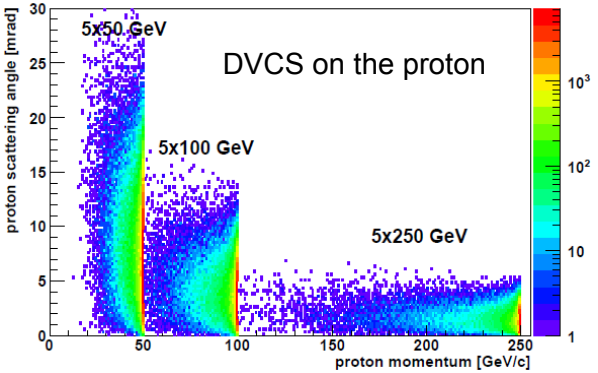


2. Good acceptance for recoil baryons (rigidity similar to beam)

- Small beam size at second focus (to get close to the beam)
- Large dispersion (to separate scattered particles from the beam)

3. Good momentum- and angular resolution

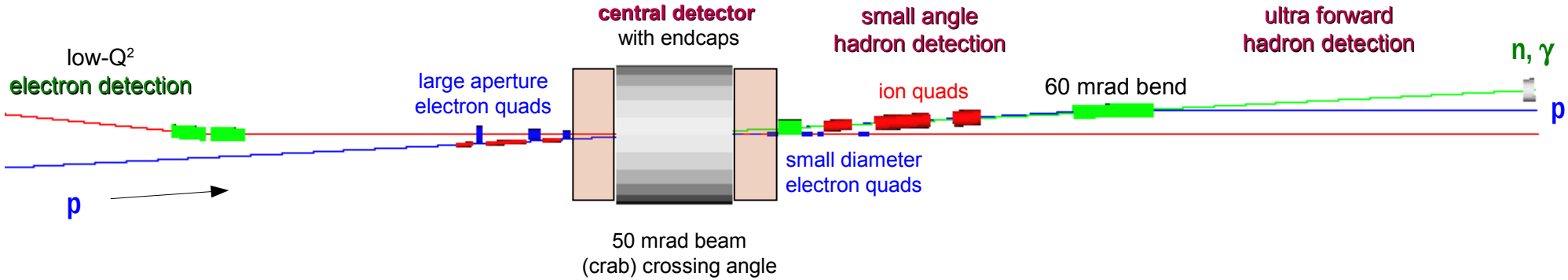
- Large dispersion (*e.g.*, 60 mrad bending dipole)
- Long, instrumented magnet-free drift space

