H6 Modification – Smaller Beam Spot

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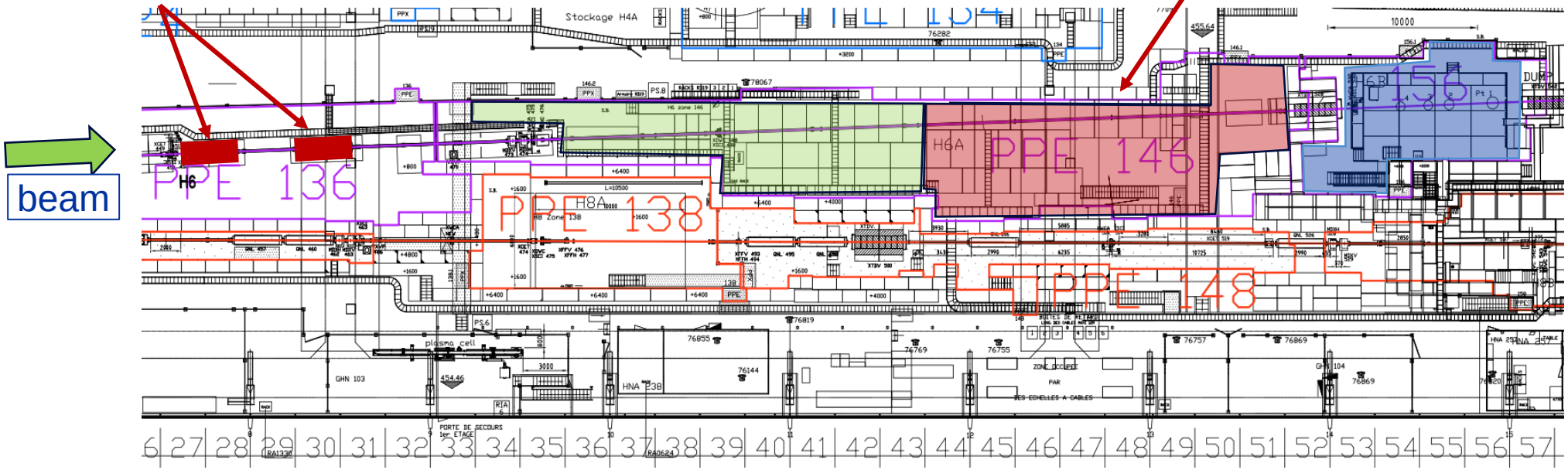
A Brief Recap

- **R&D silicon groups testing small silicon sensors which require smaller beam size for sufficient rate (already at RP safety limit)**
- **Investigate possible configurations of quadrupoles to minimize beam spot**
- **Accurately predict beam size taking into account filtering of secondary beam and multiple scattering in air**

