UW-Madison IEC Laboratory

continuing capacity upgrades and infrastructure upgrades

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University of Wisconsin -- Madison
Fusion Technology Institute
Inertial Electrostatic Confinement Group

Presentation Outline

1. Current Status
2. Laboratory configuration and basic operation
3. Power Supply Installation
4. Other Infrastructure Improvements

Prof. Gerald Kulcinski provided an overview of experiments in progress this morning.

Current Status of Laboratory

- Personnel:
  - 7 graduate students
  - 1 staff engineer/researcher/laboratory manager
  - 4 faculty

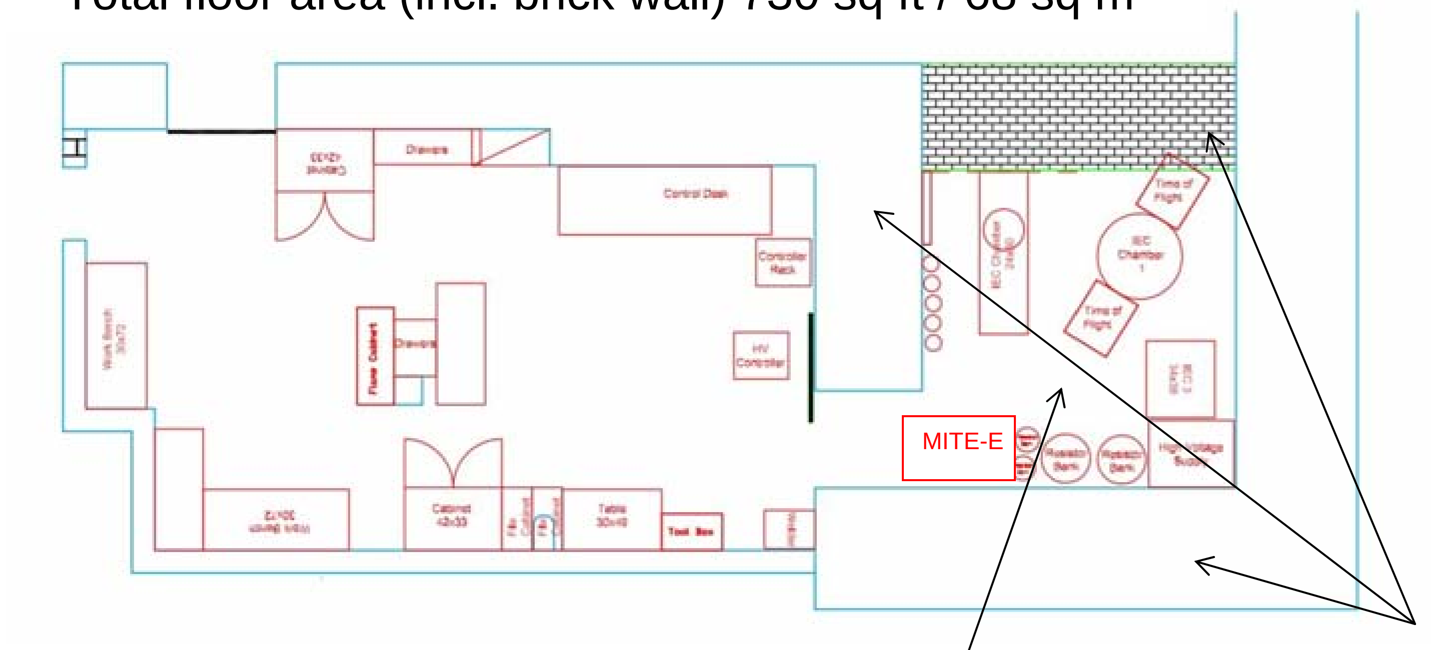
Current Status of Laboratory (as of October 2009)

- Apparatus
  - 3 operating IEC devices
  - 1 materials testing device (newly installed)
  - 300 kVDC power supply (newly installed)
  - 2-channel low-ripple filament-heating-and-bias power supply (newly installed)

