



Paper Rehearsal:

First measurement of escaping energetic ions
by the Faraday cup fast ion loss detector on
Wendelstein 7-X

Phys. Rev. Letter

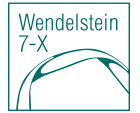


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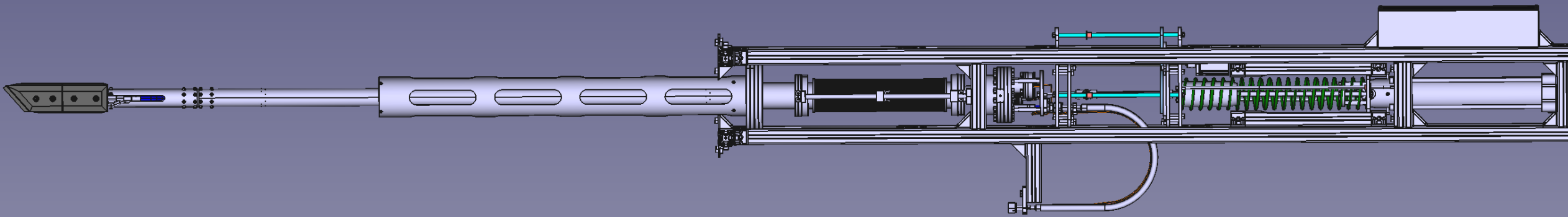
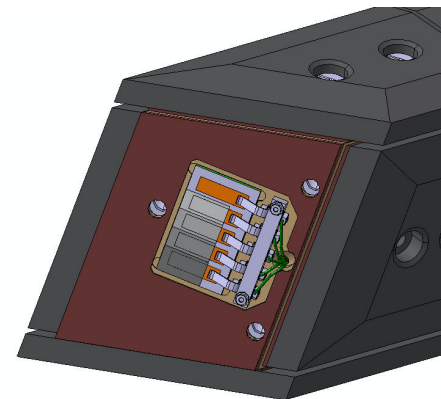
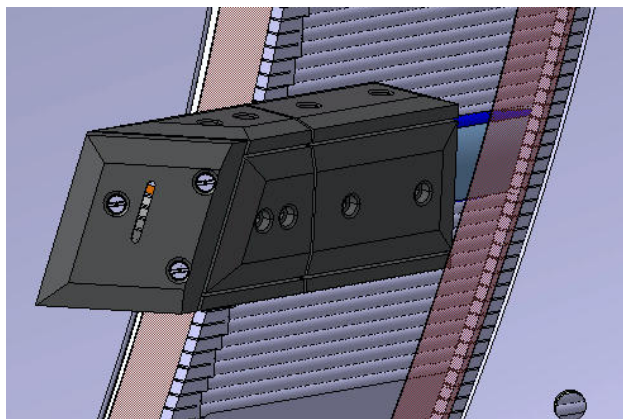
Scope of Paper (Abstract)



- **A prototype Faraday cup fast ion loss detector (FC-FILD) operated in OP2.1**
- **Demonstrated in-wall-tile mounting concept on reciprocating probe head**
- **Measurements made in outward shifted low shear magnetic configuration (MMG)**
- **Open path to arrays of in-wall-tile mounted detectors in future.**

