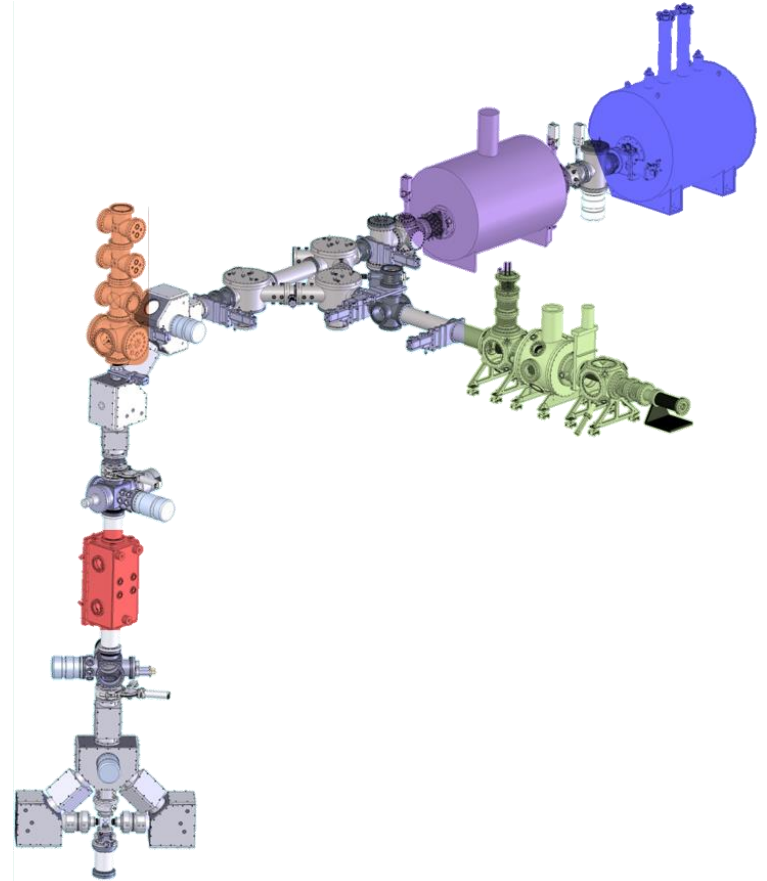


Ion Transport Simulations for the TITAN Experiment

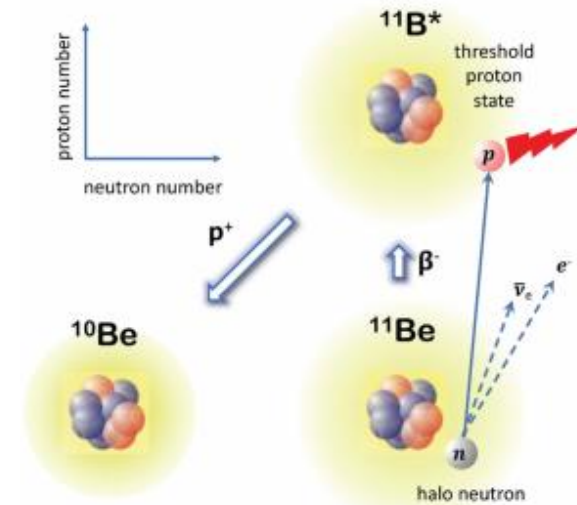


Abhilash Javaji

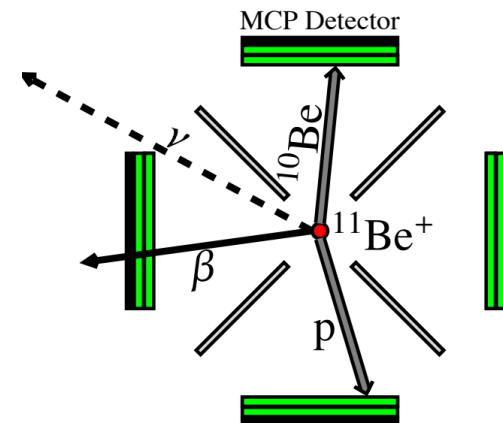
Graduate Student at TRIUMF/UBC

Motivation:

- Study fundamental mechanisms of beta decay
- Decay spectroscopy with unobstructed confinement
- Textbook-like conditions of an ion trap
- Track and study the recoil of all emitted decay products



[GANIL-SPIRAL2](#)

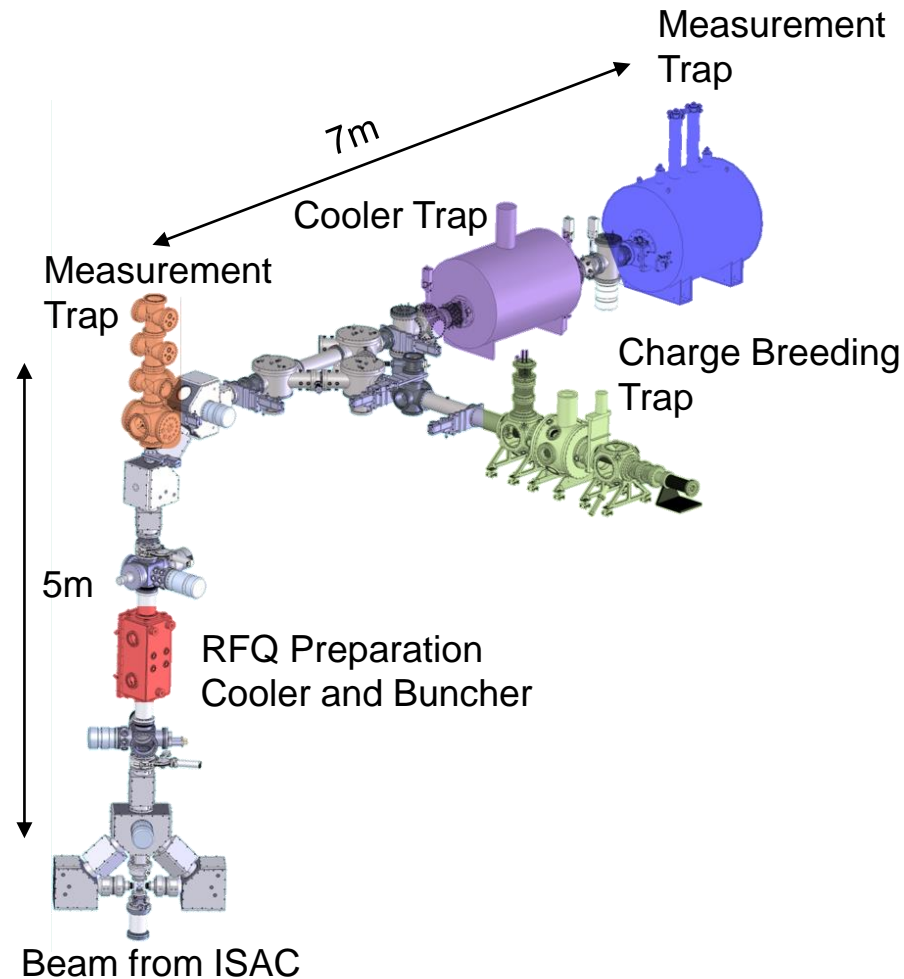


TRIUMF S1918LOI

TITAN:

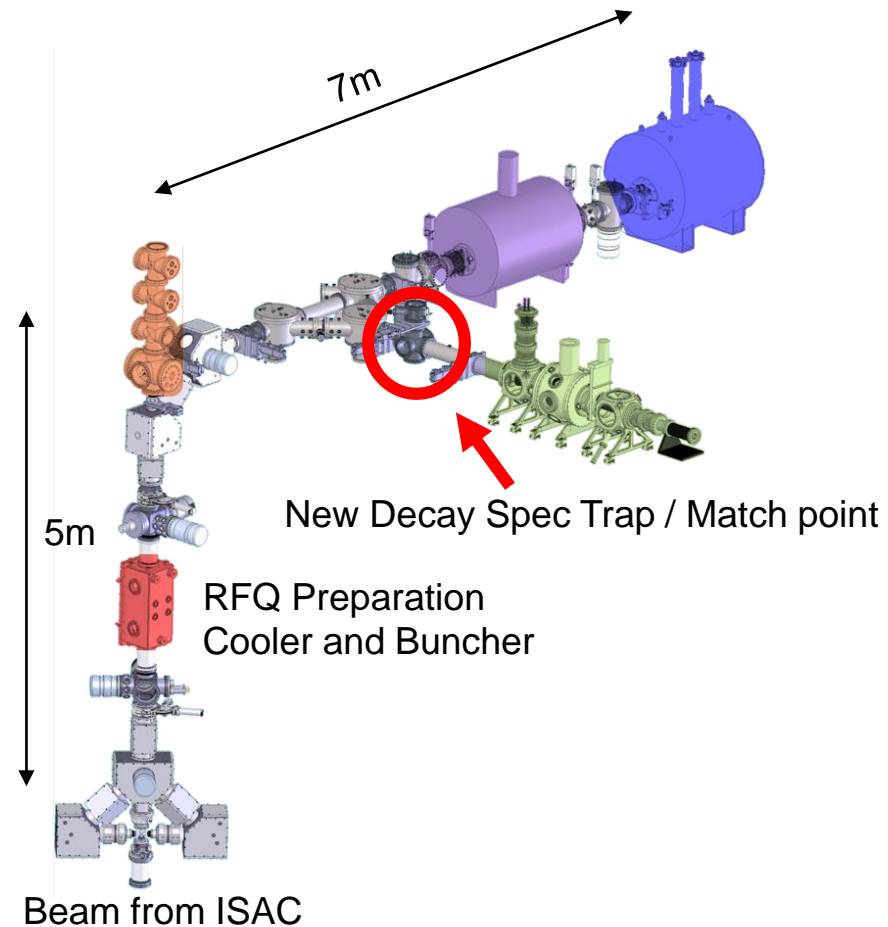
TRIUMF's Ion Trap for Atomic and Nuclear Science

- Experiment receives (radioactive) ion beams from ISAC at TRIUMF
- Transport with mostly electrostatics
- TITAN traps ions primarily for mass measurements.
- Multiple traps for preparation and measurement

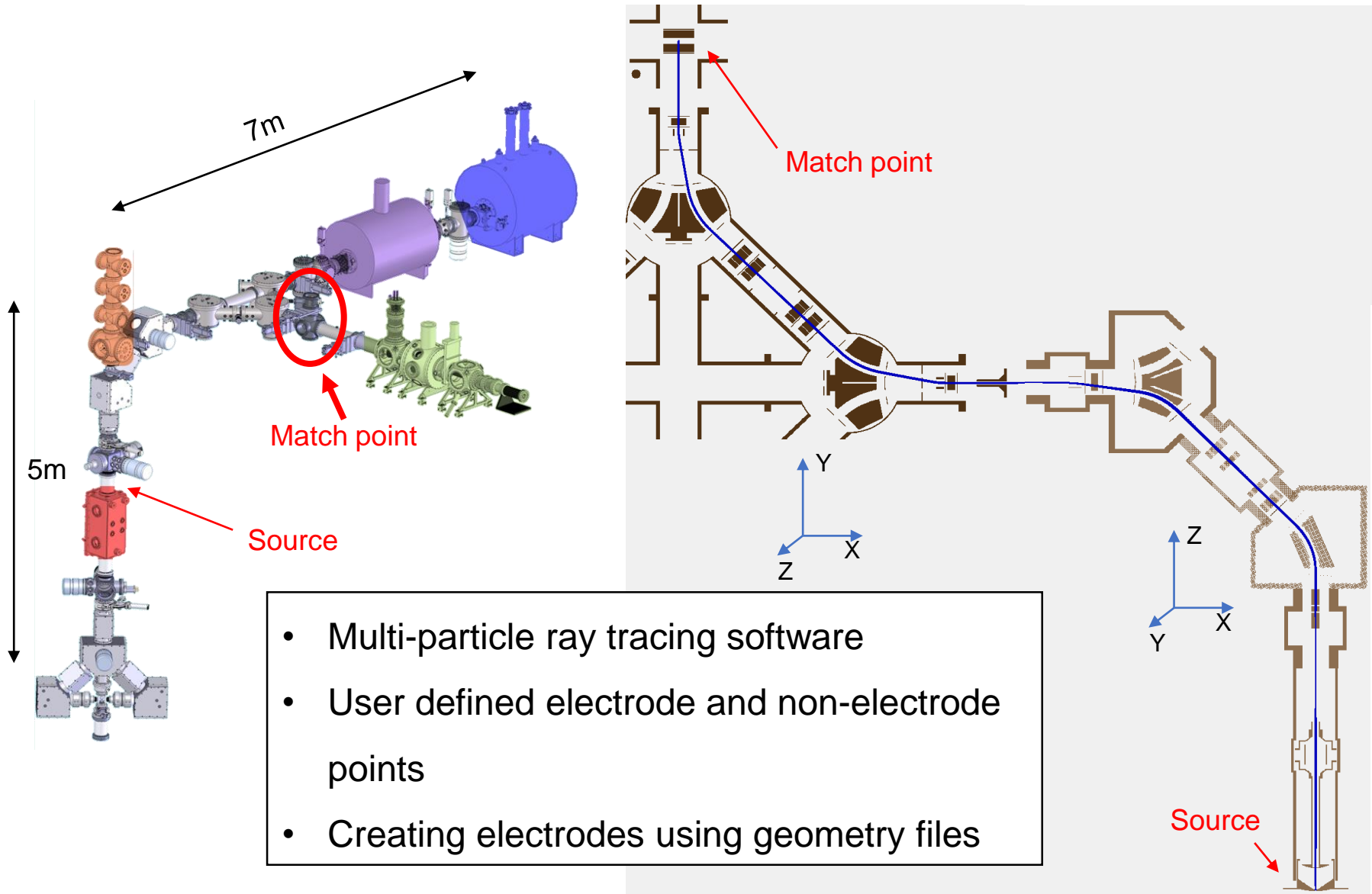


A new transport path for the new trap

- My goal: Transport beam from preparation trap to new decay spectroscopy trap
 - Simulate beam
 - Assess beam quality at new trap
 - Implement in experiment



