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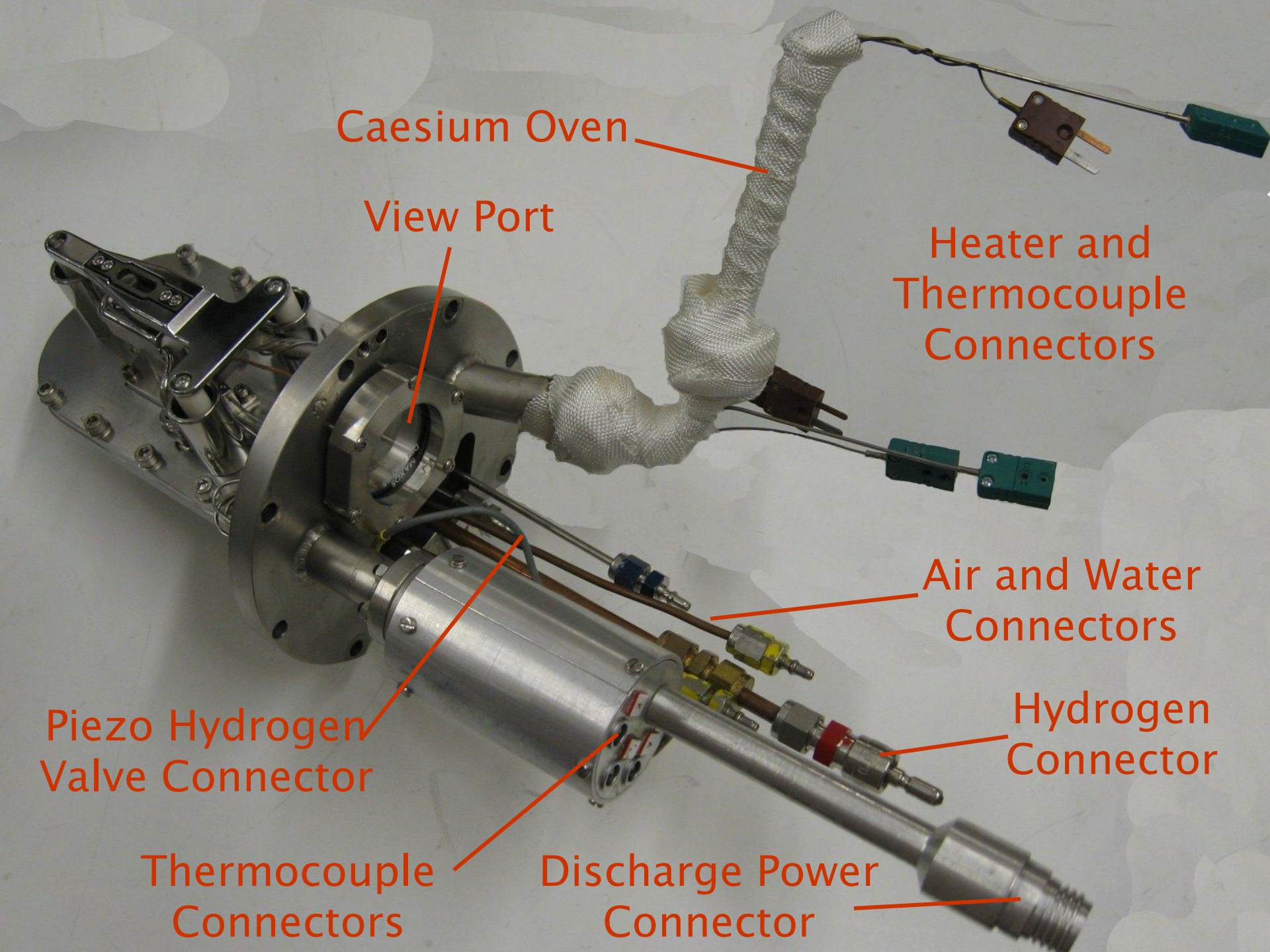
Introducing the VESPA

