# Multivariate Density Estimators

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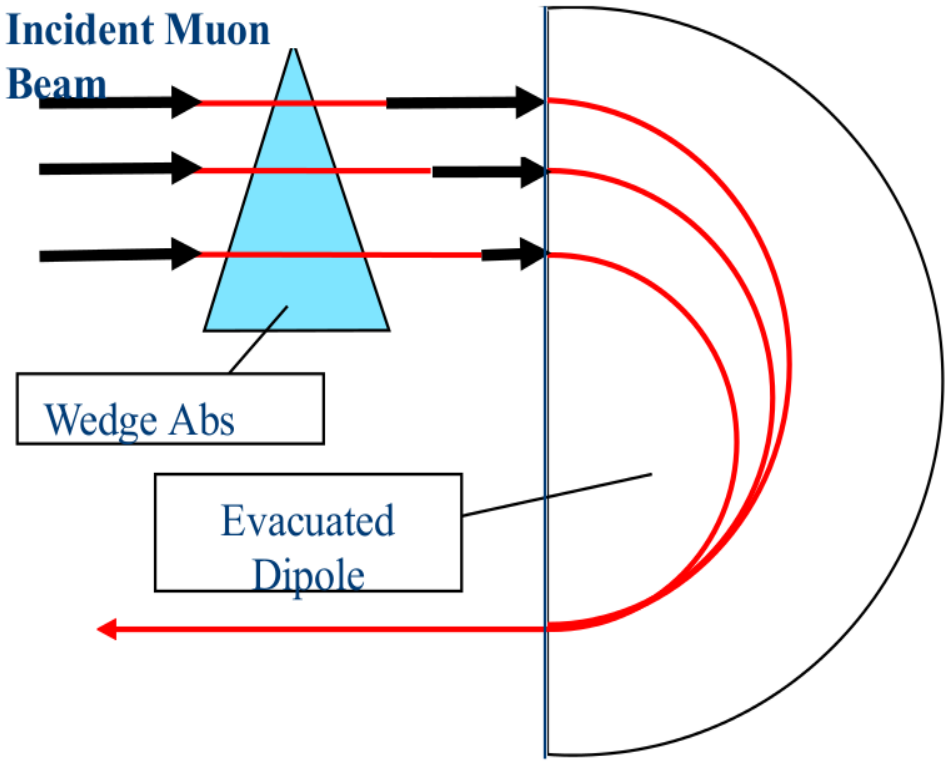
ILLINOIS INSTITUTE OF TECHNOLOGY

