

From Laser to Beam

Early Results from the PALLAS Laser Plasma Accelerator at IJCLab

Jana Serhal. October 8th Journées Accélérateurs de la Société Française de Physique (SFP)

Laser Plasma Acceleration: Concept and Mechanism

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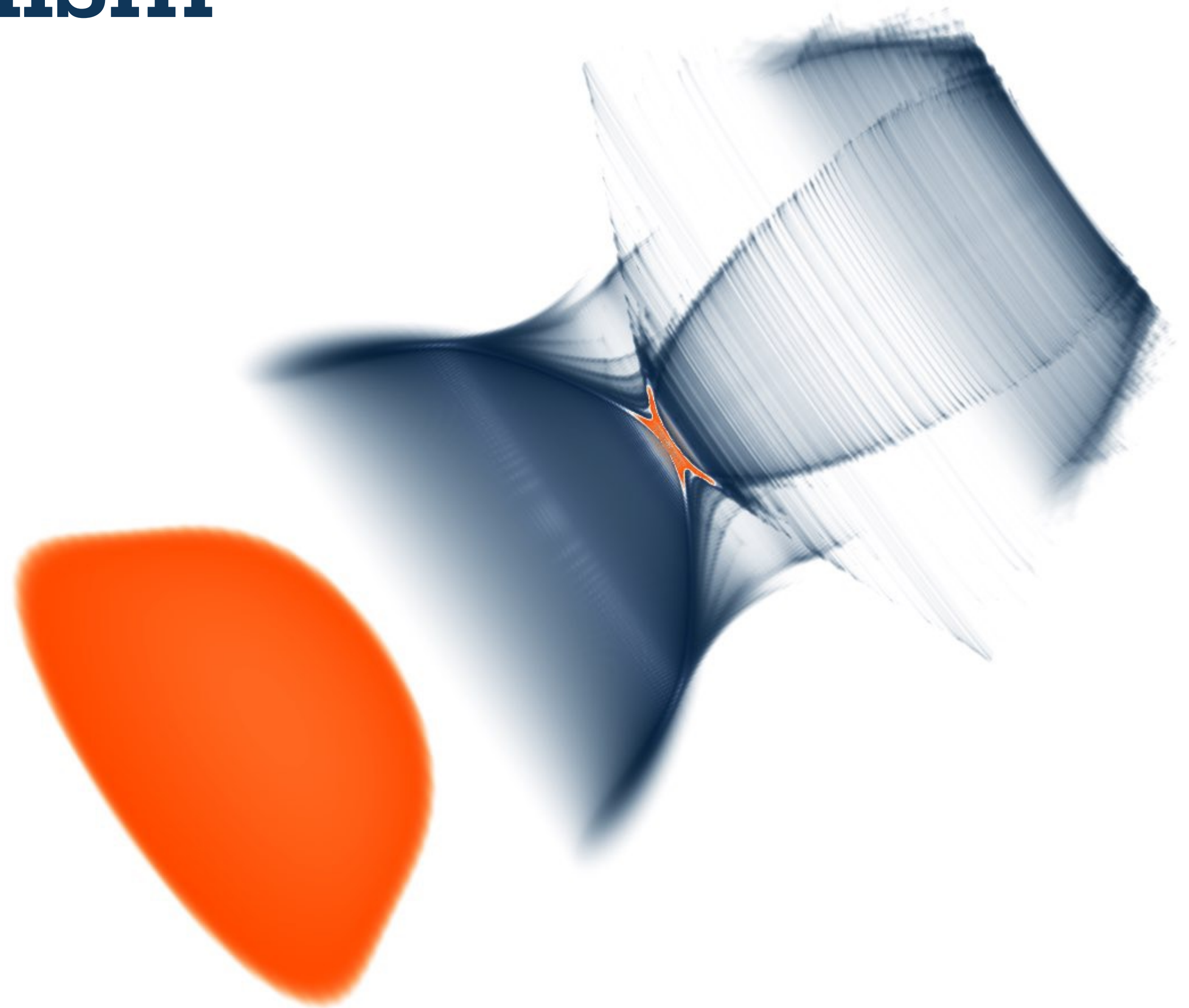
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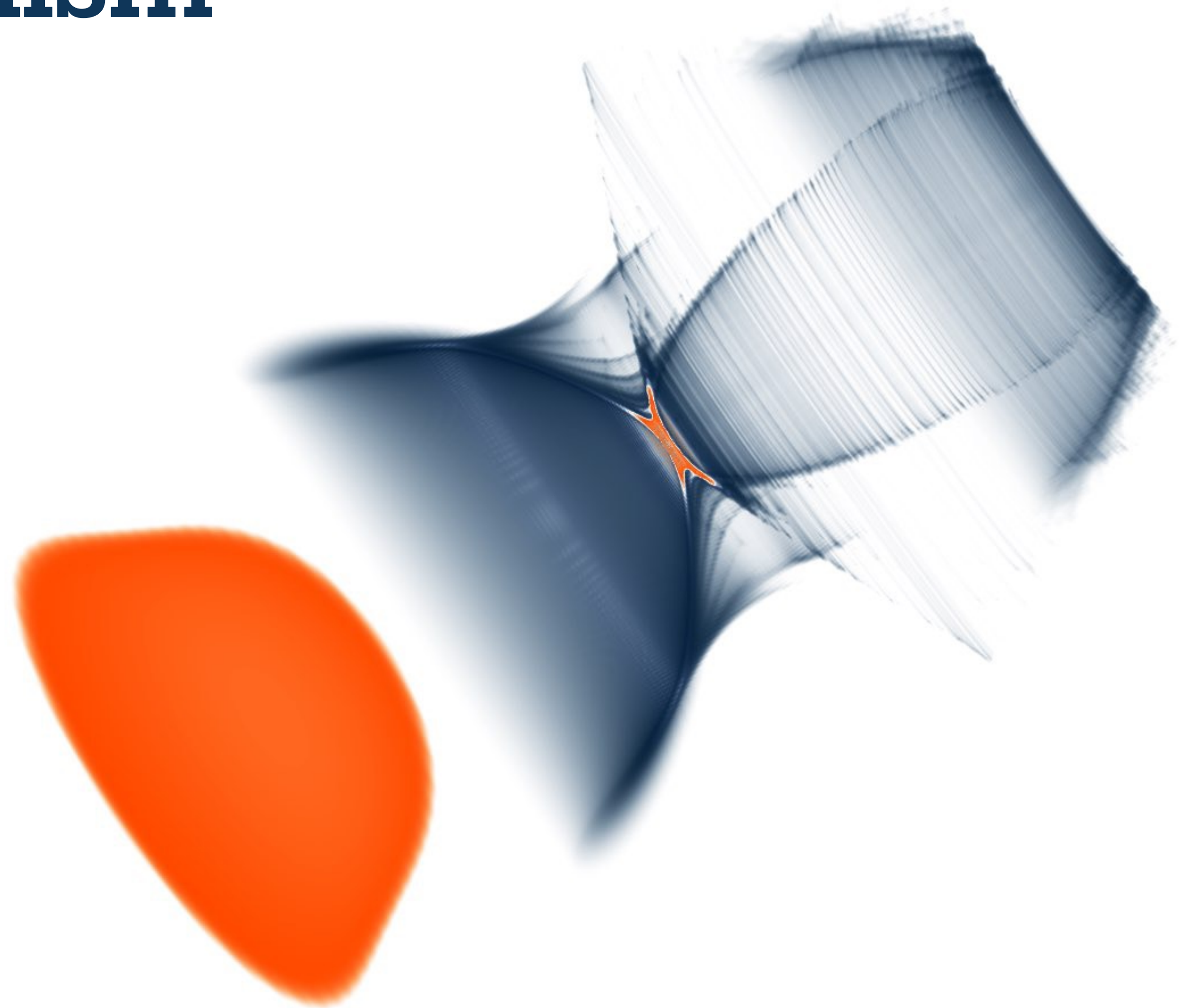
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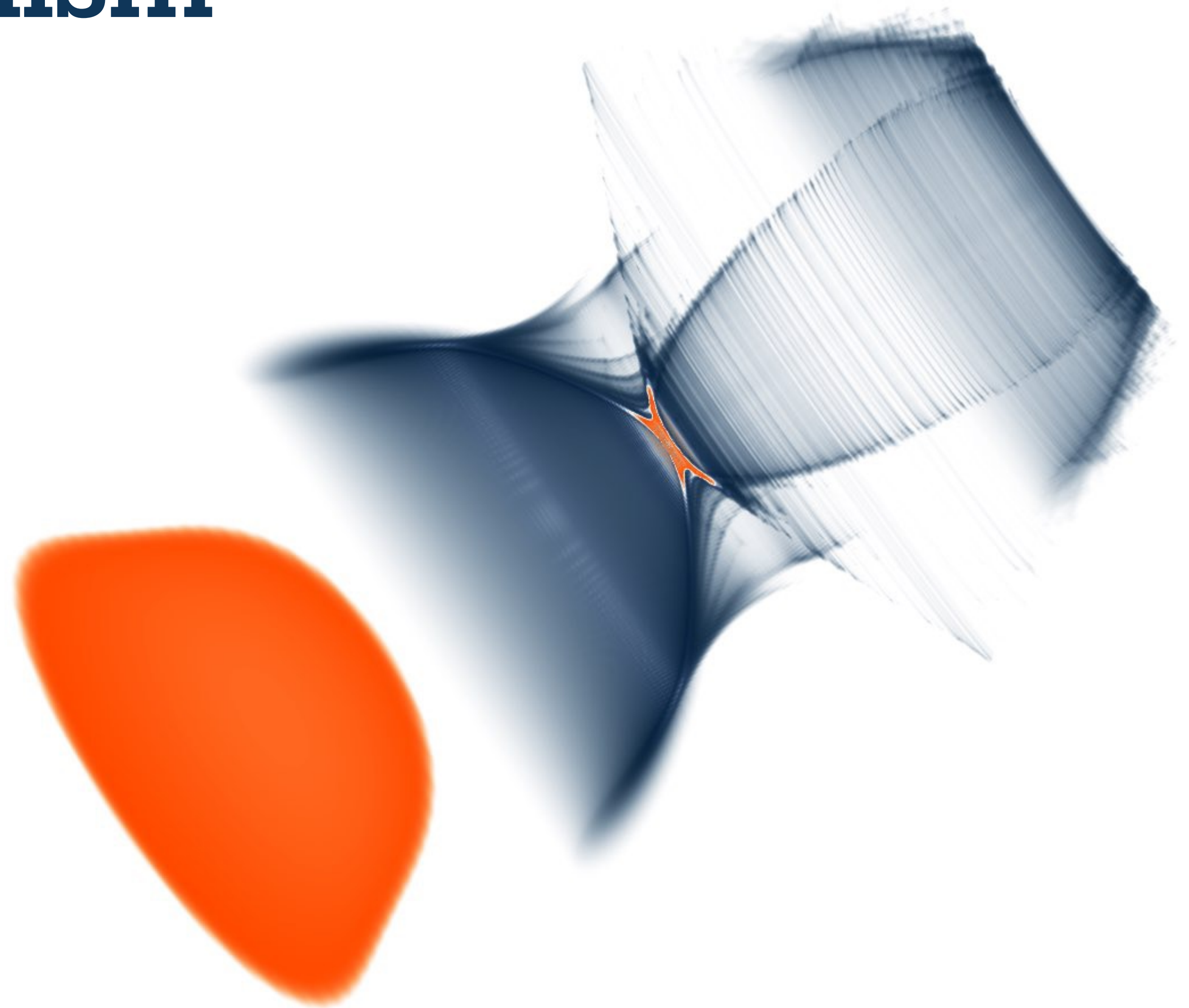
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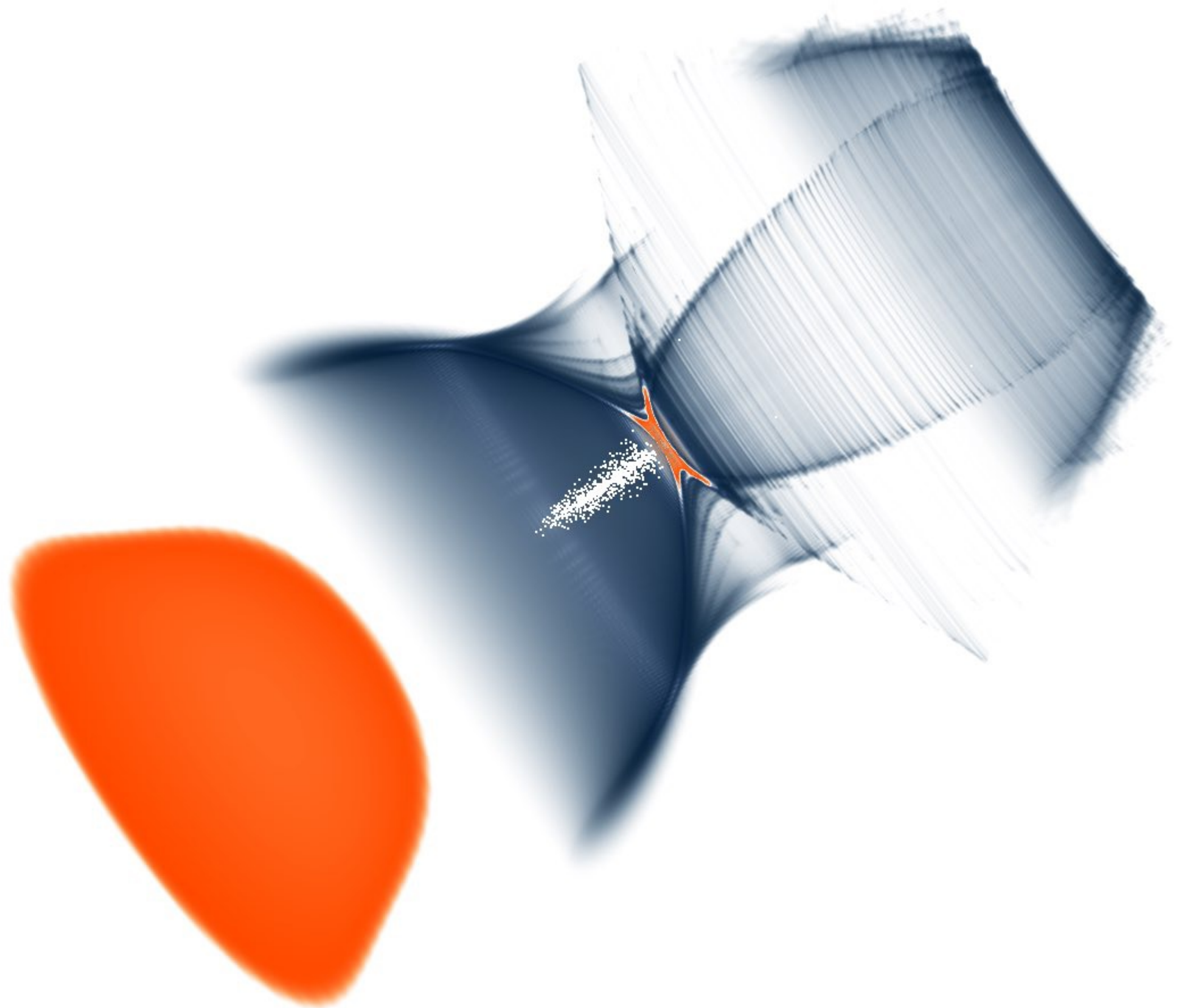
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- Gradient: **~ 100 GV/m** \rightarrow 1000 \times convention accelerators.



