

Development of a Gas Stopper for Heavy Elements Chemistry at Texas A&M University

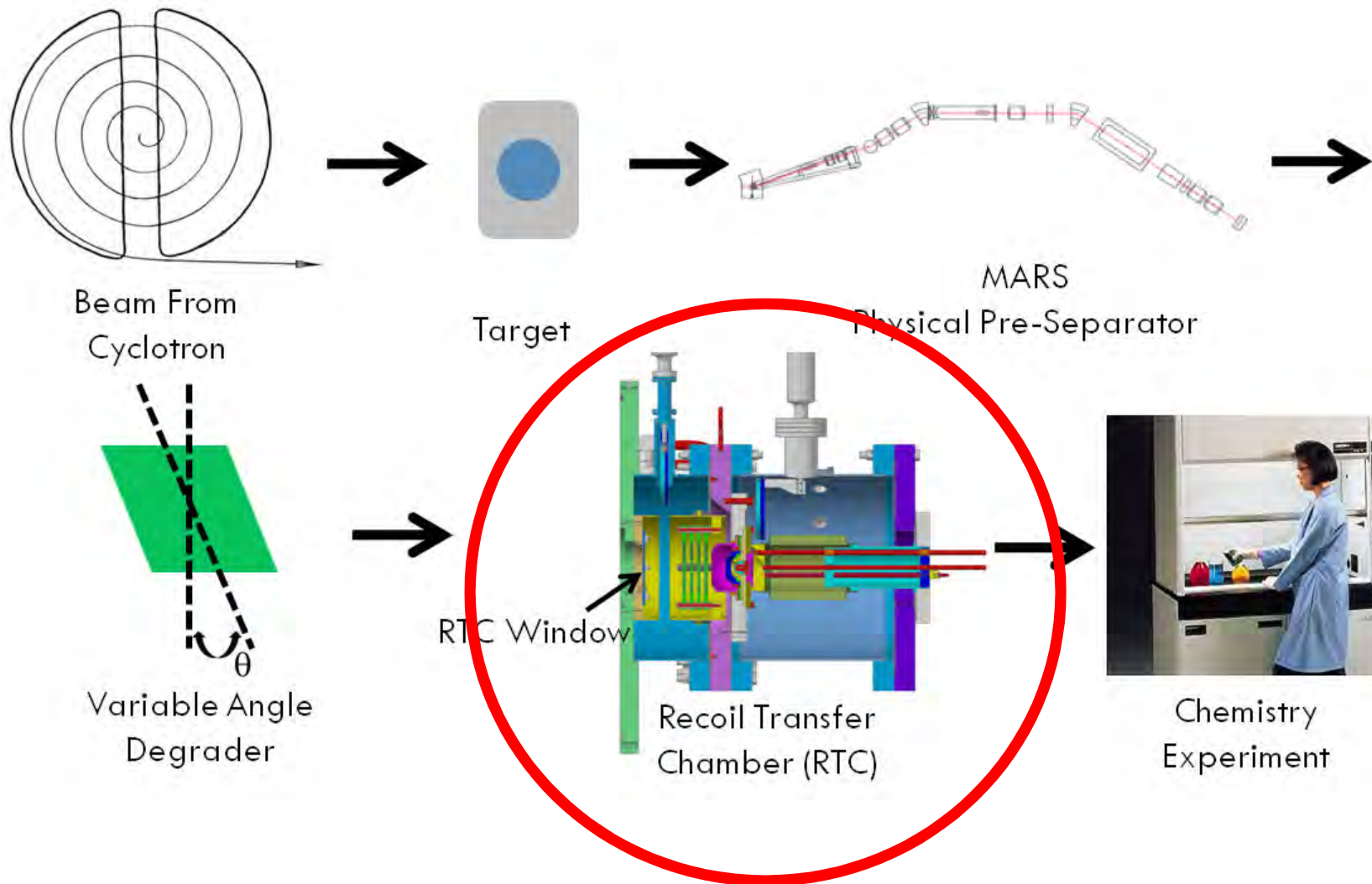
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and C. M. Folden III^{*}

**The Cyclotron Institute at Texas A&M University, College Station, TX*

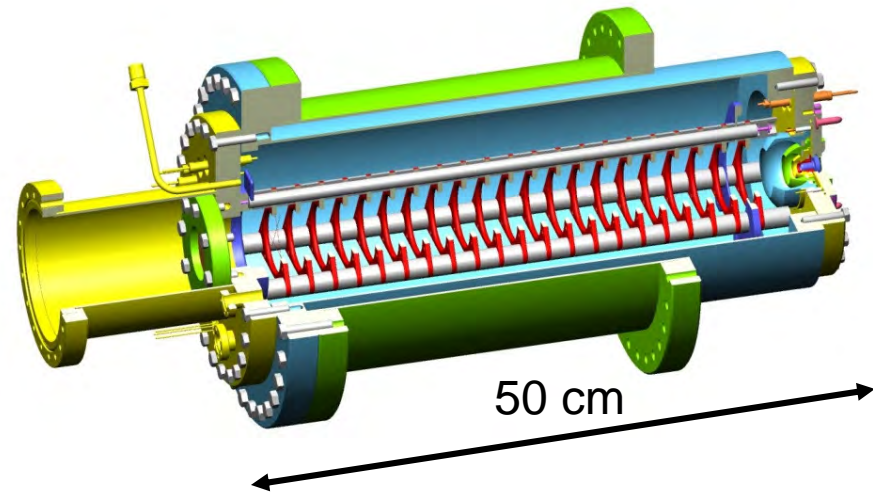
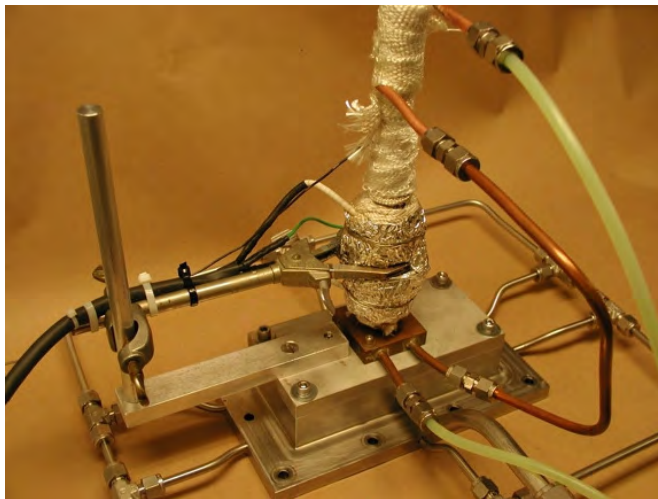
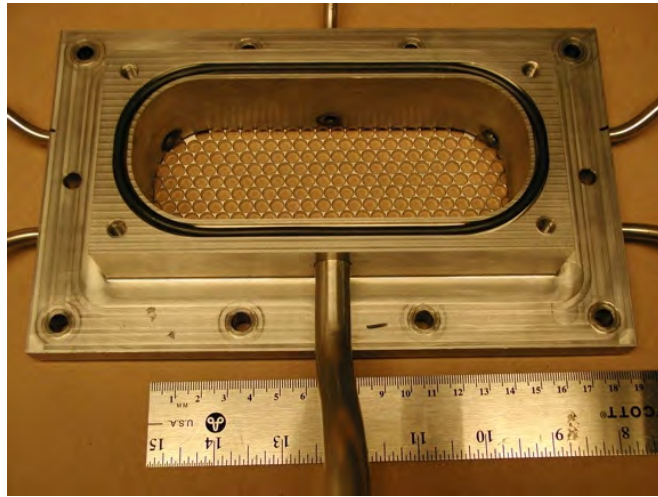
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Towson, MD*

