Prototype Design of an EDM Cell UCN Valve

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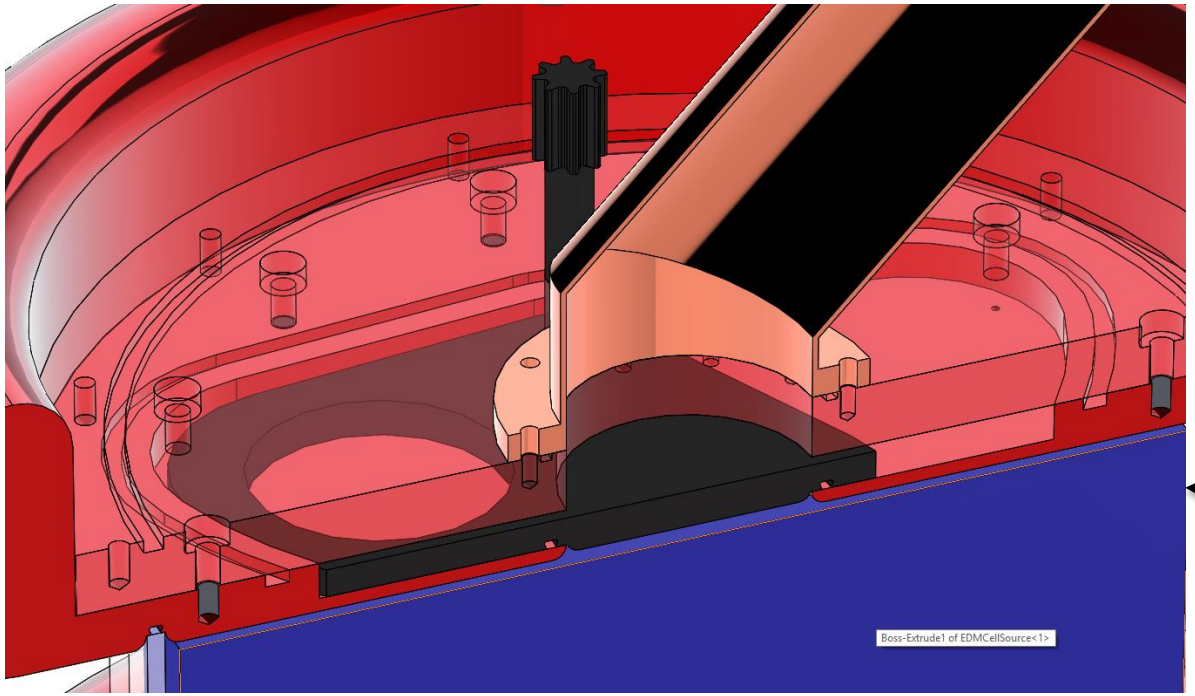
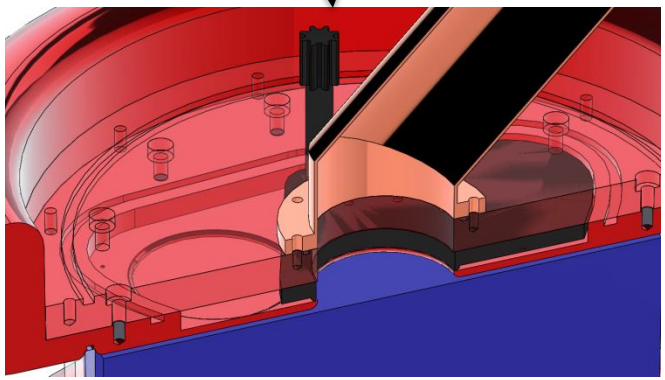
Valve Requirements

- **Mechanism**: pneumatic actuation (no motors), fast open/close [<2s?], no contamination/degradation of cell/measurement due to mechanism operation (eg. avoid abrasion between coated parts)
- **Structural**: minimize deformation during operation (must be accounted for in field analysis, fatigue reliability analysis, sealing requirements)
- **Vacuum**: seals between co-magnetometer gases and vacuum when closed [<1e-7 mbar-l/s]
- **Transport**: high transmission when open [>98%?], minimal losses during opening/closing [<5%?], >200neV fermi potential
- **Storage**: minimize reduction of storage lifetime [<10% reduction (compared to what?)], >200neV fermi potential
- **Magnetostatics**: minimize permanent magnetic dipole effects (door cavity dipole was a significant systematic effect in PSI analysis)
- **Electrostatics**: minimize contribution to electric field inhomogeneity, achieve good HV behaviour
- **Reliability**: should operate for a full year of data collection without failure [>100000? open/close cycles] , similar time [>50000? cycles] without needing maintenance
- **Control/monitoring**: must be remotely operated, must include end switches to monitor position

