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Expanding the D-D Voltage and Current Operating Space between 0.1 to 1 mTorr in the UW IEC Device HOMER

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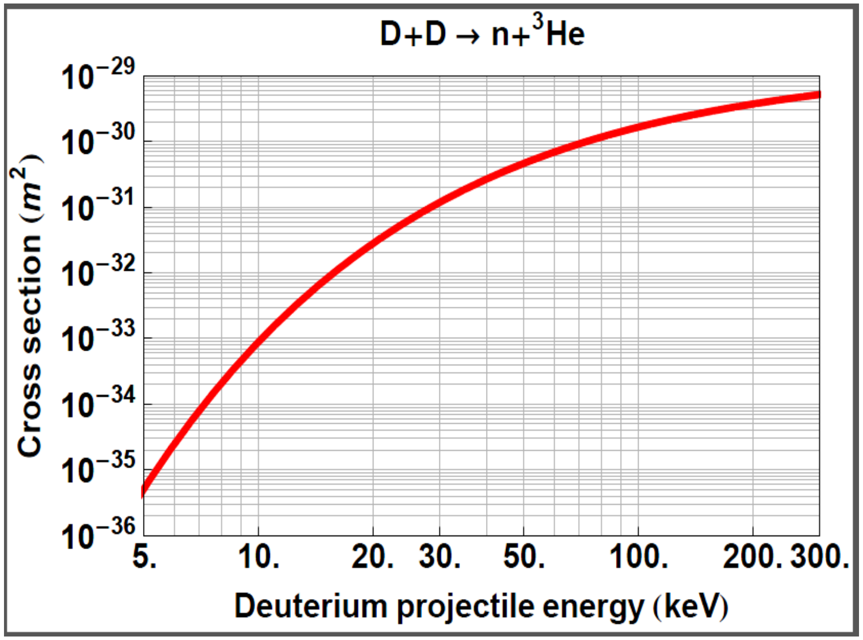
Overview of presentation

- Motivation for pushing parameter space
- Background on UW IEC high voltage, high current operation
- Overview of progress to-date
- Results $\leq$1 mTorr (0.13 Pa) operation with comparison to 2.5 mTorr (0.33 Pa) operation

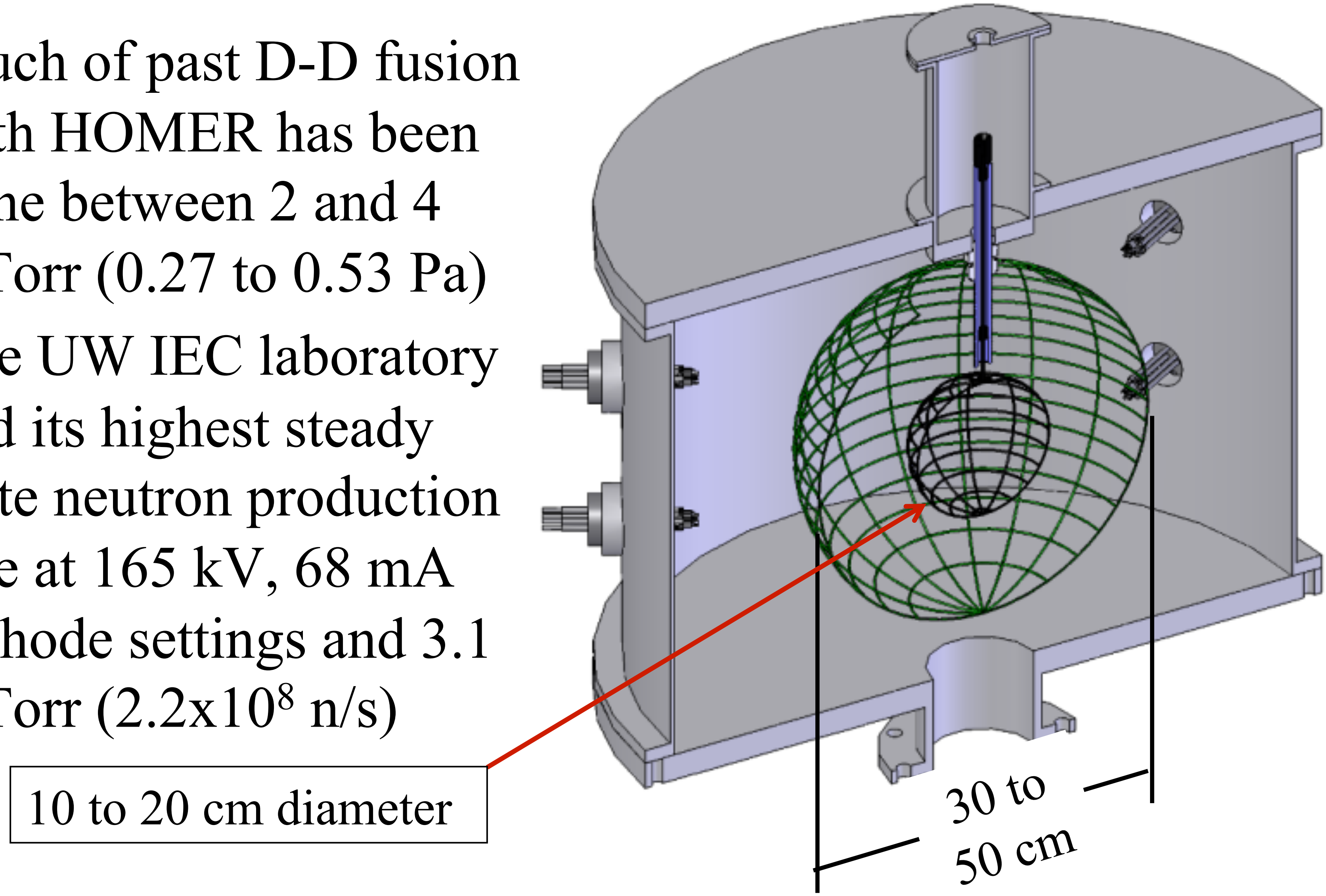
Taking advantage of higher fusion cross section is motivation for expanding operating parameter space