Experimental Set-Up

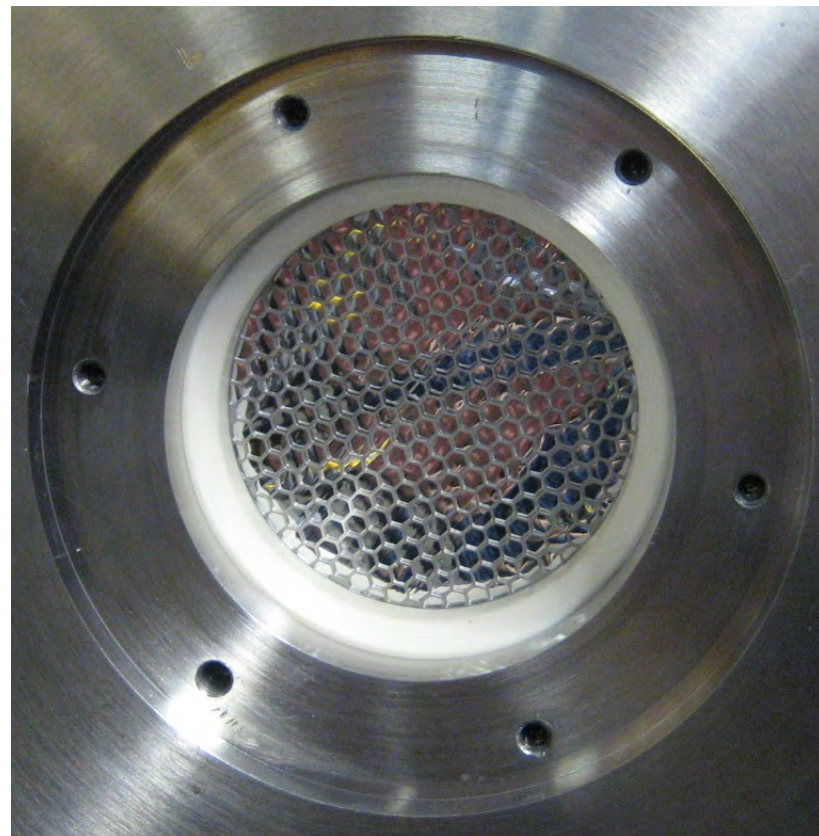


Hybrid RTC

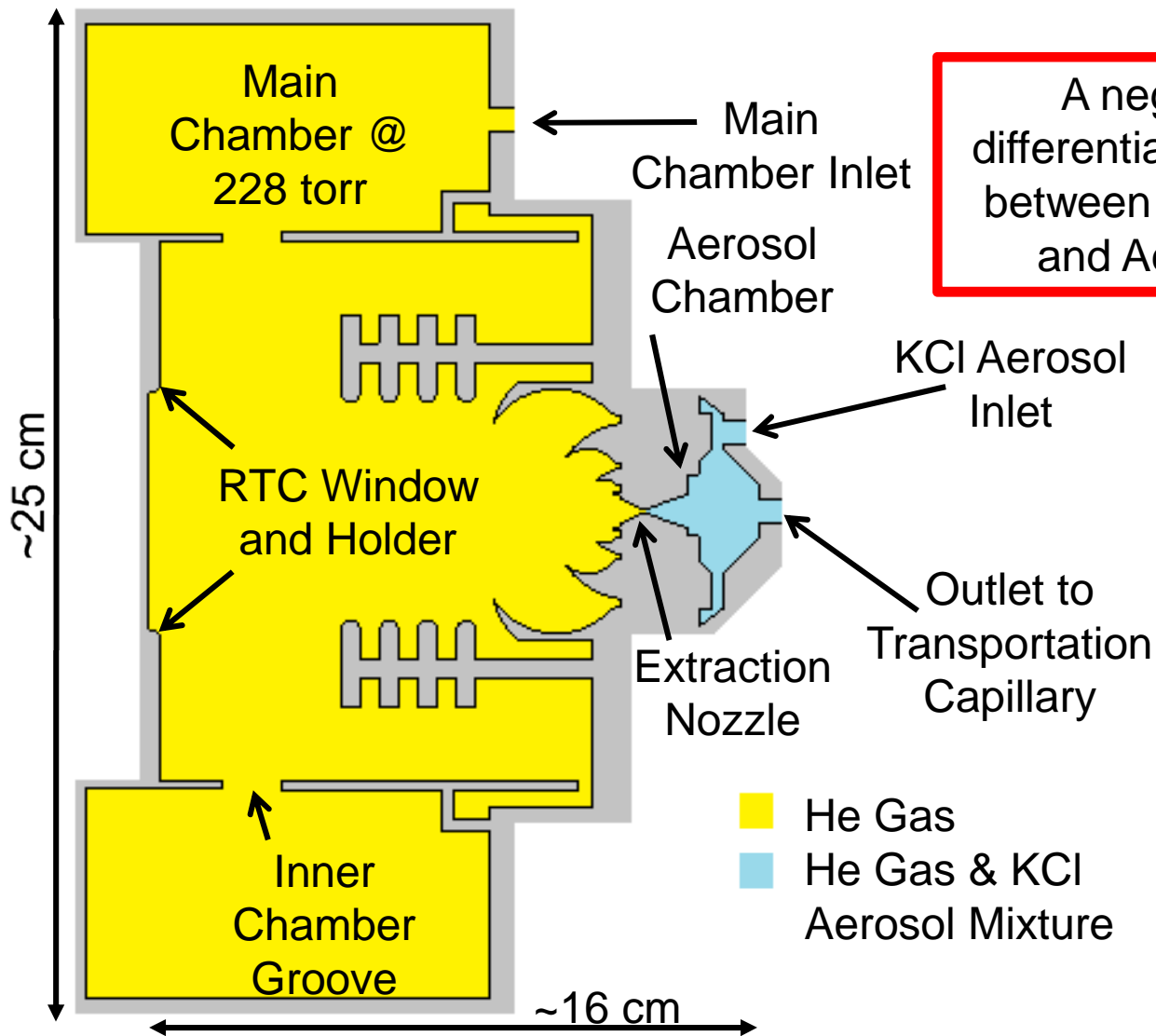


RTC Capabilities

- Ability to use all metal window system
- Honeycomb grid transmission: 88%
- Entire system is bakeable to 100°C
- Large-scale modification possible