How to Inject Electrons into the Wakefield?

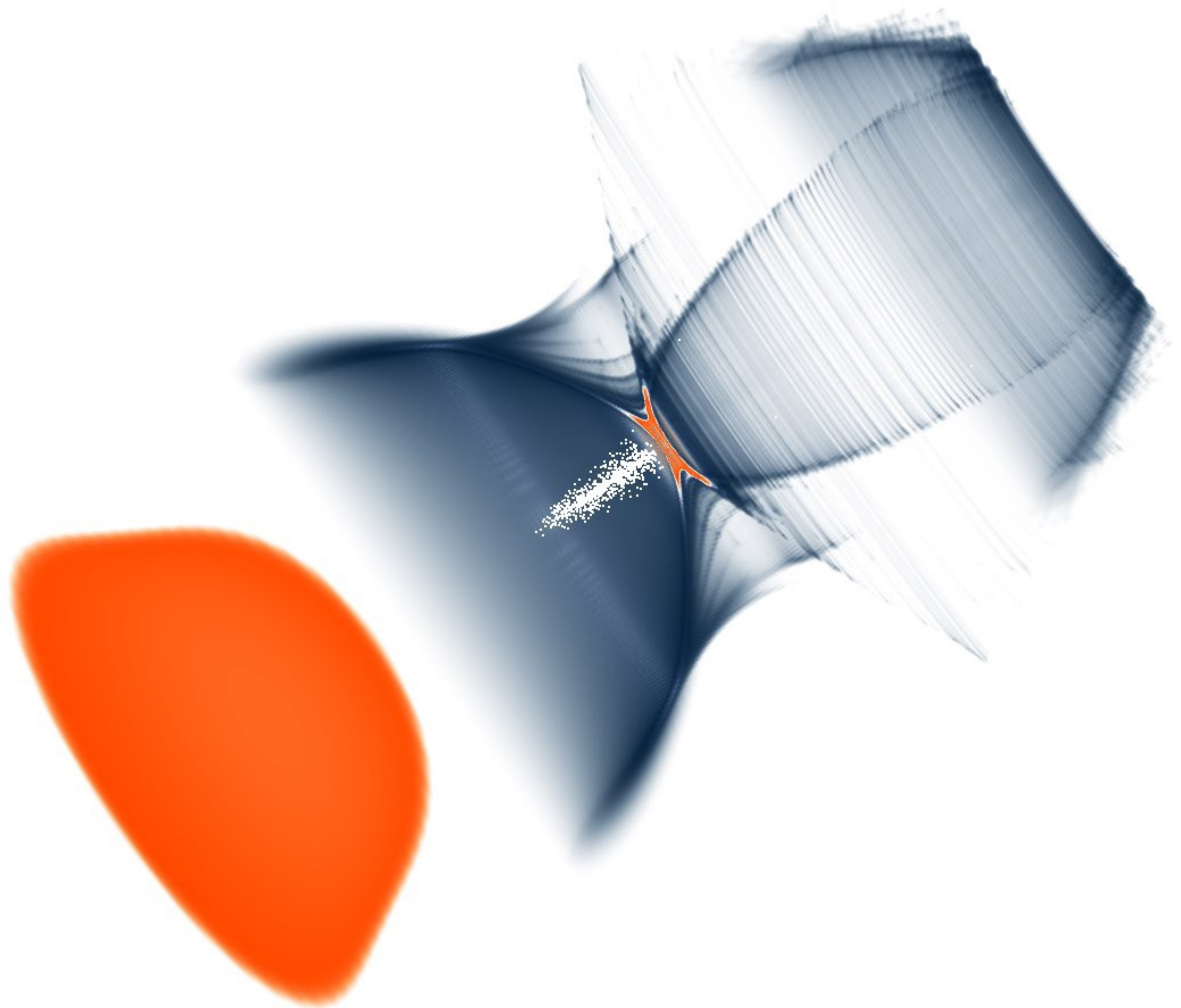
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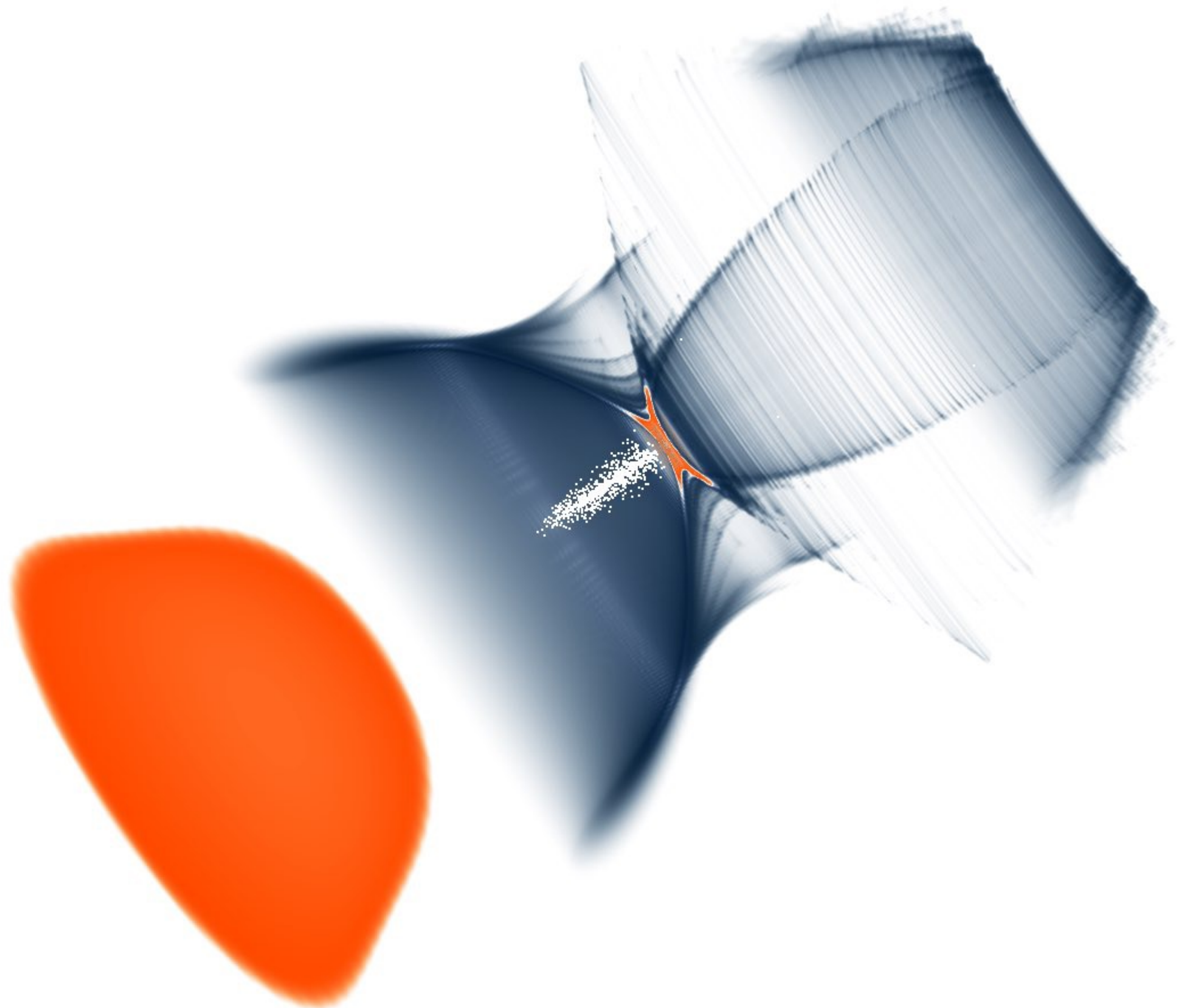


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- Ionization injection: high-Z dopant (N₂) in low-Z gas (He).
- Electrons born inside the wake are trapped and accelerated.