MICE

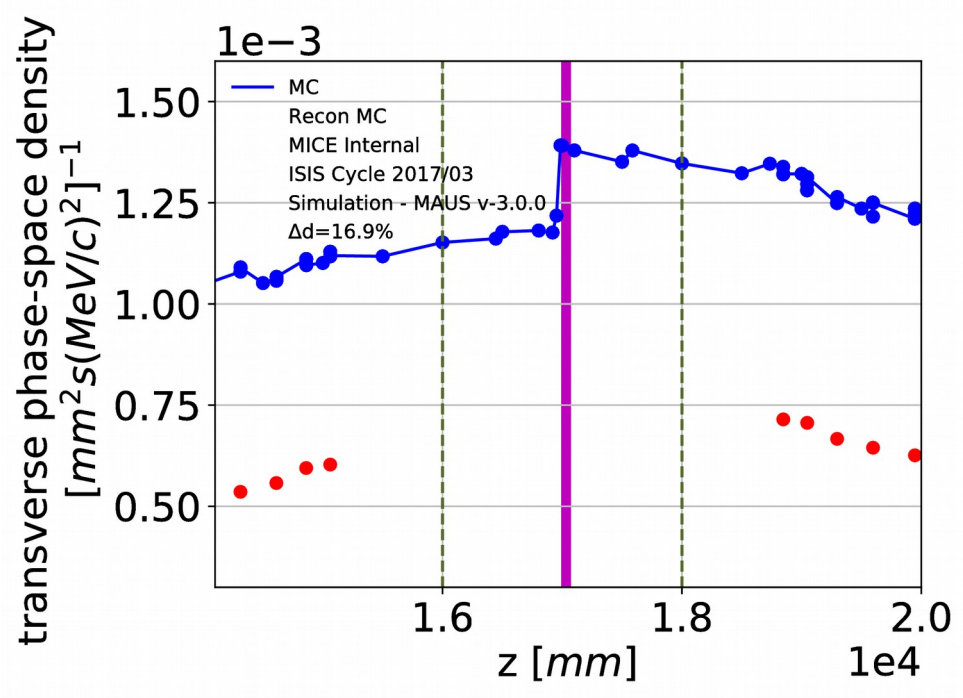
# Simulated 6D Cooling

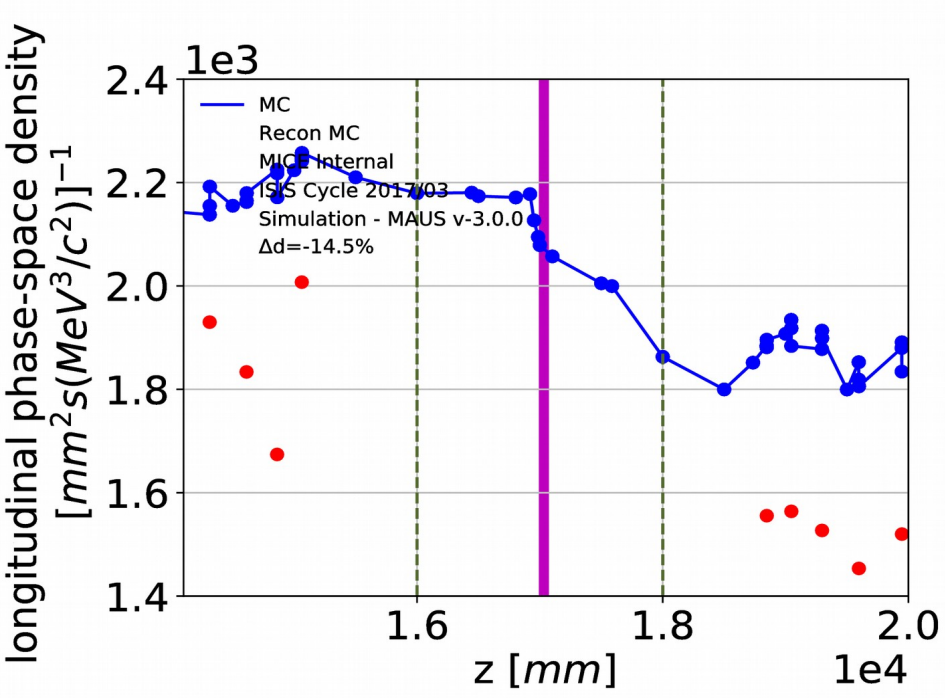
- Place a wedge in the path of a non-dispersive beam
- Result: reverse emittance exchange (longitudinal heating and transverse cooling)