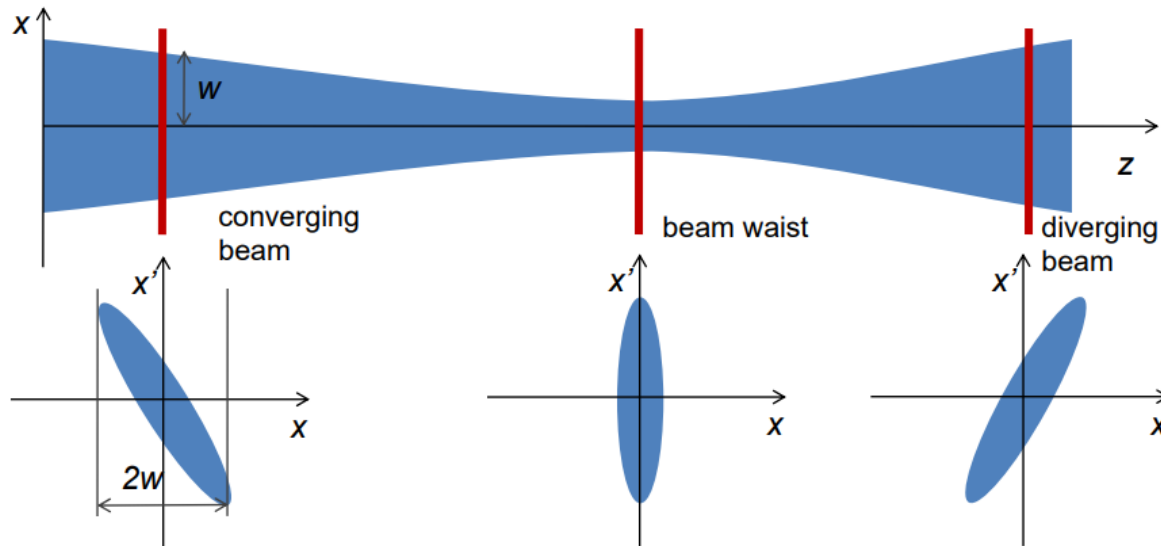
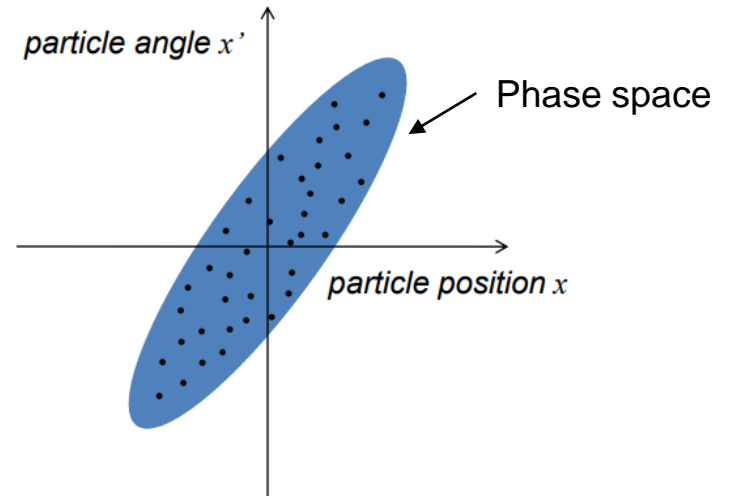
Simulations in SIMION



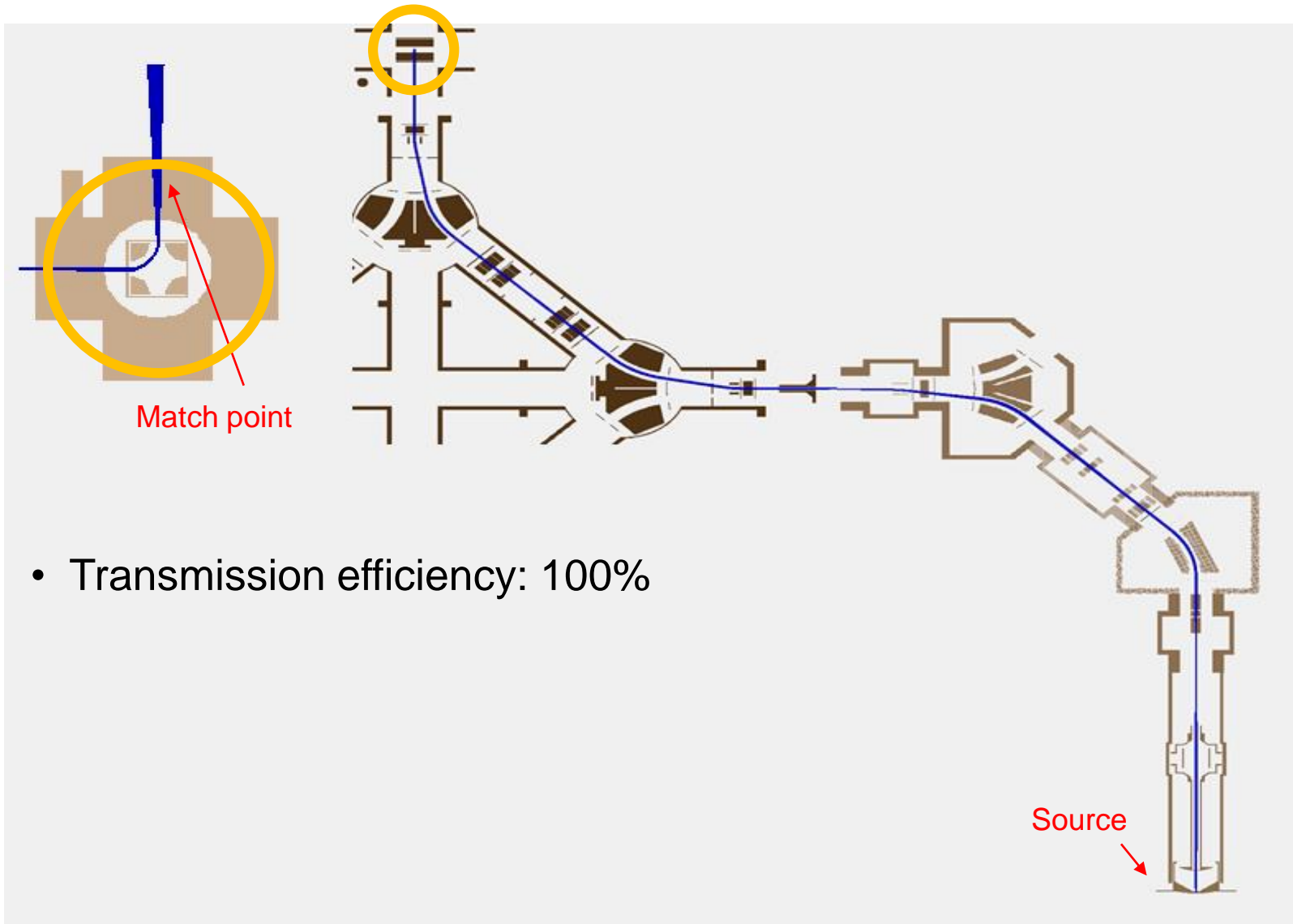
- Multi-particle ray tracing software
- User defined electrode and non-electrode points
- Creating electrodes using geometry files

How is beam quality defined?