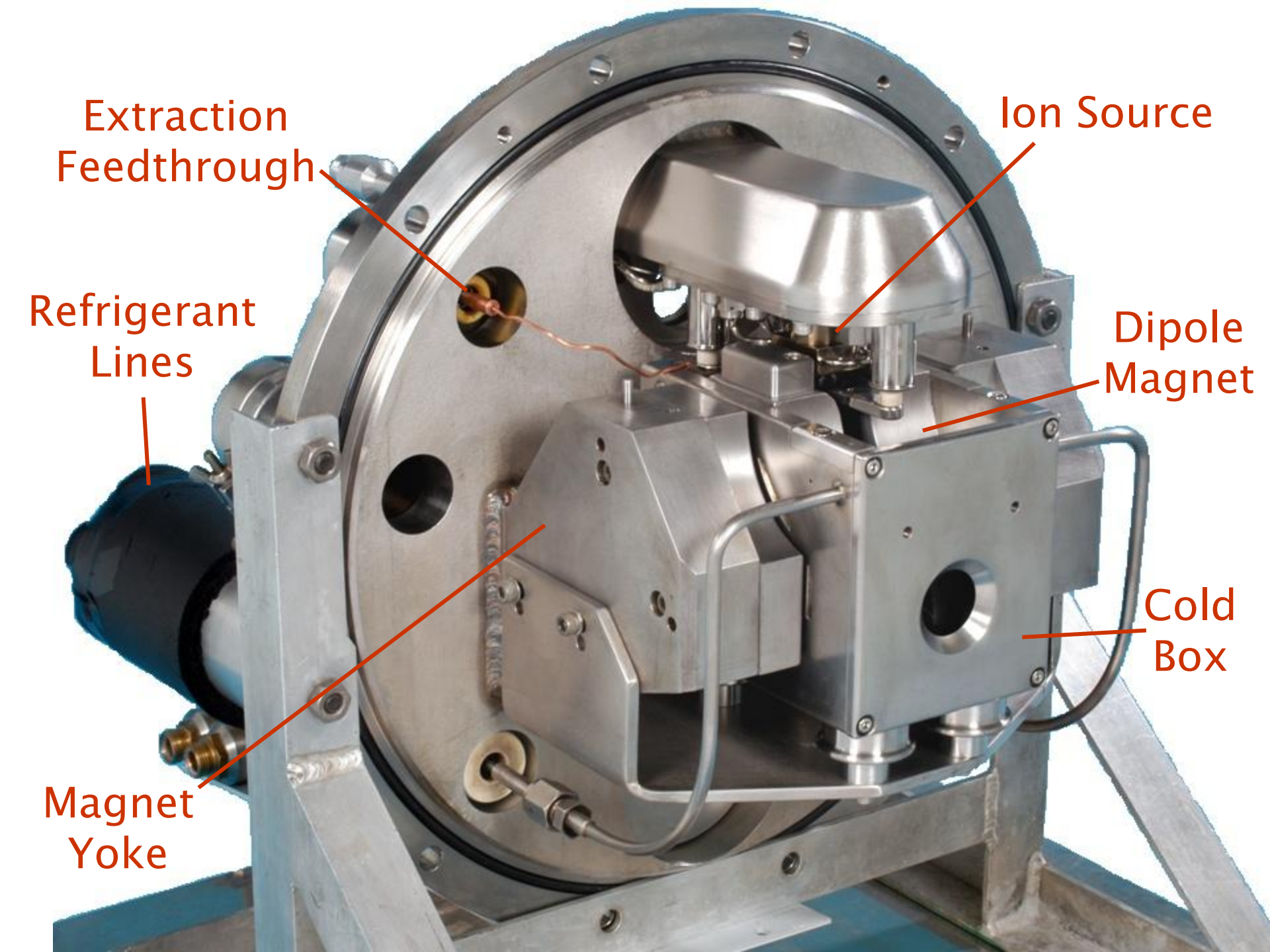
FETS Meeting

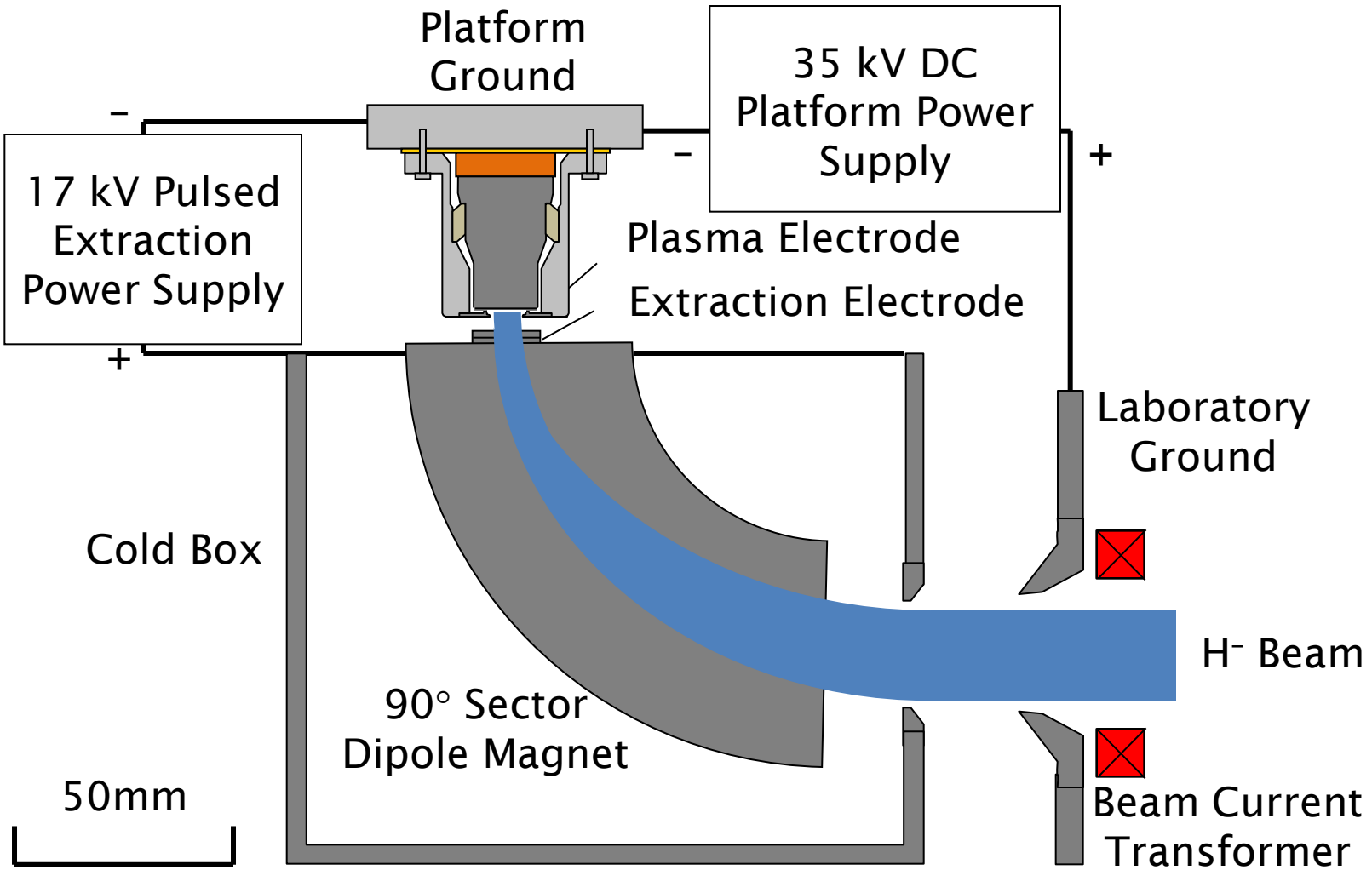
27th June 2012

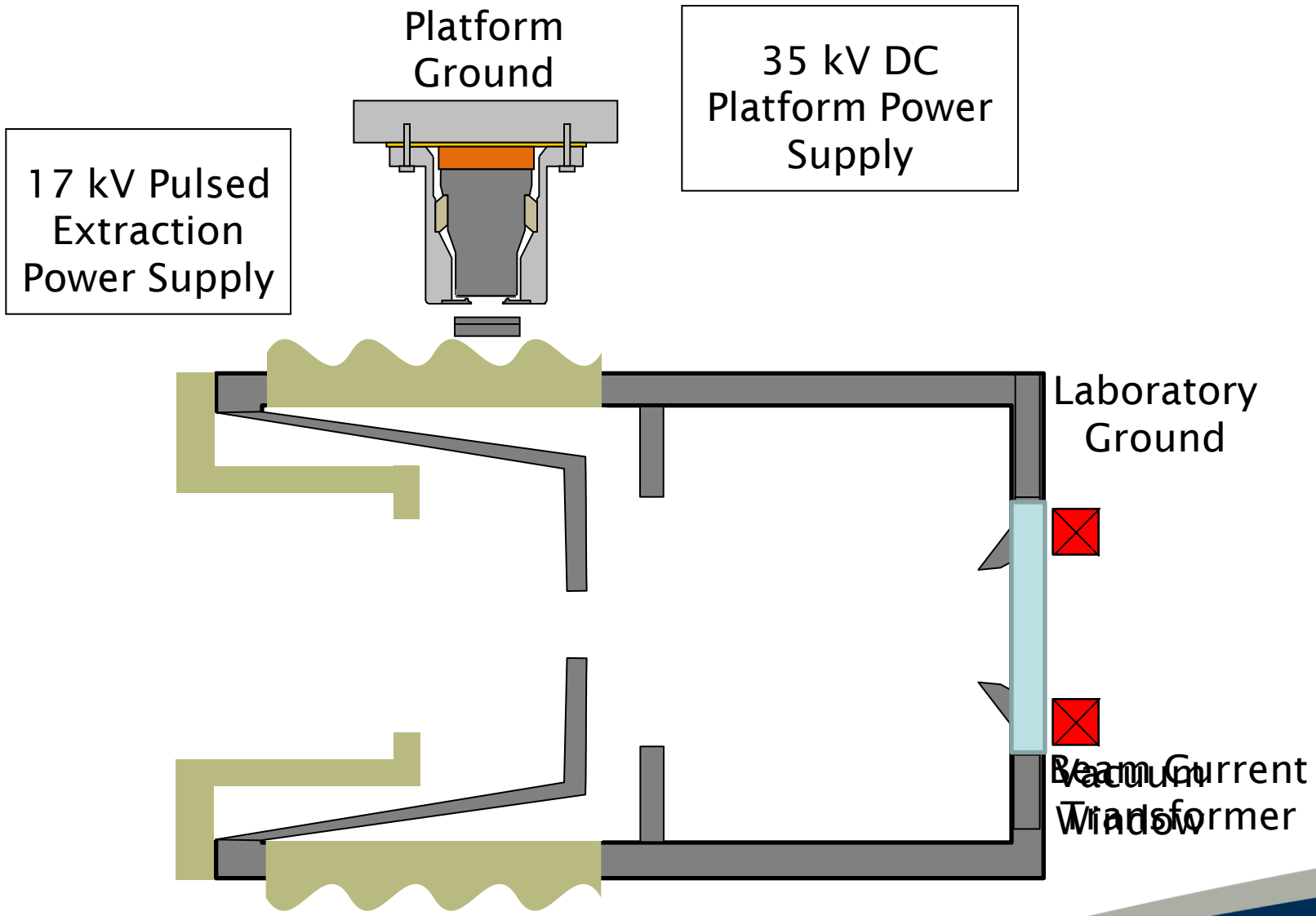
Ion Source R&D

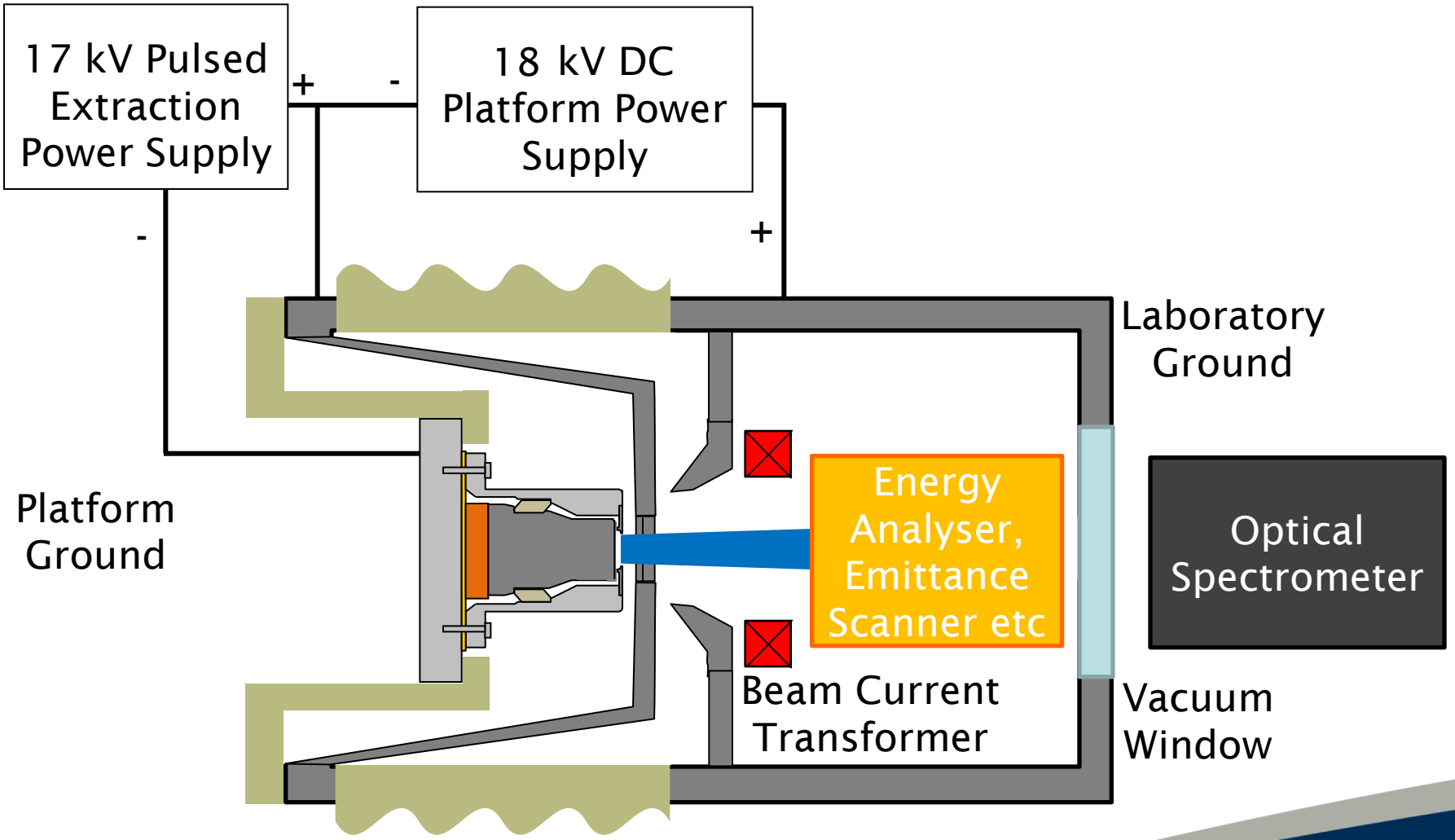
- Post-acceleration, Sector Magnet, Extraction…
- Don’t know what beam source actually makes!
- No plasma studies; don’t know starting conds.
- Want a dedicated plasma test stand
- Perform detailed plasma and extraction studies