# Recent Wedge MC Production

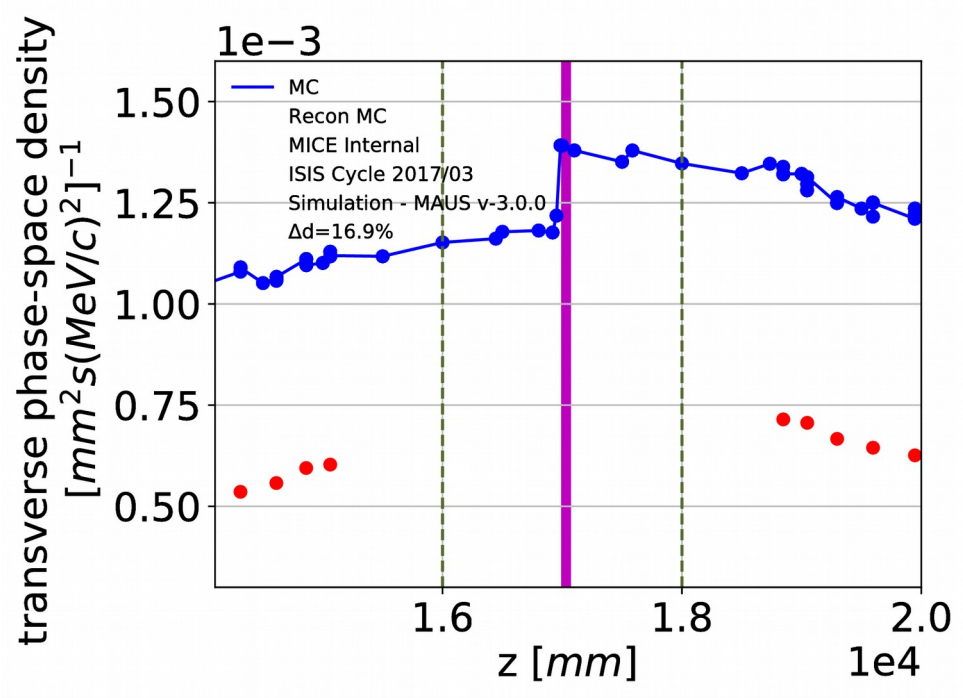
- 6-140 with wedge and same magnet settings as previous wedge results
- No dispersion
- Transverse density shows cooling + longitudinal shows heating as expected (reverse emittance exchange)
- Red: recon MC, blue: MC
- Caveat: time coordinate to be added