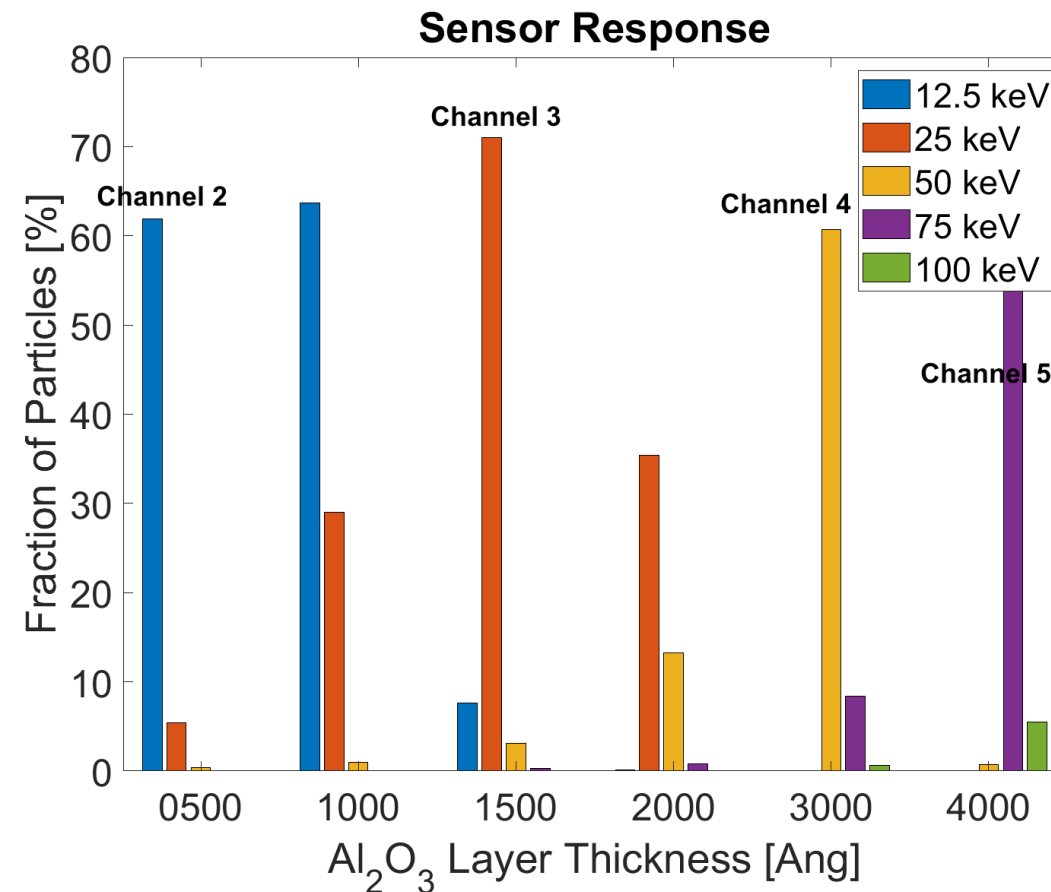
FC-FILD is a prototype to demonstrate diagnostic suitability for W7-X.

- Energy resolving fast ion loss detector
- Small form factor allows for in-wall-tile mounting concept
- Prototype demonstrates mounting concept.



