



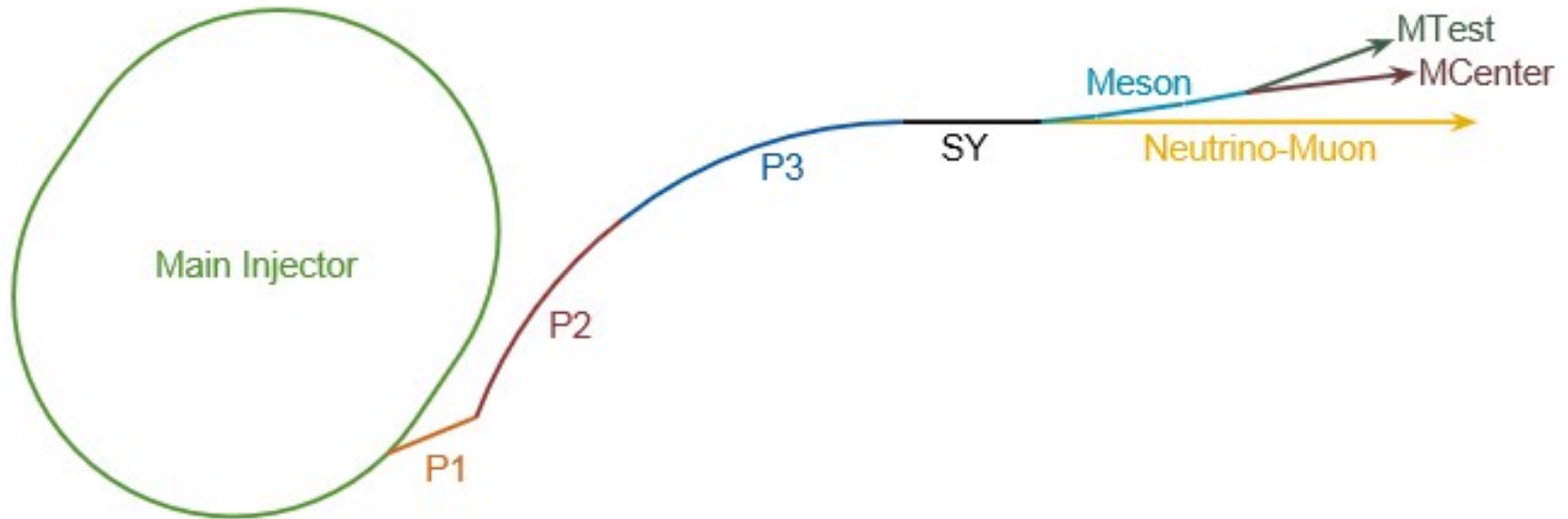
MCenter test beam

Adam Watts

AD, External Beamlines

06/26/2020

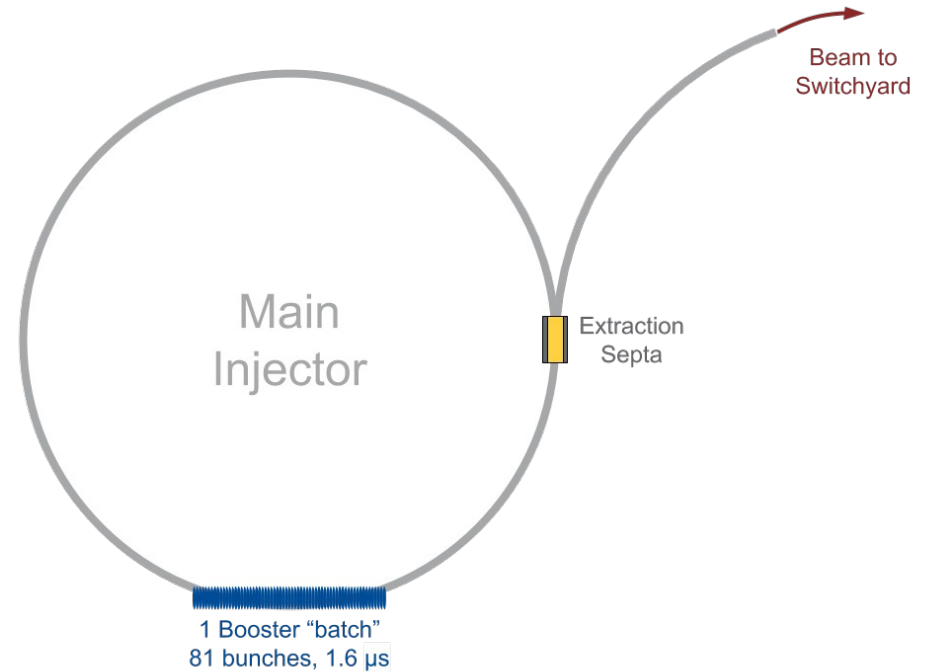
Switchyard 120 GeV beam



- 120 GeV/c momentum protons are extracted from the Main Injector once per minute in a 4.2s-long “spill”