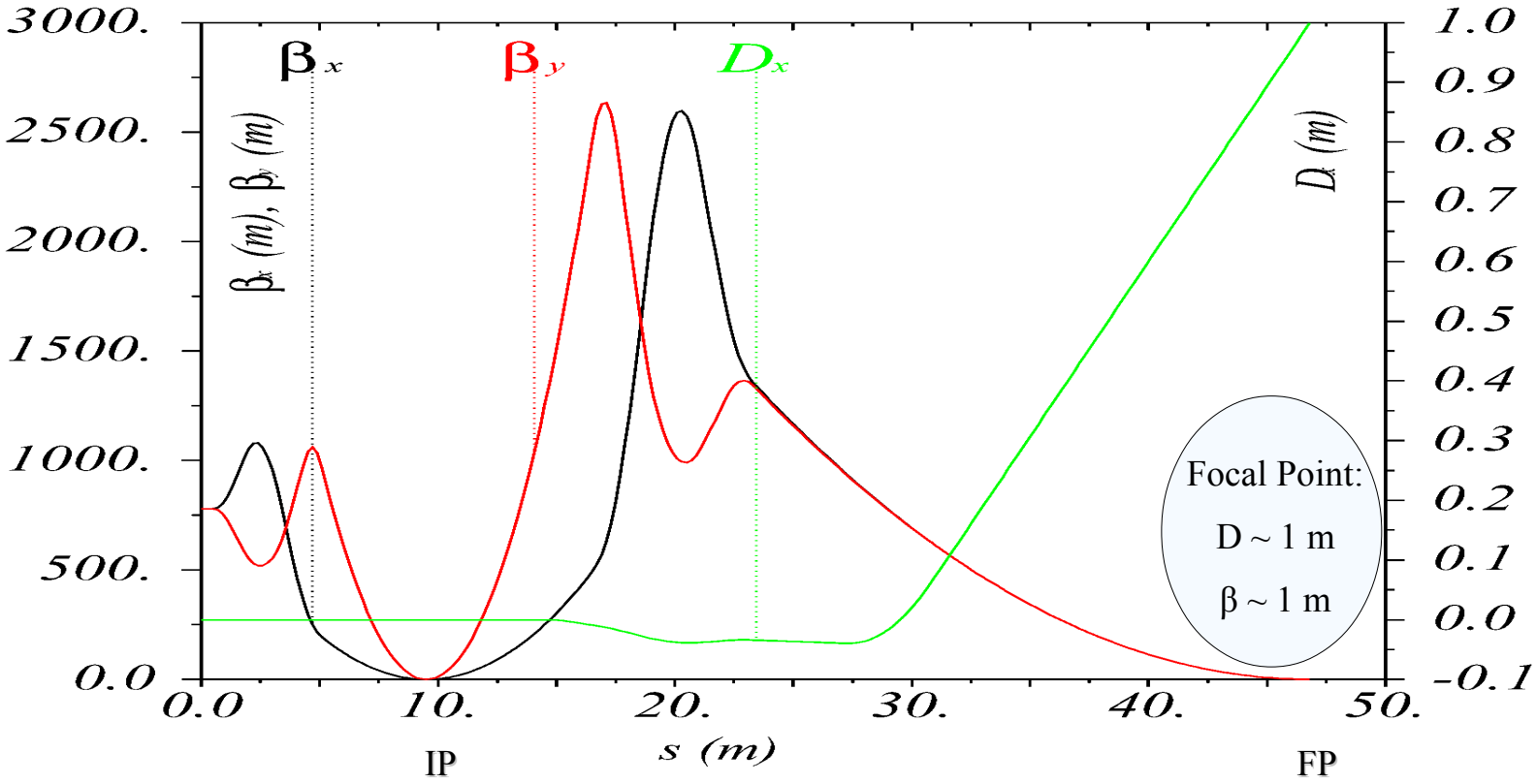


4. Sufficient separation between beam lines (~1 m)

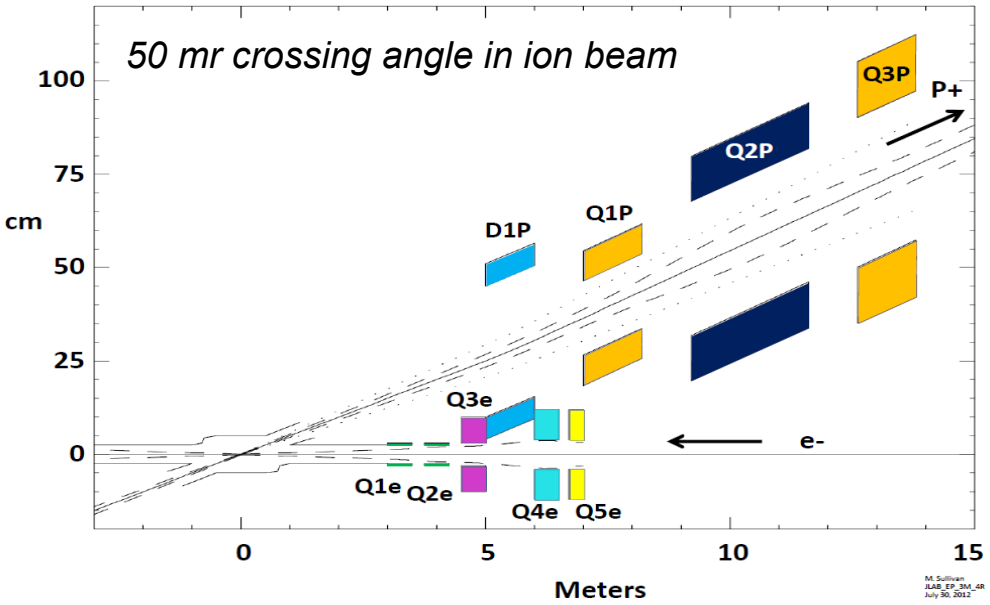
Ultra-forward detection at secondary focal point