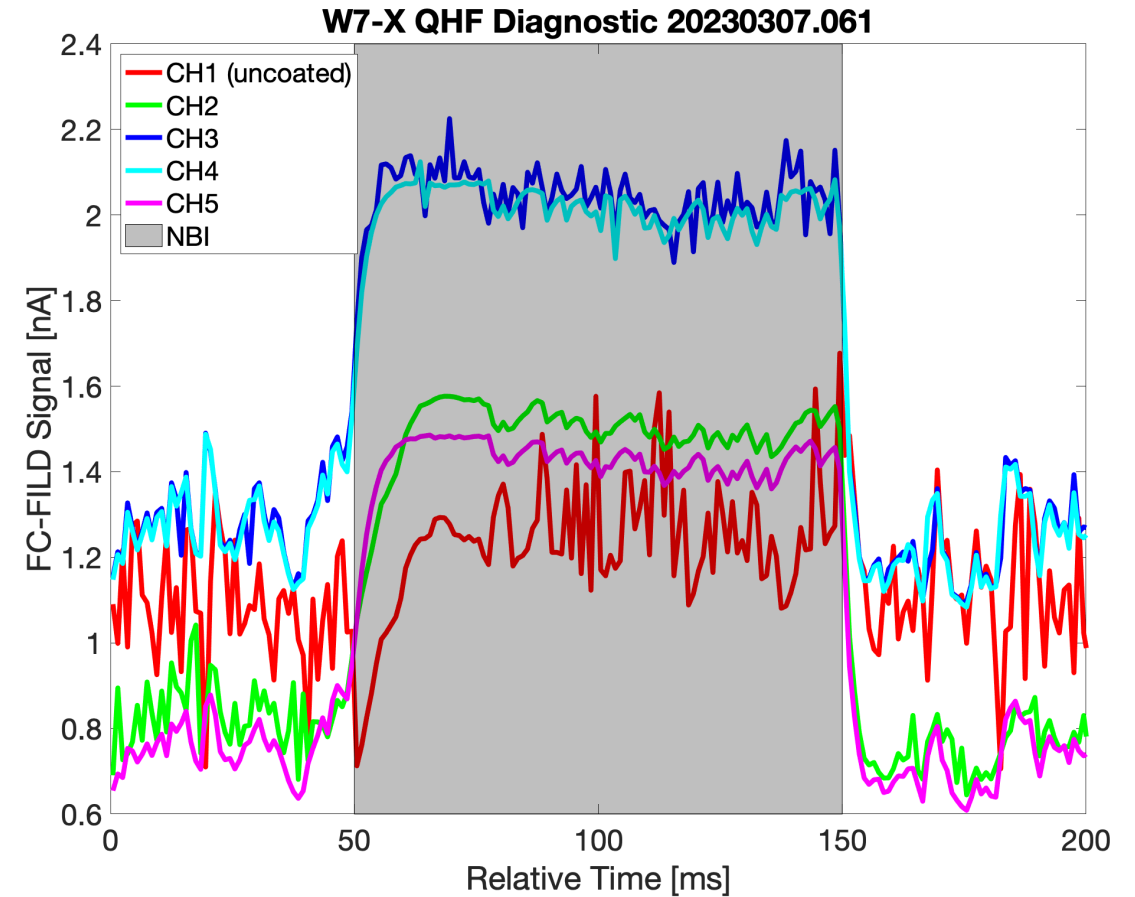
Sensor is stainless steel with 100 nm thick layers

- Stainless steel substrate
- Al₂O₃ insulating layer
- 100 nm thick Al fingers
- Variable thickness Al₂O₃ overlay for energy discrimination.



First measurement made in outward shifted low shear configuration

- NBI S4 continuous S7 5 Hz 50% Duty cycle
- Average over 5 cycles
- Relative signals consistent with power.