- Approx. 2.5 km of so-called “Switchyard” beamline to transfer to the external experiments
- Beam is split up to two times for form up to three beams with varying relative intensities determined by the splitting ratio

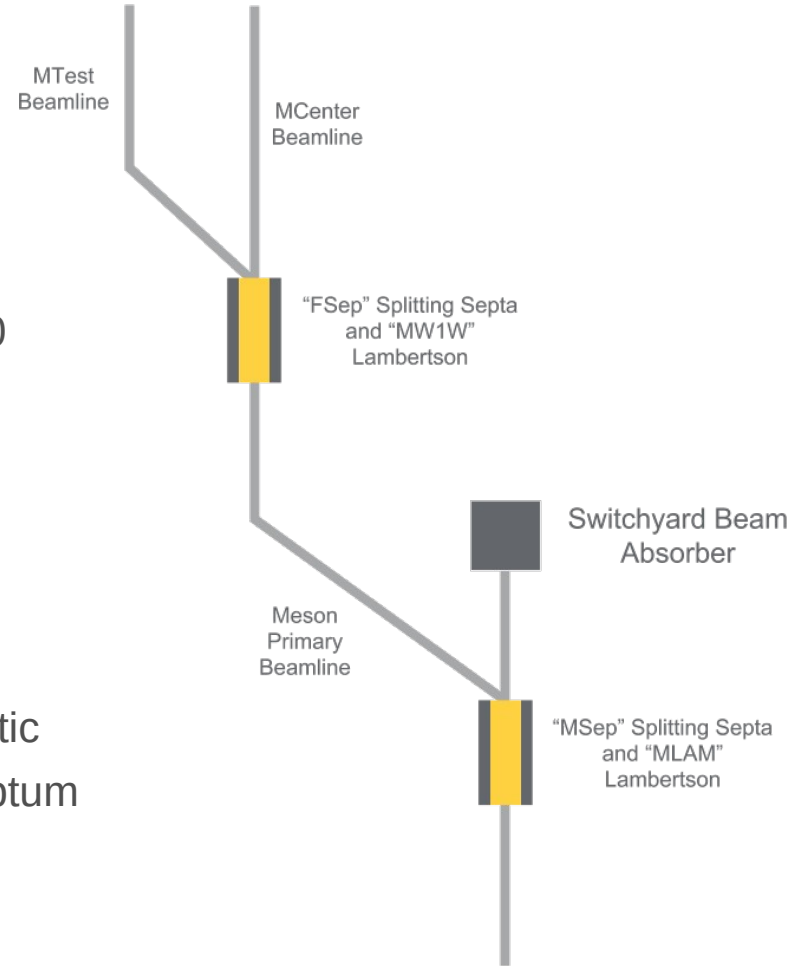
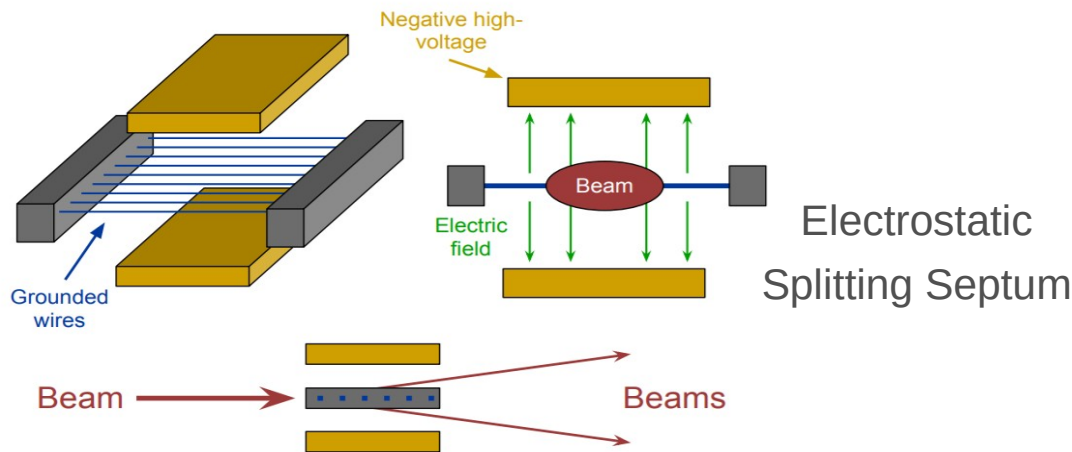
Beam structure