No other magnets or apertures between IP and FP!





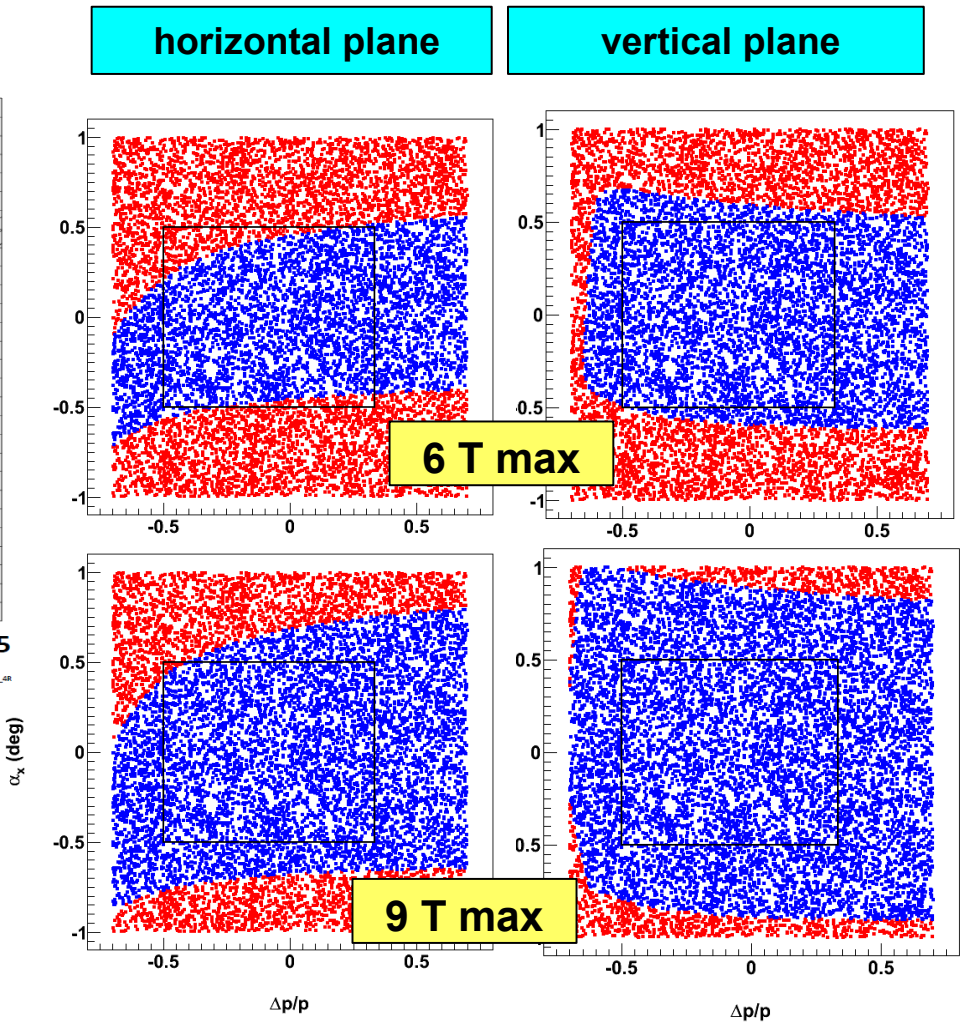
Ultra-forward charged-hadron acceptance



Red: Detection before ion quadrupoles

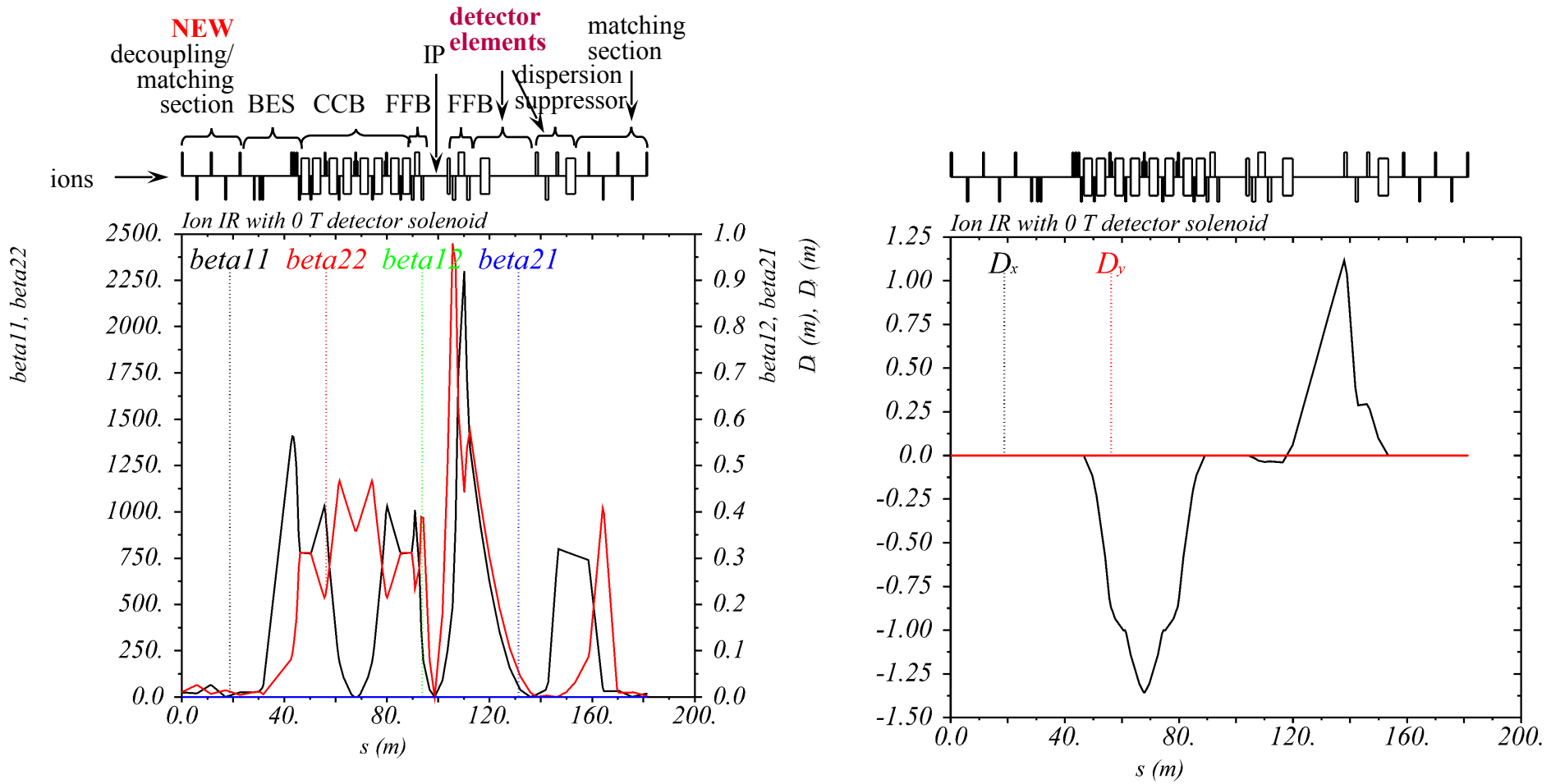