- Increased D-D fusion cross as particle energies increase
- Two ways to increase ion energy
  - Lower pressure reduces the number of collisions of ions with background gas
  - Increase cathode potential



Background on UW IEC device HOMER

- Much of past D-D fusion with HOMER has been done between 2 and 4 mTorr (0.27 to 0.53 Pa)
- The UW IEC laboratory had its highest steady state neutron production rate at 165 kV, 68 mA cathode settings and 3.1 mTorr (2.2×10^8 n/s)



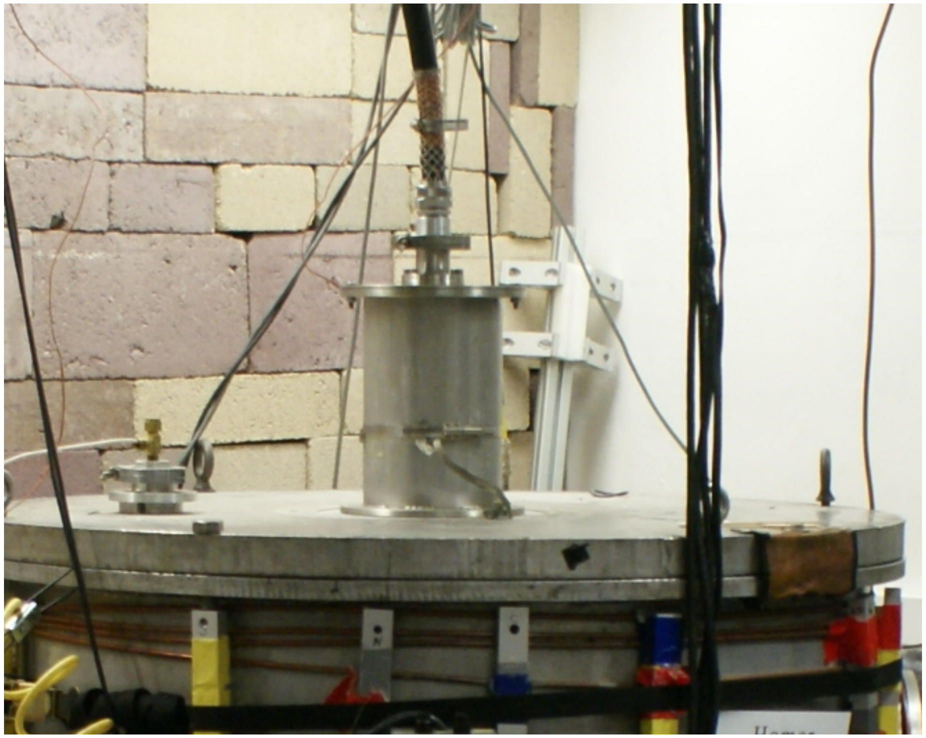
Present thrust of research requires much high voltage design and conditioning

The UW IEC laboratory is in the midst of a campaign to qualify a new feedthrough design (Fancher) to 300 kV and 200 mA as well as making a resistor ballast (Bonomo) capable of the same conditions.

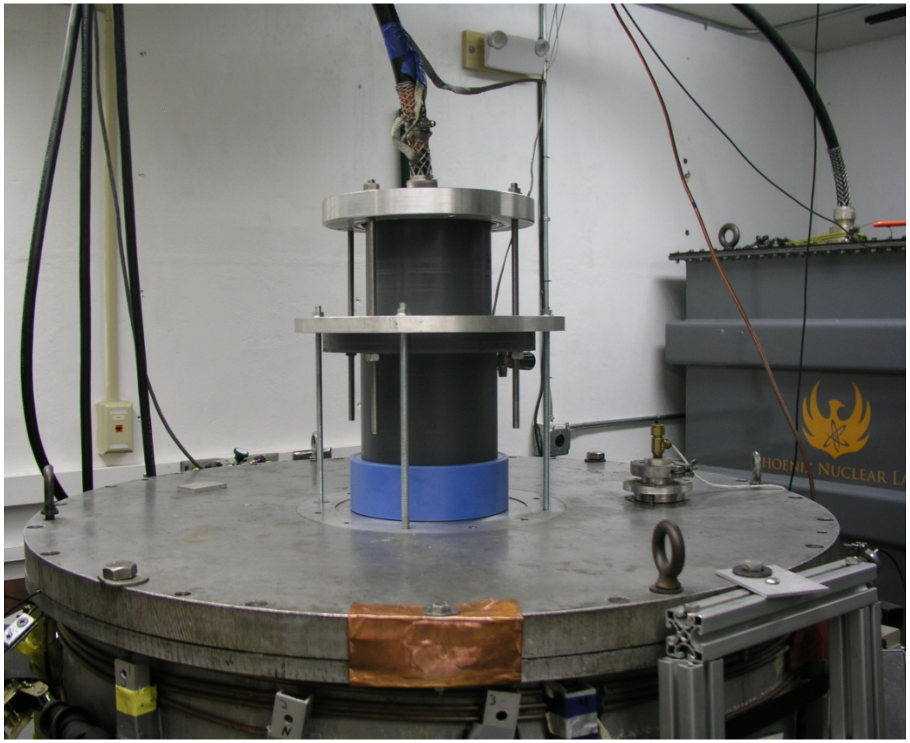
Going to 300 kV requires a new feedthrough design