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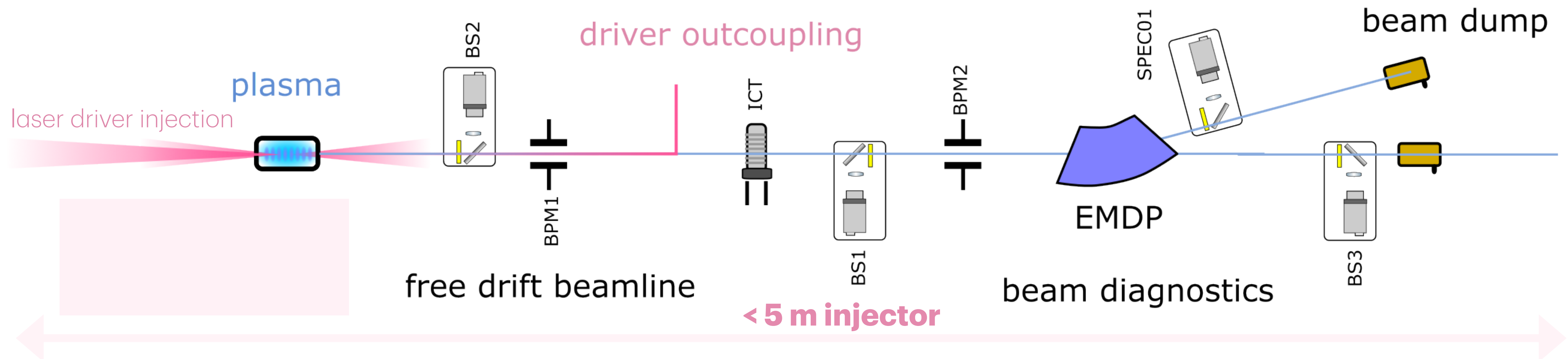
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- 1 Hz rep rate
- Stability: 11–13 μrad (PV)

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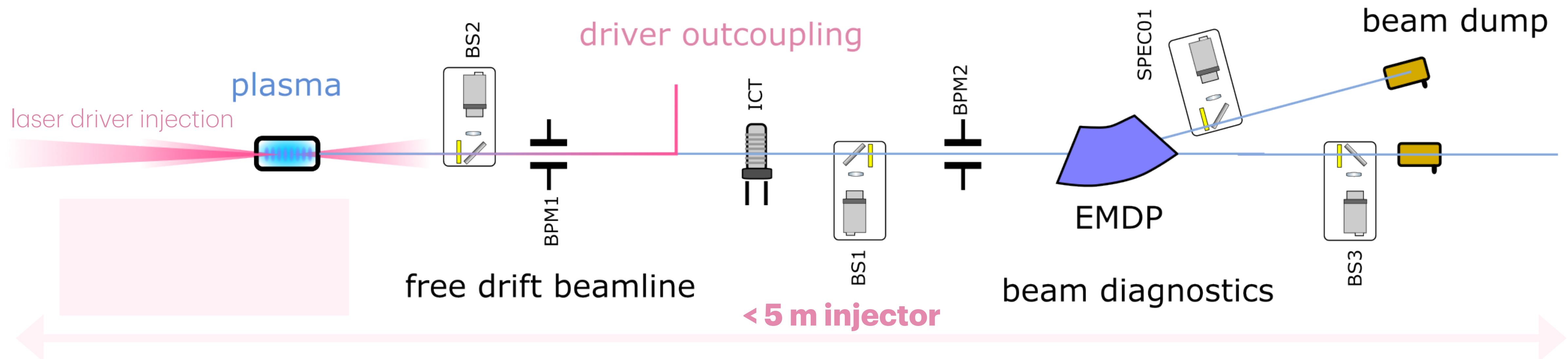
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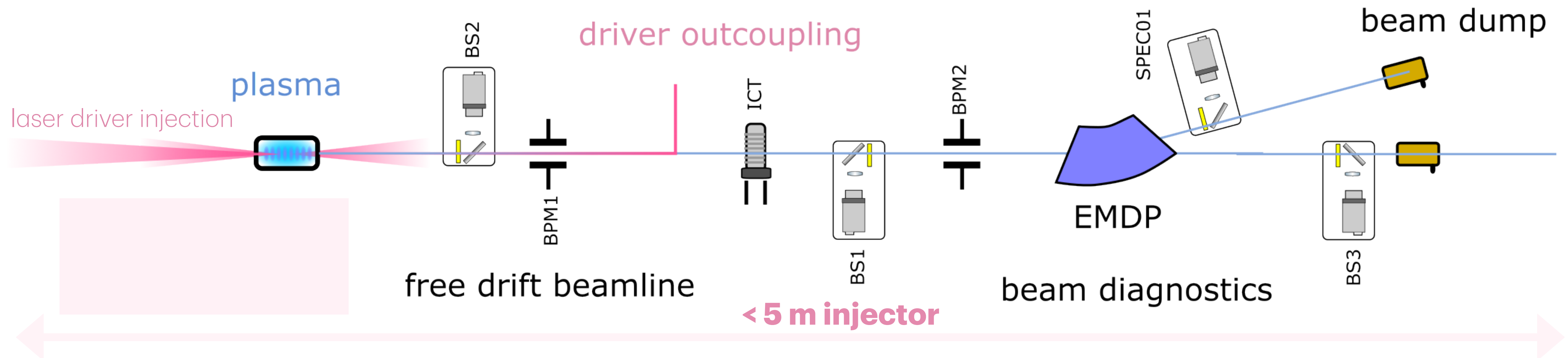
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Target Laser System:

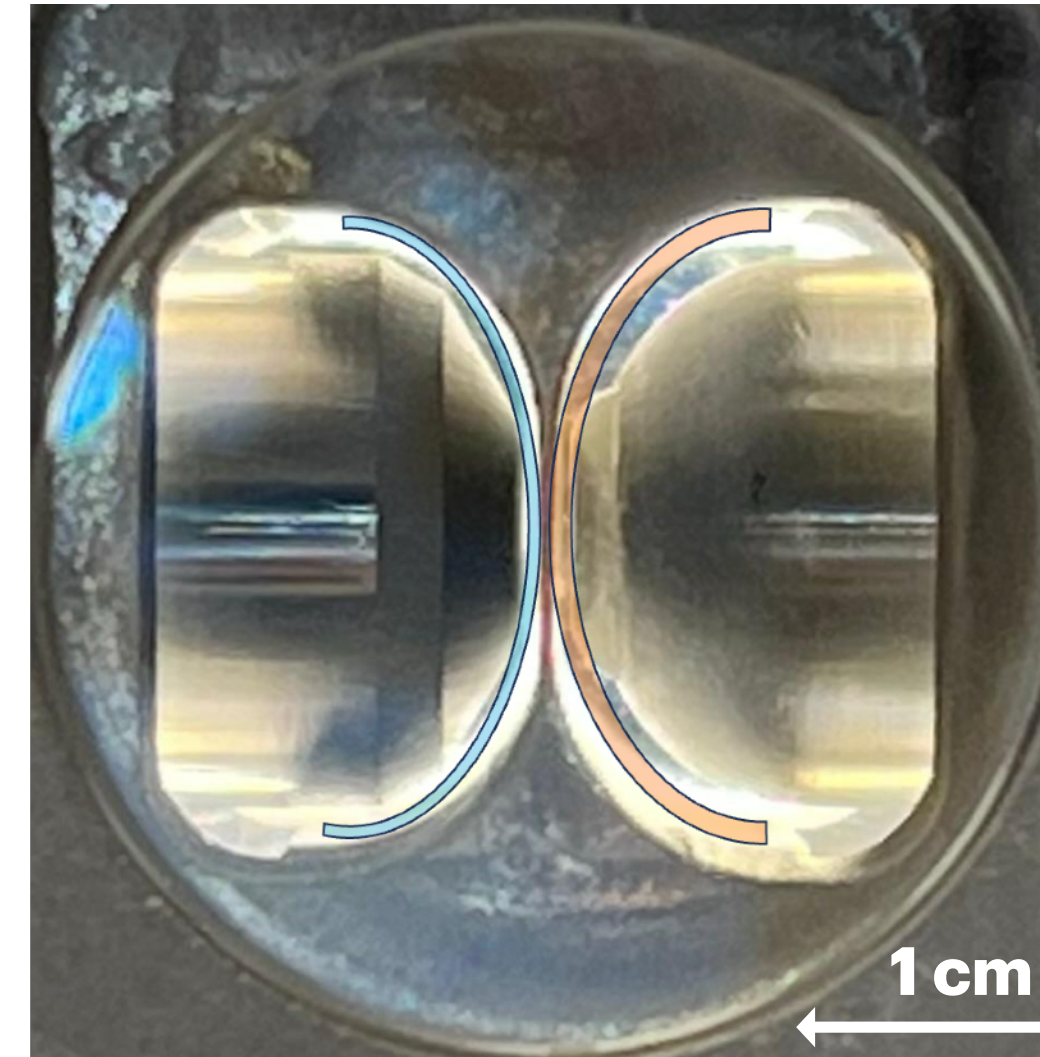
- 3J, 40 fs
- 10 Hz rep rate
- Stability < 1 μrad (PV)



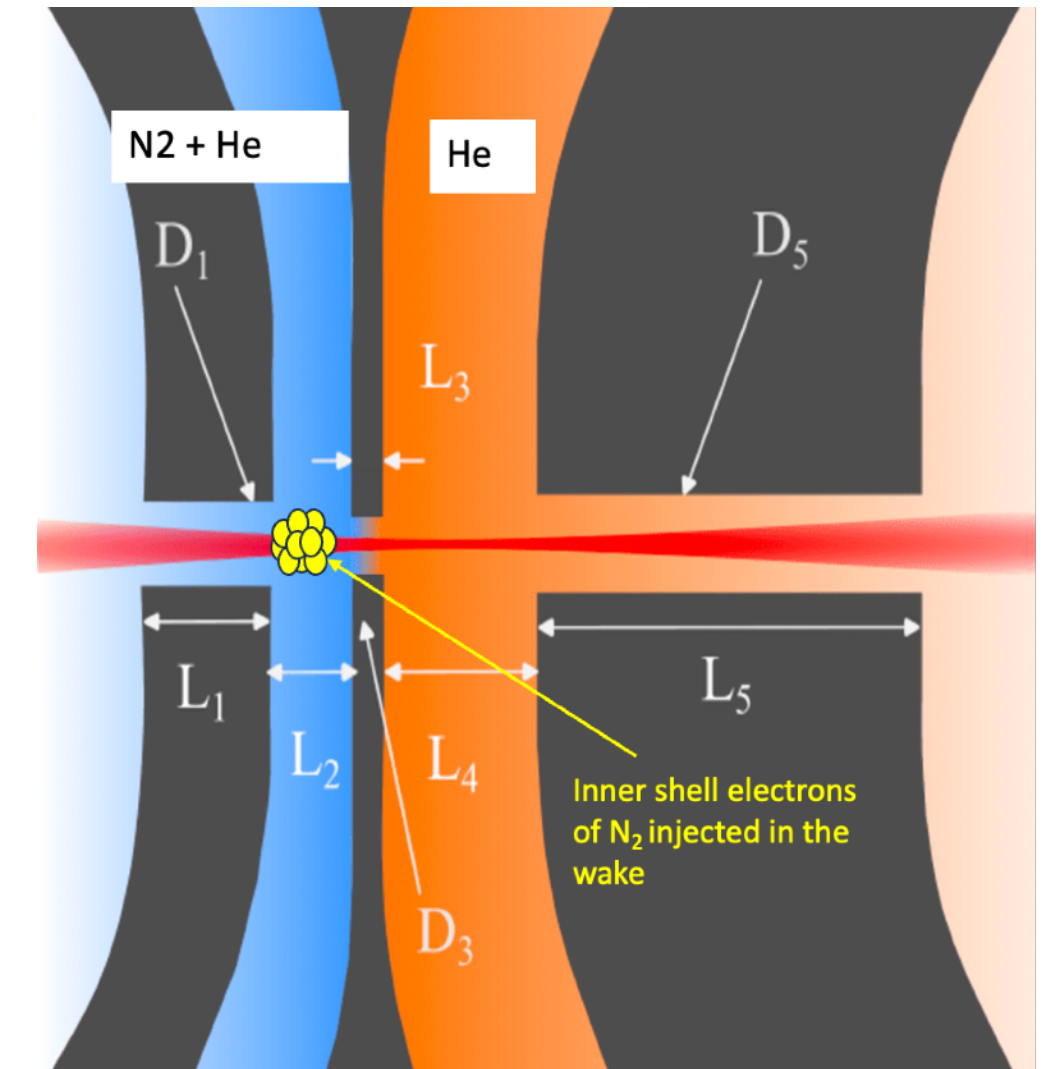
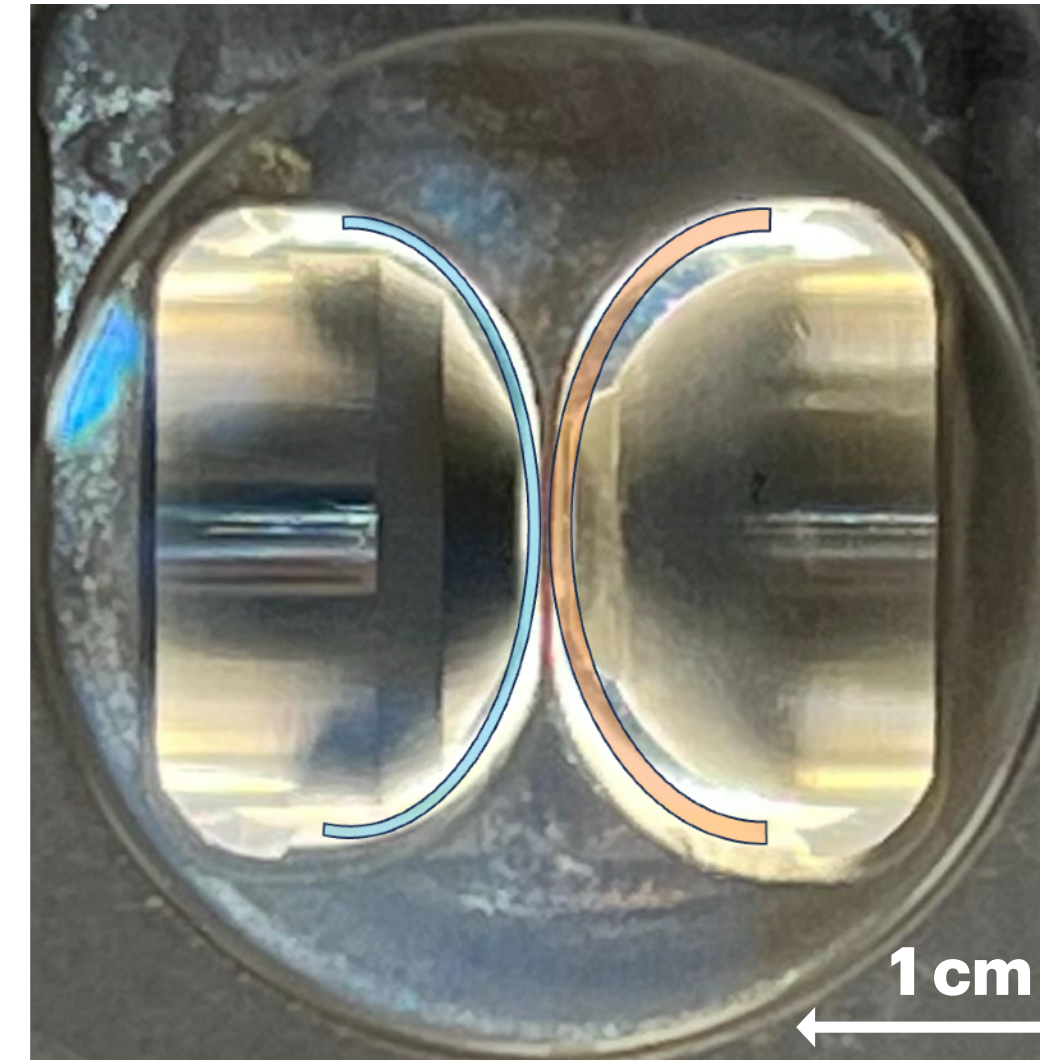
Two-Chamber Gas Cell: Injection & Acceleration