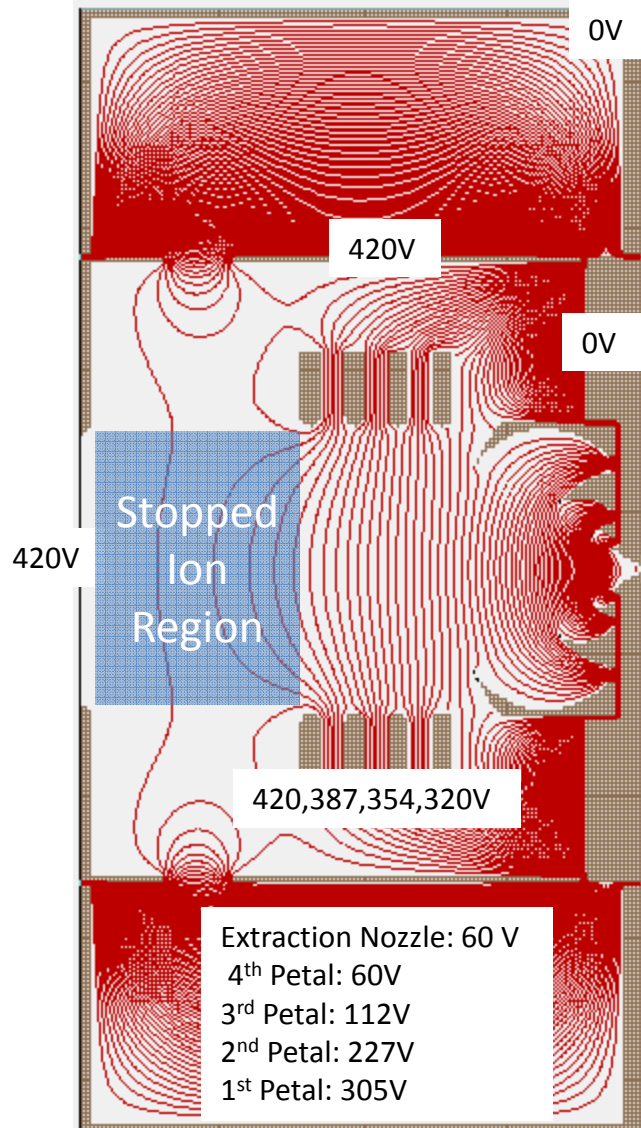


ICE: Ion Catching and Extraction



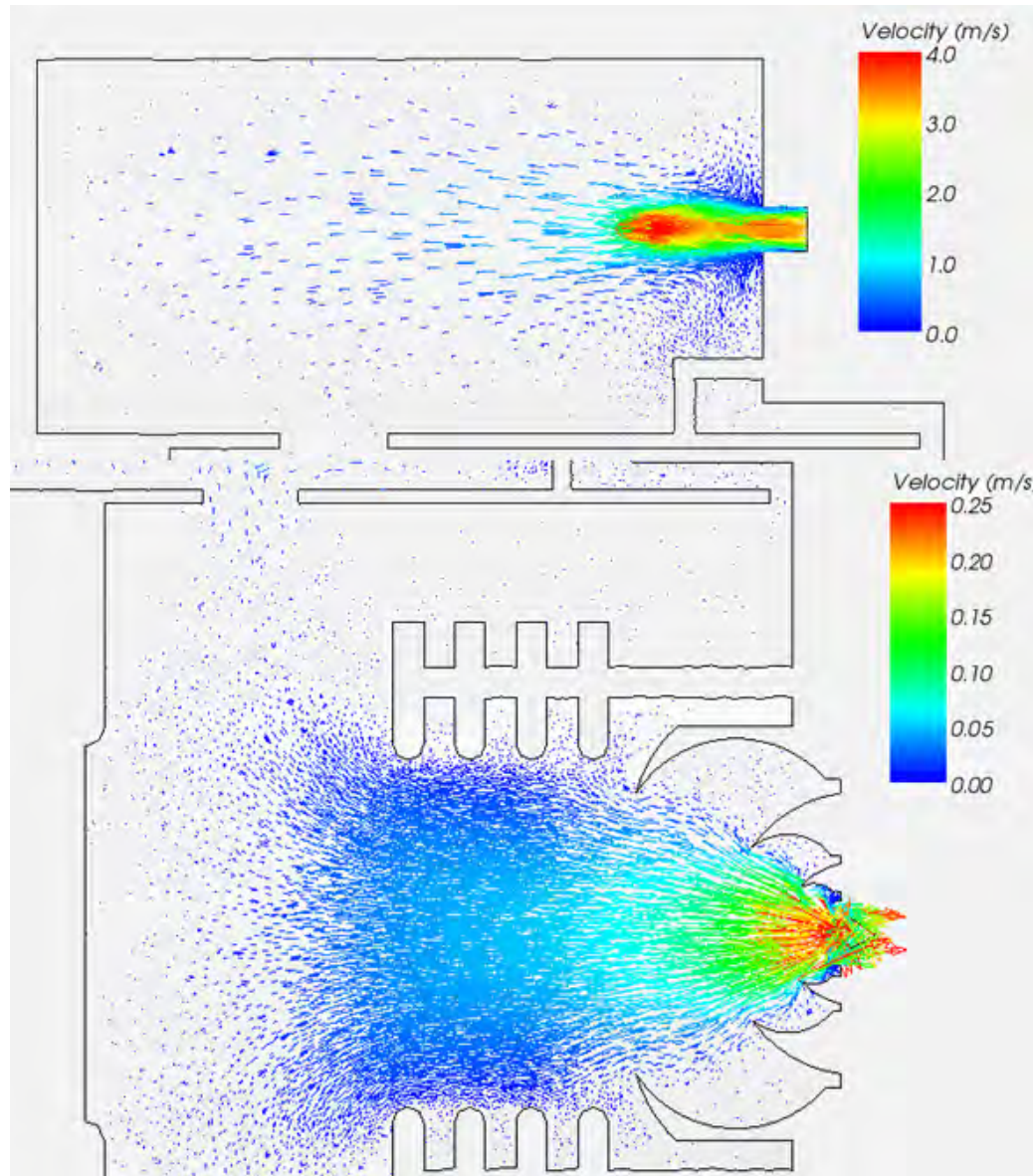
A negative pressure differential will be maintained between the Main Chamber and Aerosol Chamber.

Electric Field



- Ion travel perpendicular to equipotential lines.
- The decrease potential pulls the thermalized ion through.
- Spherical electrodes focus the ions into the Extraction Nozzle.
- SIMION was used to determine the optimum electric field setting.

Gas Flow Simulations

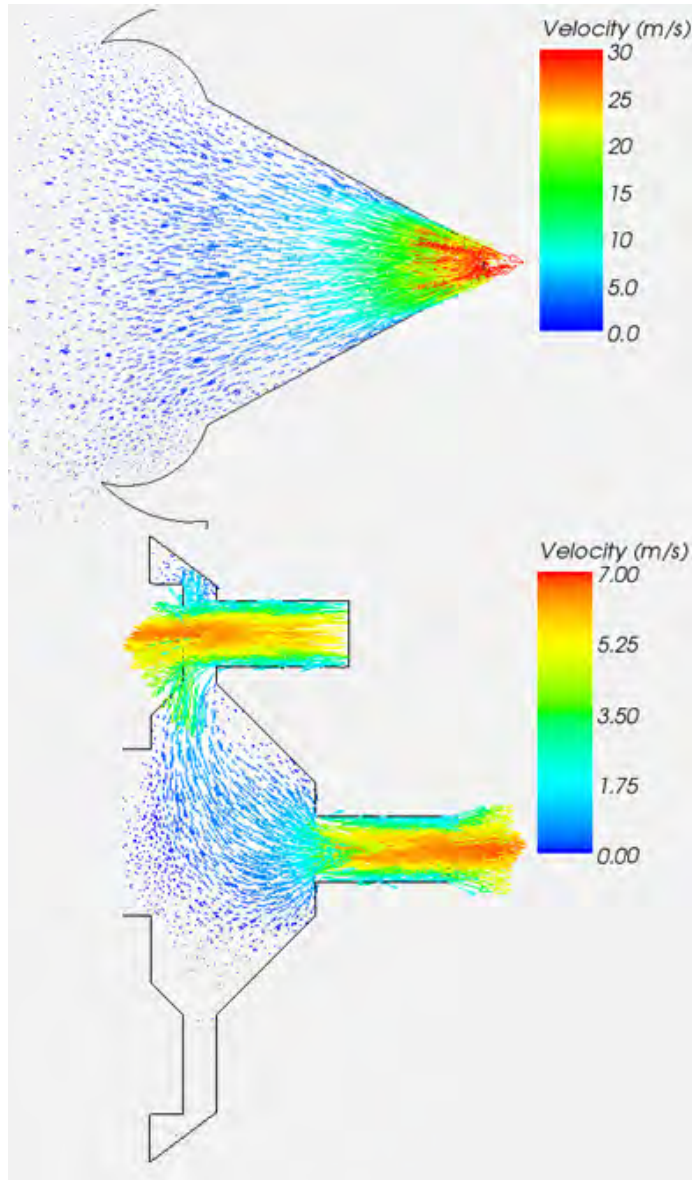


Near the Main Chamber Inlet there is turbulent flow.