2017/18 Concept Design

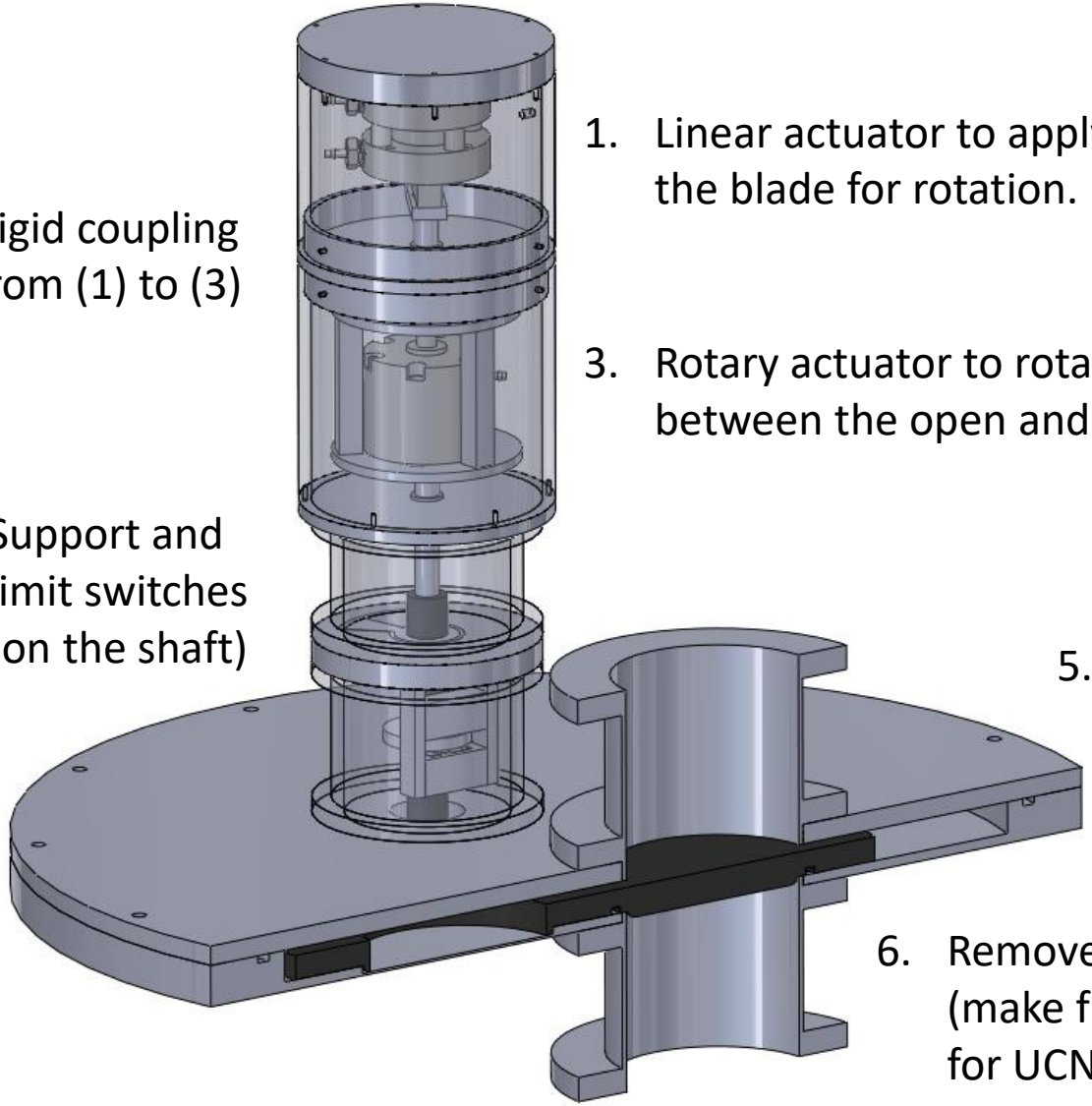


Movement: from the closed position the blade lifts, then rotates into the open position. From the open position the blade rotates, then is pushed down into the closed position.



- Closed position: valve “blade” is pushed down to plug the cell entrance and form a seal.
- Open position: a small ridge fills the gap between the blade and the electrode.

Prototype Design (WIP)



1. Linear actuator to apply sealing force and lift the blade for rotation.
2. Rigid coupling from (1) to (3)
3. Rotary actuator to rotate the blade between the open and closed positions
4. Support and limit switches (on the shaft)
5. “Electrode plate” representing inner section of electrode
6. Removeable guide section (make from SS, no coating, use for UCN tests)

Goals

- Complete prototype design and carry out UCN tests of the prototype during the fall run (also perform tests of sealing, long term reliability)
- Optimize based on test data and results of simulations, leading to another design iteration mid-2019

Timeline

- Early September: finished prototype design
- September-November: machine/order parts and assemble prototype
- Early November: sealing tests of prototype
- Late November: UCN tests of prototype?
- December: reliability tests of prototype

Transport/storage simulations carried out in parallel for benchmarking and future optimization (if time permits)