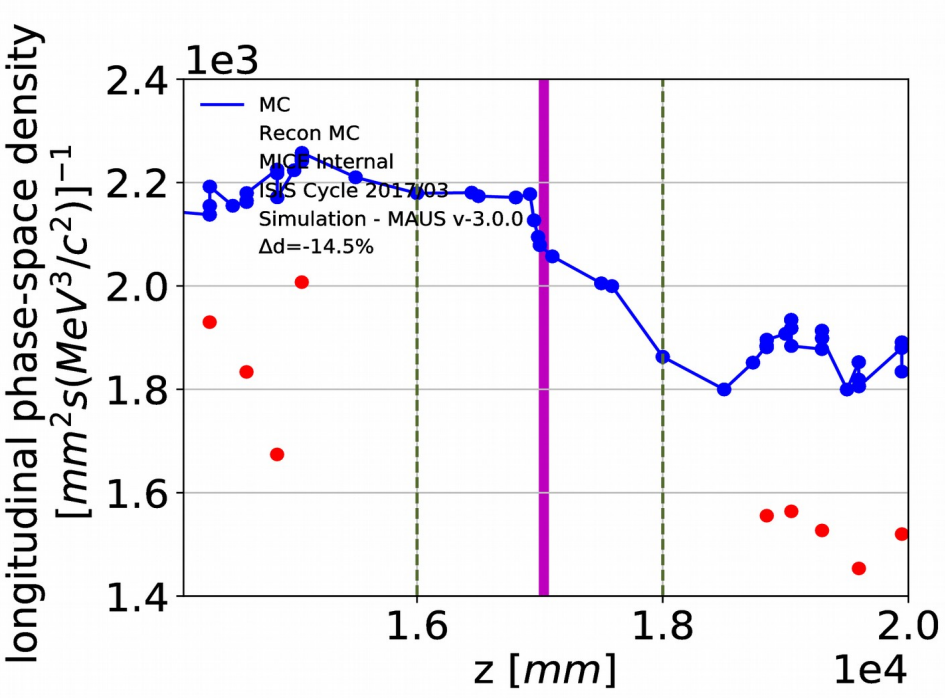


# Recent Wedge MC Production vs Data

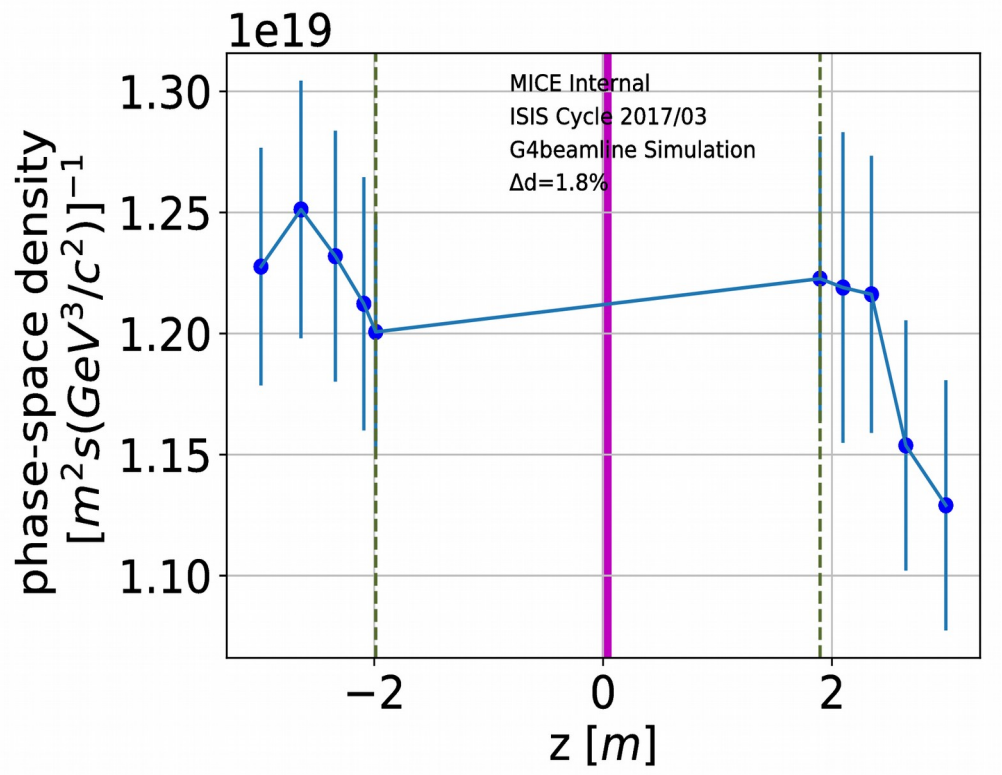
- 6-140 with wedge and same magnet settings as previous wedge results
- No dispersion
- Transverse density shows cooling + longitudinal shows heating as expected (reverse emittance exchange)
- Red: data, blue: MC
- Caveat: time coordinate to be added