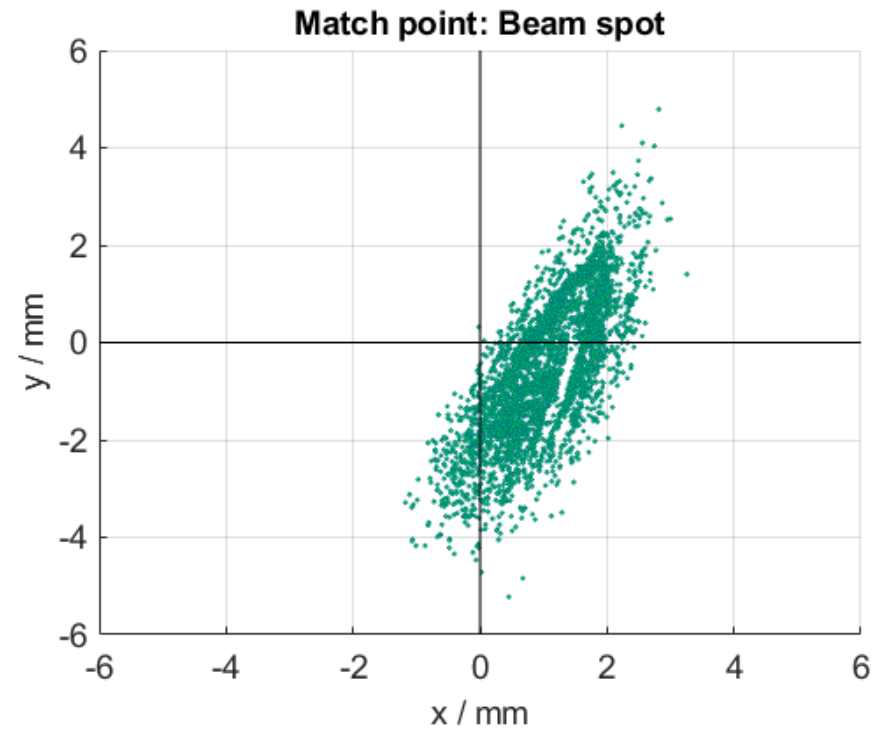
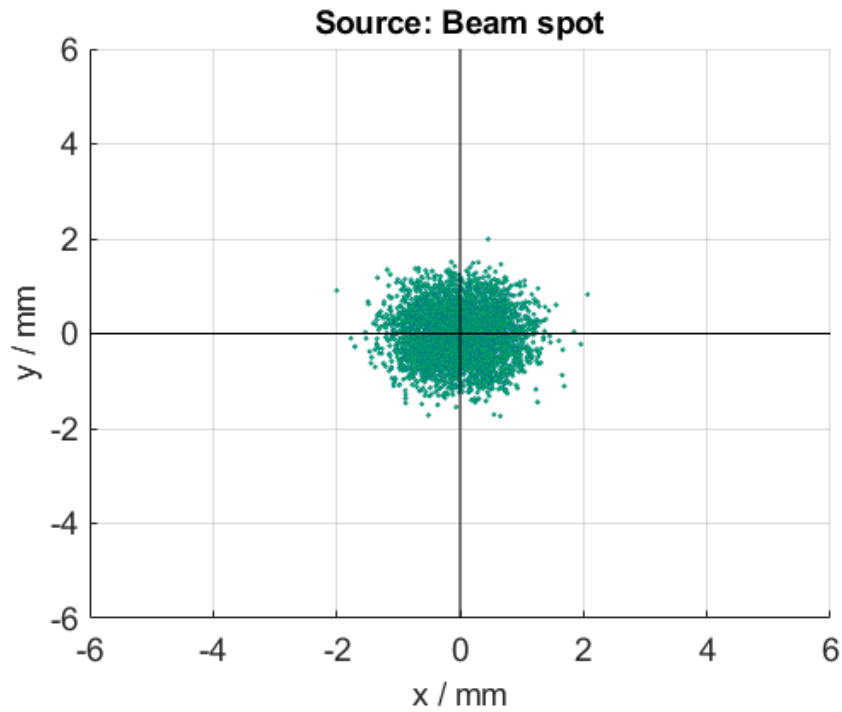
- Transmission efficiency
- Beam spot
- Emittance: Area in phase space