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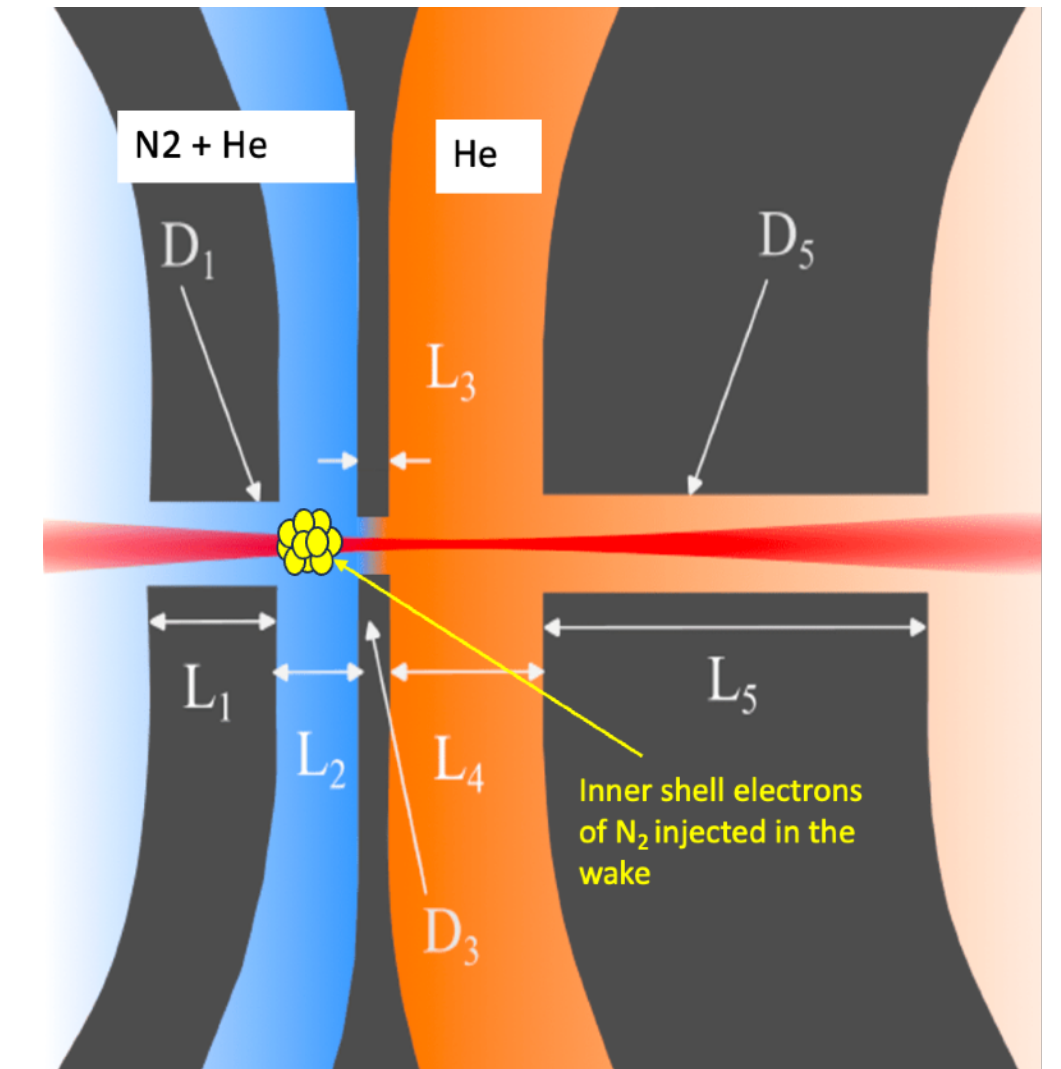
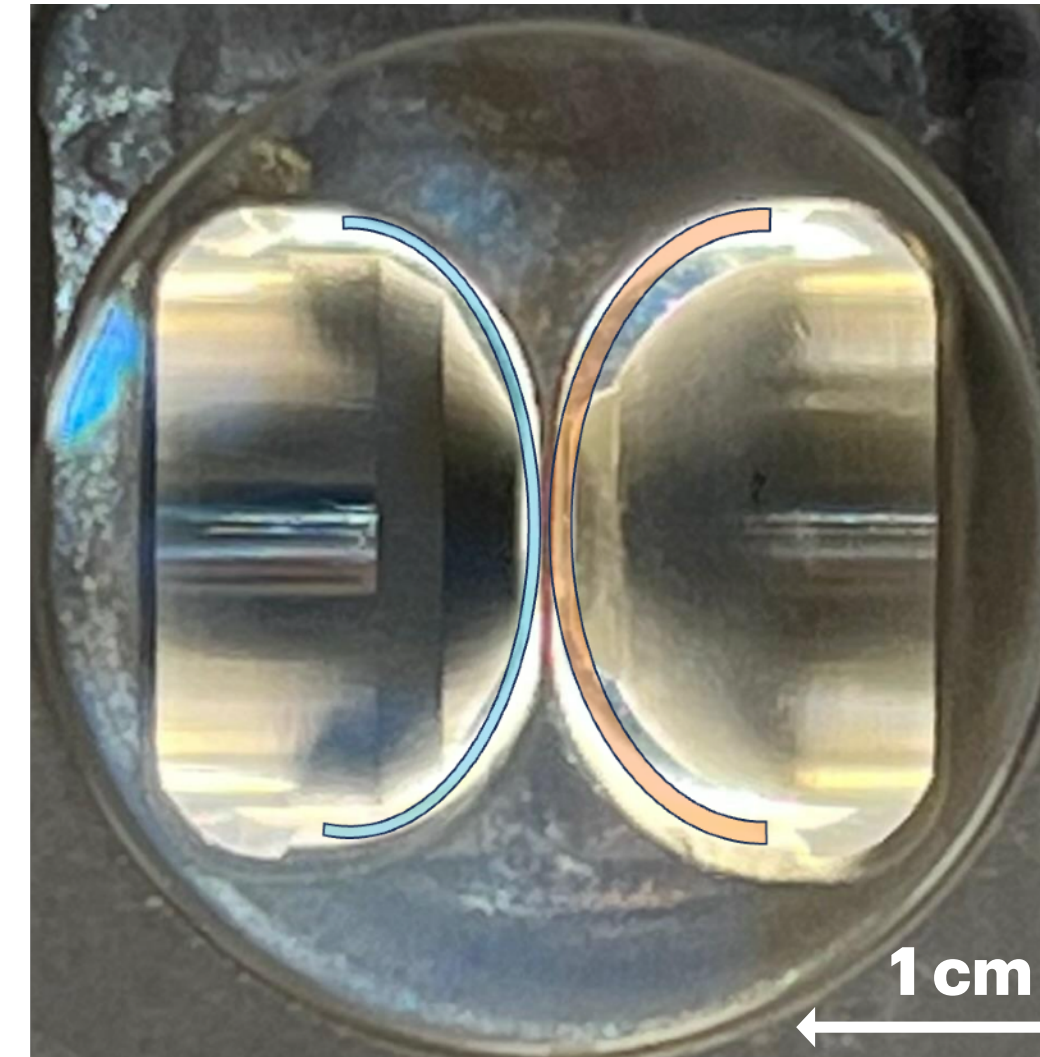