Laboratory Layout

FTI Primary Laboratory
B151 ERB

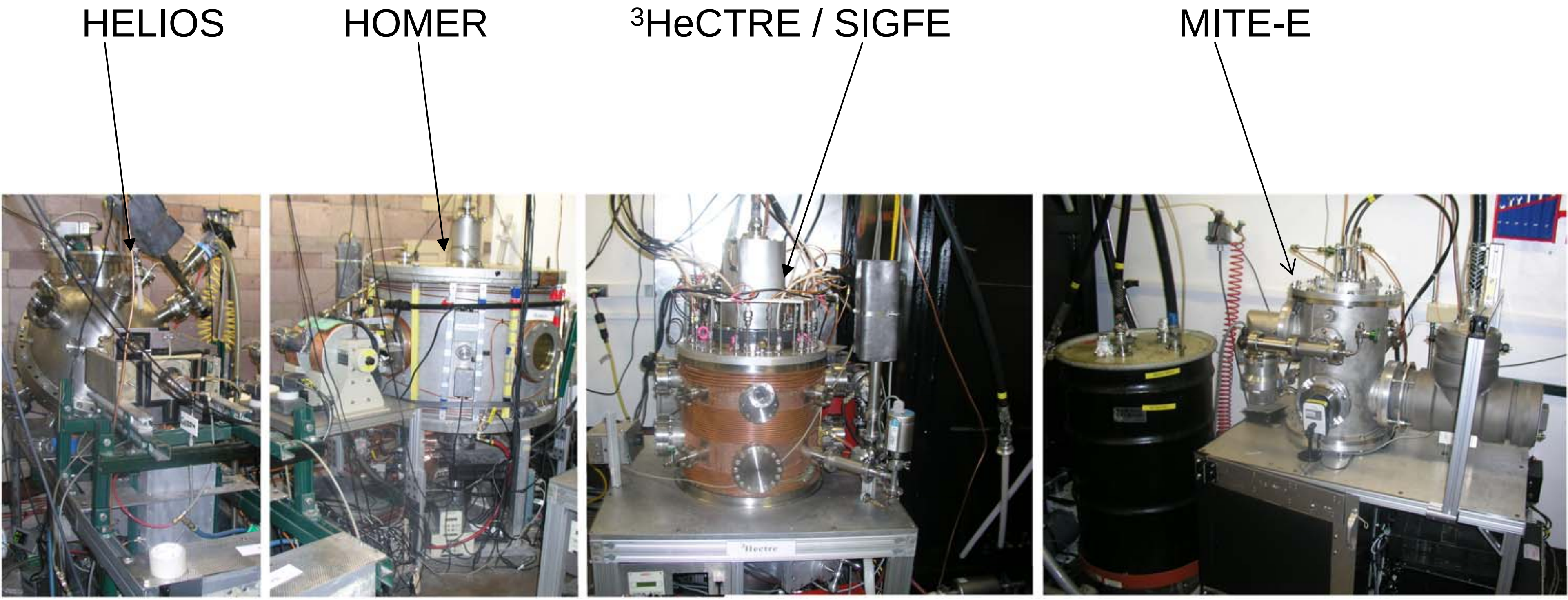
Total floor area (incl. brick wall) 730 sq ft / 68 sq m



Experiment cell (12 X 12 ft) / (3.7 X 3.7 m)