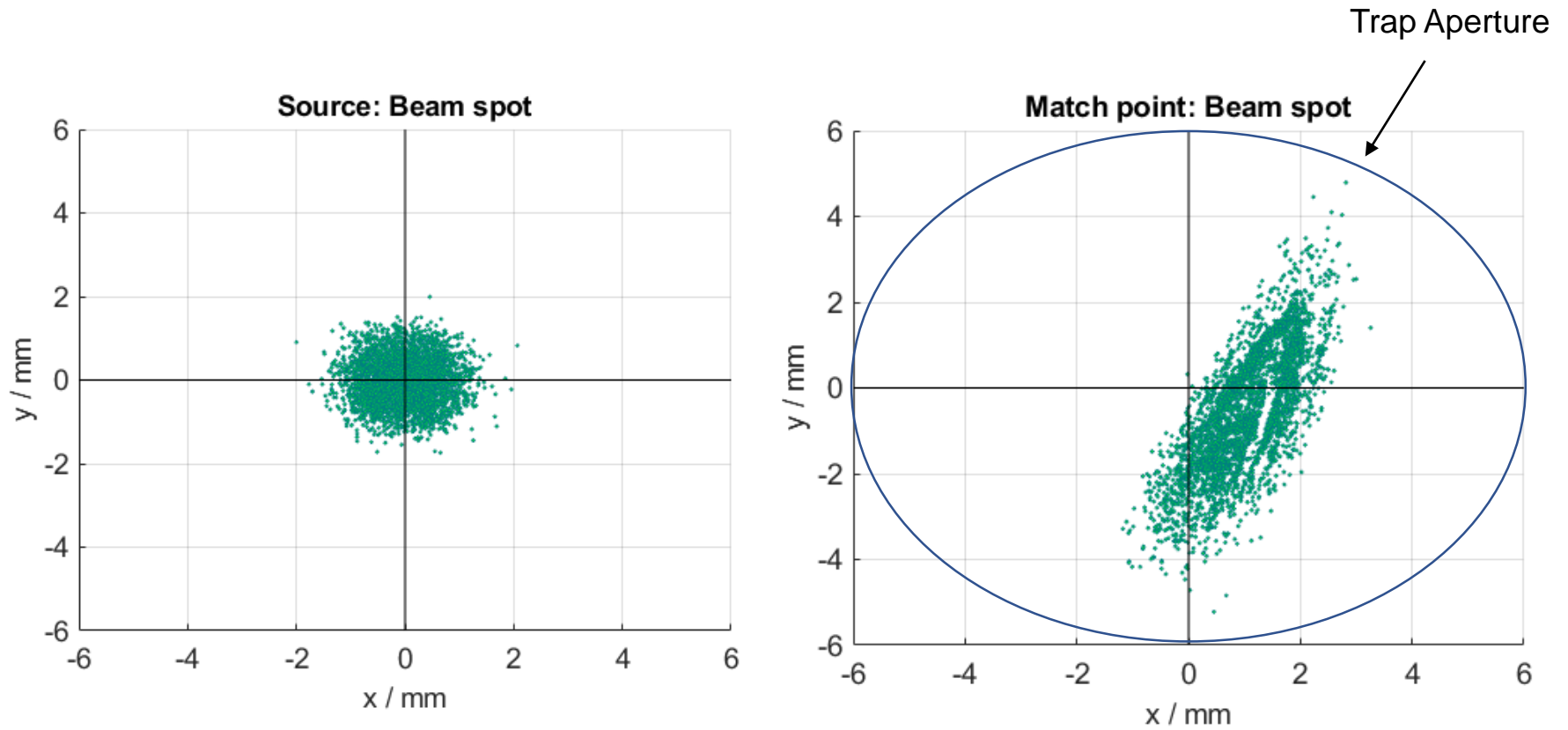
Beam quality: From source to new trap



Beam spot: From source to new trap

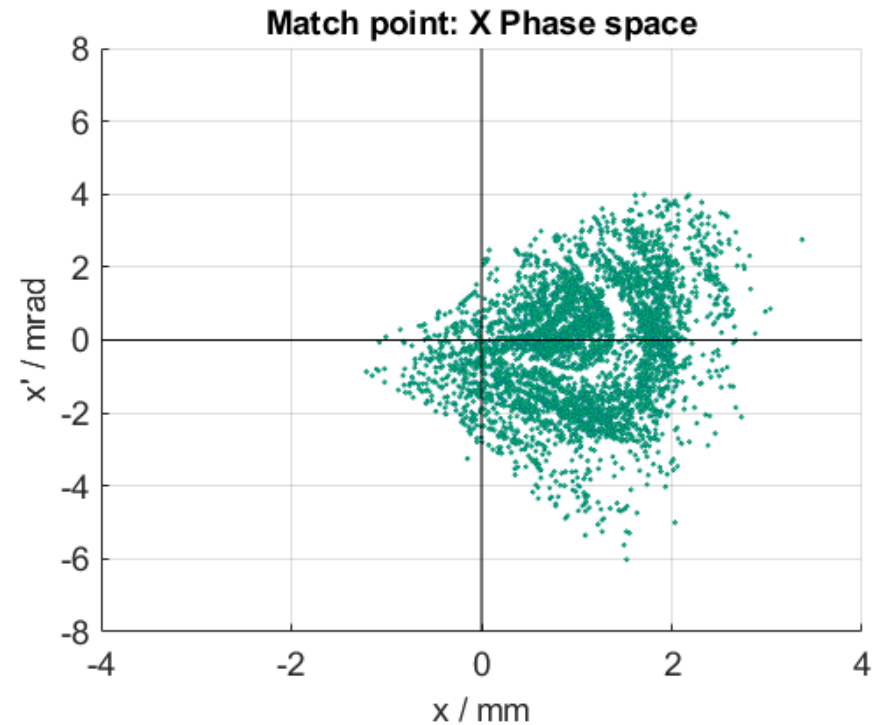
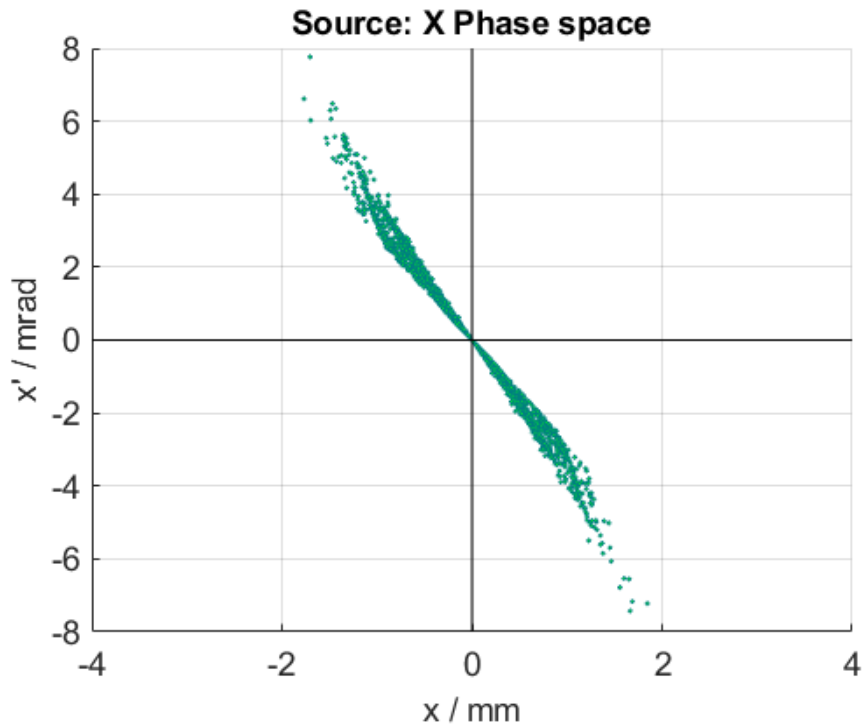