Blue: Detection after ion quadrupoles

Forward acceptance vs.magnetic rigidity



Tagged d beam: dp/p = -0.5
Tagged ^{3}He beam: dp/p = +0.33

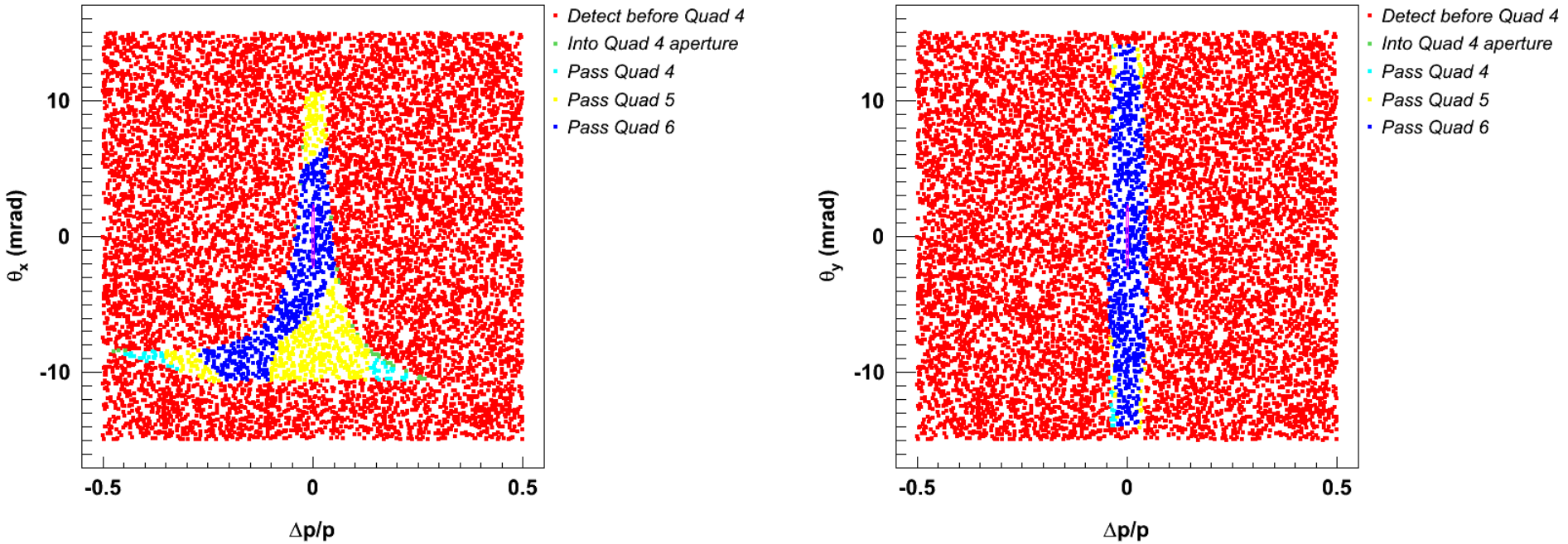
Ultra-forward detection downstream of focal point



- Dispersion suppression section after the secondary focal point offers an excellent opportunity for supplementary low-t, near-beam detection