14 MeV-n-rated walls

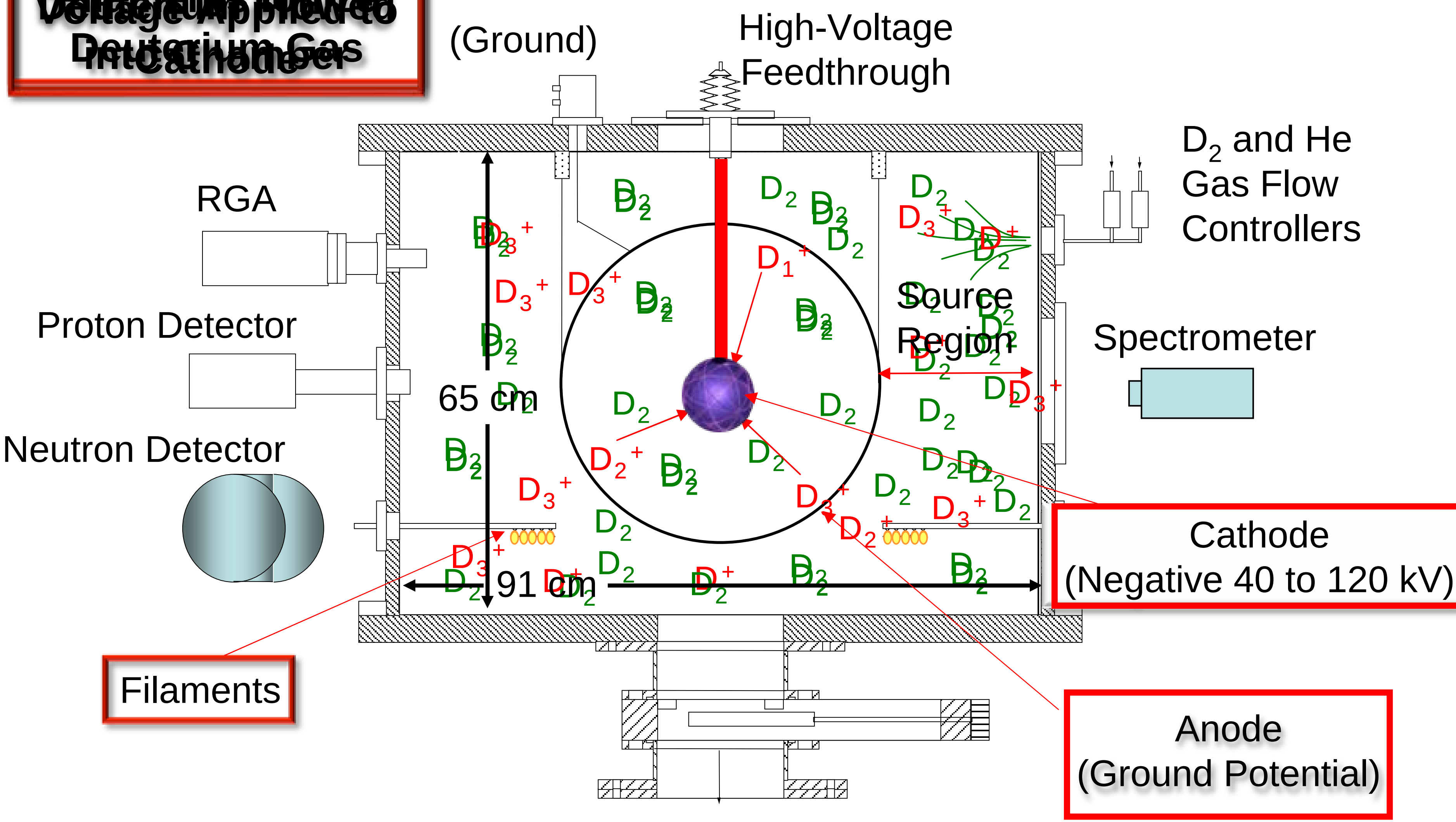
Laboratory Apparatus



Filaments Ionize Deuterium Gas

Deuterium Flowed Into Chamber

Voltage Applied to Cathode