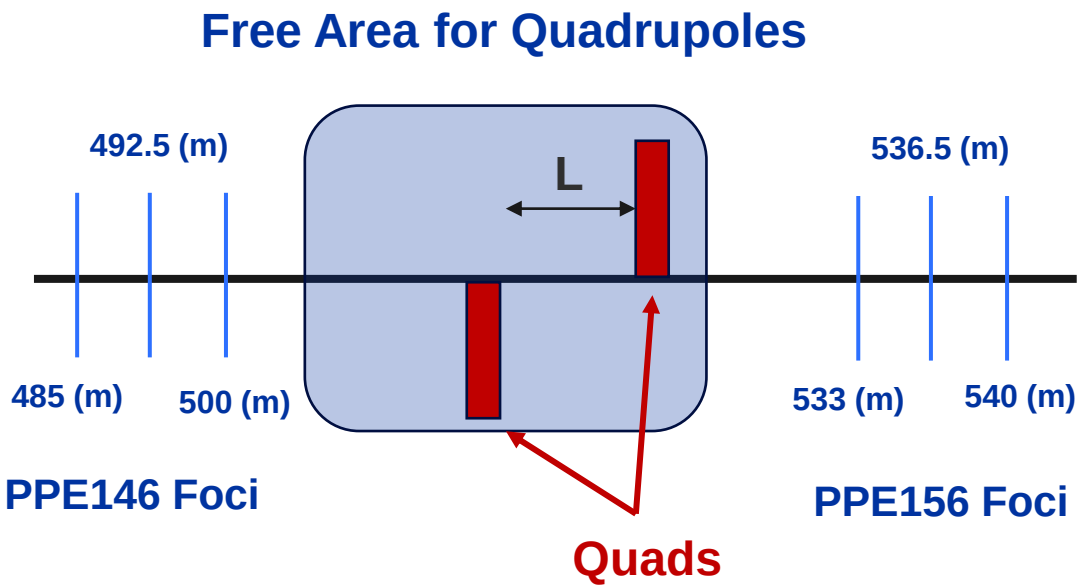
Free Area for Quadrupoles

Last doublet of quadrupoles



Work Thus Far

- **Final focus study**
- **Determine acceptance**
- **Application of Twiss parameters and R-Matrices to model beam optics**
- **Utilize MAD-X to evaluate different configurations of quadrupoles varying:**
  - Position
  - Separation
  - Quadrupole number
- **Compared focus size at different positions in user zones PPE146 and PPE156**