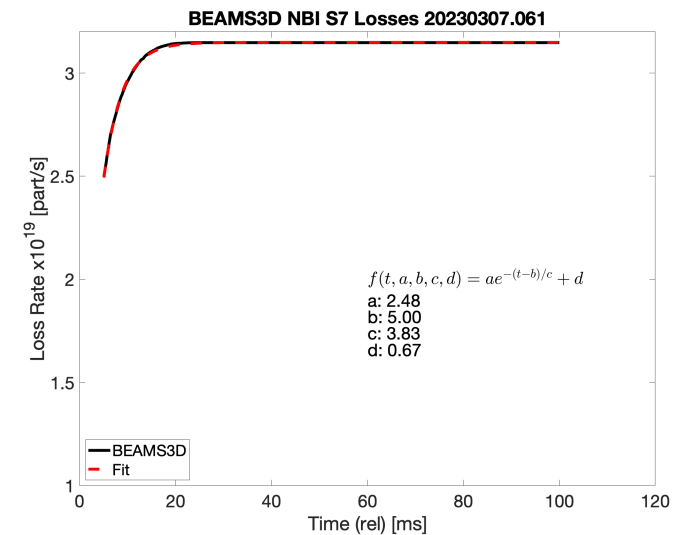
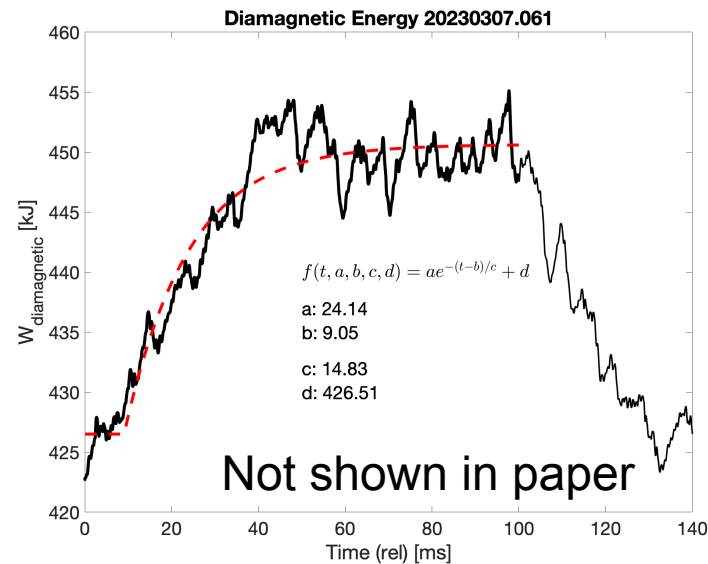
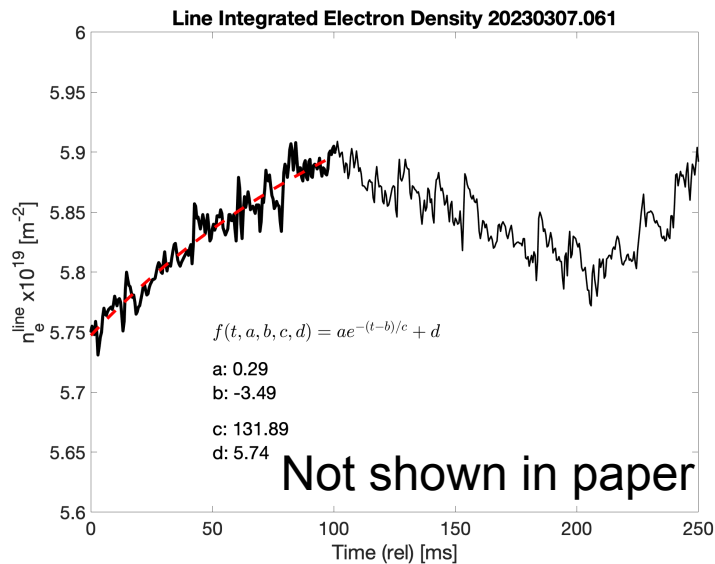
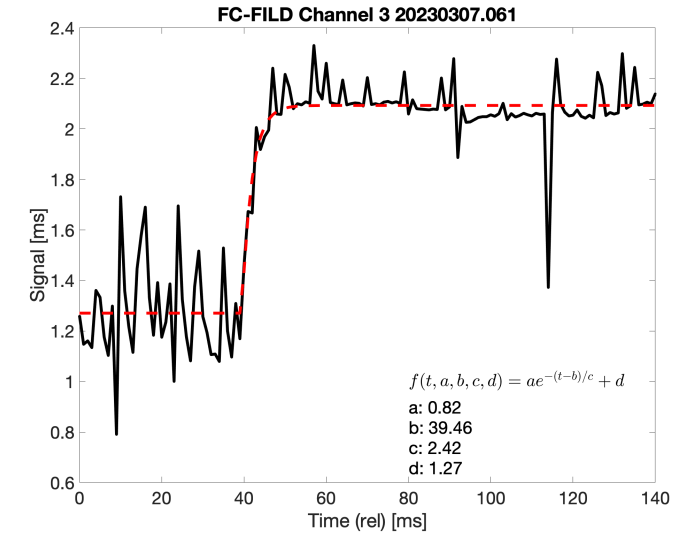