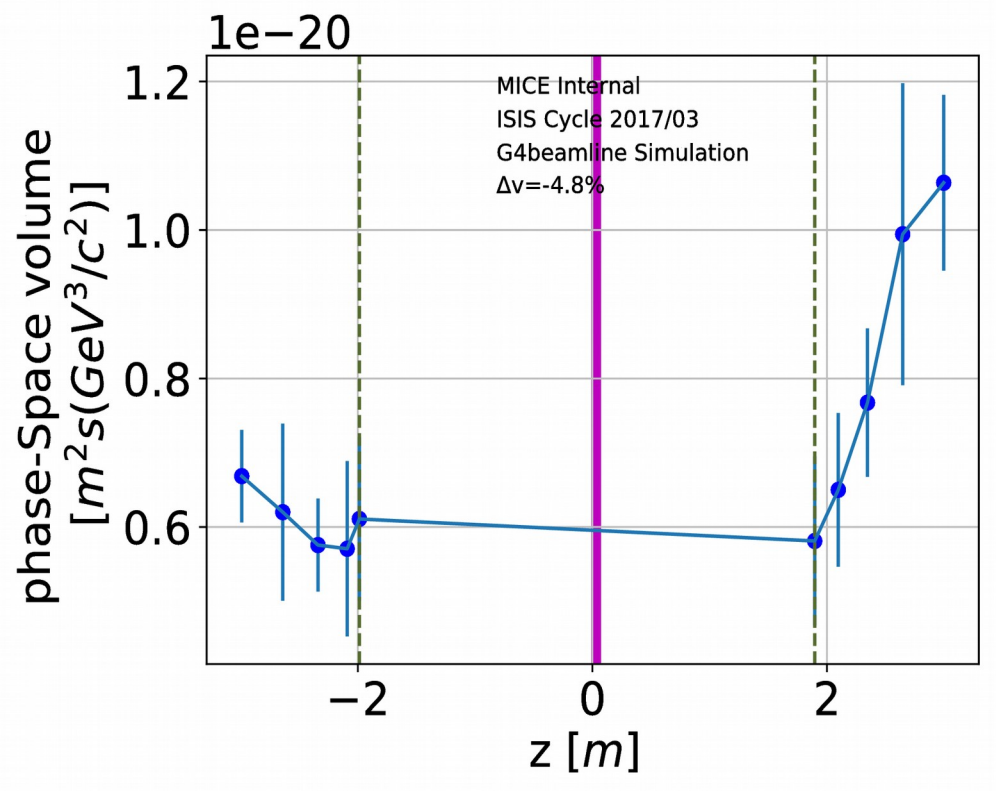


# Reverse Exchange – 6D Phase-space

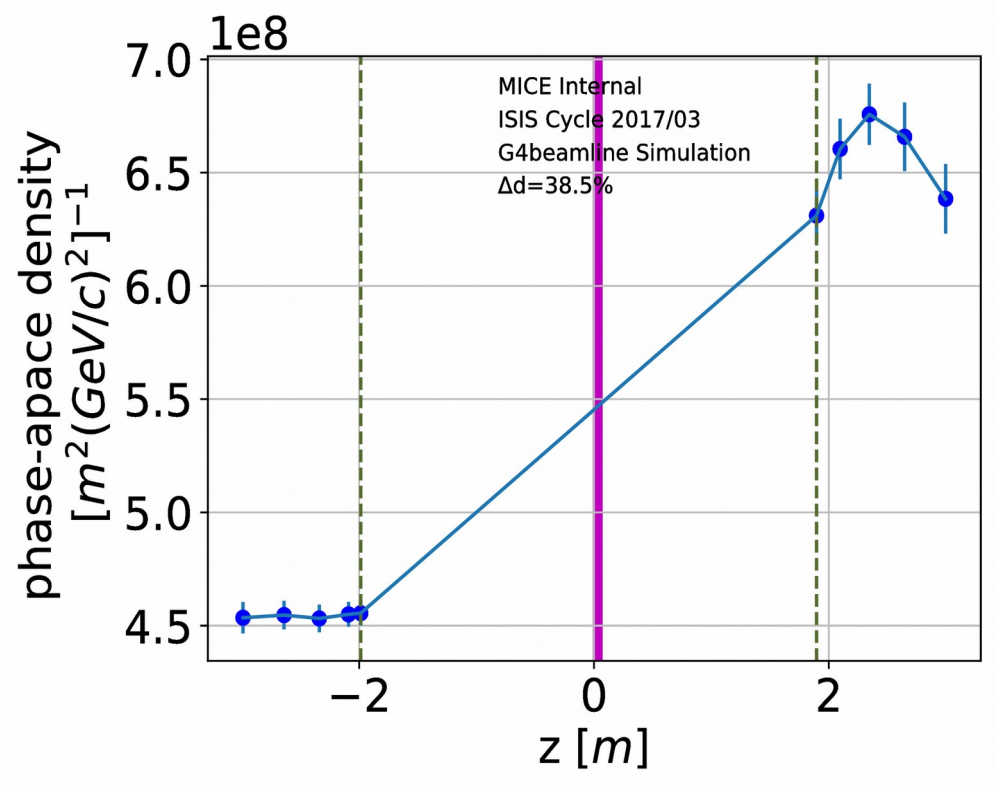
- $\varepsilon_{\perp}$: 6 mm; $p_{ref}$: 140 MeV/c
- 6D coordinates: $\Delta t$, $\Delta E$, x, $p_x$, y, $p_y$
- KDE-based density and volume of the 2nd percentile contour (~1σ of 6D distribution)
- Density ↓, Volume ↑: 6D heating; expected for a beam with a small dispersion