Inner Chamber Groove allows for a more laminar flow in the Main Chamber.

15 torr Pressure Differential
Pump speed: 4 L/min

Gas Flow Simulations

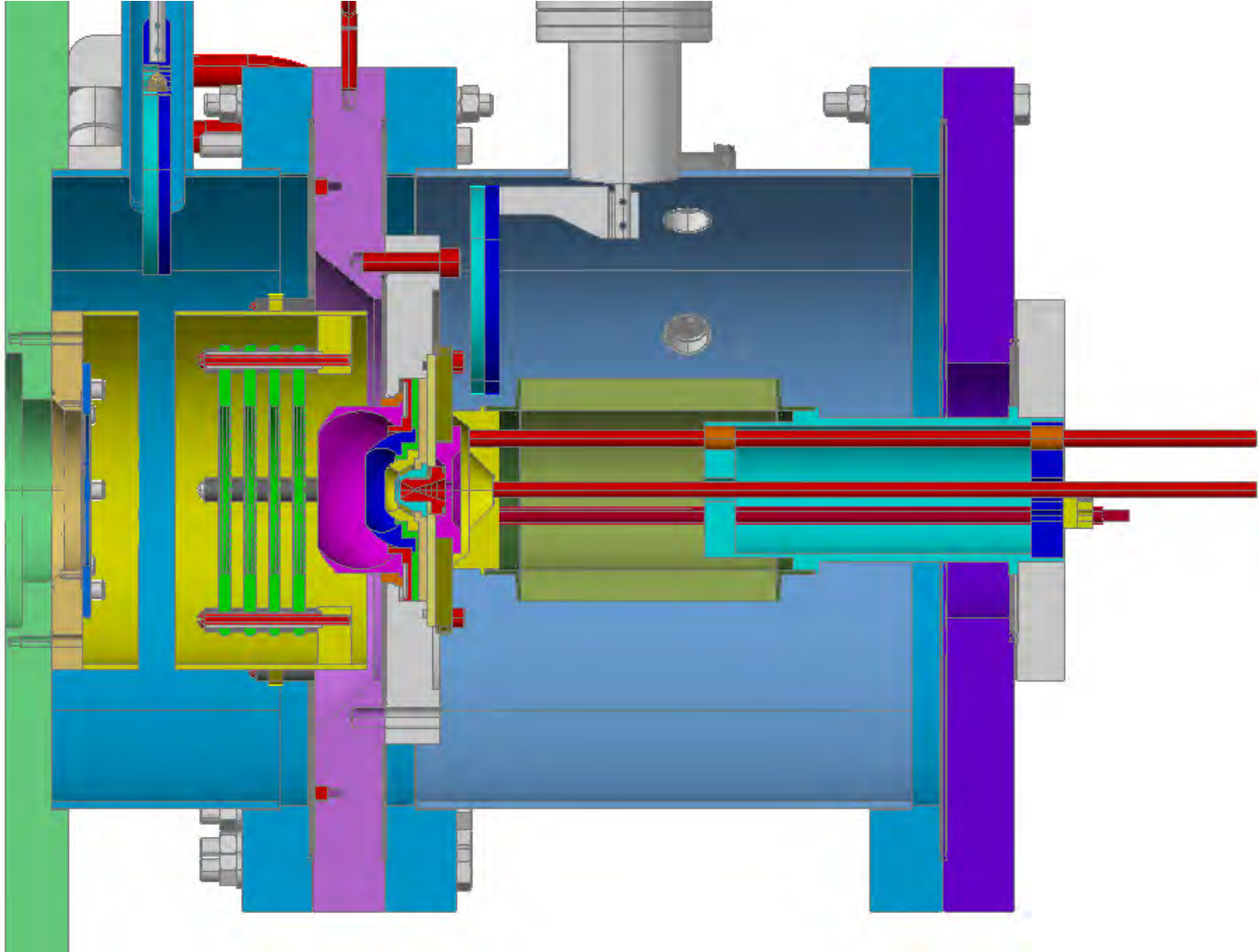


Flow in the Extraction Nozzle is a more dominating force.

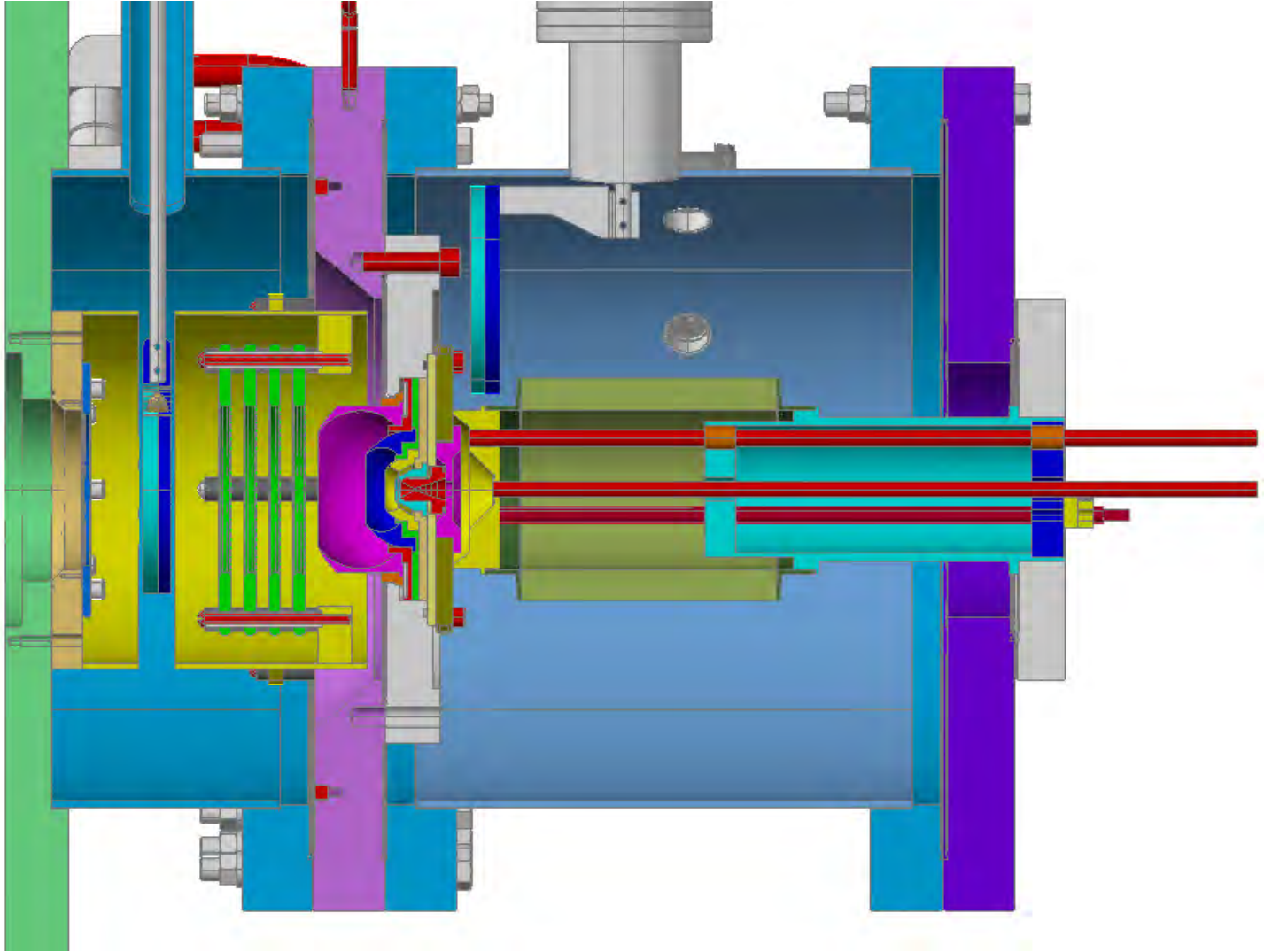
In the Aerosol Chamber there is laminar flow that carries the ions into the Transportation Capillary.