- Distance from grounded metal to the high voltage conductor increased from about 1.1 cm to 8.4 cm

Old design

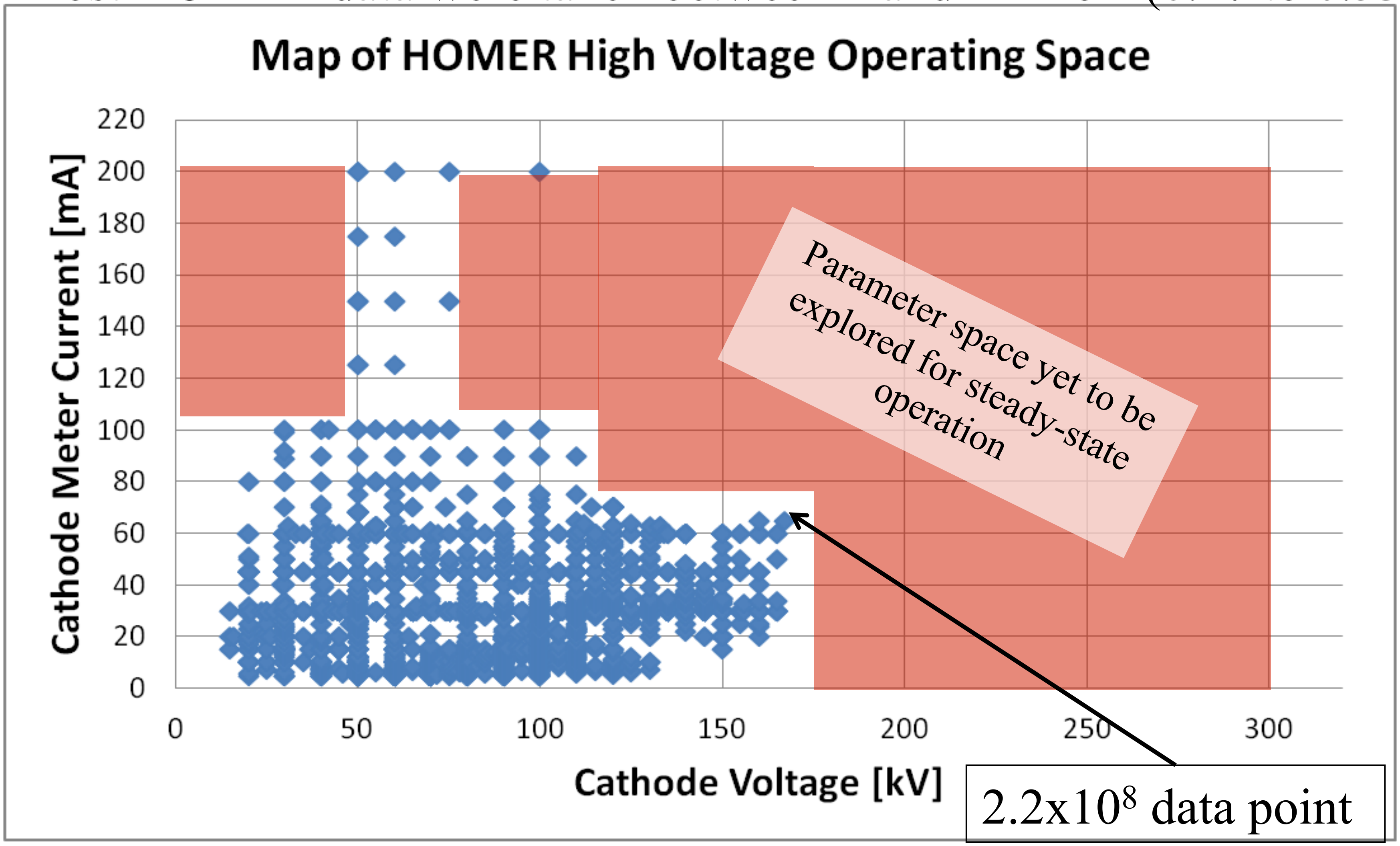


New design

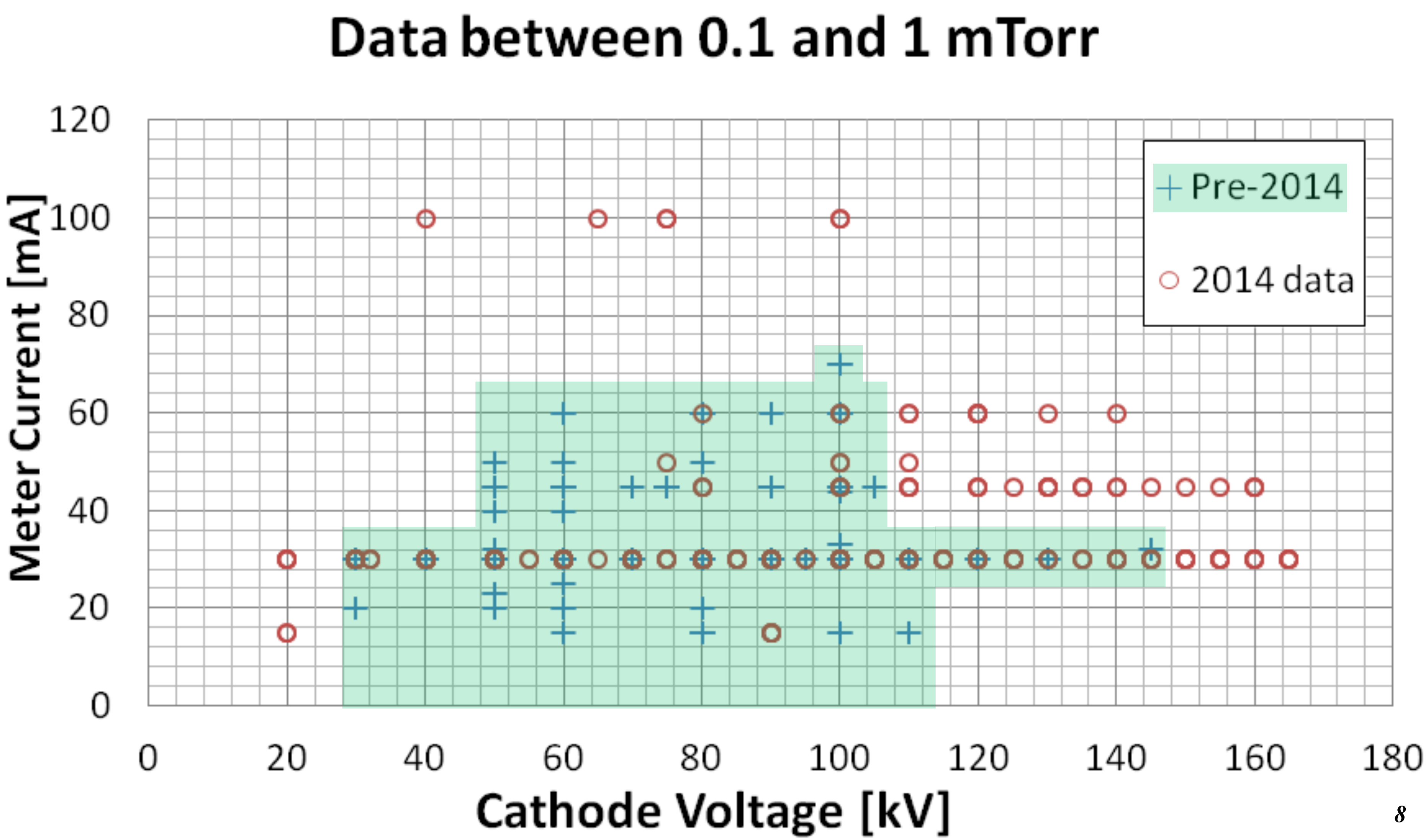