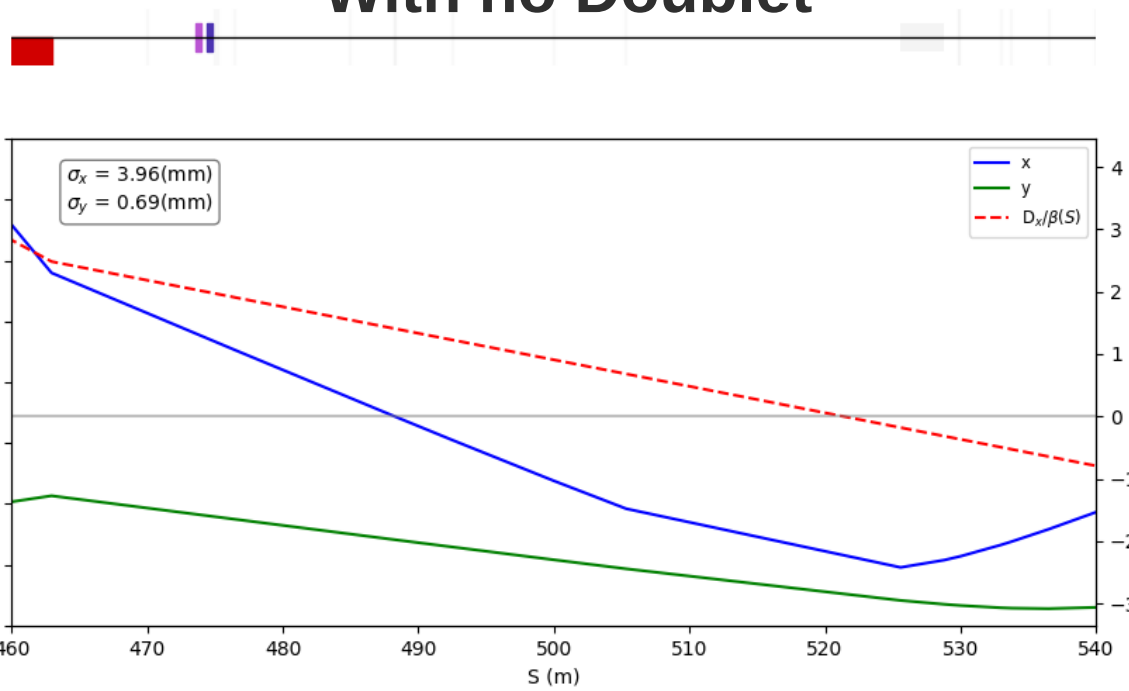


Optimal Setup

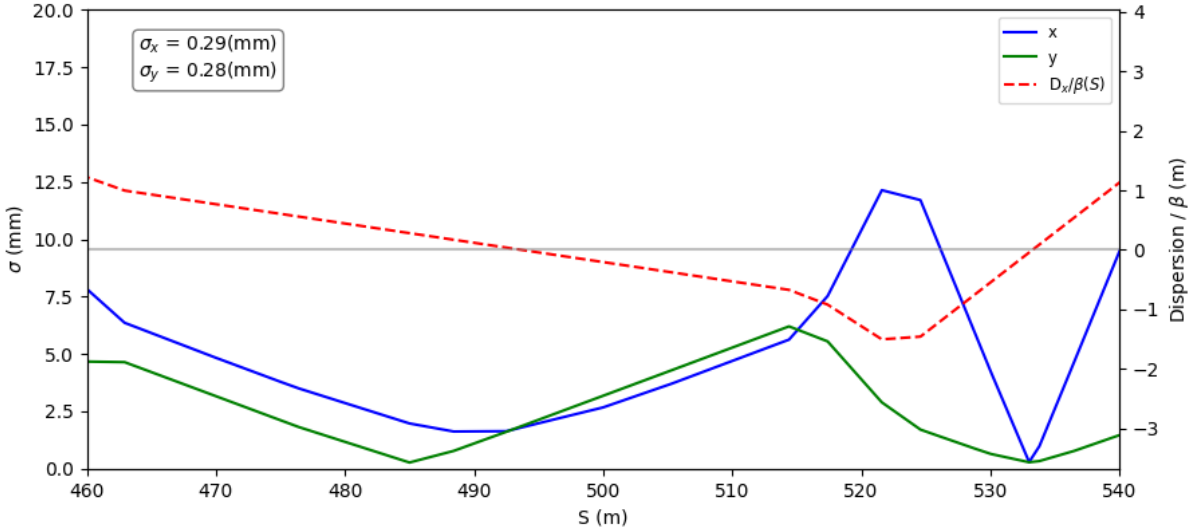
- **Doublet Solution** – makes sense as previous focus comes from a Doublet
- **Quads as far downstream as possible** – larger beam focuses to smaller spot size
- **Separation of 4.2 (m)** – determined from varying separation distances in MAD-X