15 torr Pressure Differential
Pump speed: 4 L/min

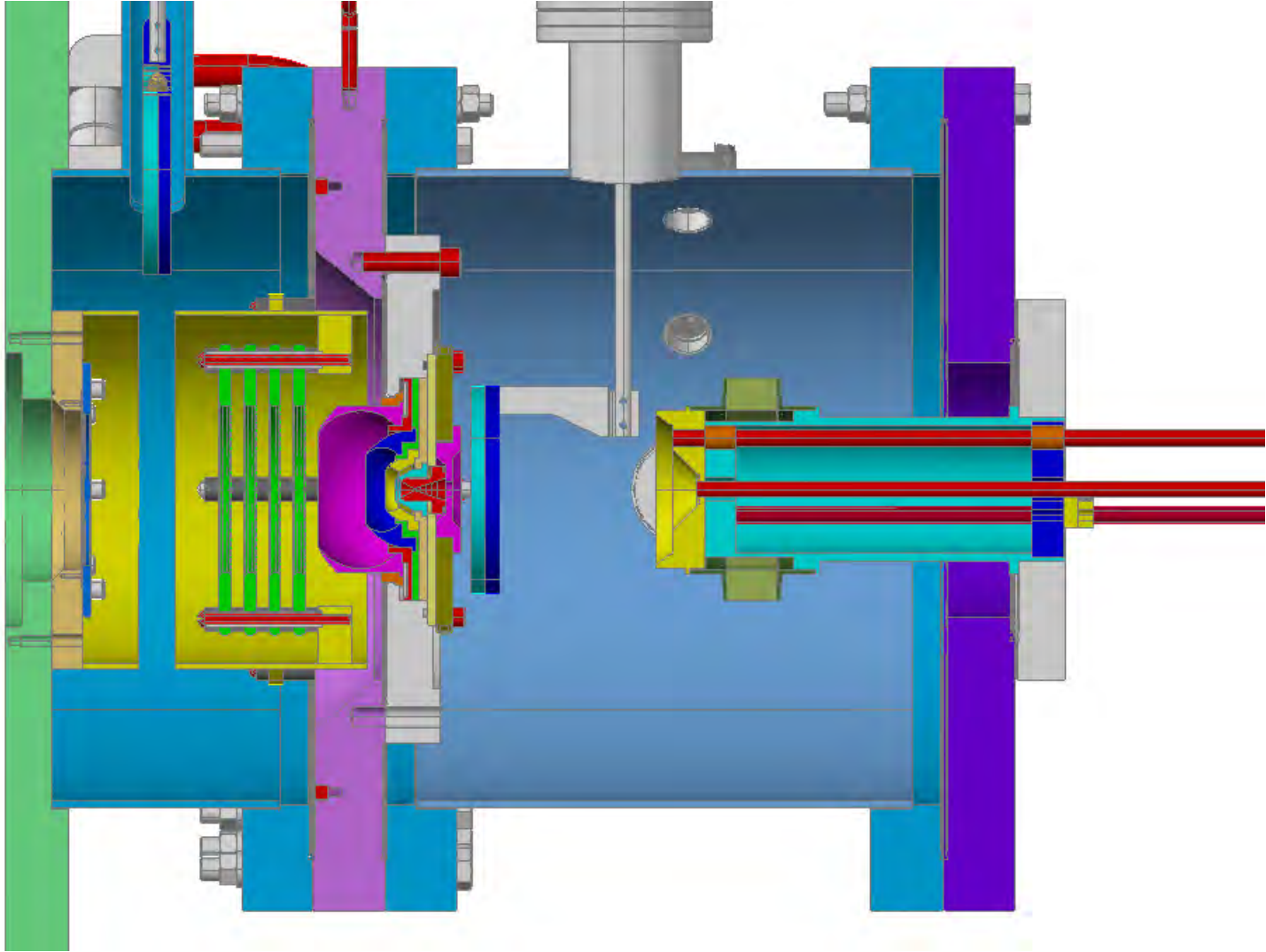
Detector System for ICE



Detector System for ICE

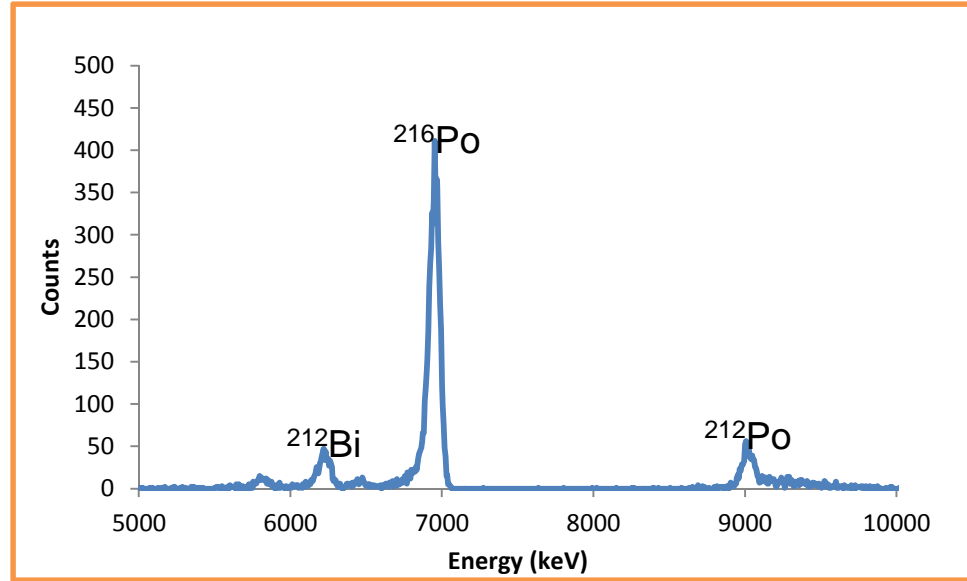
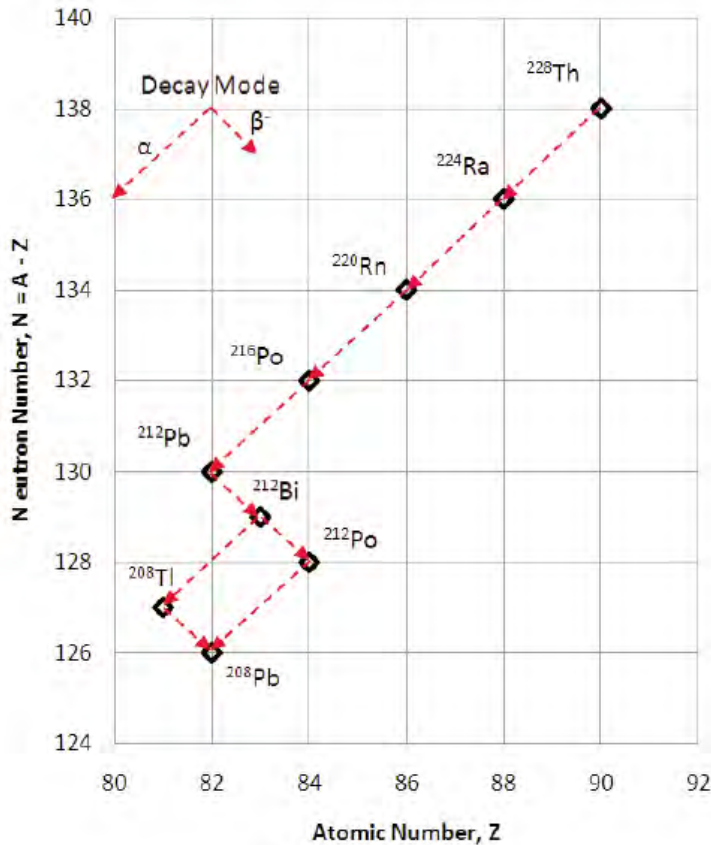