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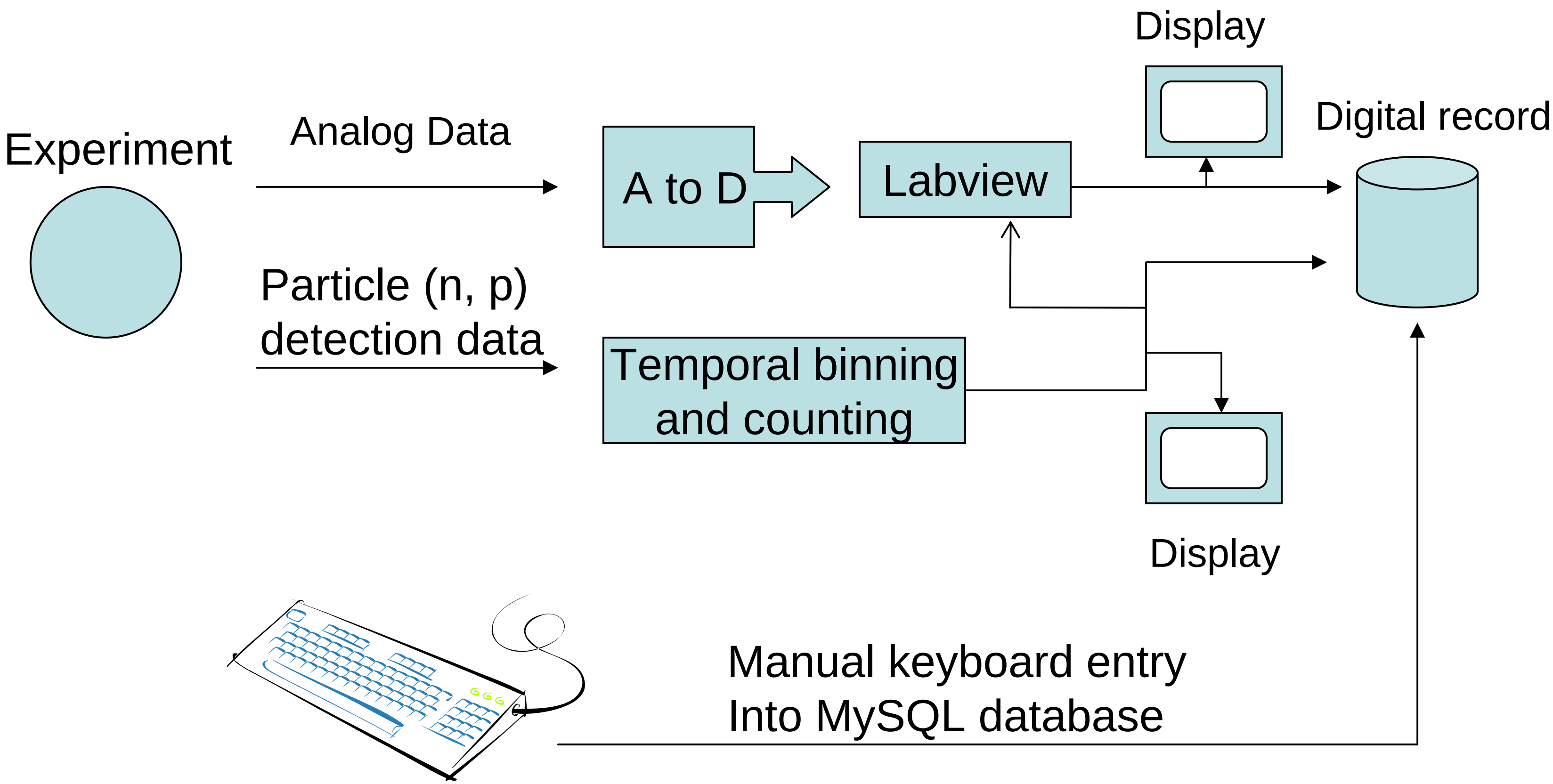
Data Flow (typical)



Data are analyzed using a number of software packages available in the laboratory and at the college computing facility