- Minimum-intensity beam from MI means only partially-loading the ring
- Beam arrives at experiment in 1.6 μs bursts of 53 MHz bunches, spaced 11.2 μs apart.
- Experimental intensity needs must be balanced, and this structure can change.
- This represents the *ideal* structure; in reality, the 53 MHz bunches are not evenly-filled due to the realities of extraction process

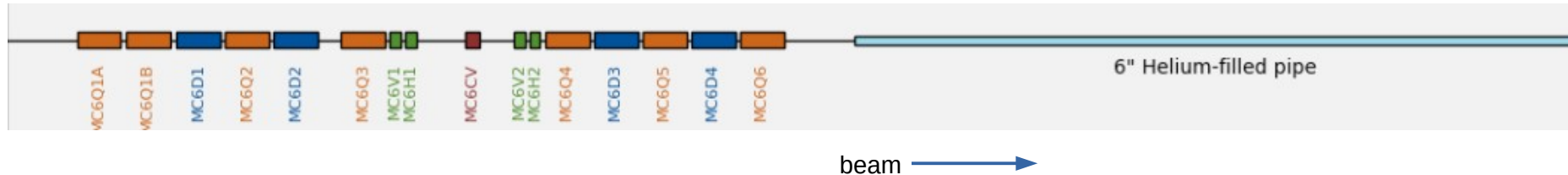


Beam splitting in Switchyard

- Relative beam intensities between experiments are controlled by varying the split ratios.
- Split ratio depends on septum position with respect to beam position
- Beam position movement during the spill is inevitable, and leads to non-uniformity in delivered intensity
- Meson Center can receive a maximum of $1.5E10$ protons per spill as per shielding rules