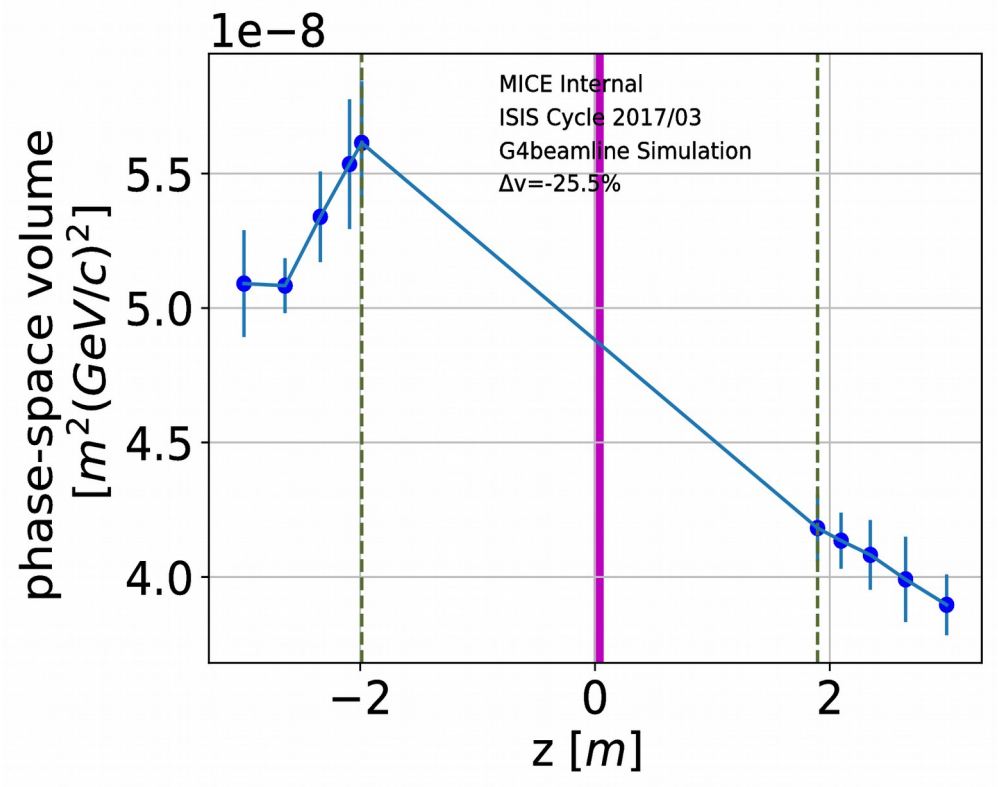


# Reverse Exchange – Transverse Phase-space

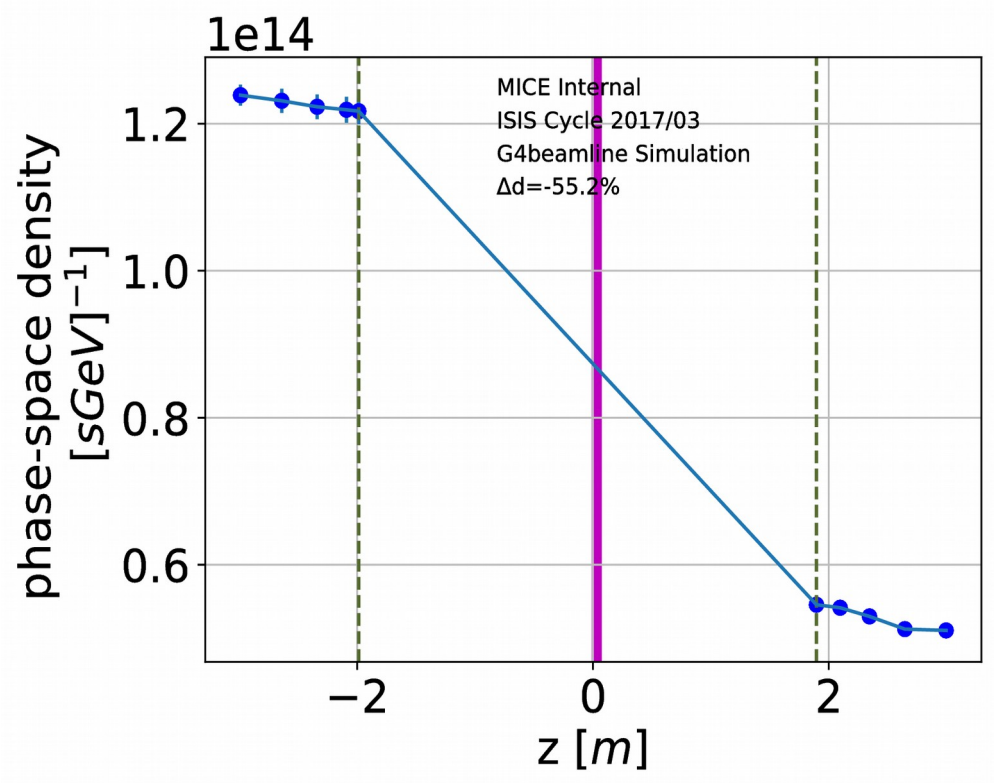
- $\varepsilon_{\perp}$: 6 mm; $p_{ref}$: 140 MeV/c, transmission:
- 4D coordinates: x, $p_x$, y, $p_y$
- KDE-based density and volume of the 9$^{th}$ percentile contour (~1σ of 4D distribution)
- Density ↑, Volume ↓: transverse cooling