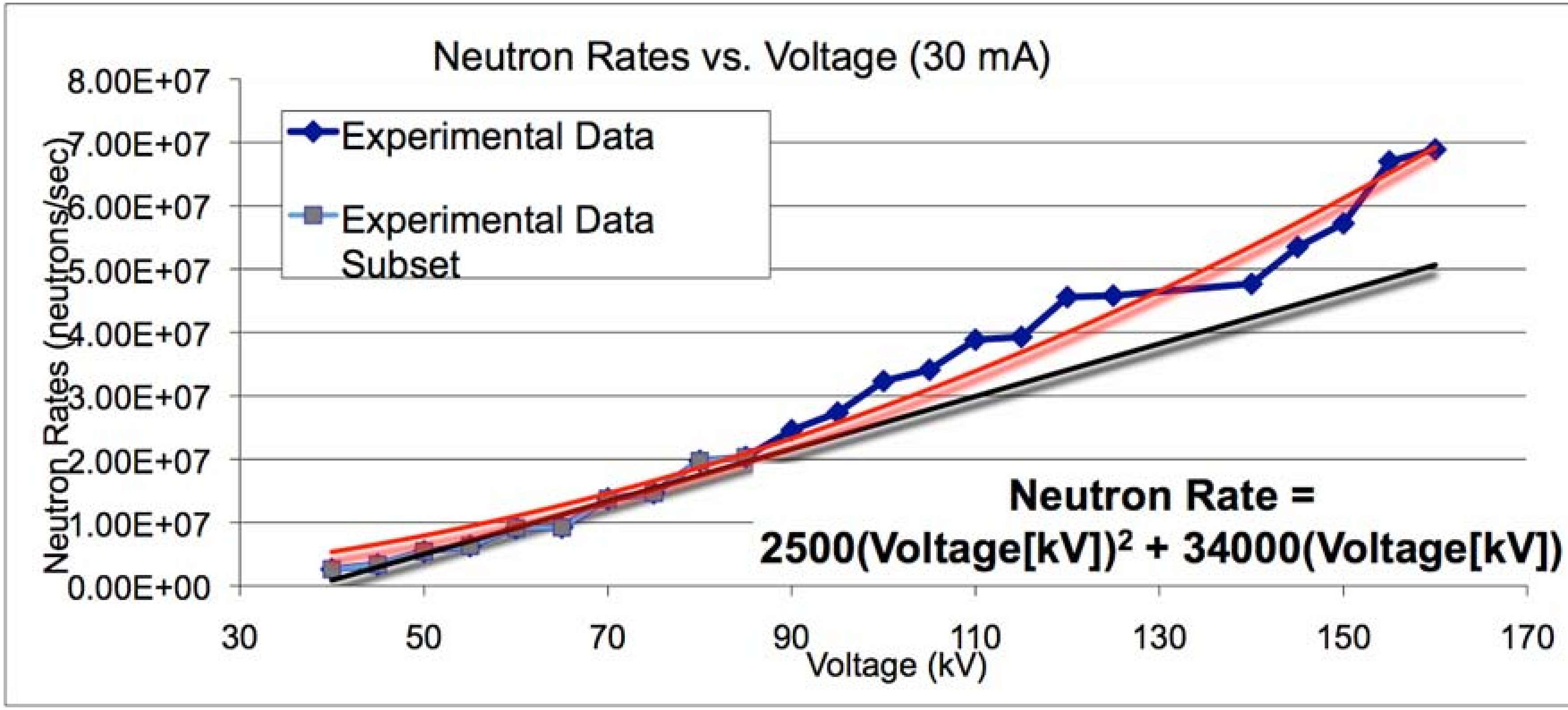
Infrastructure Improvement

- Completed since last year

✓ Installation of the new negative-polarity high-voltage power supply, 0-300 kVDC, 0-200 mA purchased from Phoenix Nuclear Laboratories (Piefer, earlier today)

Motivation for Power Supply Upgrade

- Neutron flux appears to be monotonically increasing with voltage (greater voltage ==> more neutrons)