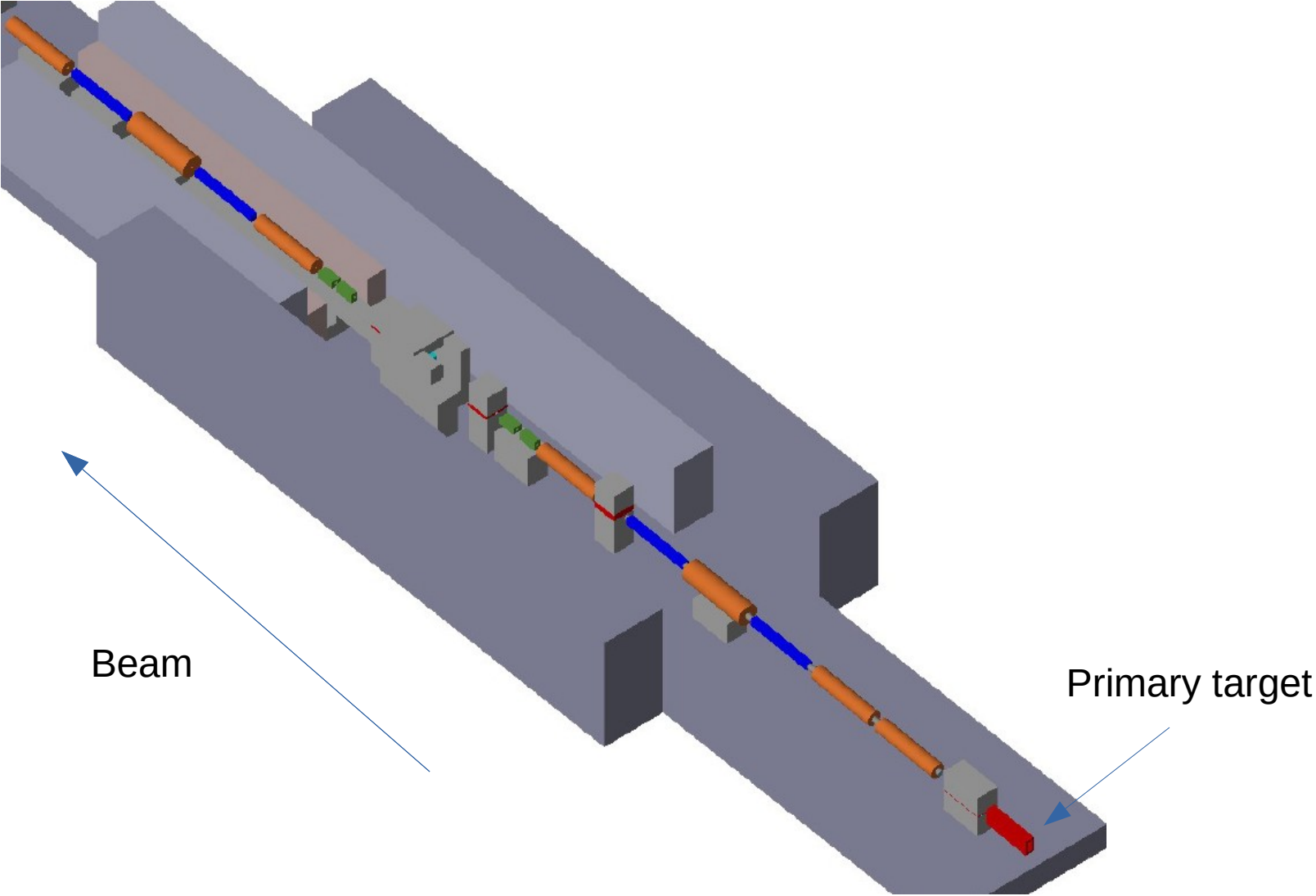


MCenter secondary beamline

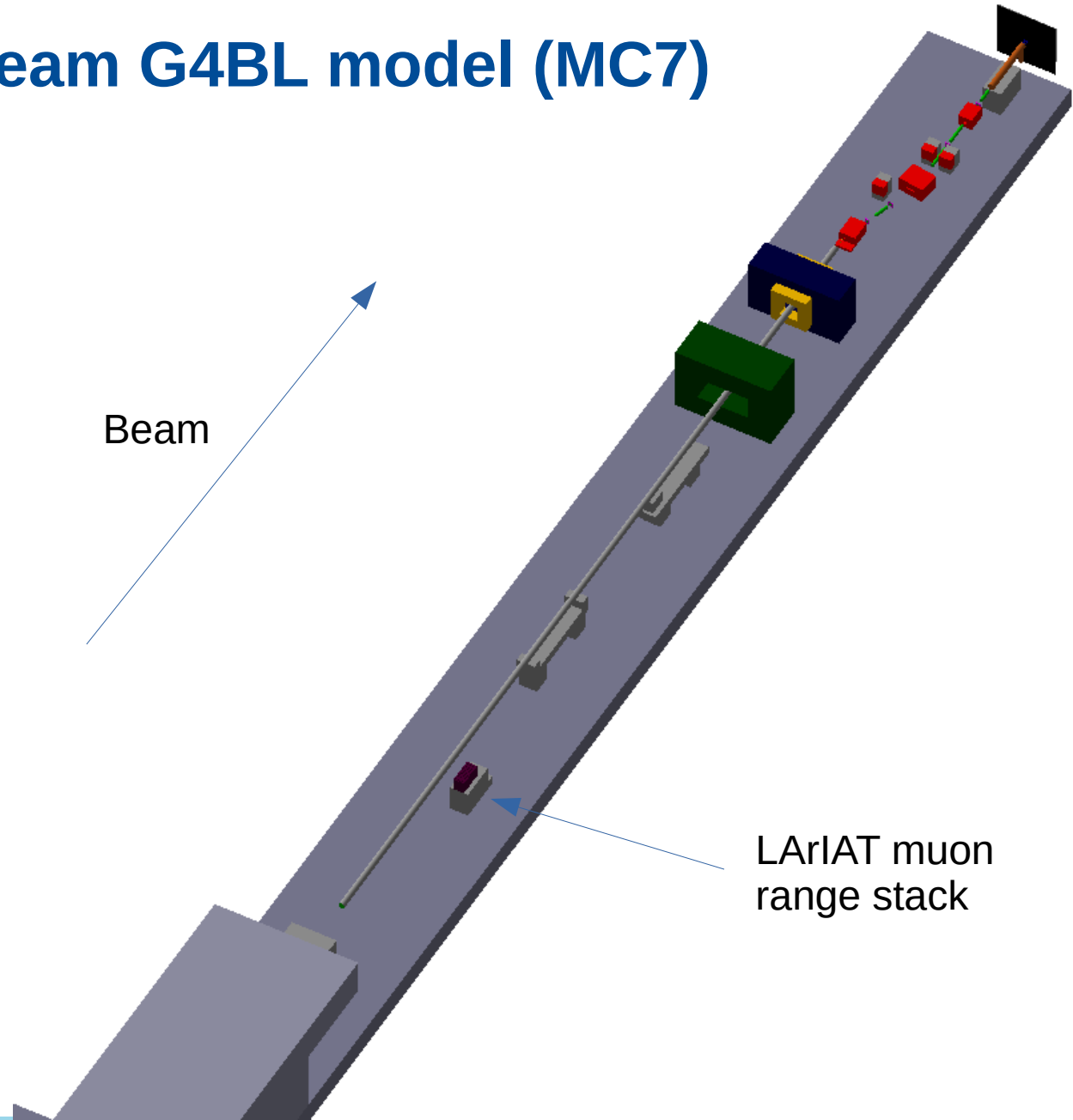


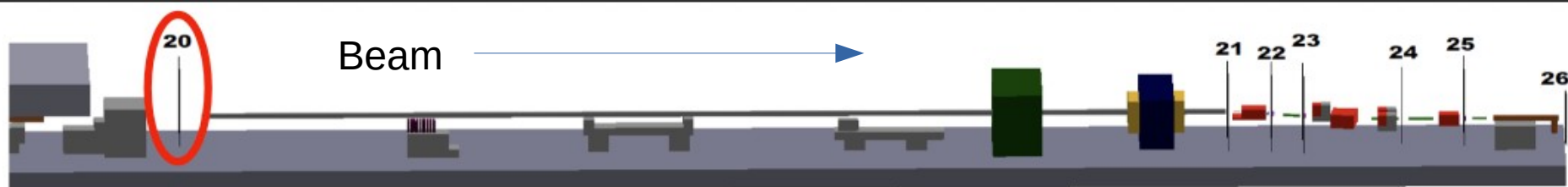
- Capable of secondary mixed-species beam of momentum 10 GeV/c – 80 GeV/c. Lower momentum range not often explored, and power supply regulation ability is in question.
- Remotely-adjustable vertical aperture collimator MC6CV for rough momentum bite selection.
- Beamline momentum tune determined analytically and verified with simulation for upper momentum modes. No magnetic field regulation.
- Secondary beam is really a collimated spray from the primary target (see G4BL results).

MCenter test beam G4BL model (MC6)