Beam spot: From source to new trap



Beam Emittance: From source to new trap

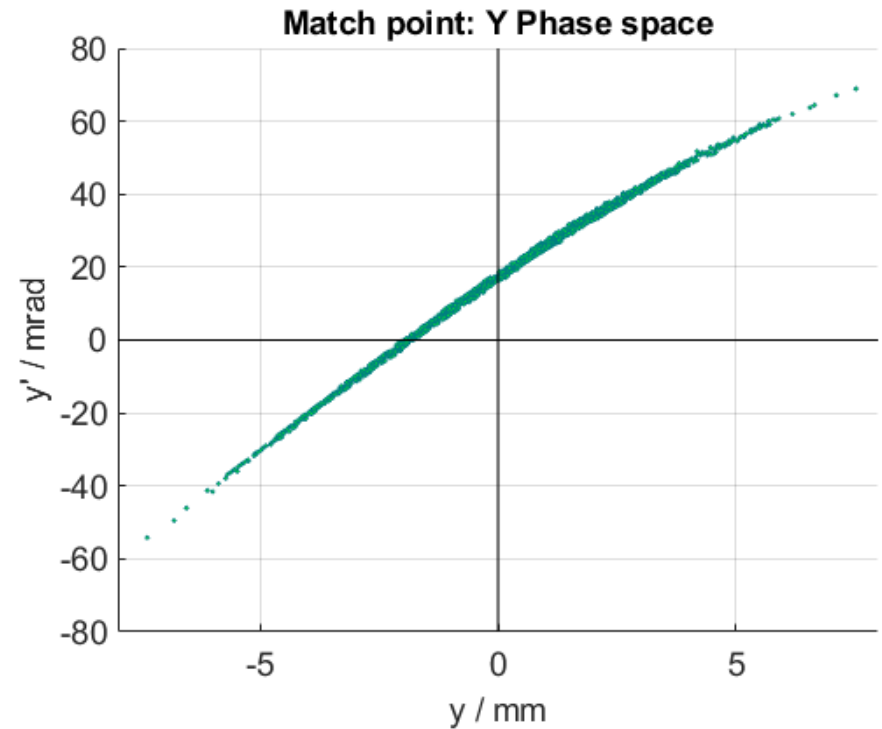
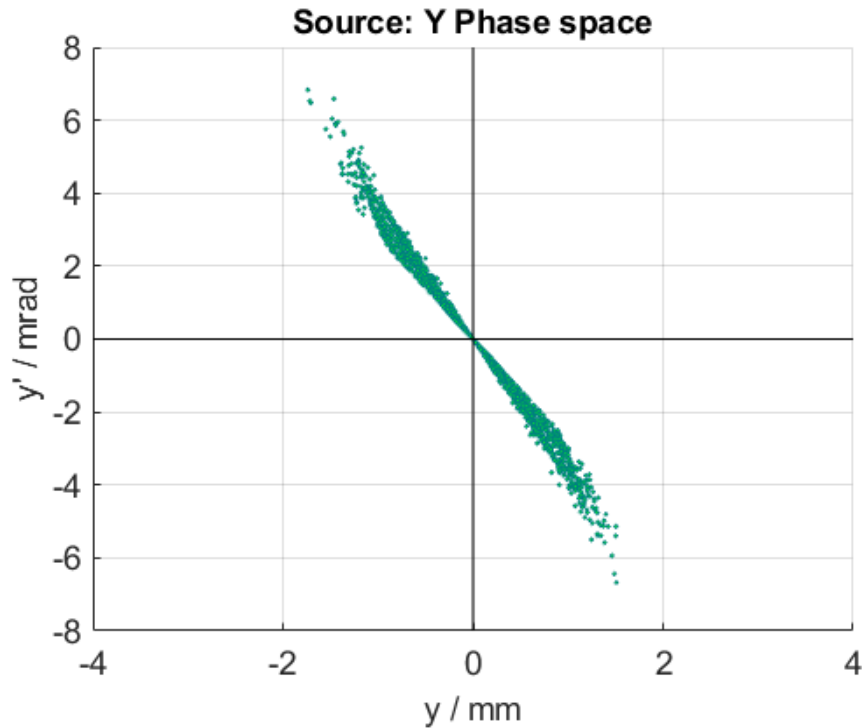
- X Emittance:



- Effective emittance: $0.1 \text{ mm} \cdot \text{mrad} \rightarrow 1.87 \text{ mm} \cdot \text{mrad}$

Beam Emittance: From source to new trap

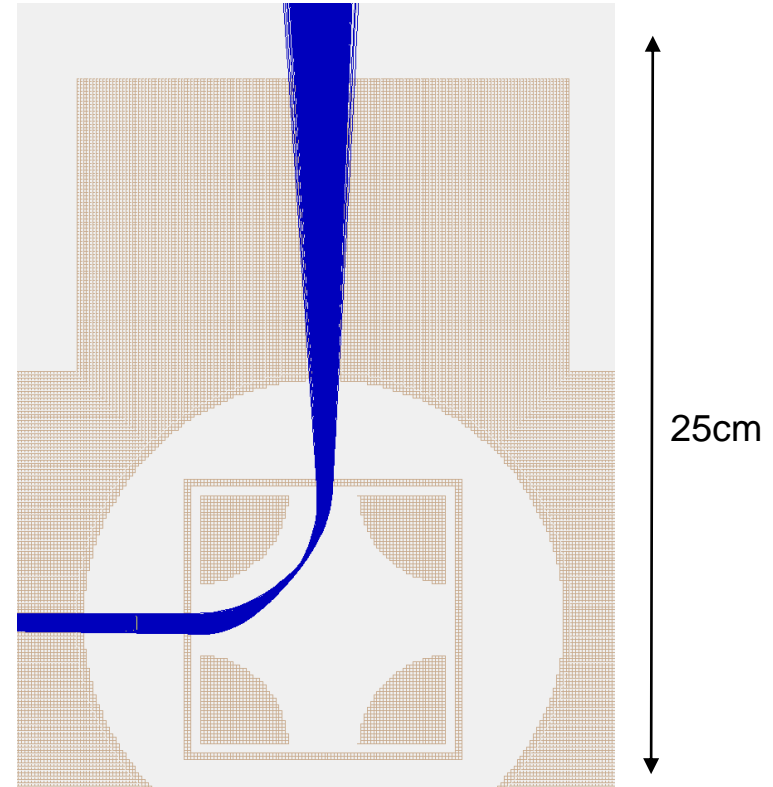
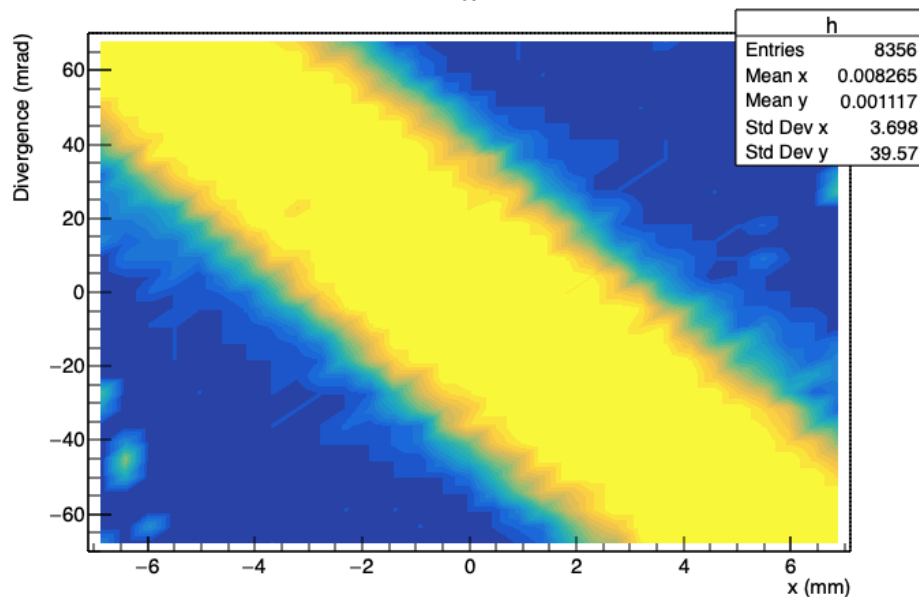
- Y Emittance:



- Effective emittance: $0.1\text{mm}\cdot\text{mrad} \rightarrow 3.46\text{mm}\cdot\text{mrad}$

Next step/solution: Add a focusing element

- Acceptance of new trap requires convergent beam
- Divergent beam at match-point needs a focusing element