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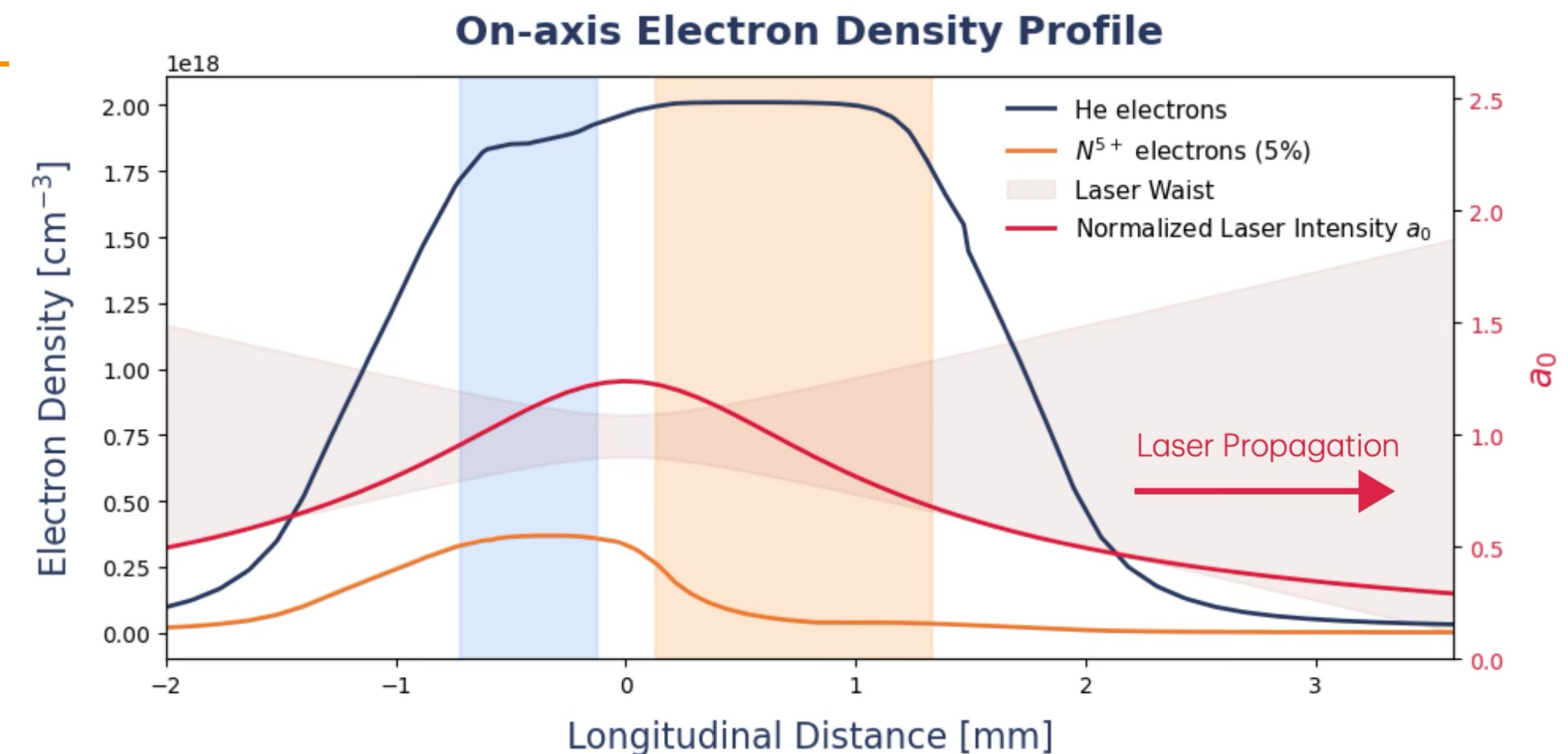
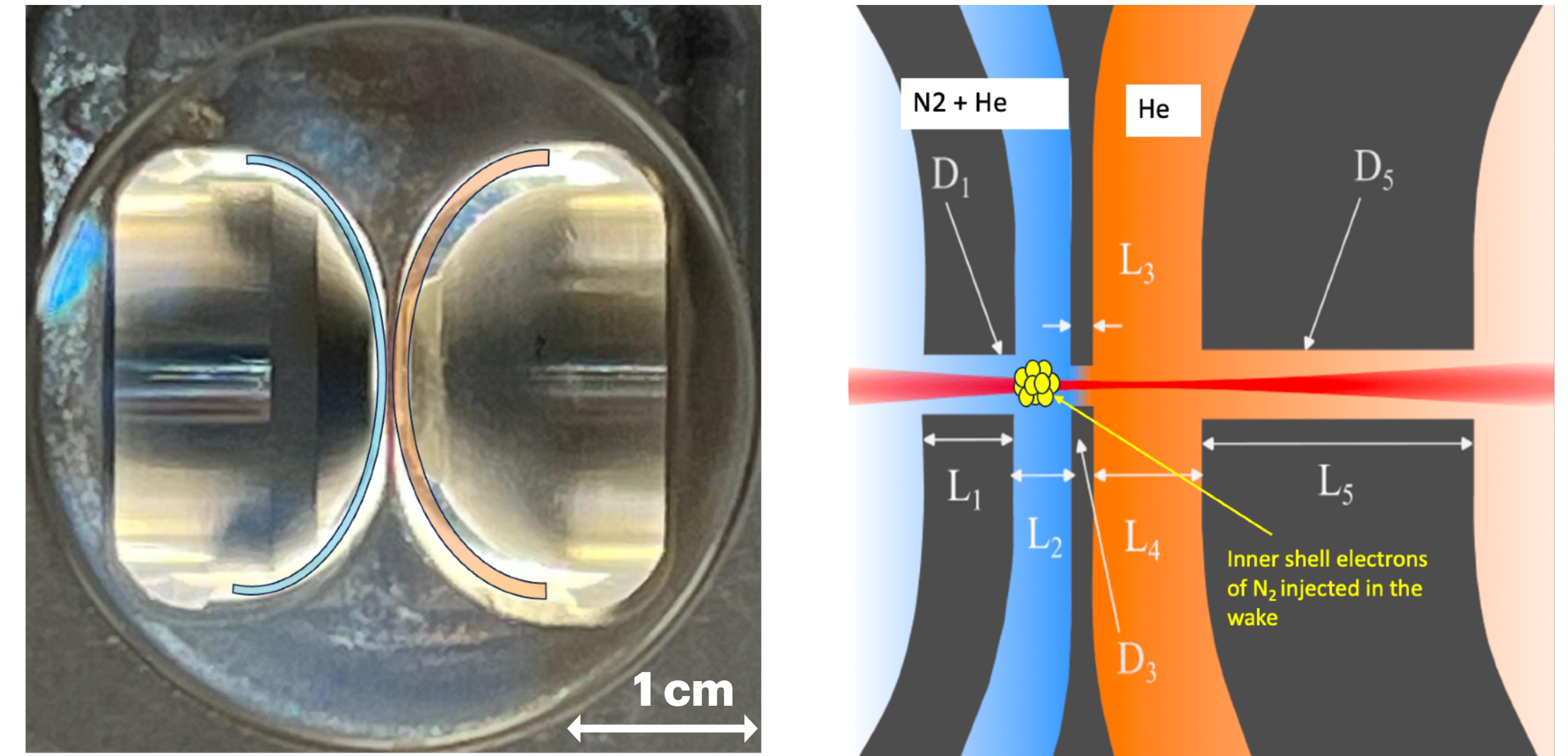
Two-Chamber Gas Cell: Injection & Acceleration

- **Injection chamber (blue):** N_2/He mixture \rightarrow ionisation injection
 - **Acceleration chamber (orange):** pure He for energy gain
 - **Gas profiles:** validated with computational fluid dynamics simulations
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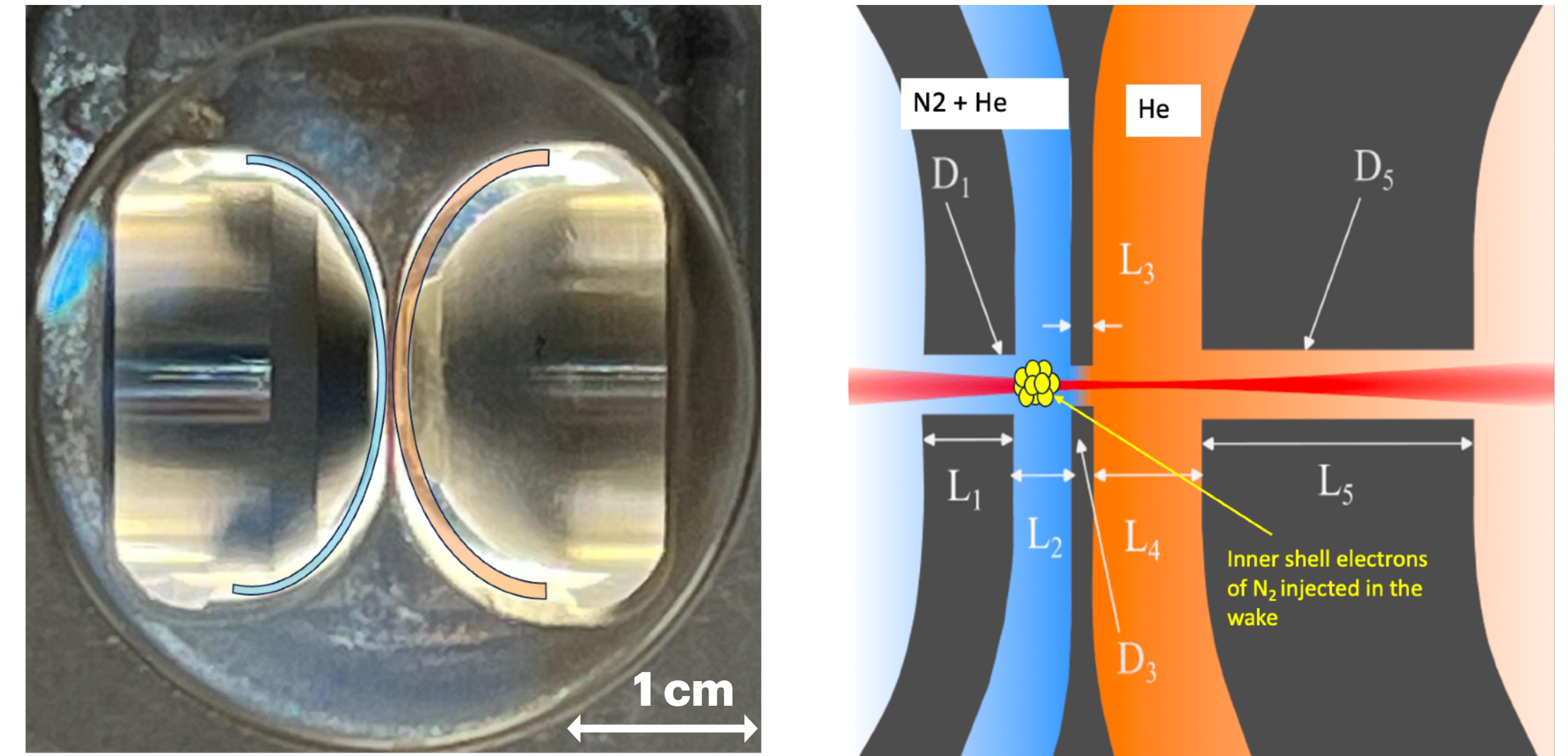
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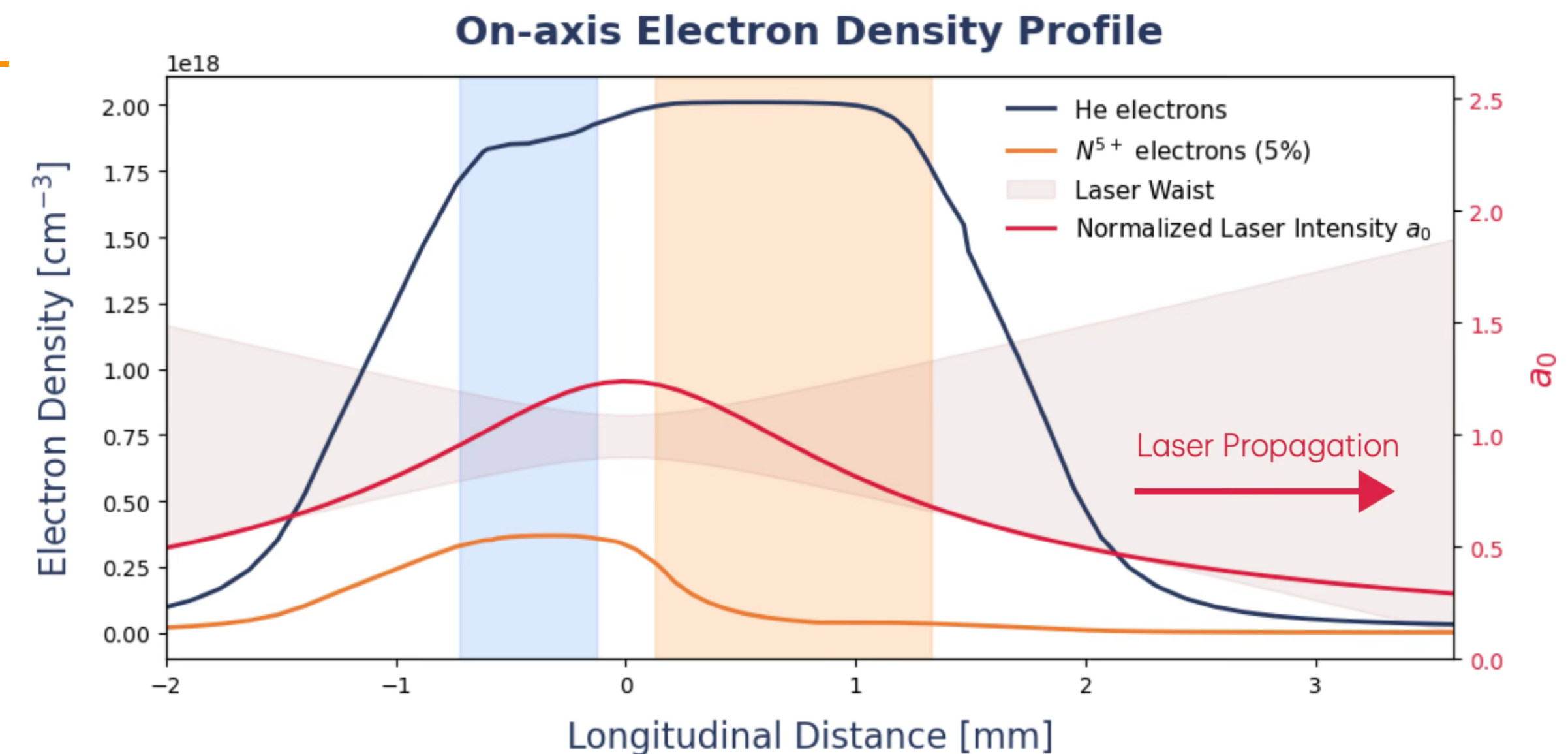
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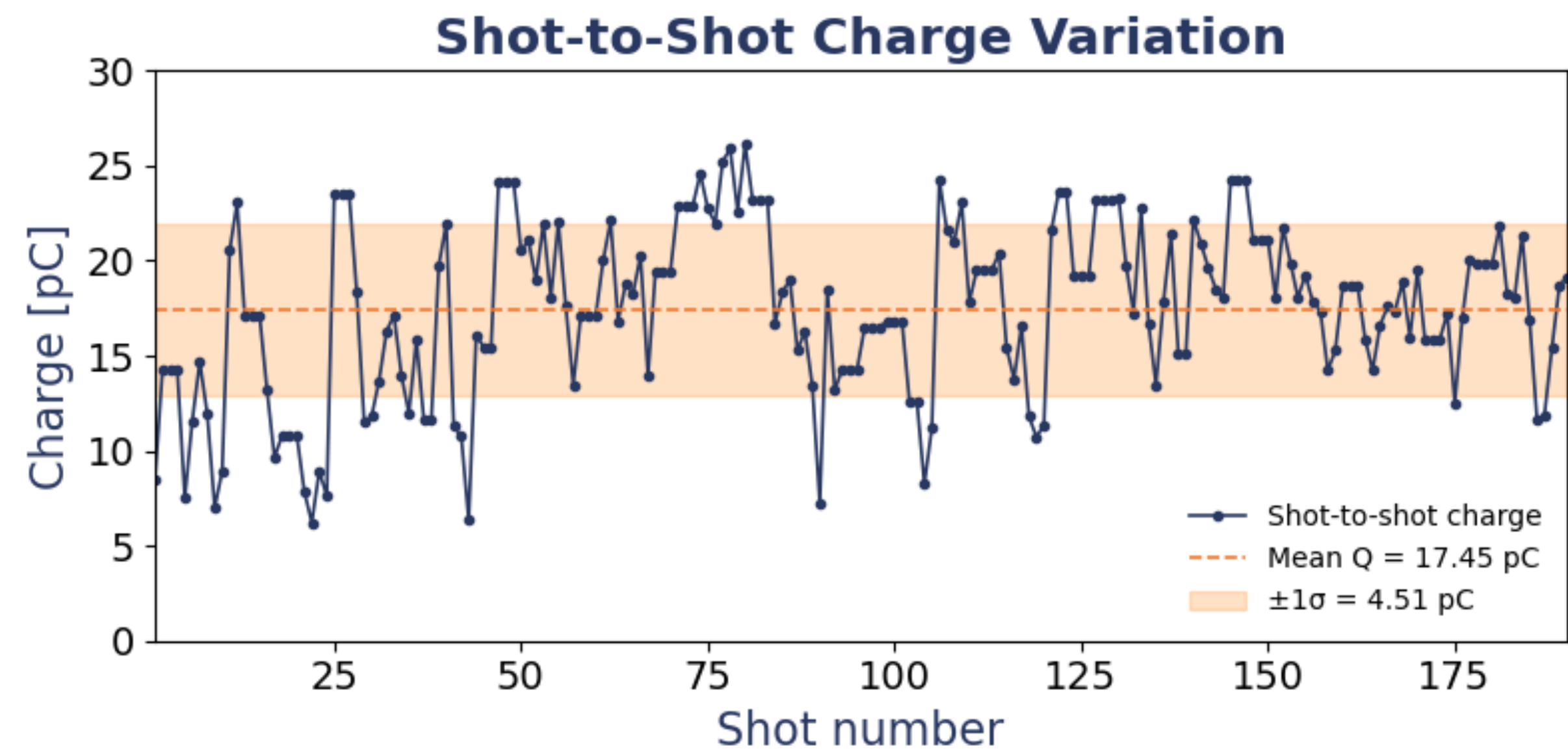
Plasma diagnostics:

- Probe beam for electron density
- Spectral diagnostics for dopant localisation via spectral emission lines

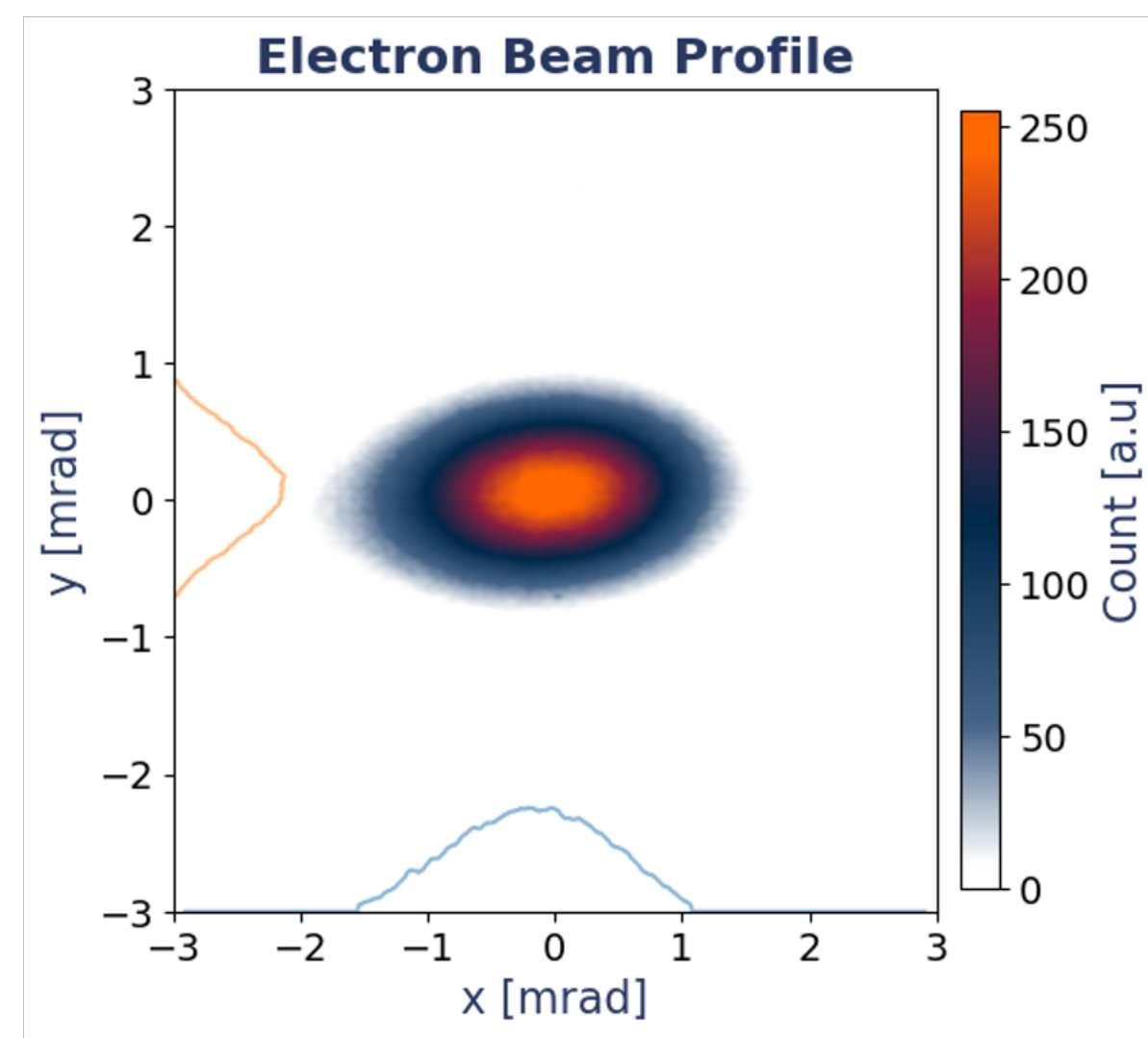
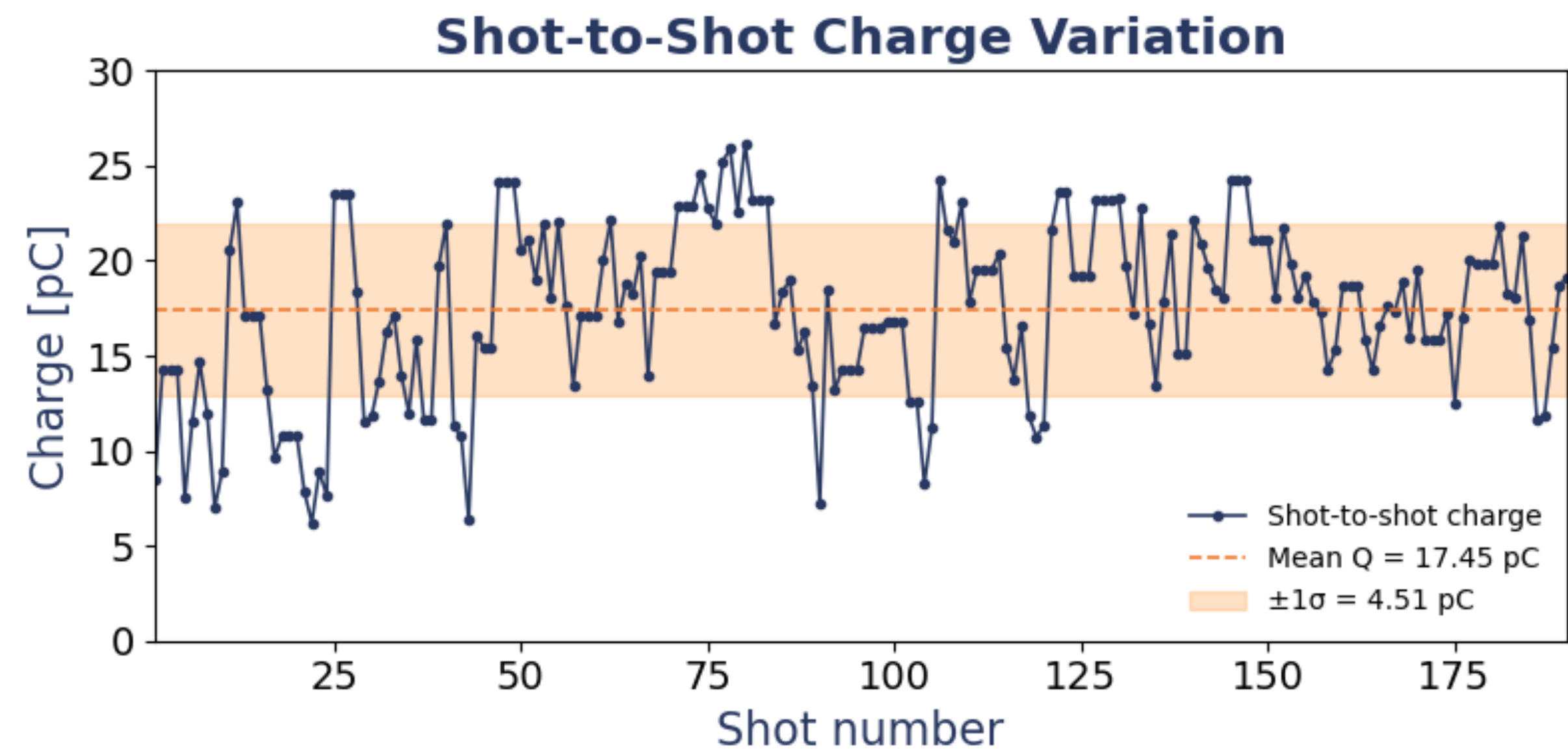