Signal well correlated with NBI blips not plasma changes



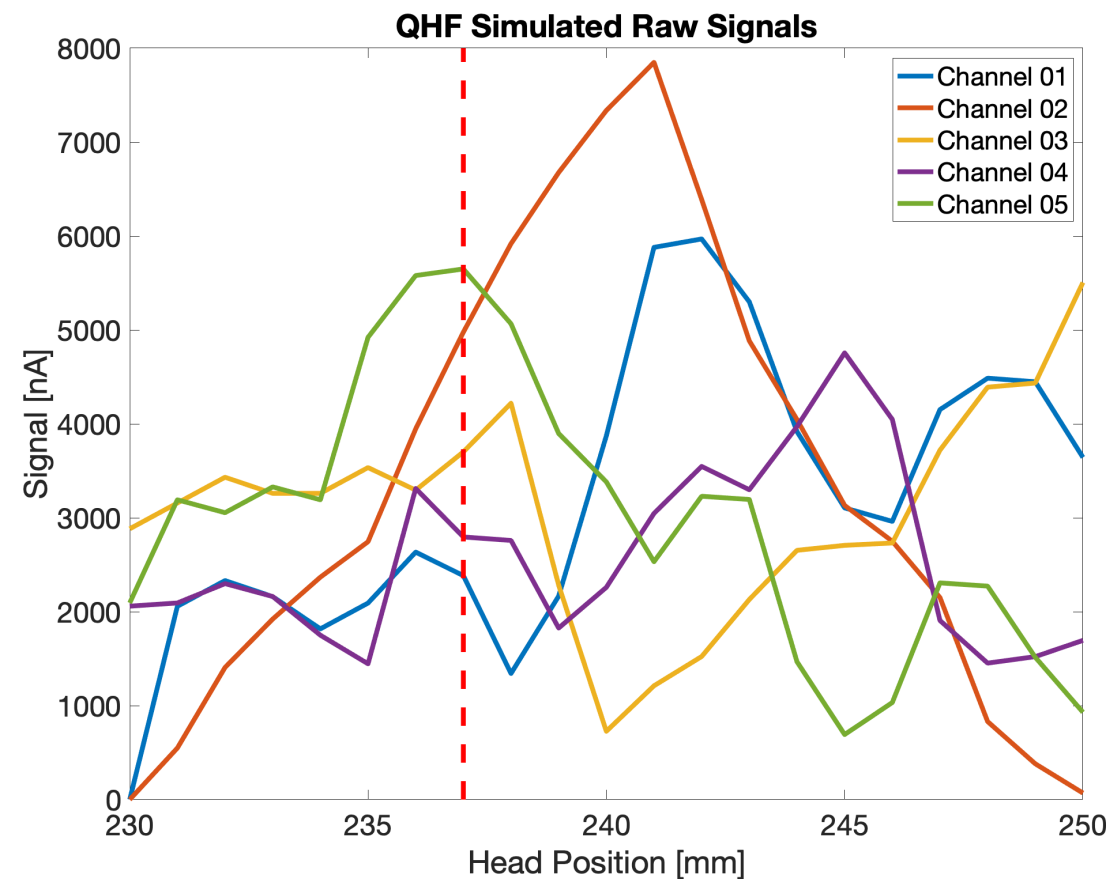
TABLE I. Fit parameters for rise time of FC-FILD signals. Upper (c_{upper}) and lower (c_{lower}) 95% confidence intervals for fit are shown. Coefficient has units of ms.

Channel	c_{lower}	c_{fit}	c_{upper}
1	-10.6	3.3	17.2
2	2.47	4.28	6.09
3	0.868	2.42	3.98
4	1.46	2.99	4.52
5	2.43	3.42	4.41



Discrepancy exists between simulated and measured amplitudes

- BEAMS3D NBI gyro center to LCFS
- Collisionless gyro orbit to detector head
- Gyro orbit backtracked $60 \mu\text{s}$
- Gyro orbit filled with 360 markers and followed forward
- Channel signal extracted (no energy filtering)



Upgrades for future campaigns



- Aperture design limited access to sensor.
- Future sensors to use thru-hole design to allow for nearly flush-mount of sensor to carbon tile face.
- In the interim the sensor has been moved to improve signal while still protecting the electrical contacts.