σ_x : 13.65 times smaller
σ_y : 2.56 times smaller

With no Doublet

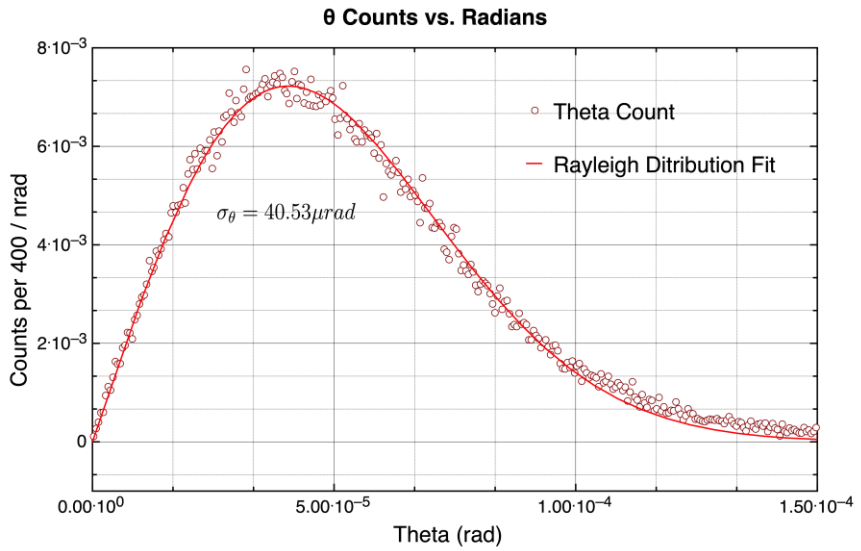


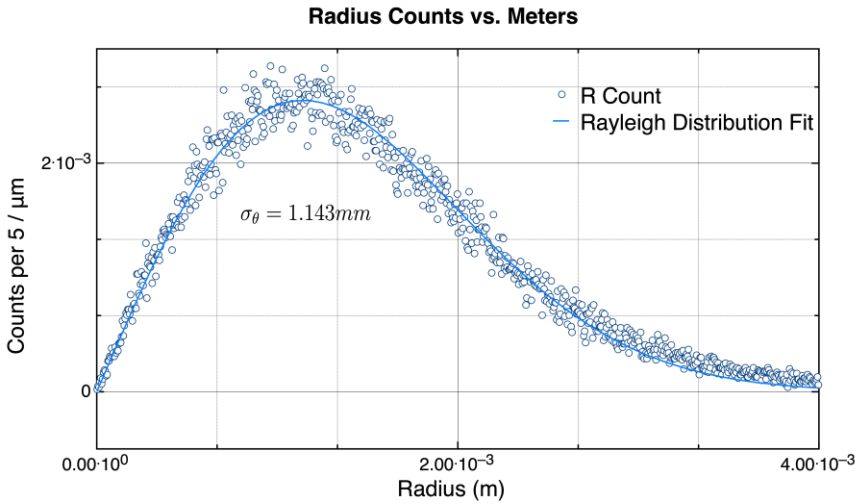
With Doublet

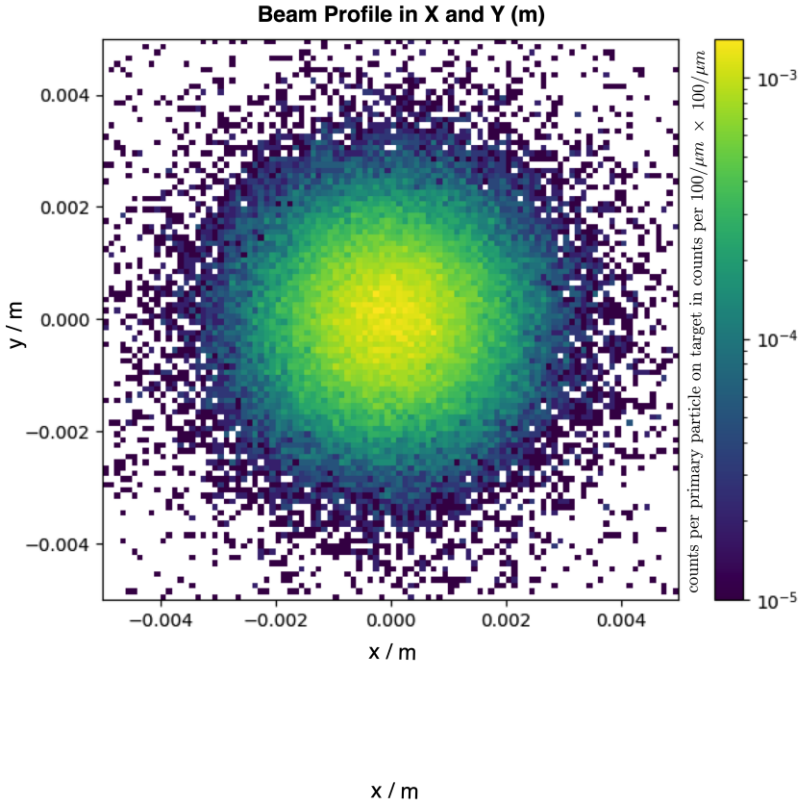


Multiple Scattering

- End of beamline has ~40 m of air
- Monte Carlo simulation of multiple scattering in air from reference beam