Detector System for ICE



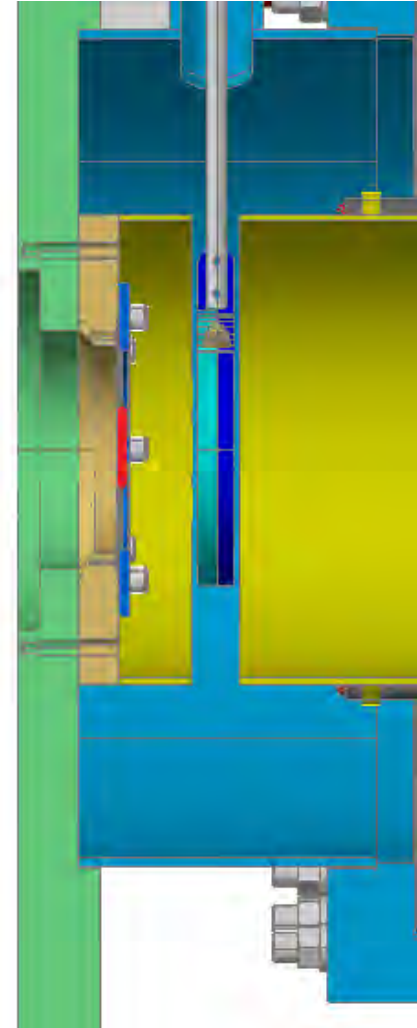
Offline Experiment

^{216}Po recoils from a ^{228}Th source were used to emulate evaporation residues.



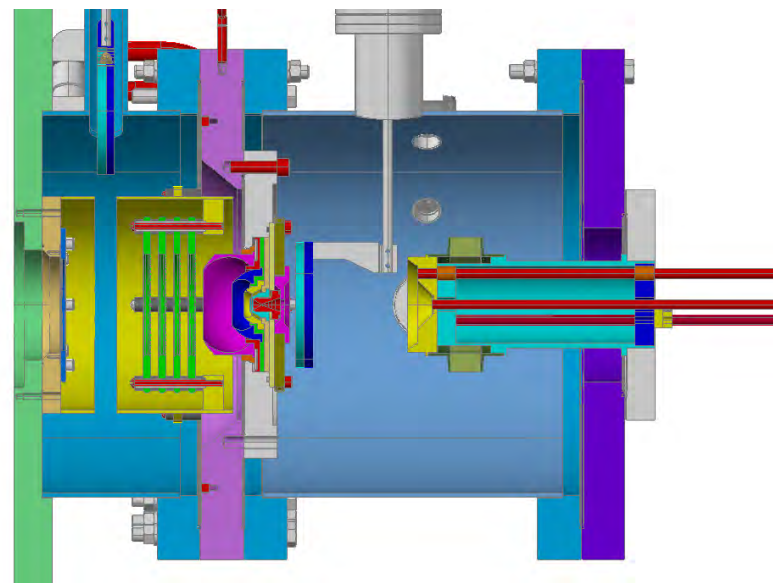
Radon Emanation

- Used Main Chamber Detector
- Positive bias applied to source
- Maximum ^{216}Po rate measured: 30 cps
- 3% radon emanation