Acceptance after dispersion suppressor quads

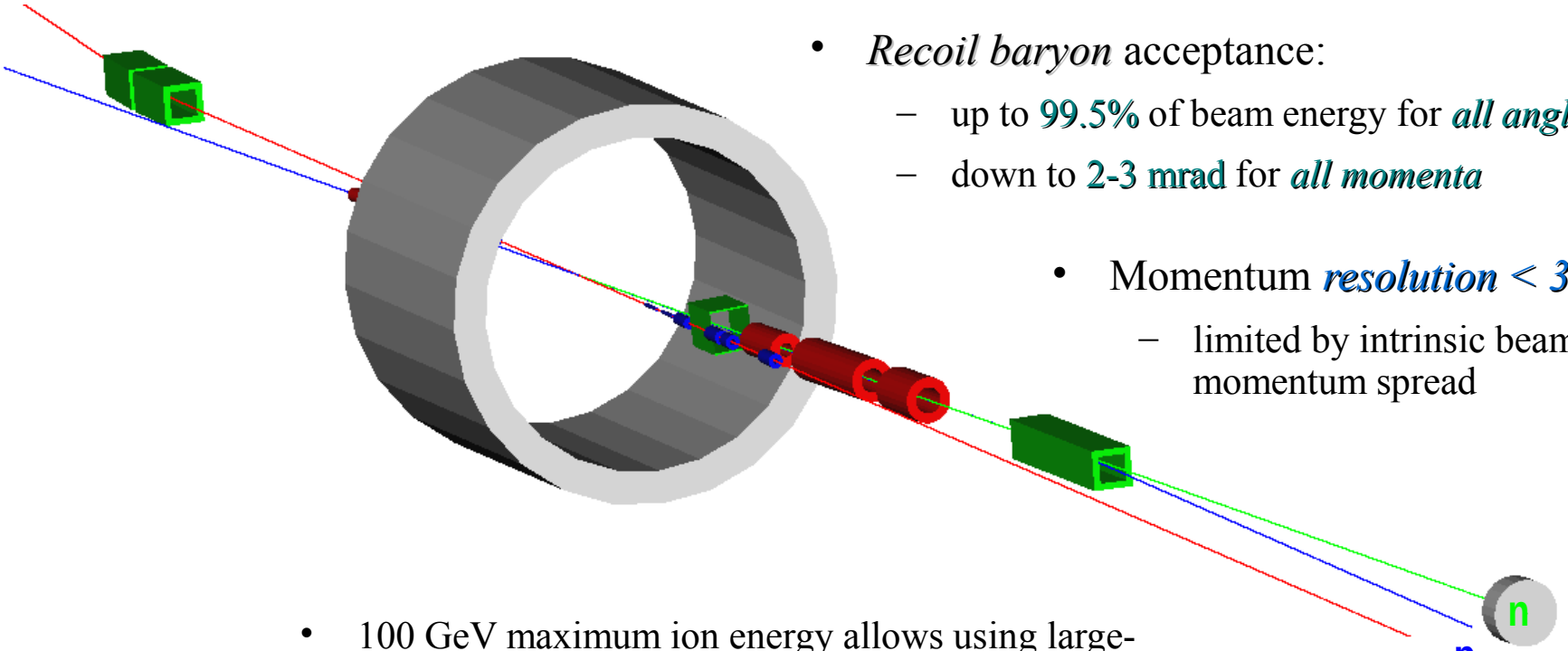
Assuming 5 cm radius of quad apertures



- Recoil baryons with rigidities close to those of the beam can be tracked all the way through the downstream dispersion suppressor quads.
  - Larger separation from beam (simpler detectors)
  - More redundancy determination of scattering angle

Ultra-forward hadron detection – summary

- *Neutron* detection in a 25 mrad cone ***down to zero degrees***
  - Excellent acceptance for ***all ion fragments***
- *Recoil baryon* acceptance:
  - up to **99.5%** of beam energy for ***all angles***
  - down to **2-3 mrad** for ***all momenta***
- Momentum ***resolution < $3x10^{-4}$***
  - limited by intrinsic beam momentum spread



- 100 GeV maximum ion energy allows using large-aperture magnets with ***achievable field strengths***