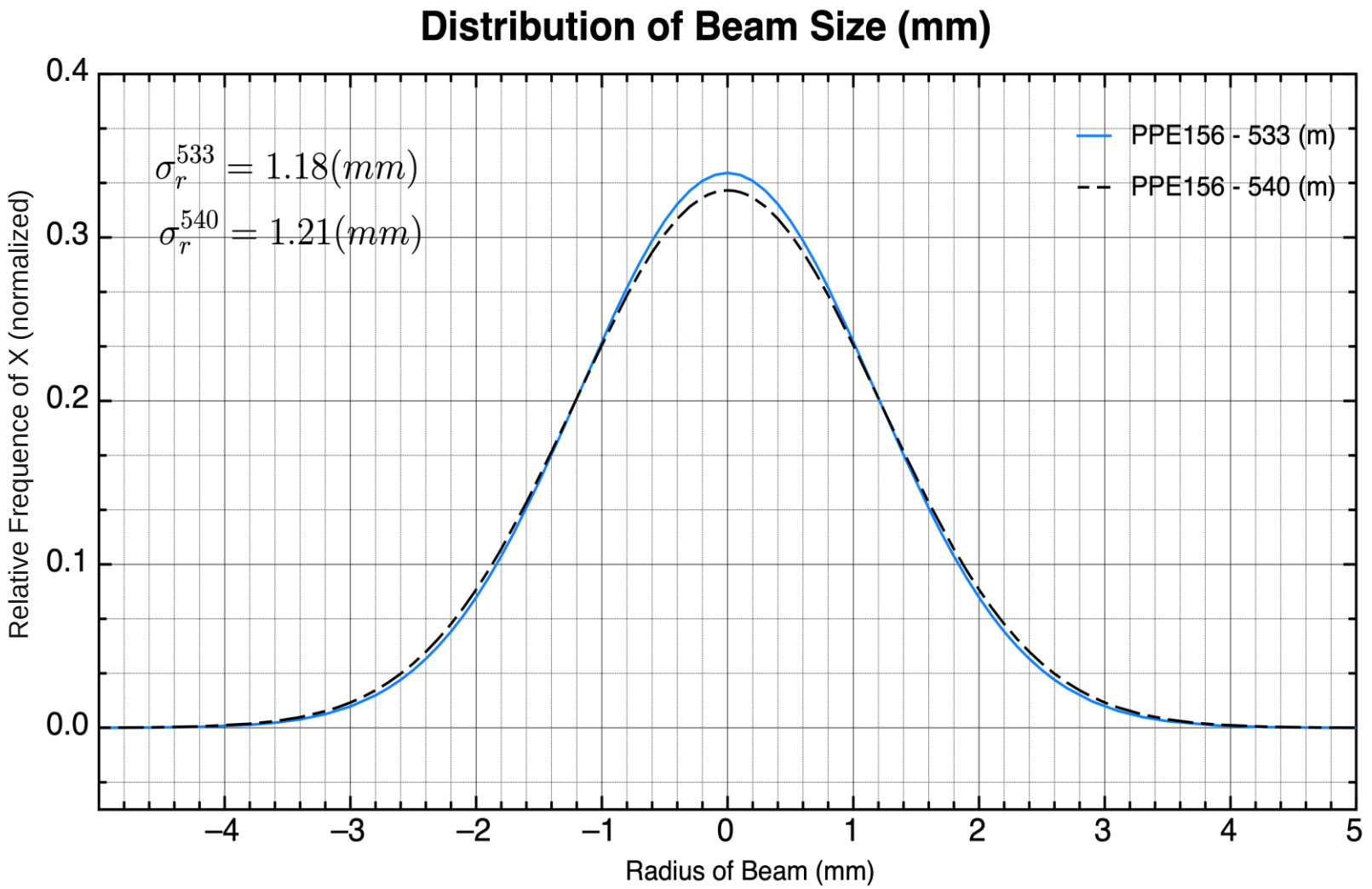
Multiple Scattering

- **Convolution with sigma**

$$\sigma_r^{533} = 0.285\ (mm)$$
$$\sigma_r^{540} = 0.407\ (mm)$$

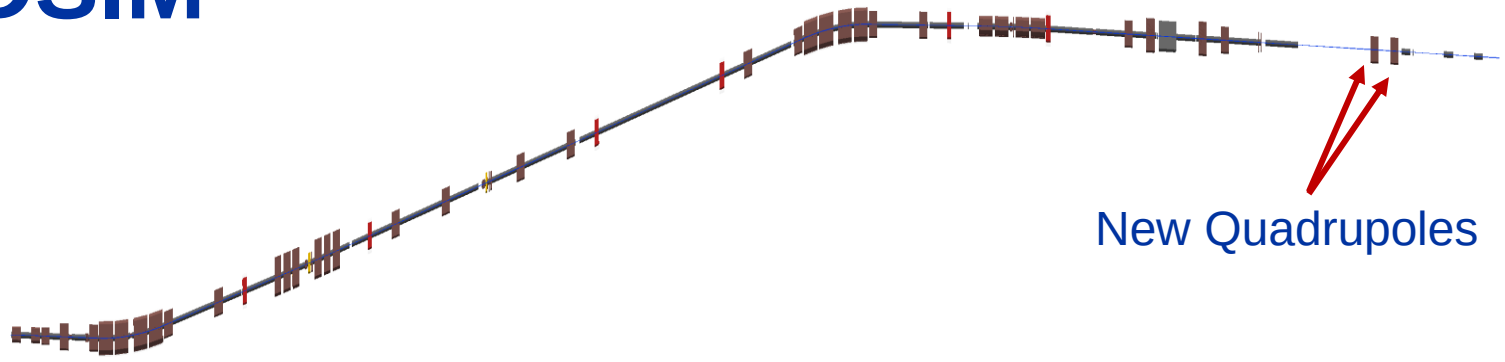