New feedthrough design has been conditioned to 165 kV, so far

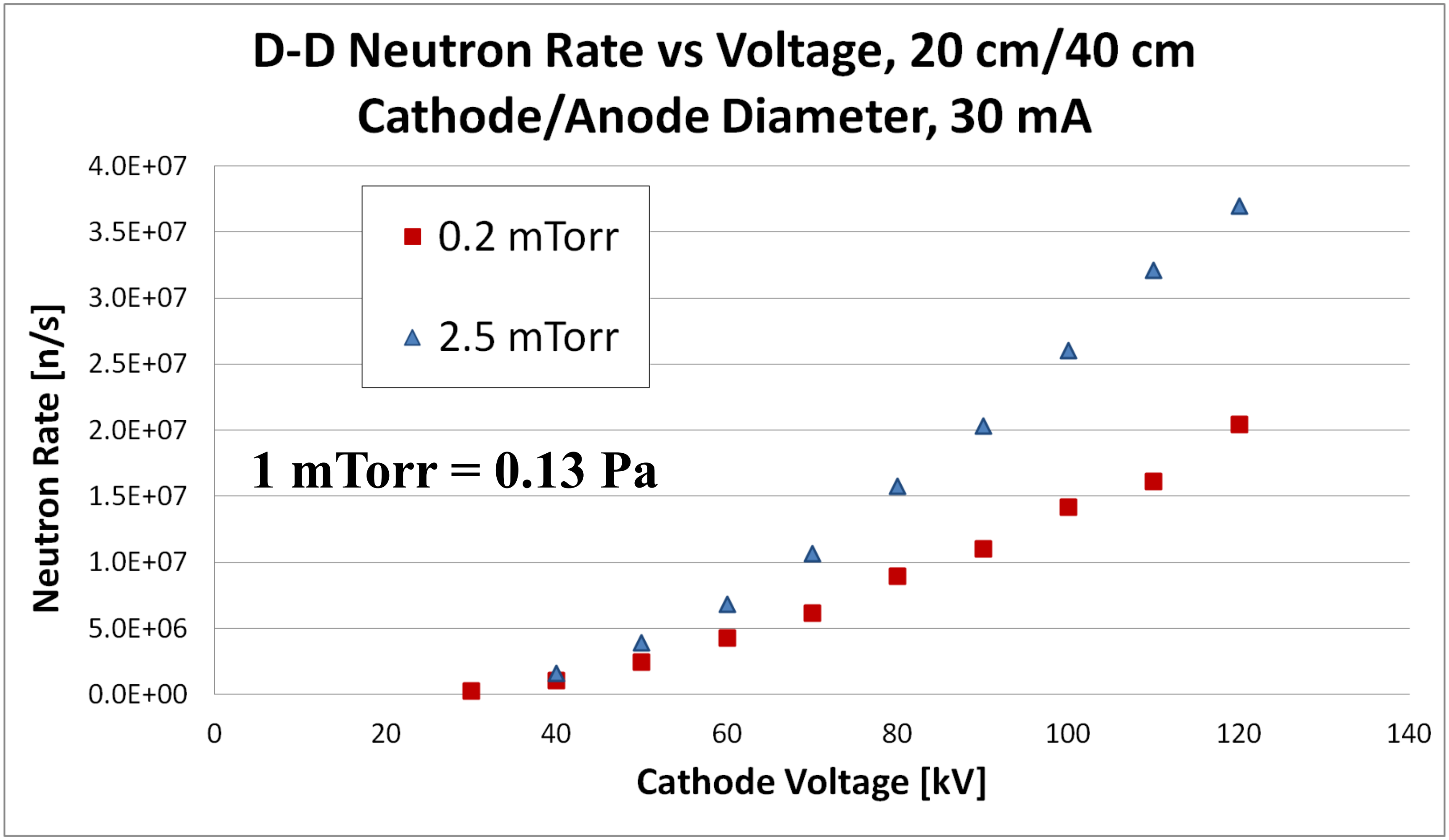
Most HOMER data were taken between 2 and 4 mTorr (0.27 to 0.53 Pa)