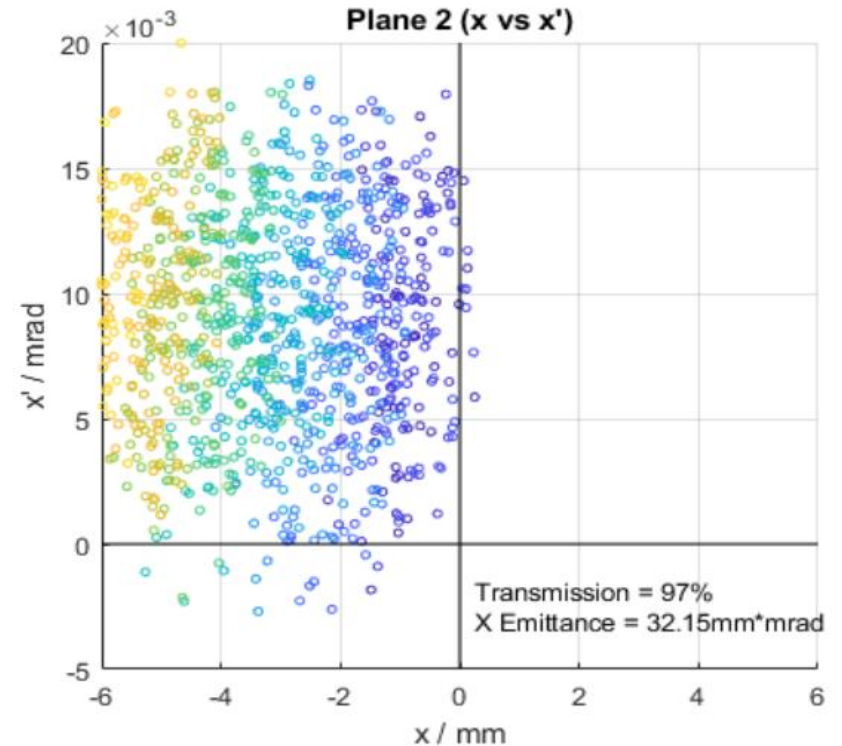
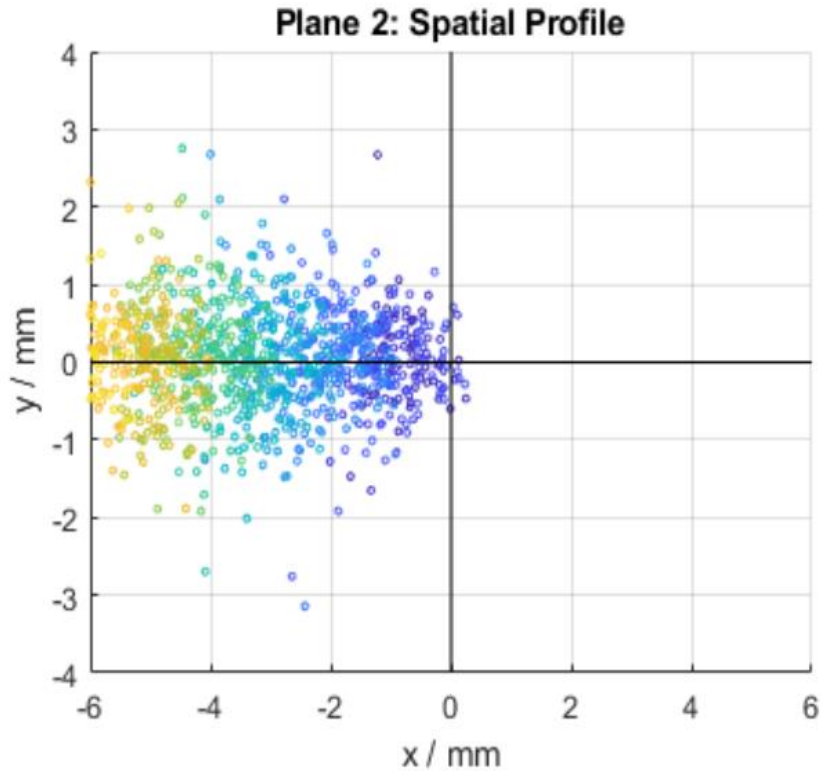
Conclusion and Outlook:

- **Current Status:**
 - A simulation tool to transport beam anywhere in TITAN
 - Perfect transmission to the new trap
 - 100% into trap based on beam spot
 - <100% accepted into new trap based on emittance
- **Future work:**
 - Ensure 100% of beam accepted into new trap
 - Compare simulation to experiment
 - Integrate the new trap (and do amazing science)



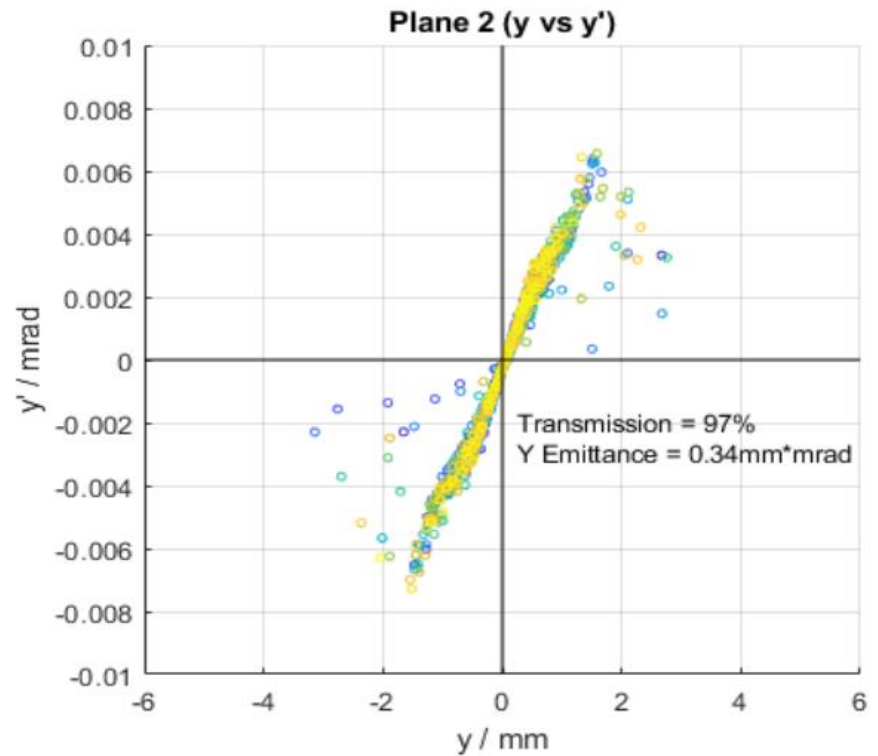
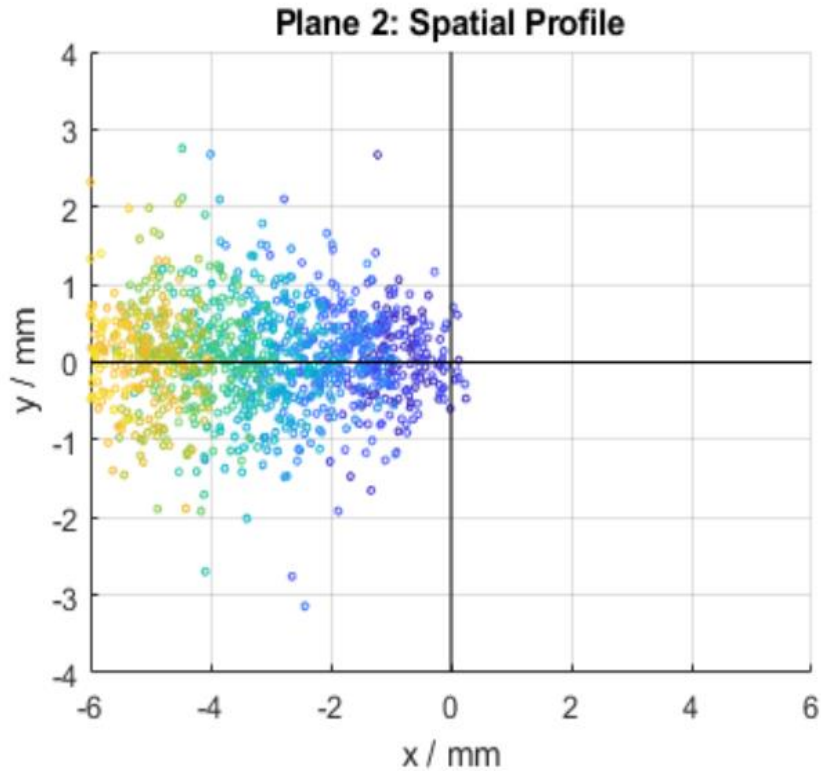
Quantifying influence of specific elements