- **Monte Carlo simulation of multiple scattering in air from reference beam**

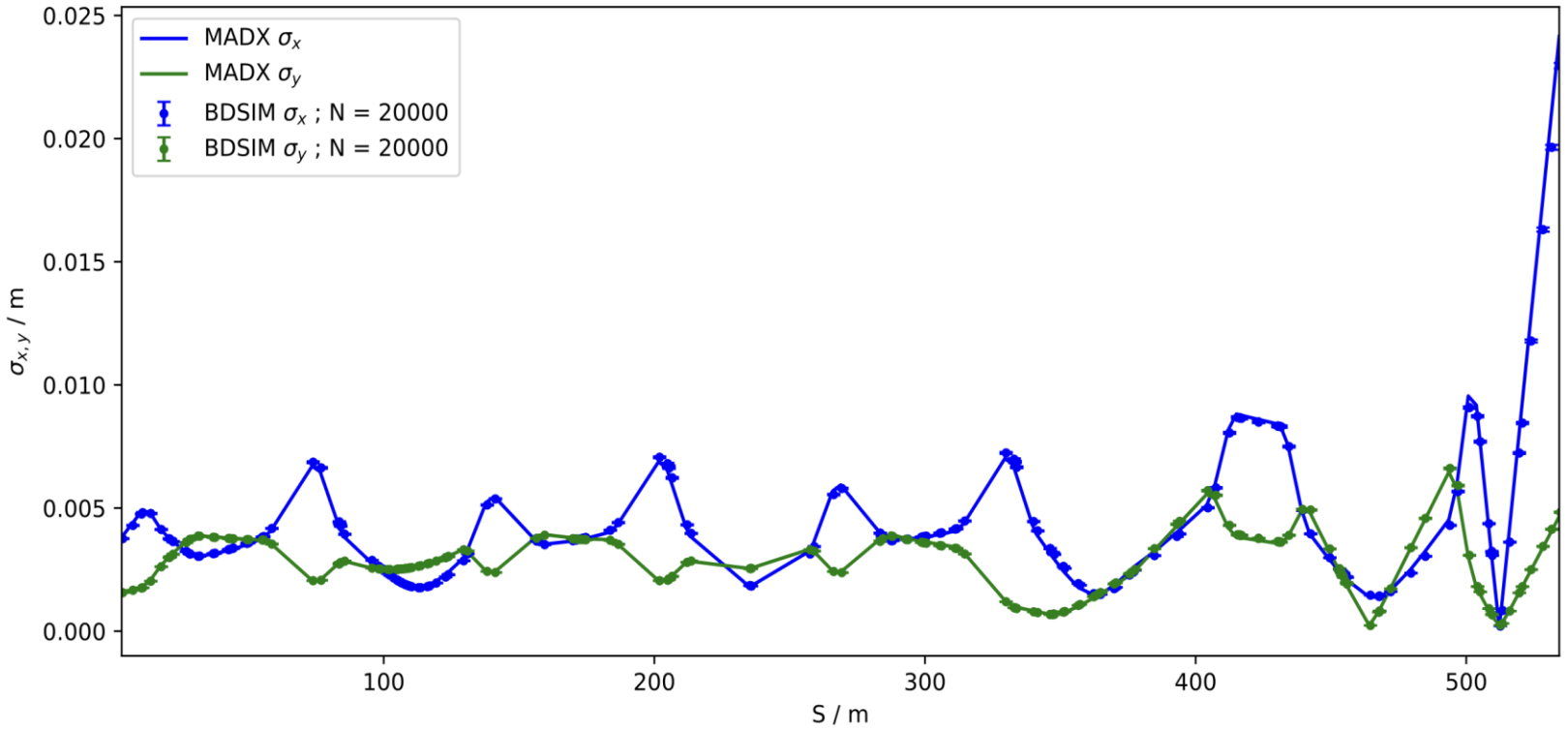
$$\sigma_r^{533} = 1.18\ (mm)$$
$$\sigma_r^{540} = 1.21\ (mm)$$