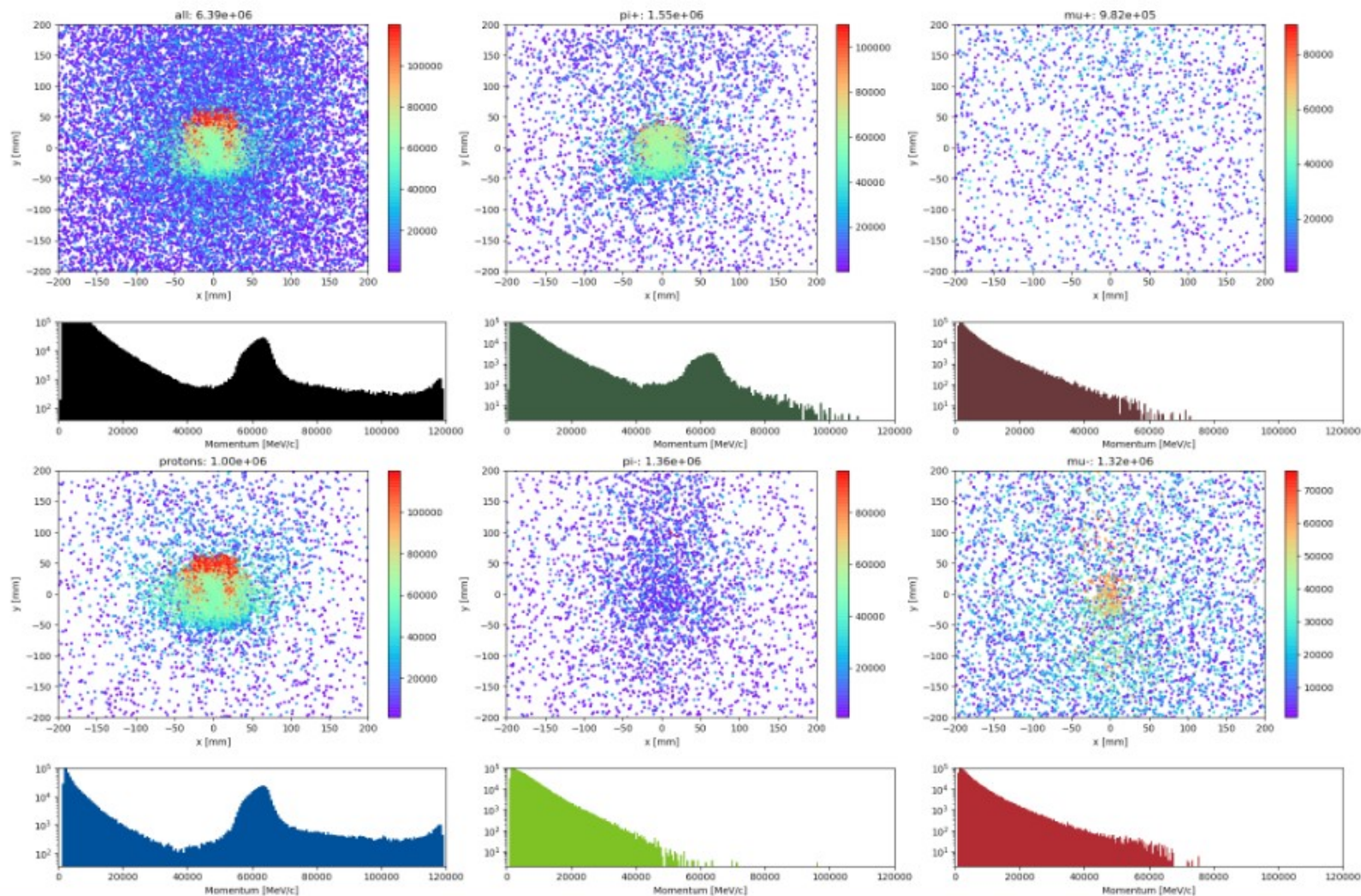


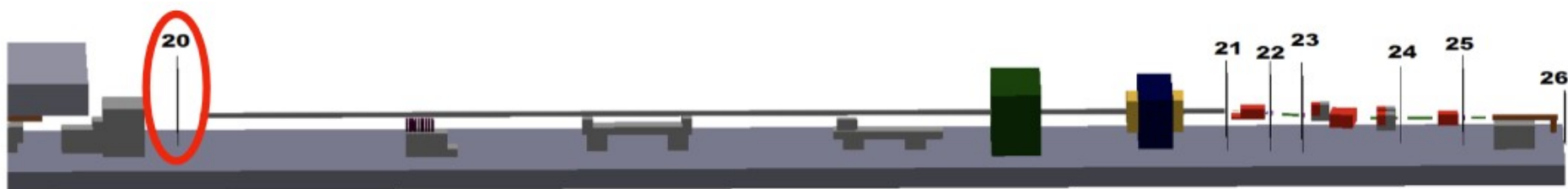
MCenter test beam G4BL model (MC7)