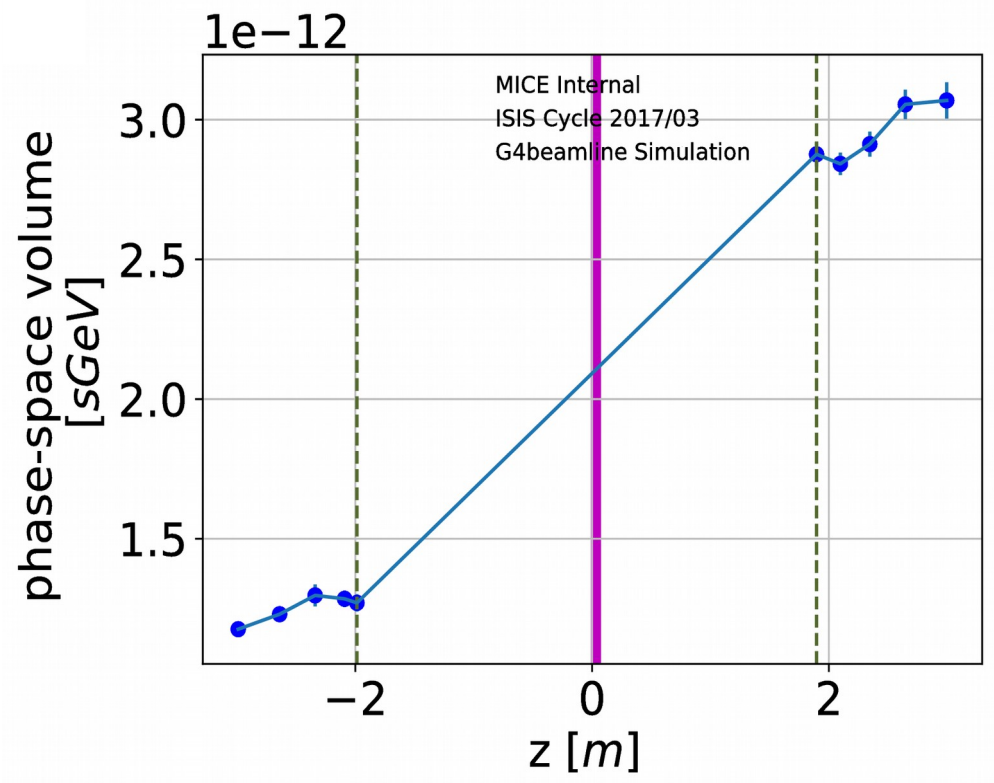


# Reverse Exchange – Longitudinal Phase-space

- $\varepsilon_{\perp}$: 6 mm; $p_{ref}$: 140 MeV/c, transmission:
- 2D coordinates: $\Delta t$, $\Delta E$
- KDE-based density and volume of the 24$^{th}$ percentile contour (~1$\sigma$ of 2D distribution)
- Density ↓, Volume ↑: **reverse emittance exchange**



# Conclusion, Next Steps

- Status of wedge simulation:
  - MAUS wedge simulation underway
  - G4beamline simulations presented at IPAC
  - Error bars to be updated
- Re-weighter routine for emittance exchange underway