Beamline Model BDSIM

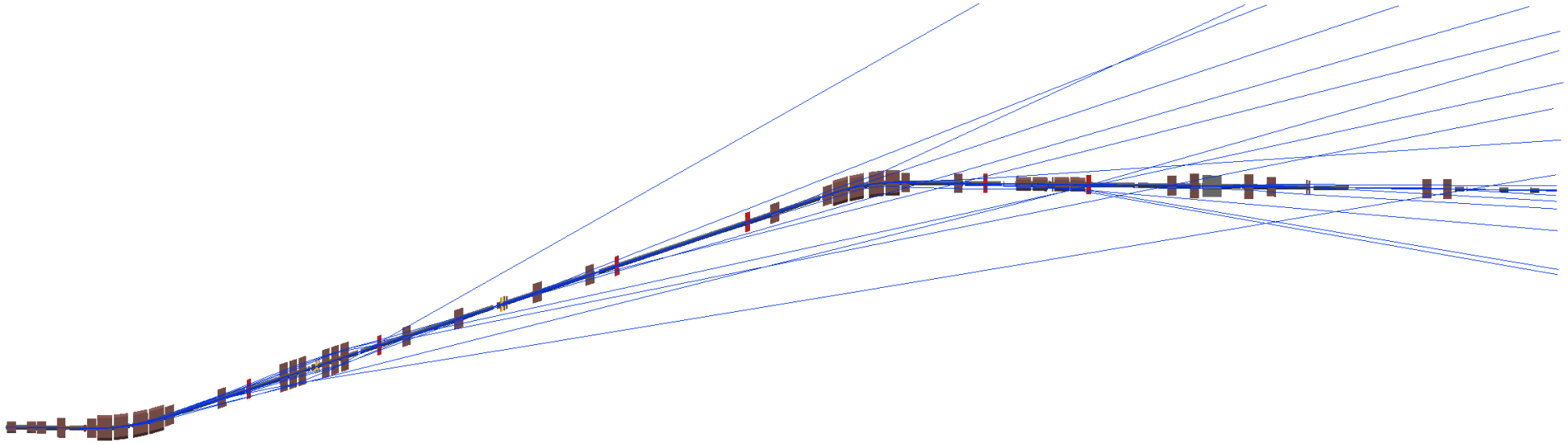
- Added vacuum begin and end statements that were missing in the previous model
- Added new quadrupoles
- Verified the optics





Next Steps

- **Simulate whole beamline start to finish in BDSIM (with physics on)**
  - Determine multi-species distribution of beam
- **Compare to measurements during first week of August**



(Preliminary Results)