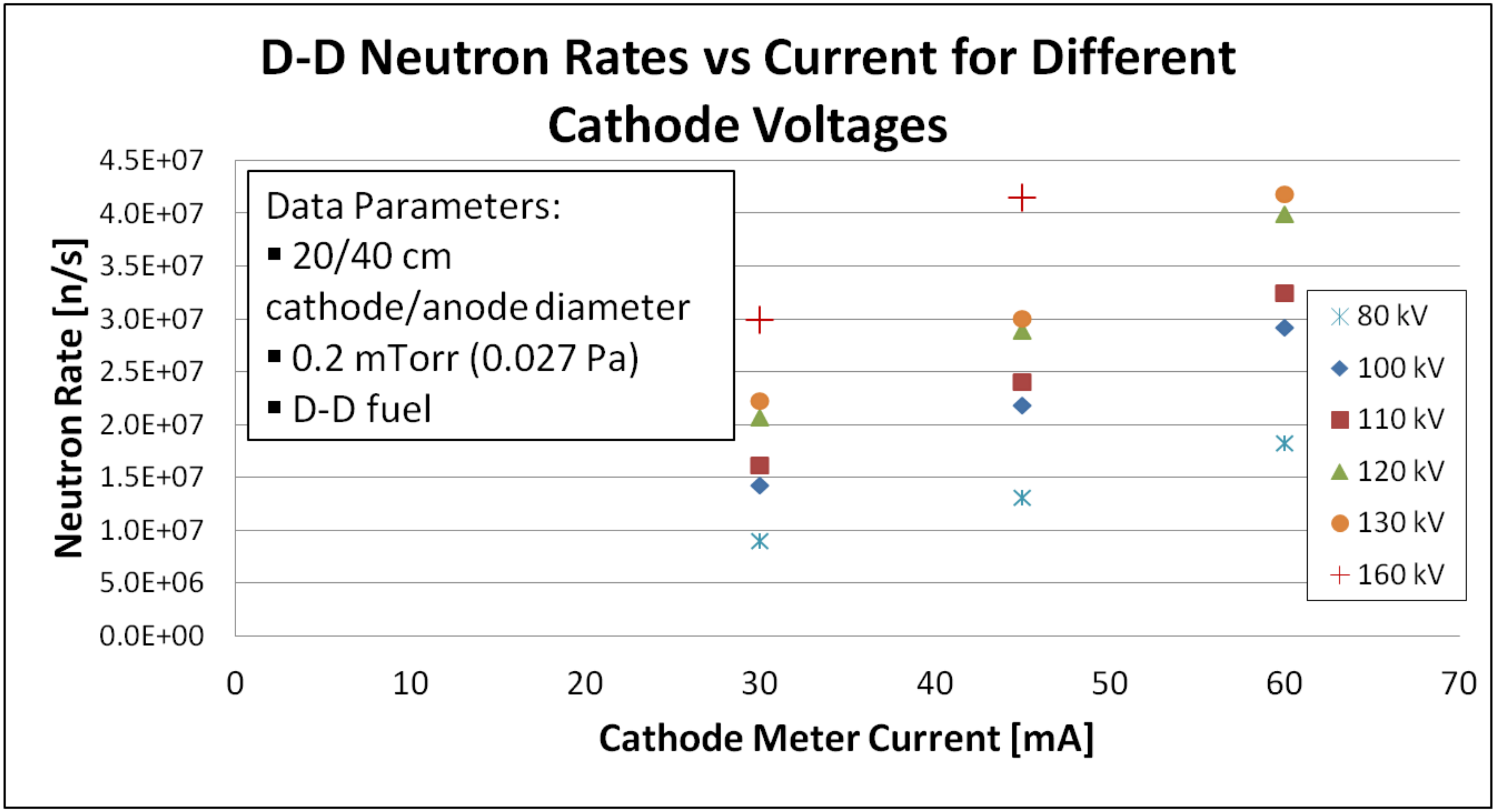
Expanded parameter space at 1 mTorr and lower in HOMER (≤ 0.13 Pa)