Caesium Oven
View Port
Heater and Thermocouple Connectors
Air and Water Connectors
Hydrogen Connector
Piezo Hydrogen Valve Connector
Thermocouple Connectors
Discharge Power Connector


Extraction Feedthrough
Ion Source
Refrigerant Lines
Dipole Magnet
Cold Box
Magnet Yoke

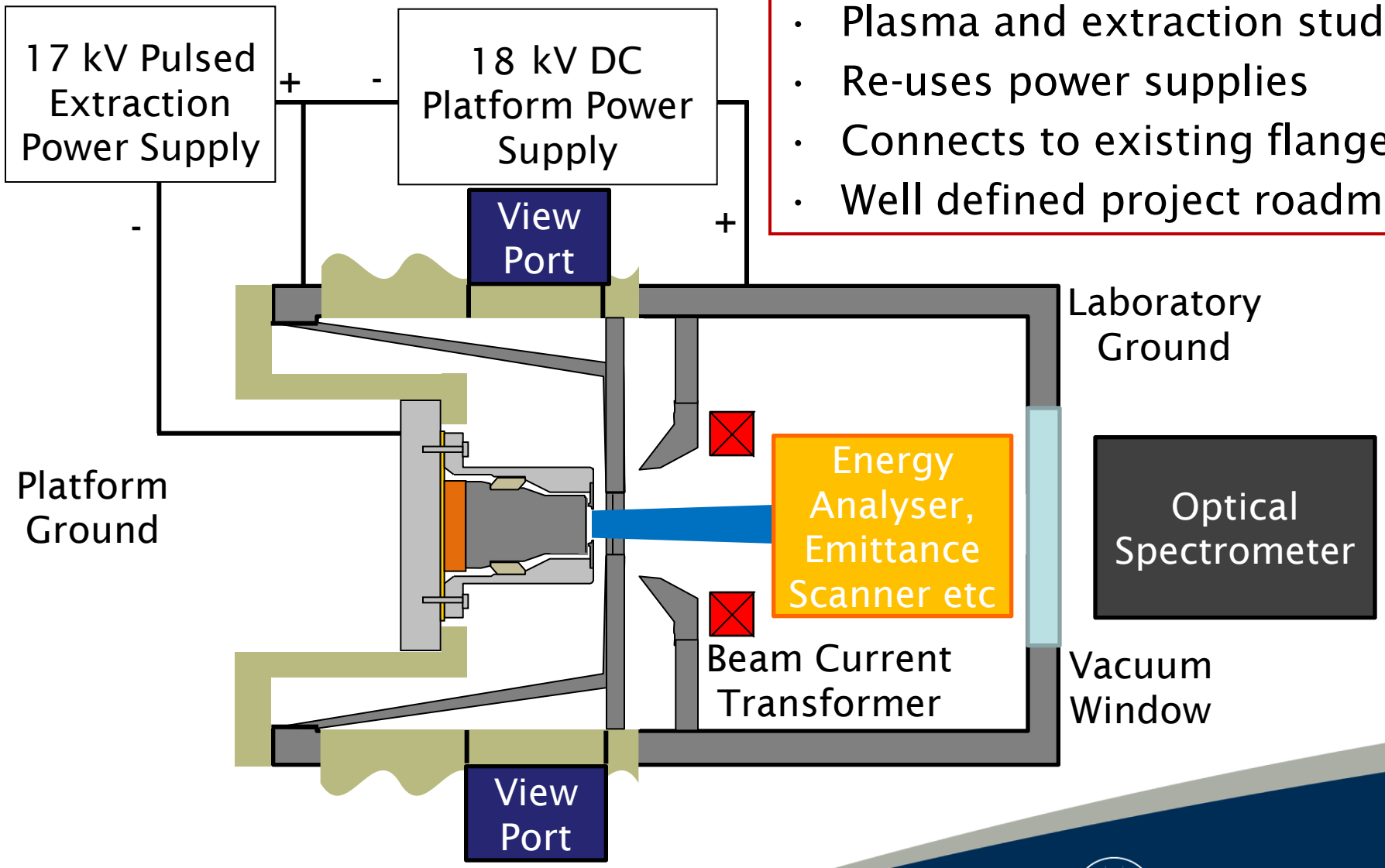

Platform
Ground
35 kV DC
Platform Power
Supply
17 kV Pulsed
Extraction
Power Supply
Plasma Electrode
Extraction Electrode
Laboratory
Ground
Cold Box
H⁻ Beam
90° Sector
Dipole Magnet
50mm
Beam Current
Transformer