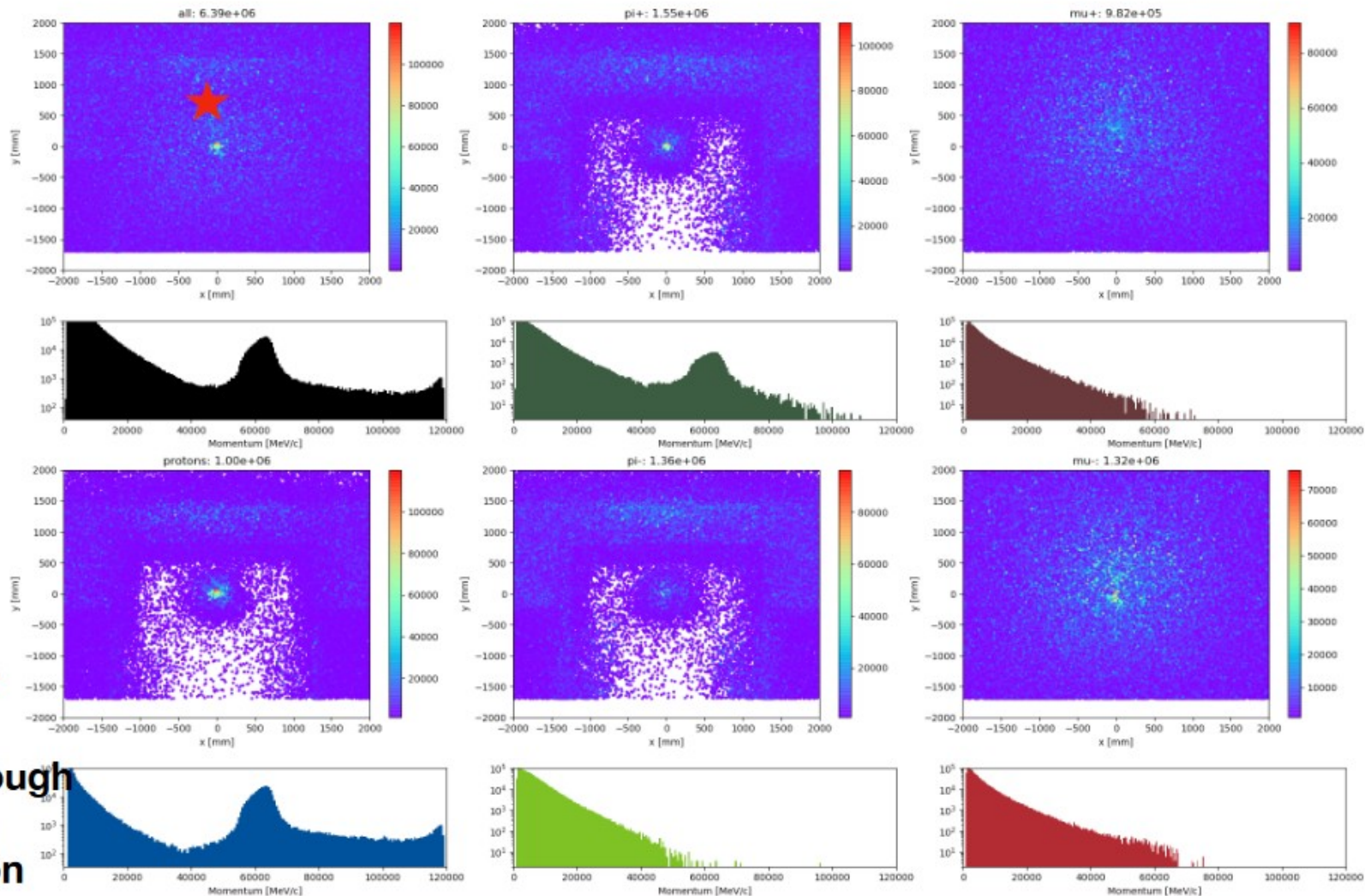


Detector 20





Detector 20



Very rough
plume
location

Conclusion

- The beam structure is non-uniform in time due to the nature of the extraction and splitting process.
- Maximum primary beam intensity on target is $1.5E10$ protons per spill, at one spill per minute. This is the primary rate limitation of the test beam.
- The secondary beam is a very broad-momentum mix of particle species.
- A G4Beamline model is available that can be used to estimate the particle distribution at the experiment as a function of secondary beamline momentum tune and aperture of the momentum-selection collimator MC6CV.
- Adam Watts is the beamline physicist for the Meson beamline on the Accelerator Division side. Looking forward to working with you!

MCenter G4Beamline model:
https://github.com/adamwatts112358/NOvA_TB