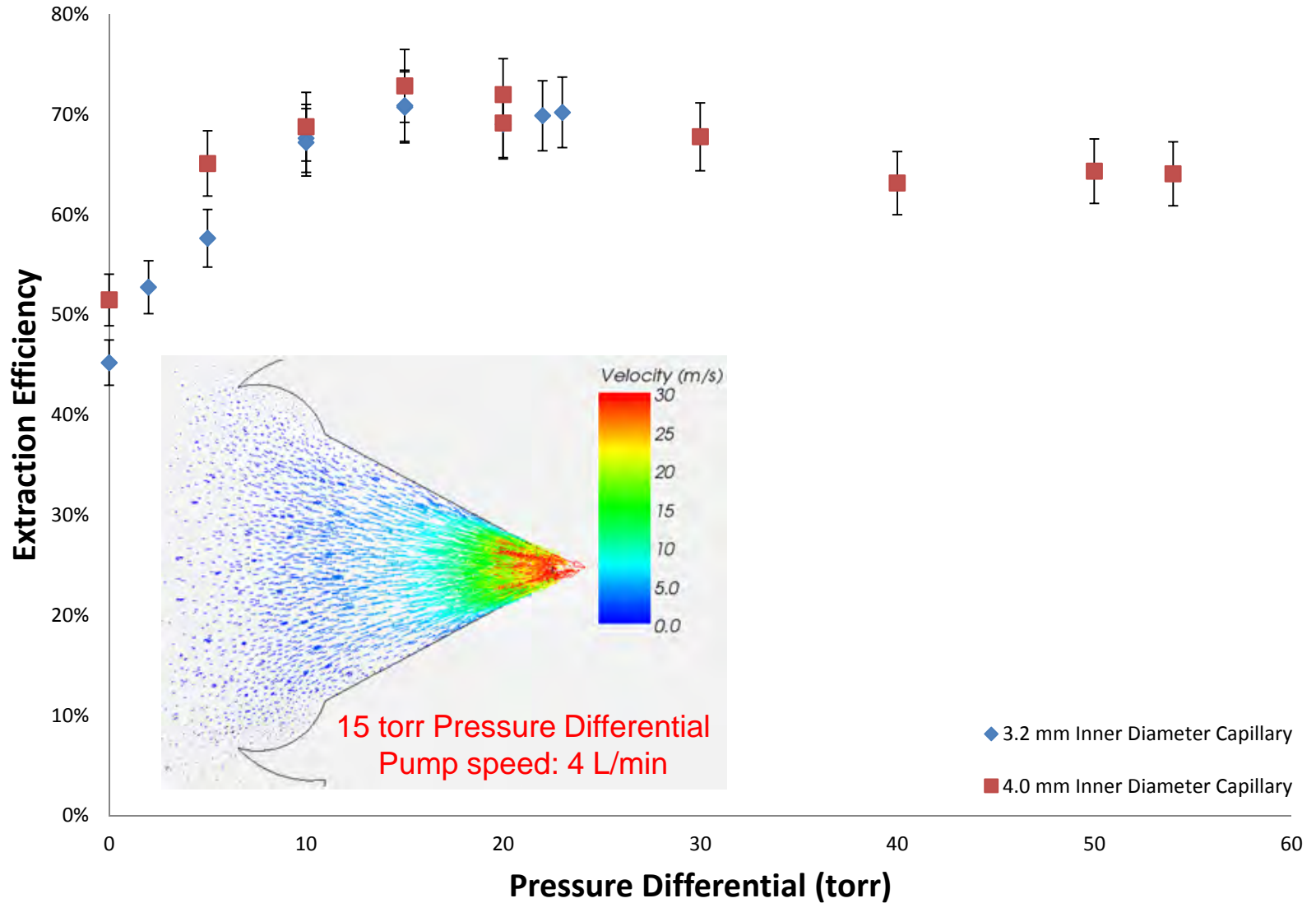


Gas Flow vs Electric Field

- Both gas flow and electric field were systemically optimized
- Optimum System Efficiency: 70-80%
- Electric Field Only Efficiency: 1.5%
- Gas Flow Only Efficiency: 0.75%

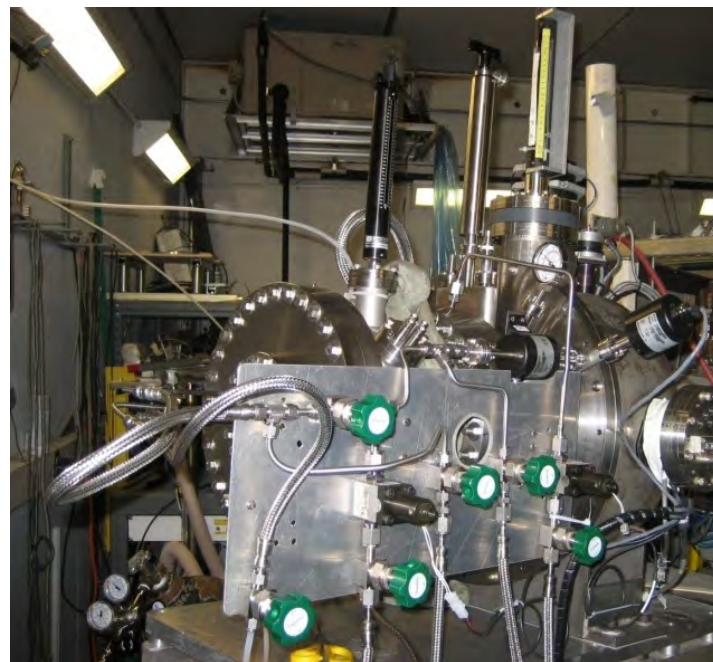


Extraction Efficiency vs Pressure Differential

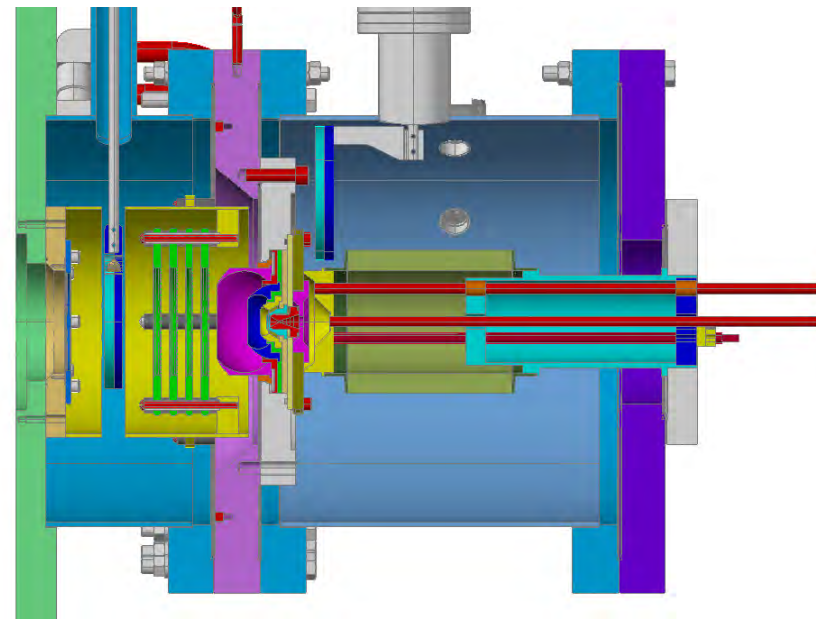
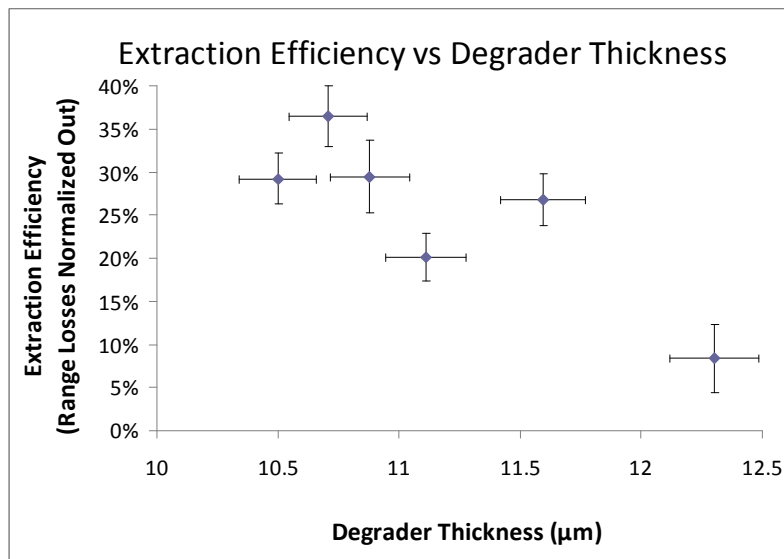
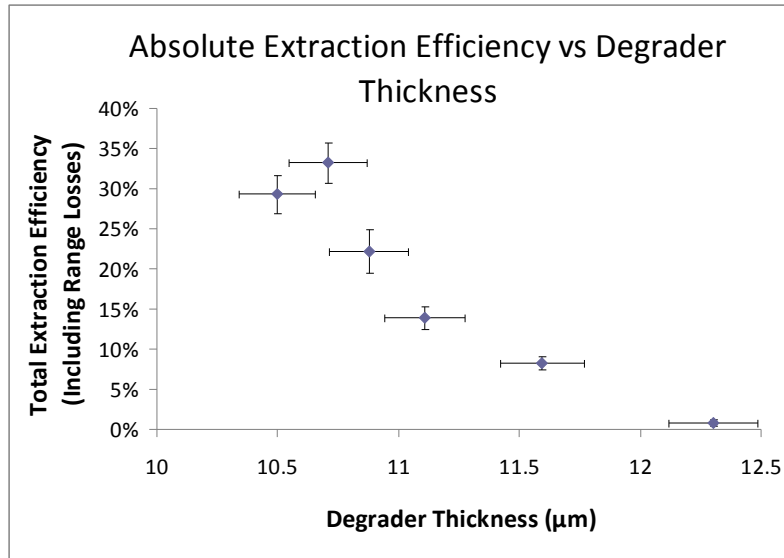