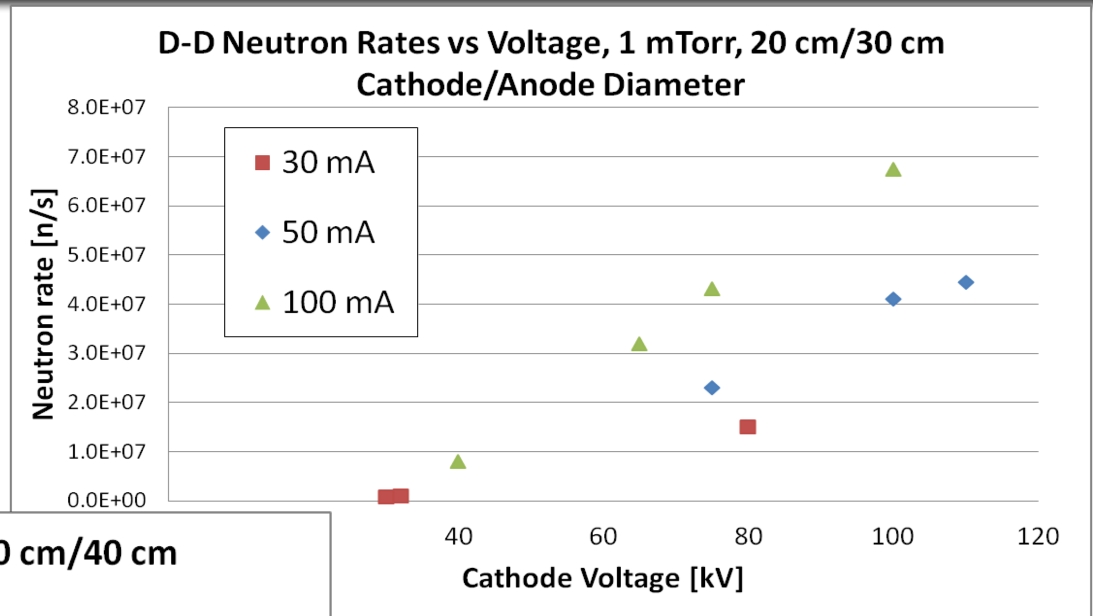
Neutron rates increase faster than linear for both 0.2 and 2.5 mTorr

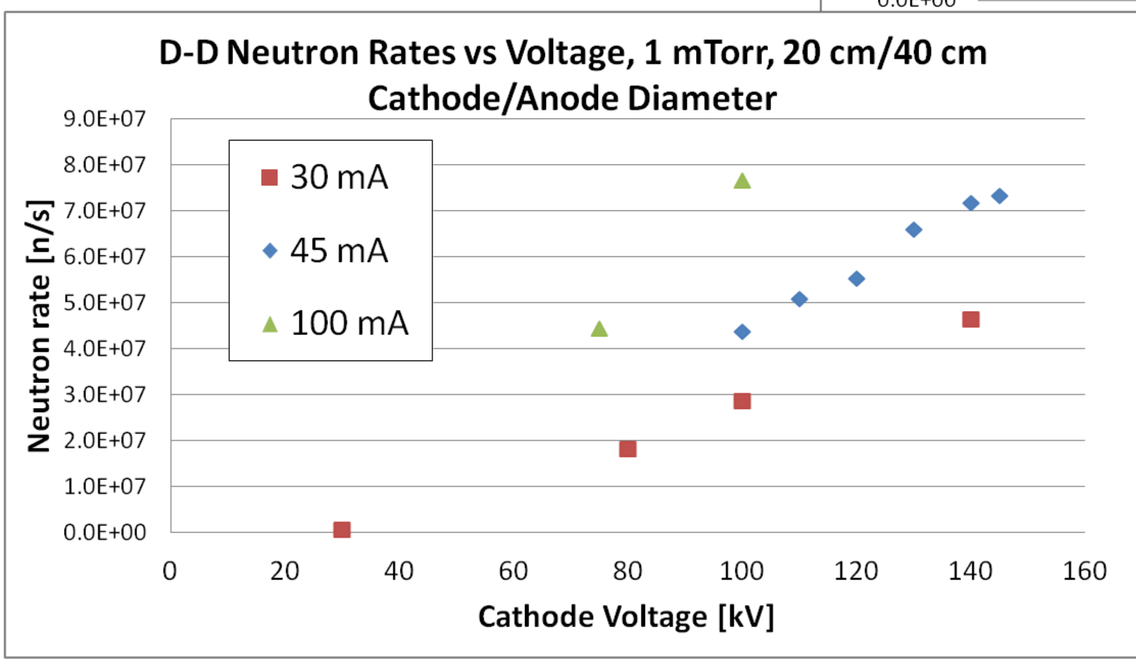


Neutron rate still scales linearly with current at 0.2 mTorr (0.027 Pa)