Electron Beam: First Results

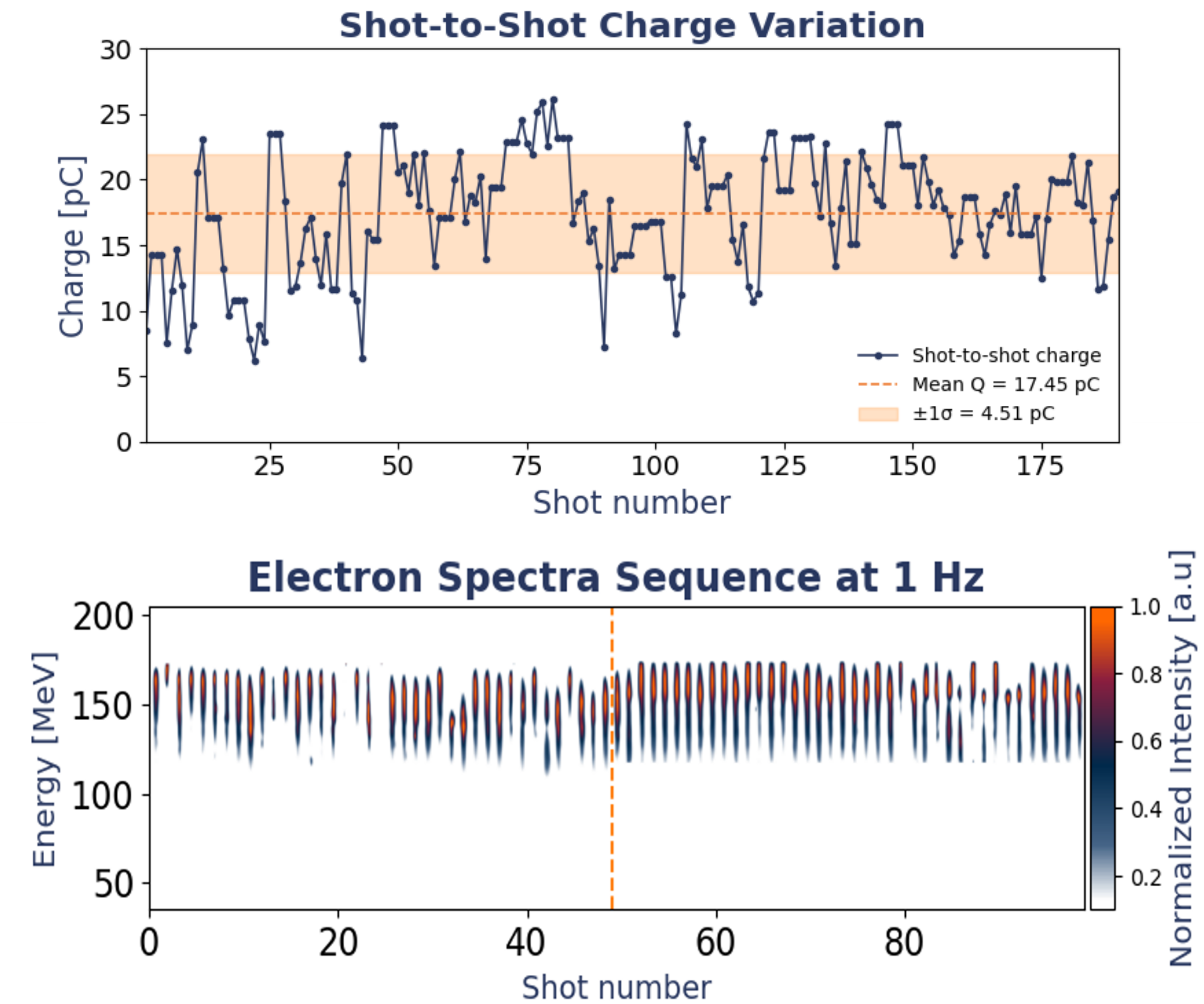
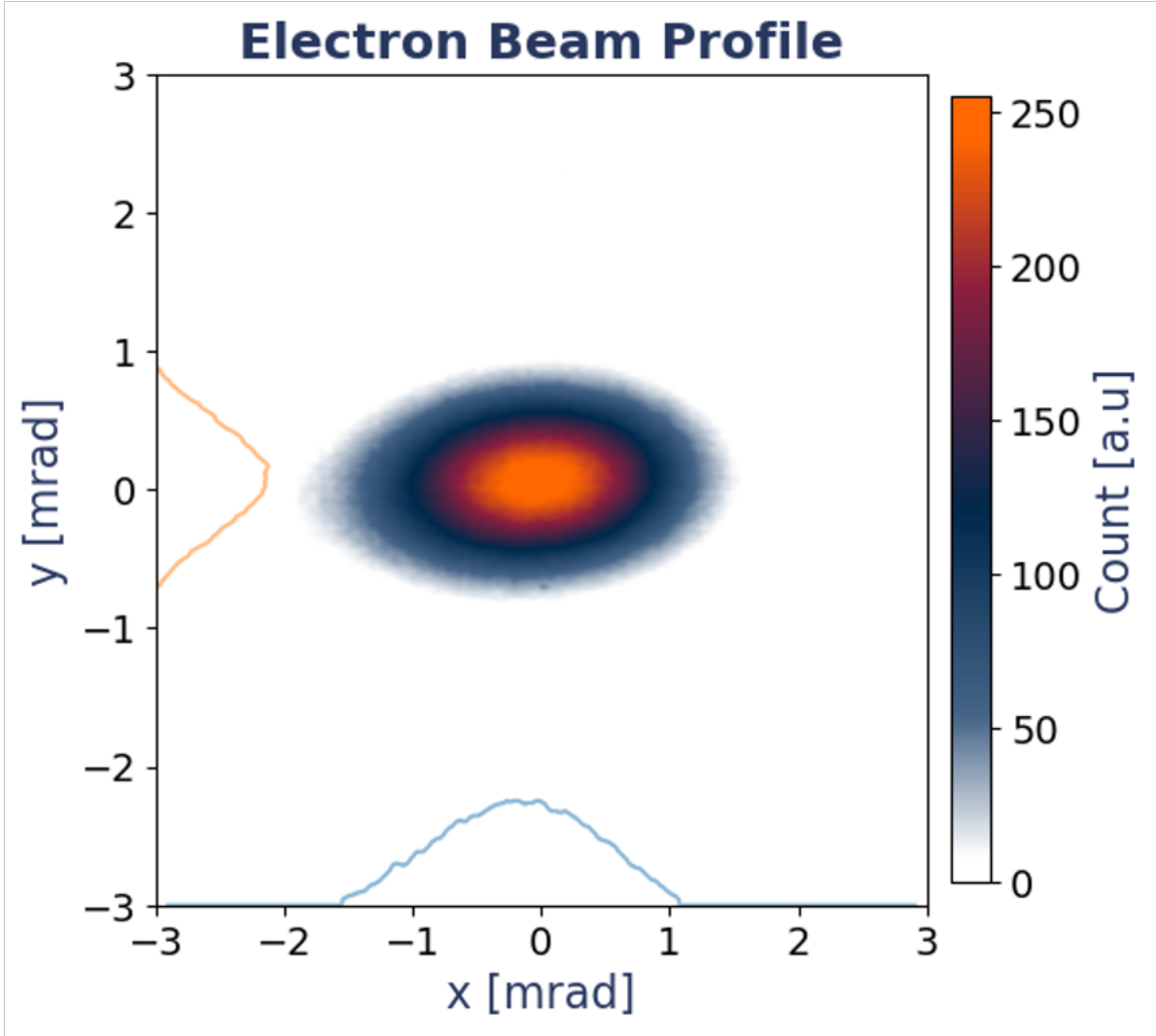
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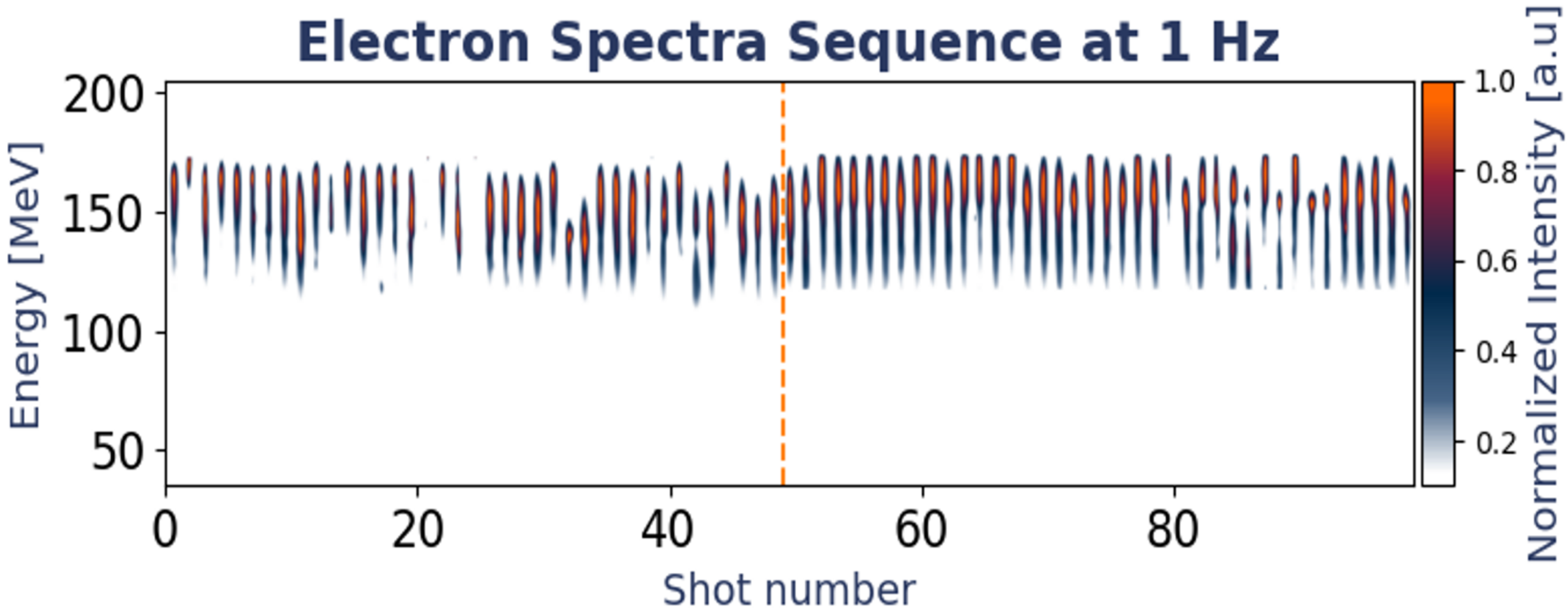
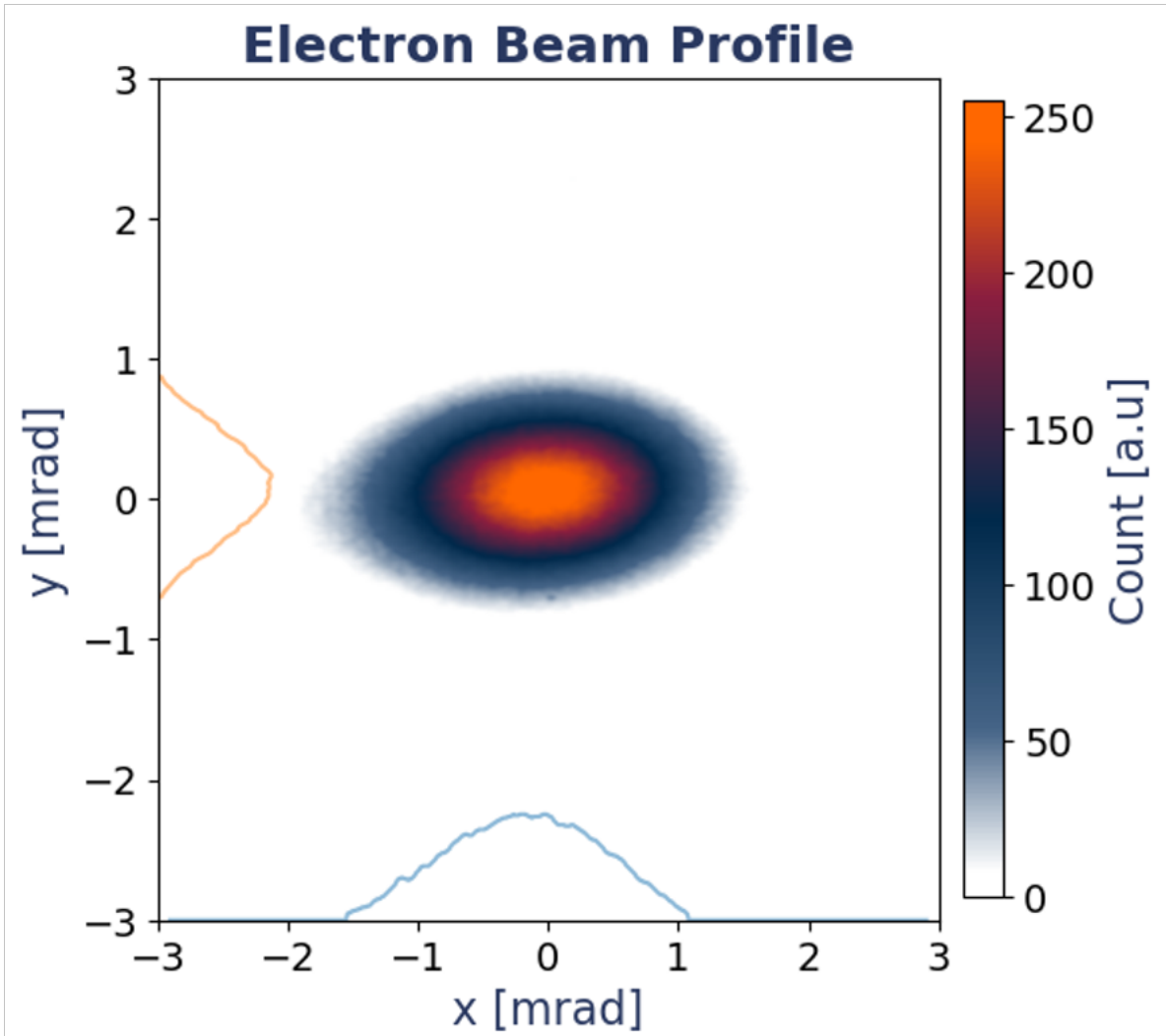
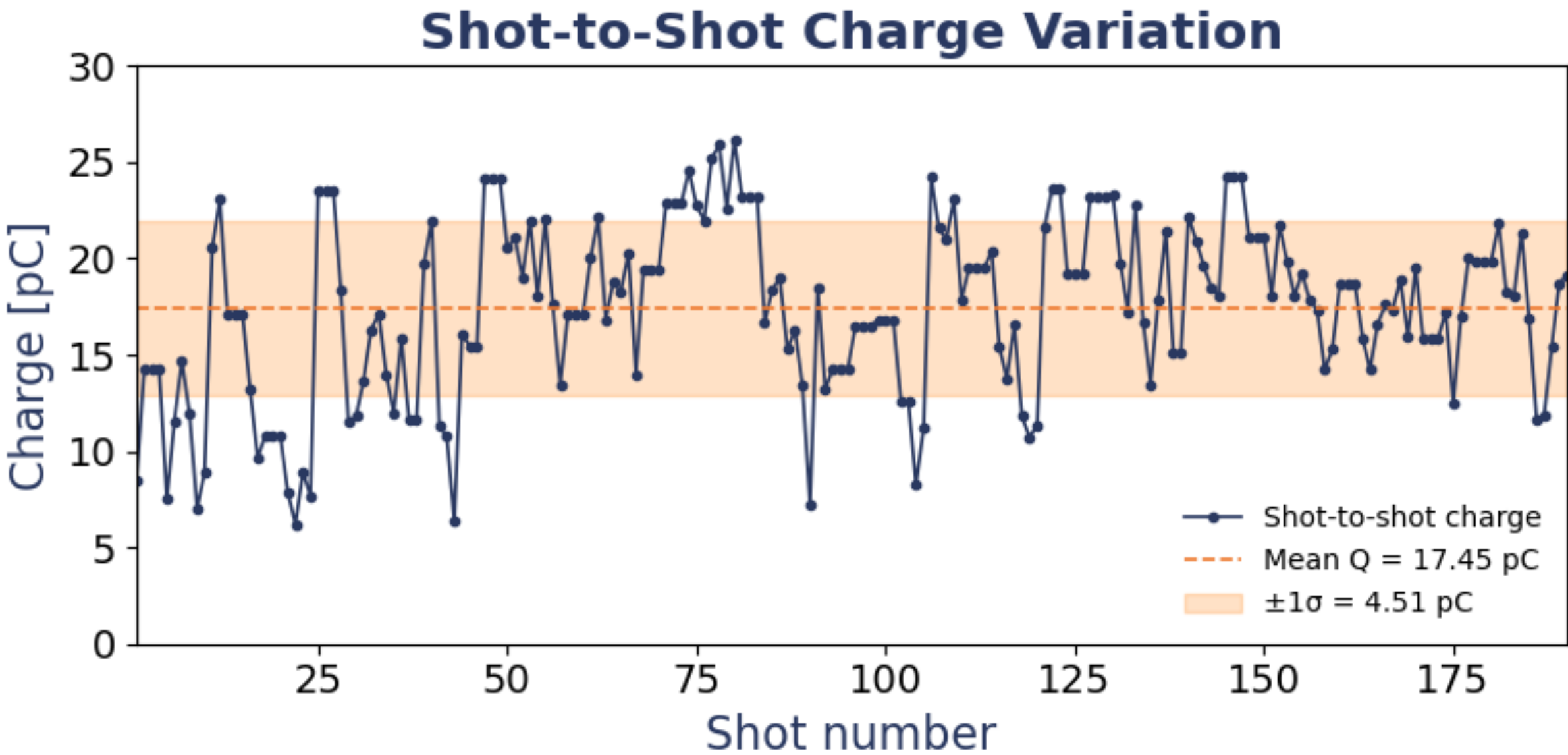