Platform Ground
35 kV DC Platform Power Supply
17 kV Pulsed Extraction Power Supply
Laboratory Ground
Vacuum Window
Beam Current Transformer


17 kV Pulsed Extraction Power Supply
+
-
18 kV DC Platform Power Supply
-
+
Laboratory Ground
Platform Ground
Energy Analyser, Emittance Scanner etc
Optical Spectrometer
Beam Current Transformer
Vacuum Window

Benefits:

- More simple and compact
- Plasma and extraction studies
- Re-uses power supplies
- Connects to existing flanges
- Well defined project roadmap



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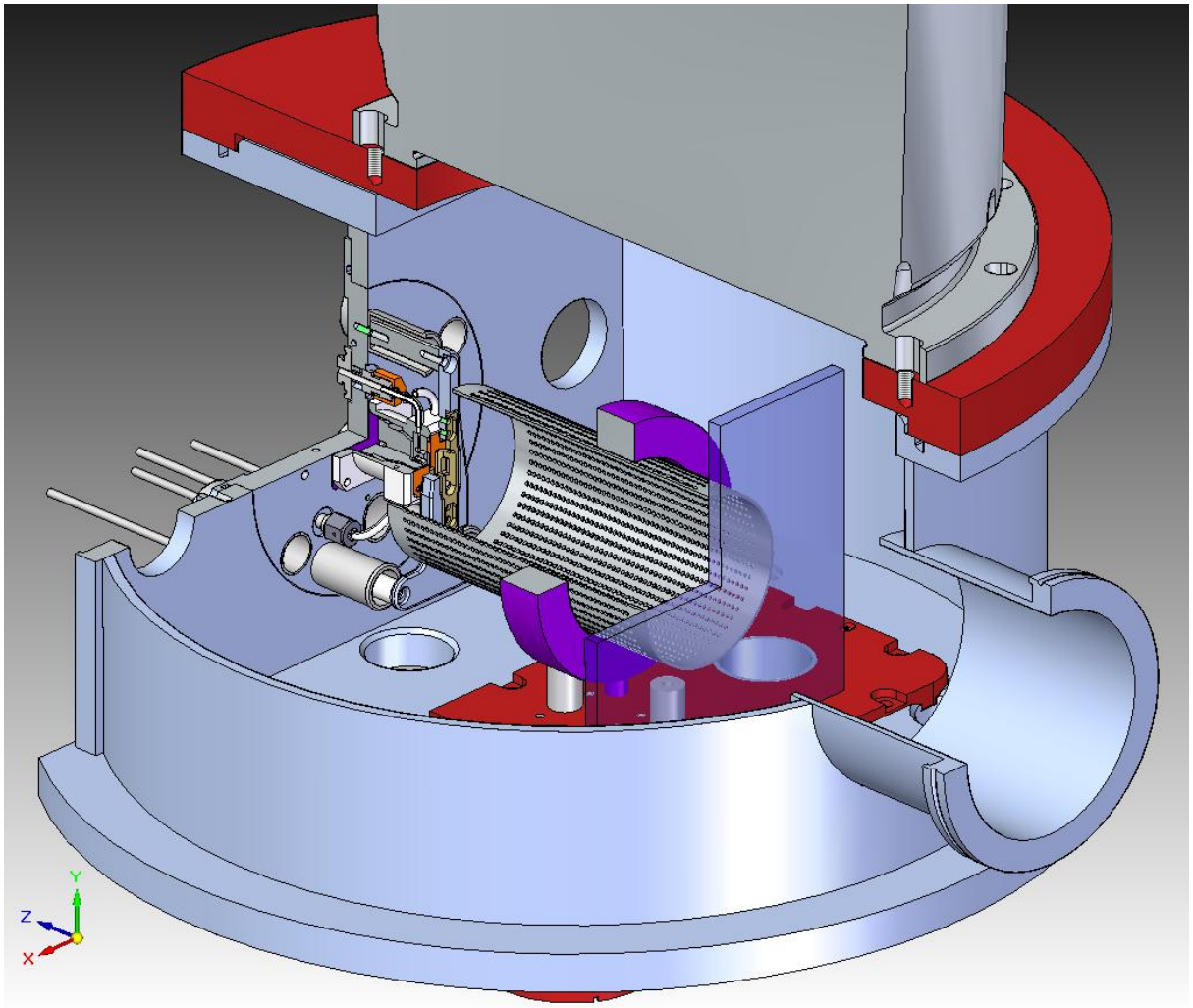
Vessel for Extraction and Source Plasma Analyses: **VESPA**

VESPA Mk. 1	VESPA Mk. 2
'Top-Loader' vessel	New bespoke vessel
One voltage stage	Full multi-volt extraction
Beam current & profile	Particle energy analyser, emittance scan, caesium mass deposition… etc
Initial spectrometer study	Multi-position spectro.
Standard ion source	Source fully modifiable
Cost estimate: £2,000	Cost estimate: £10,000