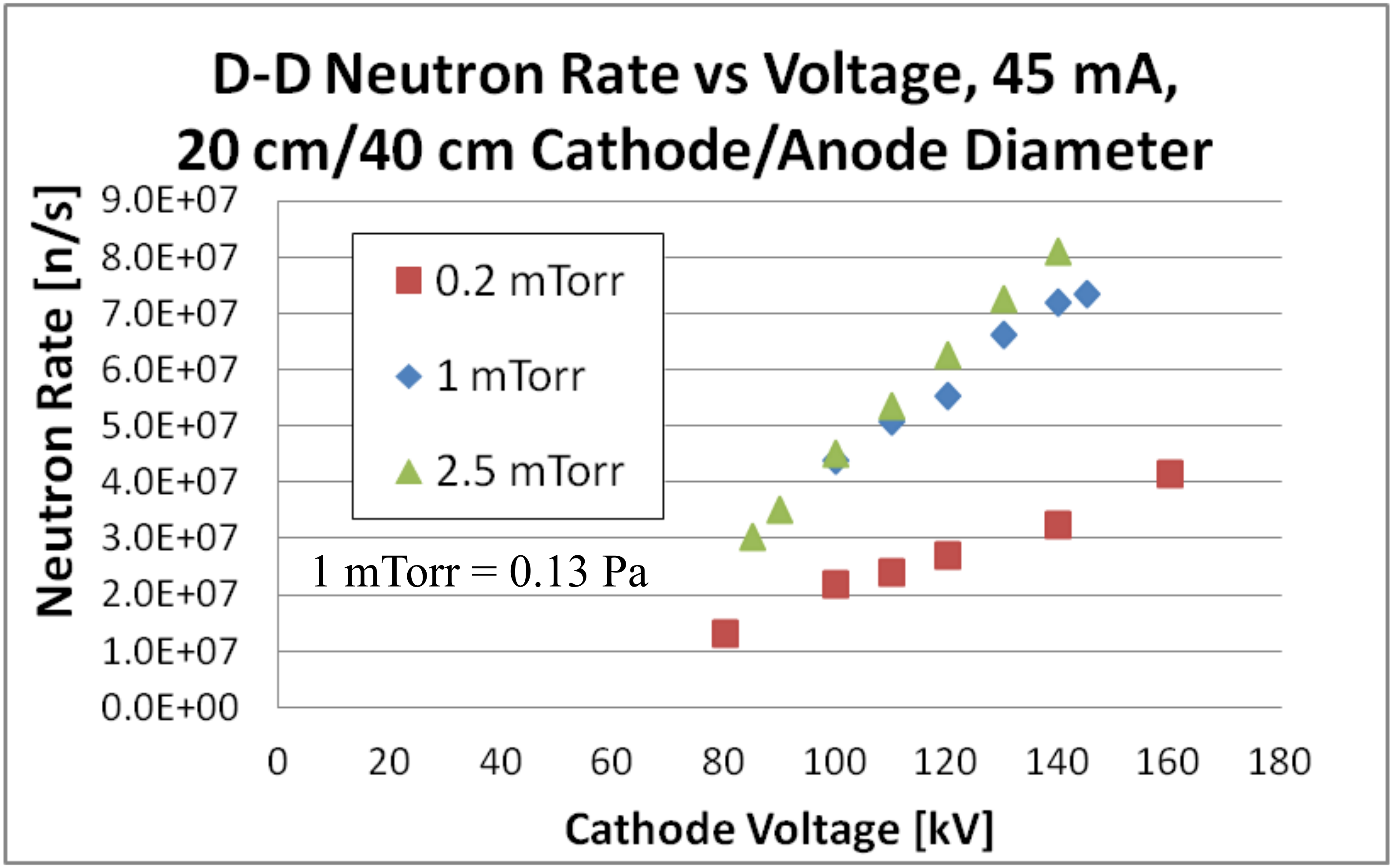


Some data has been collected at 100 mA and 1 mTorr (0.13 Pa)