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Energy (E_{med})	[MeV]	150	140-160
Energy Spread (σ_E)	[MeV]	<7.5	18-100 (+)
Charge (Q)	[pC]	15-30	10 -25
Divergence (θ)	[mrad]	<5	0.8 x 1.2
Stability	[%]	5	15 -23

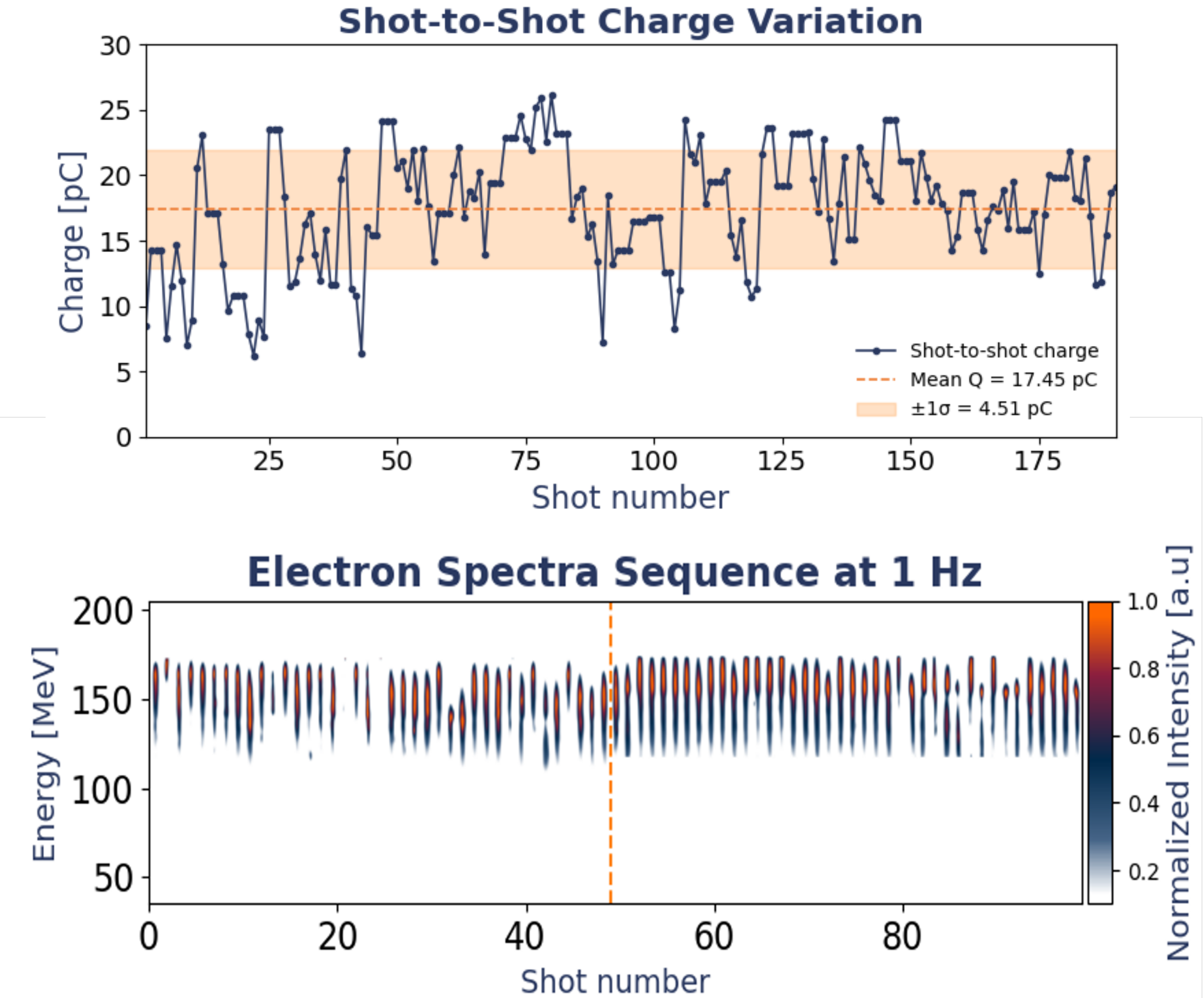


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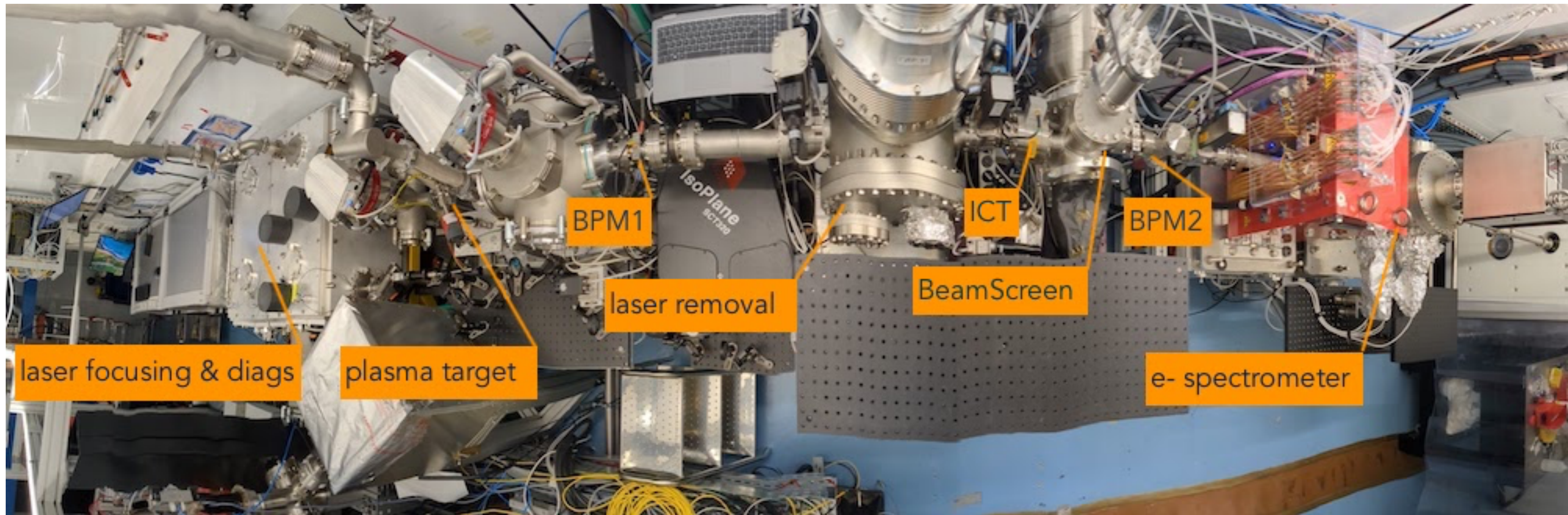
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Summary:

- Good energy and charge achieved, <2 mrad divergence.
- Stability needs improvement.



The Accelerator



The Team