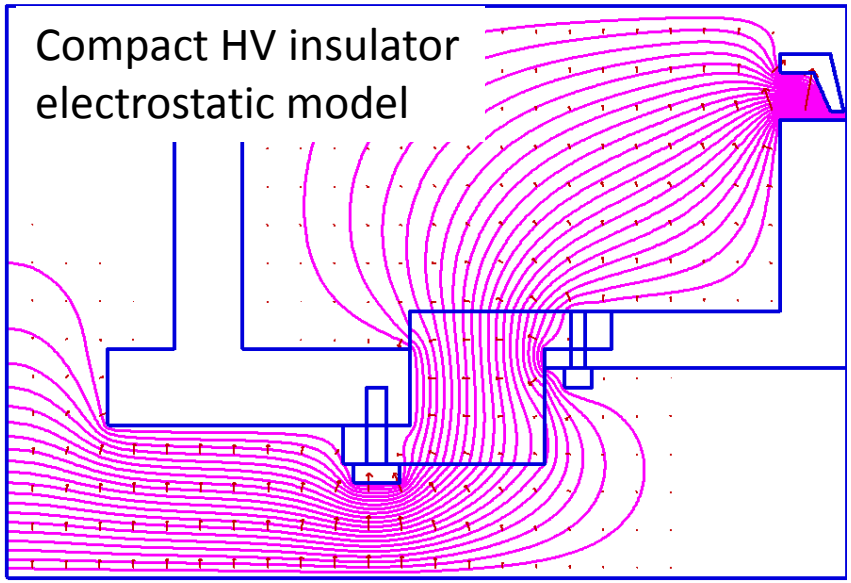
VESPA Mk. 1 ('Top-Loader')



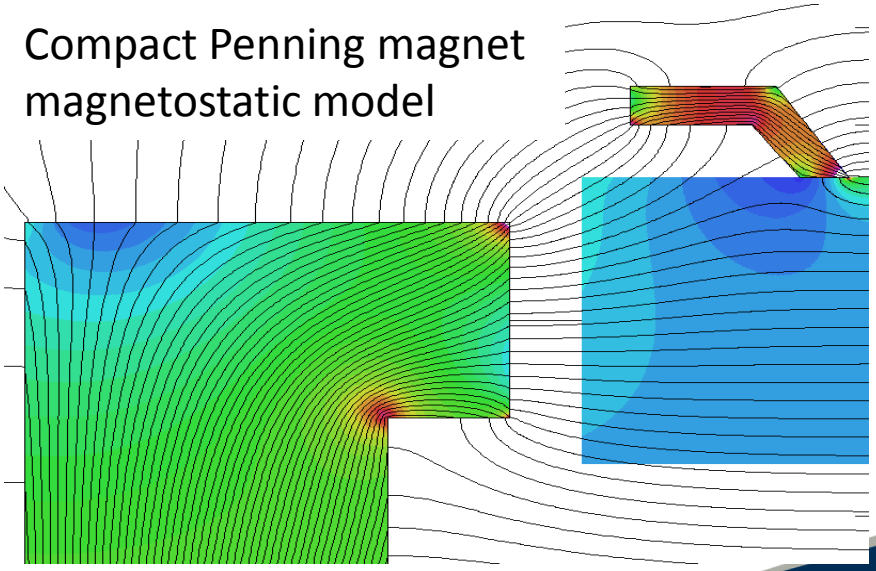
To do:

- Manufacture red parts
- Vacuum leak test
- Install on FETS platform
- Calibrate spectrometer
- Measure plasma params.
- Design VESPA Mk. 2
- Purchase beam diags.
- Beam extraction
- Plasma simulations

Electromagnetic Modelling

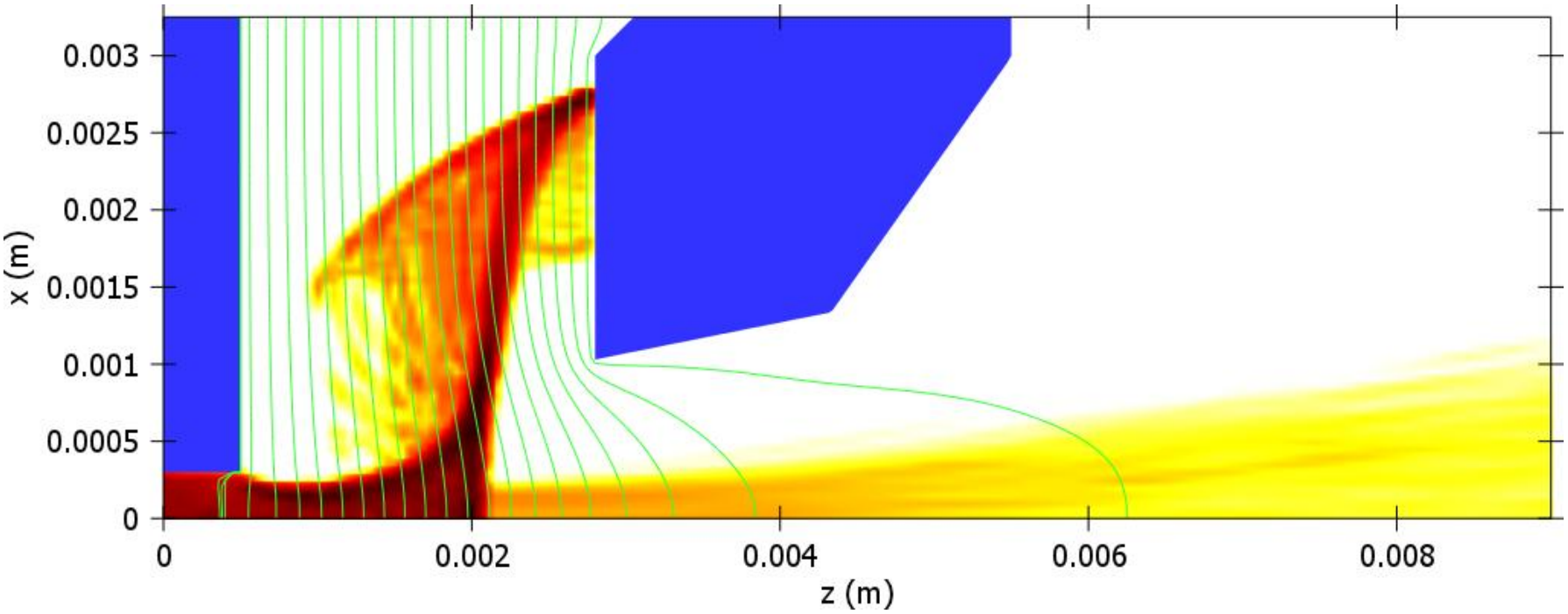


- New extraction insulator
- Material choice and size designed suitable for 25 kV
- Compact for deep source penetration into vessel