- Einzel lens voltage dependence



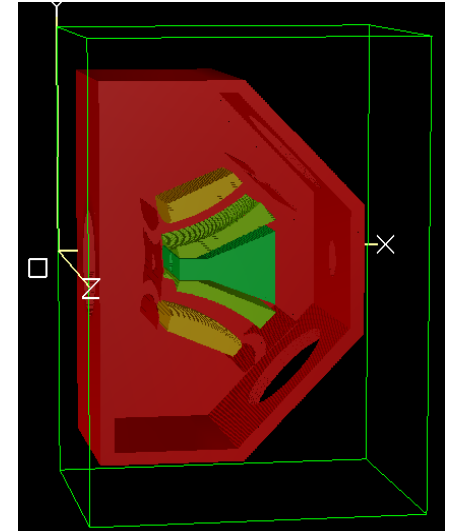
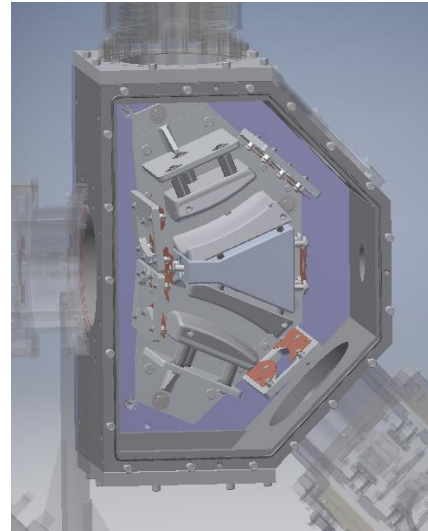
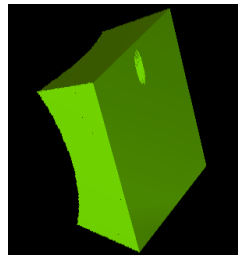
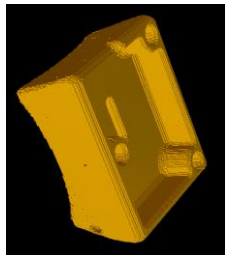
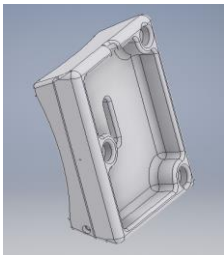
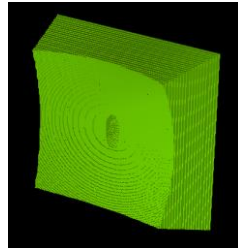
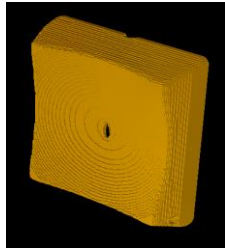
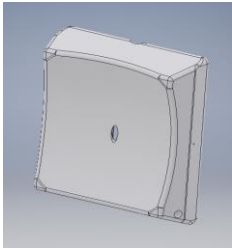
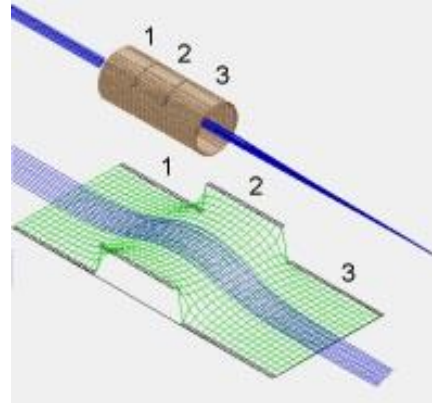
Quantifying influence of specific elements

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Simulation tool and how it was used

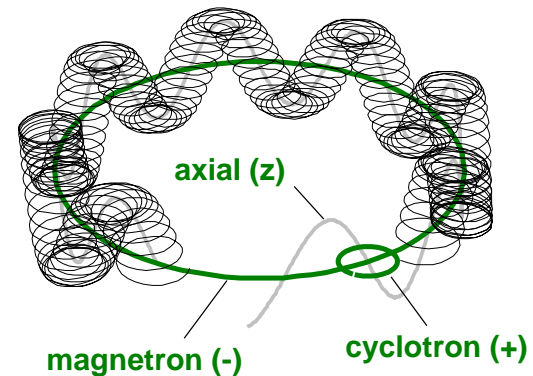
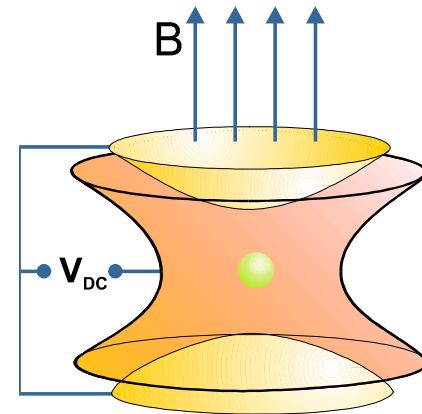
- SIMION:
- Creating electrodes:
 - Importing from STL files
 - Coding Geometry files



TITAN:

TRIUMF's Ion Trap for Atomic and Nuclear Science

- Experiment receives (radioactive) ion beams from ISAC at TRIUMF
- TITAN traps ions for high precision mass measurements.
- Measurement precision proportional to q/m
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