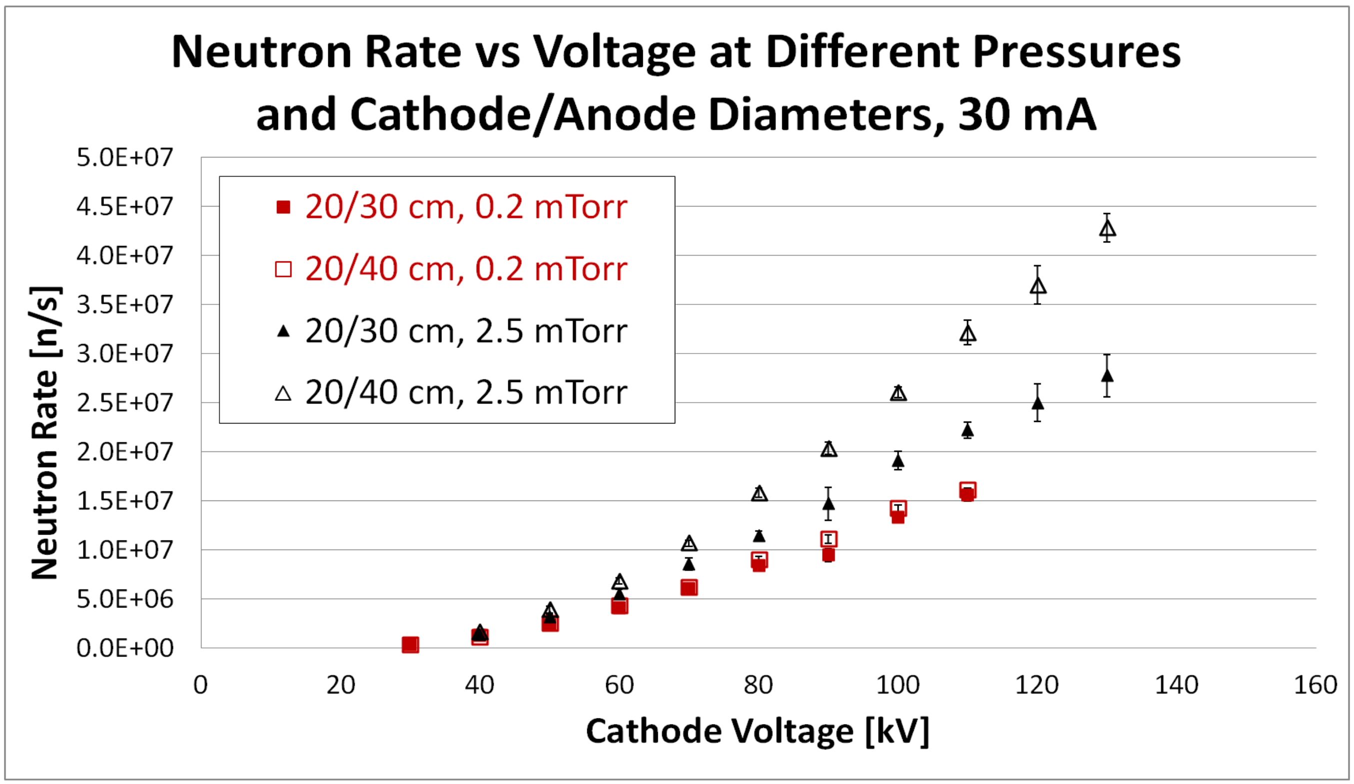


Neutron rates are similar at 1 and 2.5 mTorr but over a factor a 2 larger than at 0.2 mTorr



Cathode/anode diameter does not affect neutron rates at 0.2 mTorr as much as at 2.5 mTorr

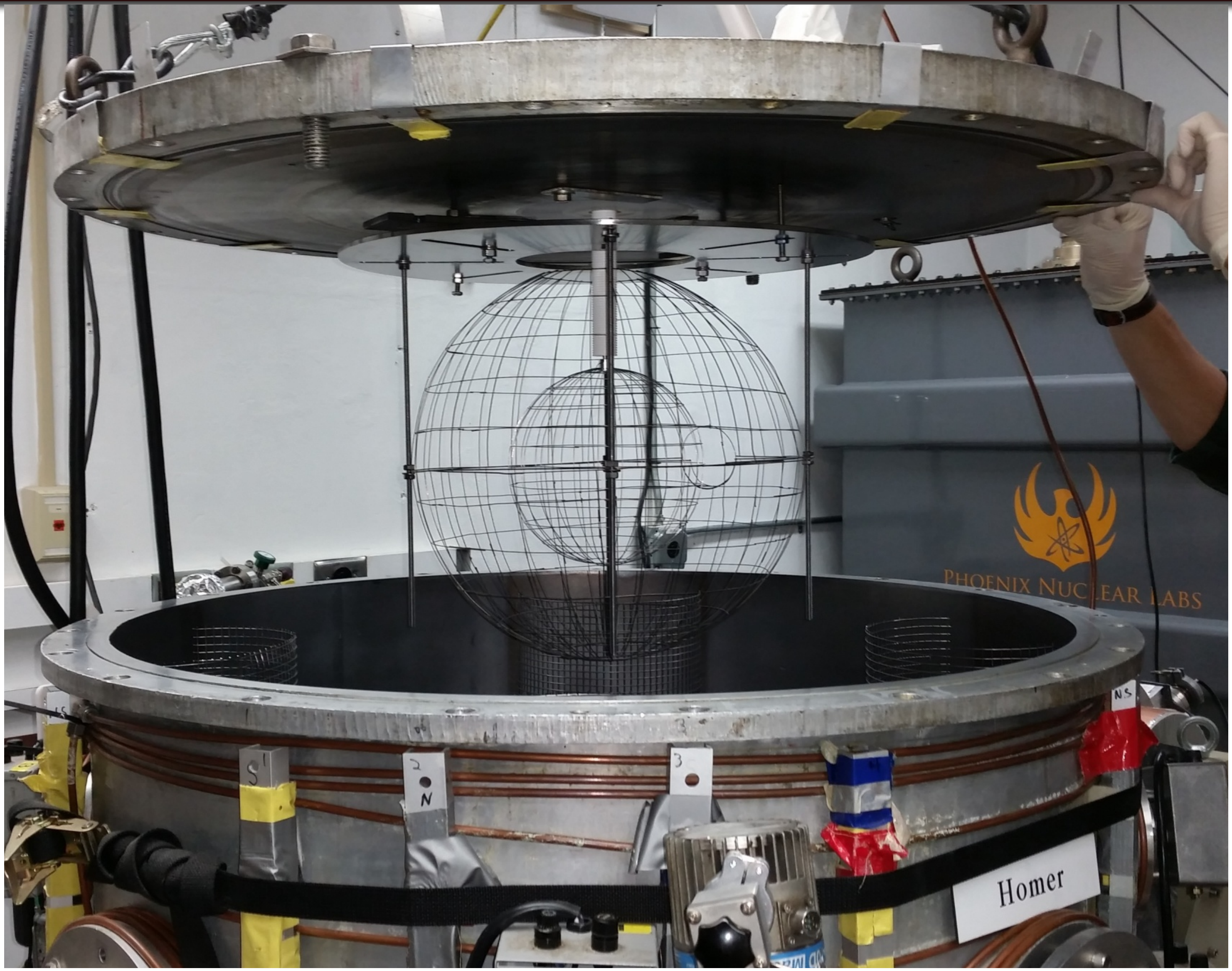
- Neutron rates increase as the anode diameter increases
- Increasing anode diameter from 30 to 40 cm (cathode diameter 20 cm) improved rates 20 to 50 % at 2.5 mTorr, but only 5 % at 0.2 mTorr



Summary

- New feedthrough design has been tested to 165 kV and will be tested to 300 kV
- At 0.2 mTorr, neutron rate scales linearly with current, as it does at higher pressures
- Neutron rates at 0.2 mTorr are lower than at 1-3 mTorr
- Larger anode diameter does not increase neutron production as much at 0.2 mTorr as at 2.5 mTorr

Questions?



Extra slides