- Small EM yoke saturates → use permanent magnets
- Ferromagnetic puller shapes field lines for e^- dumping

Beam Extraction Modelling



- First real plasma and extraction simulation of ISIS ion source
- Now know about plasma meniscus curvature → very concave
- Now understand beam asymmetry → electron space charge effect
- Implemented e^- dump → experimental test soon

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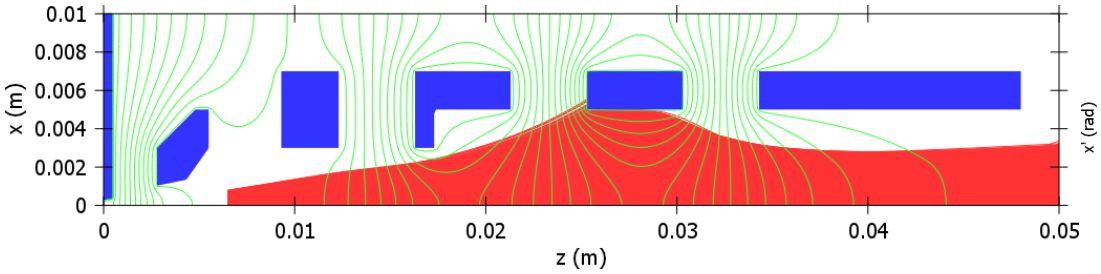
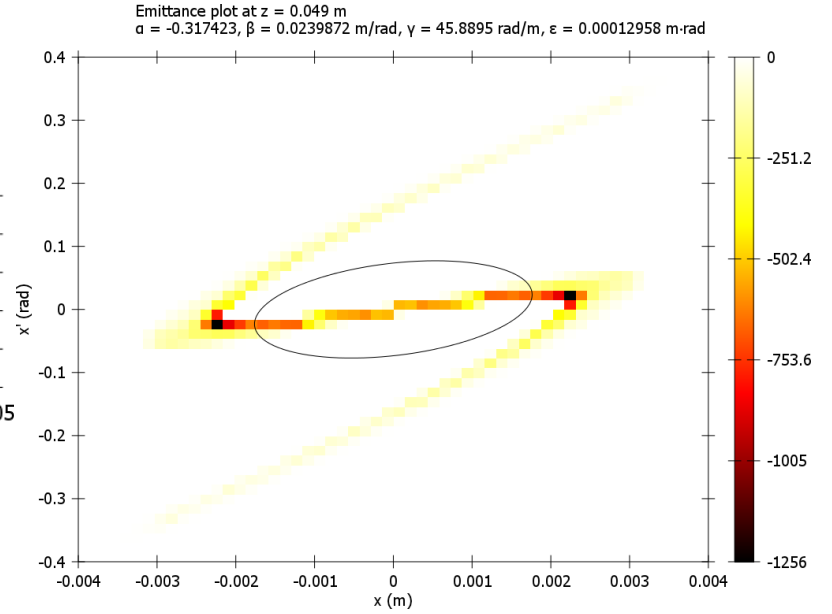
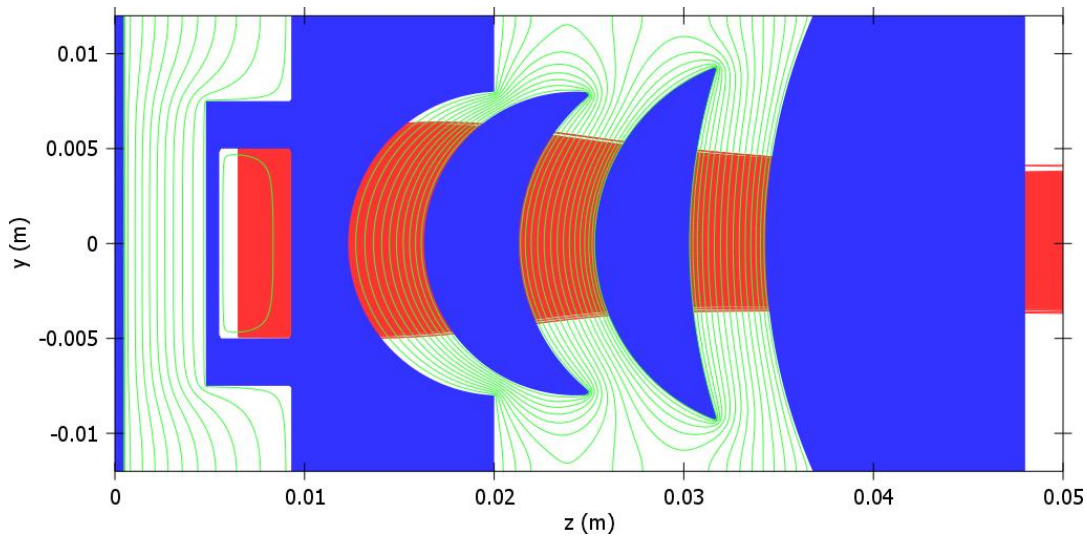
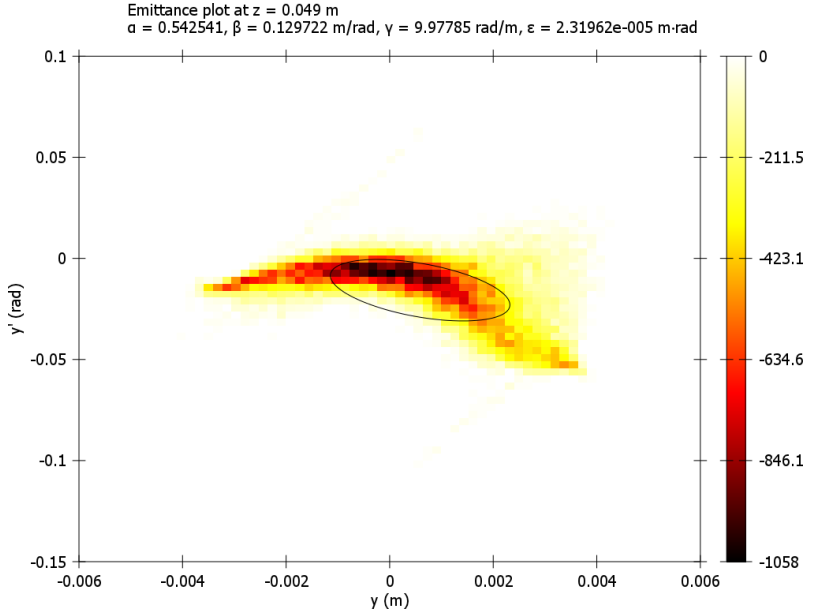
Electrostatic ‘Transaxial Lens’