ICE Commissioning, Phase I

- $^{118}\text{Sn}(^{40}\text{Ar}, 6n)^{152}\text{Er}$
- σ : ~ 100 mb
- ^{152}Er range:
11.05 μm Mylar
(estimated by SRIM)
- Rotating Degradator:
6 μm Mylar
- Window:
4 μm Aluminized Mylar

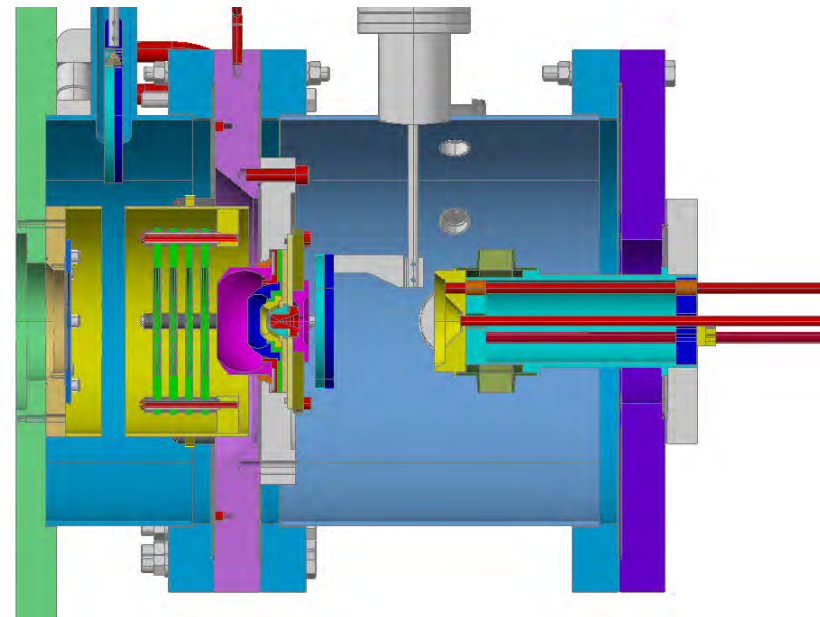
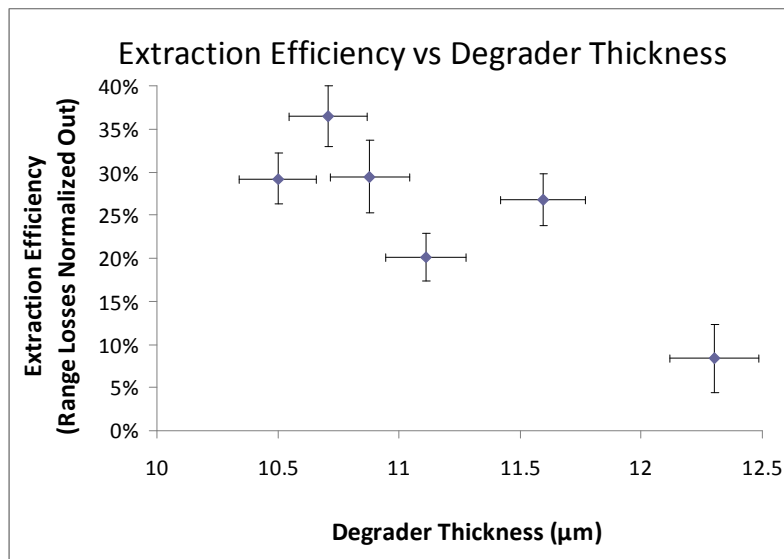
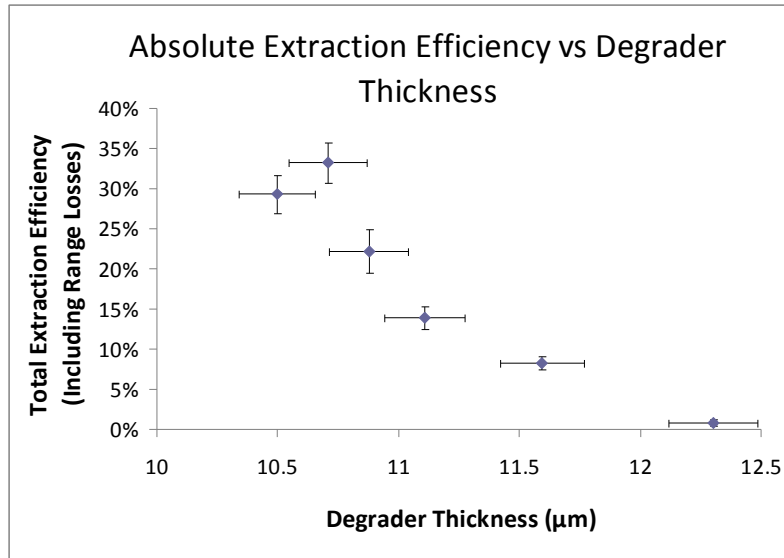


ICE Commissioning, Phase I



Gas Flow Only

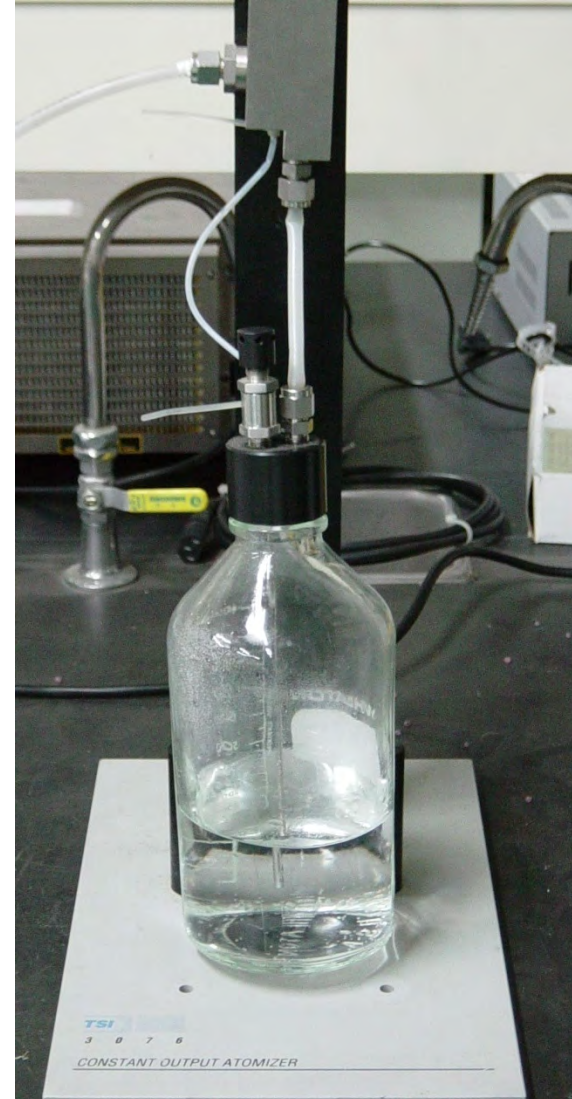
ICE Commissioning, Phase I



Gas Flow Only

Aerosol Generator

- TSI Model 3076
Constant Output
Atomizer
- Mean aerosol diameter
range: 20 – 300 nm
- Aerosol size controlled
by concentration of
solution



Conclusions and Future Work

- Offline efficiency measured: 70-80%
- Online efficiency measured: 35% (gas flow only)
- Commissioning experiment, Phase II:
 - Optimize electric field for EvRs
 - Collect EvRs at the end of transportation capillary
 - Tune ^{85}Zr and ^{169}Hf through in preparation for proof-of-principle chemistry experiment

Acknowledgements

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