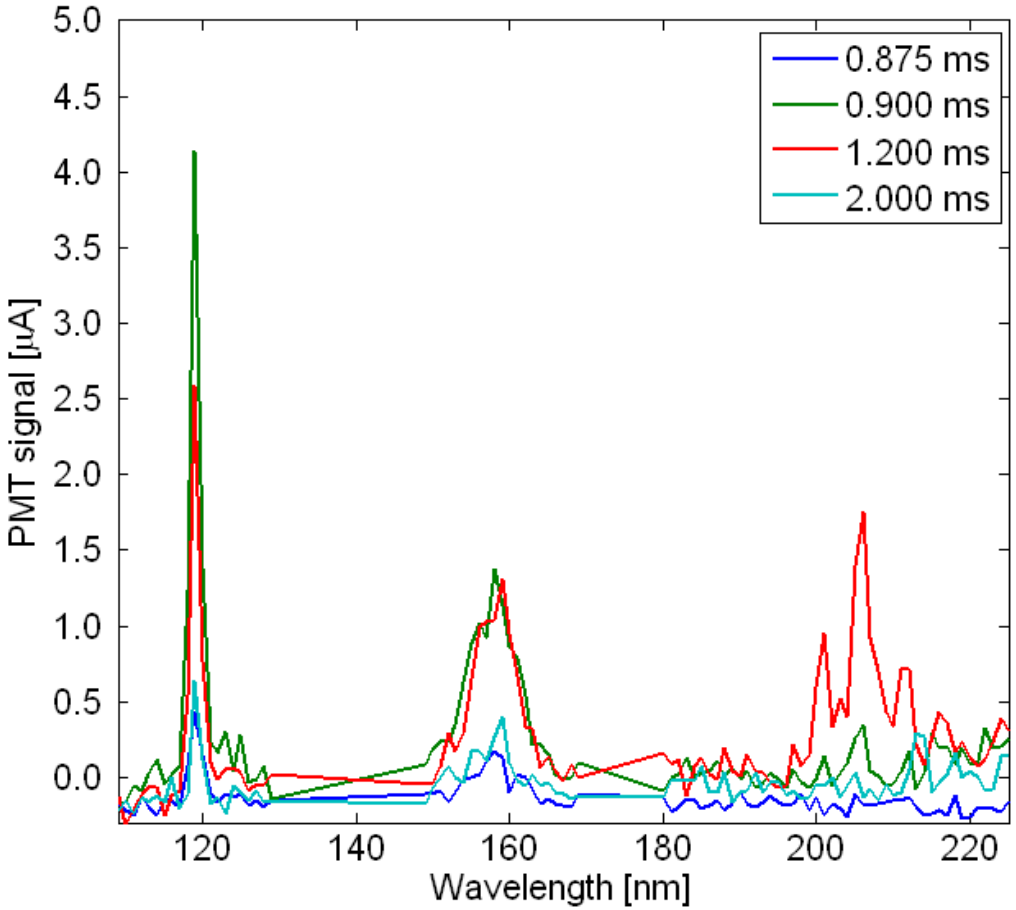


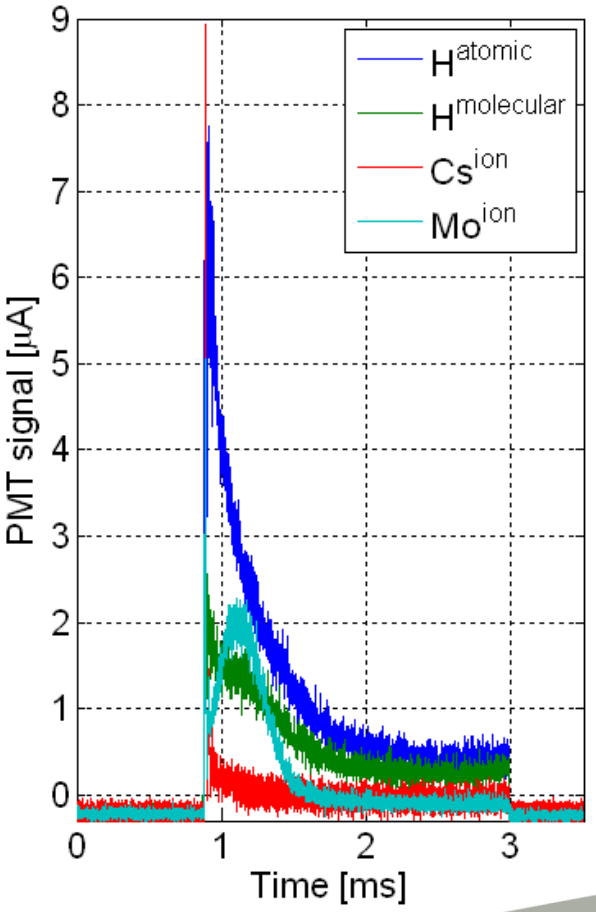






VUV Spectroscopy Experiments





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Summary

- VESPA needed for further source upgrades
- Configurable and cost-effective
- EM and beam simulations performed
- VUV spectroscopy → continue in optical
- Detailed plasma studies to commence
- Extraction studies to follow