Graph courtesy of David Donovan

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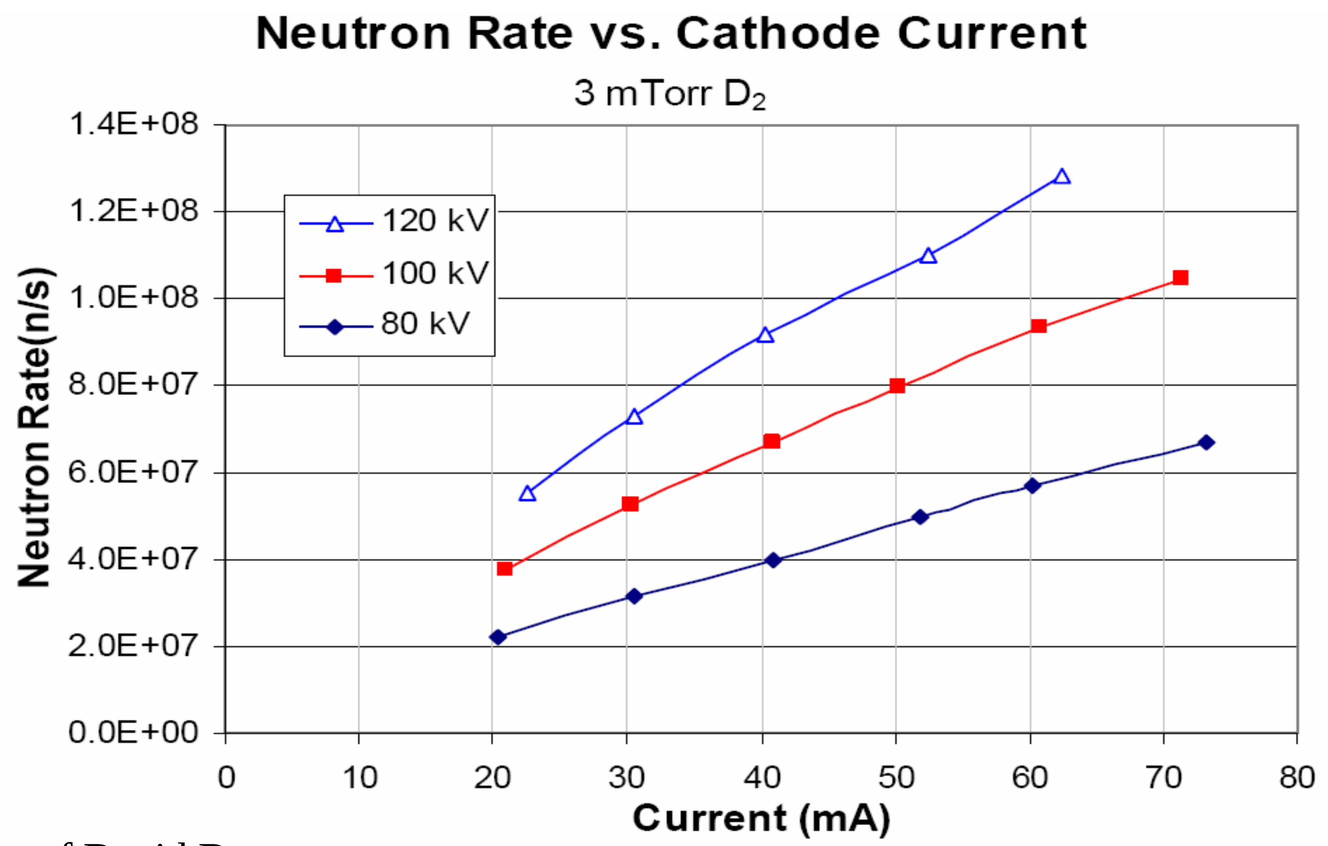


Graph courtesy of David Donovan

Infrastructure Improvement

- Completed since last year

✓ Filament heating and bias power supply

➢ 2 independent power supplies, each having:

  - ➢ 0-130 VDC for heating, up to 1 kW
  - ➢ 0-300 VDC for bias, up to ~10 A (3 kW)
  - ➢ Ripple less than 1 V_{p-p} at full output (vs. 10 V_{p-p} for old supply)
  - ➢ Four output ports, 3 of which are individually trimmed via a rheostat

Infrastructure Improvement

- Completed since last year

✓ Filament heating and bias power supply

- ➢ Extensively instrumented, and equipped for remote monitoring of:
  - ▪ Filament Voltage
  - ▪ Bias Voltage
  - ▪ Heating and Bias Currents for all eight output ports
- ➢ Monitoring circuitry interfaced to LabView

Infrastructure Improvement

- Completed since last year

✓ Design and construction of additional vacuum chamber for materials testing (Zenobia, Tues. PM)

✓ Installation of *twelve* 0-15kVDC power supplies in support of SIGFE (replaces 2 adapted capacitor-charging power supplies) (Egle, Mon. PM)

Infrastructure Improvement

- Completed since last year

✓ Design and construction of new bias-pulsing power supply for HEU detection experiments (awaiting first "live" trials)

  - More rapid turn-on and turn-off of filament bias (< 10 μs ?)
  - Compact design: reduces number of "boxes" required

✓ Repackaging of high-voltage capacitors needed to support cathode voltage during pulse operation

Infrastructure Improvement

- Completed since last year

✓ Adaptation of cable switching system to allow flexibility during the transition to higher-voltage operation (differing cable sizes)

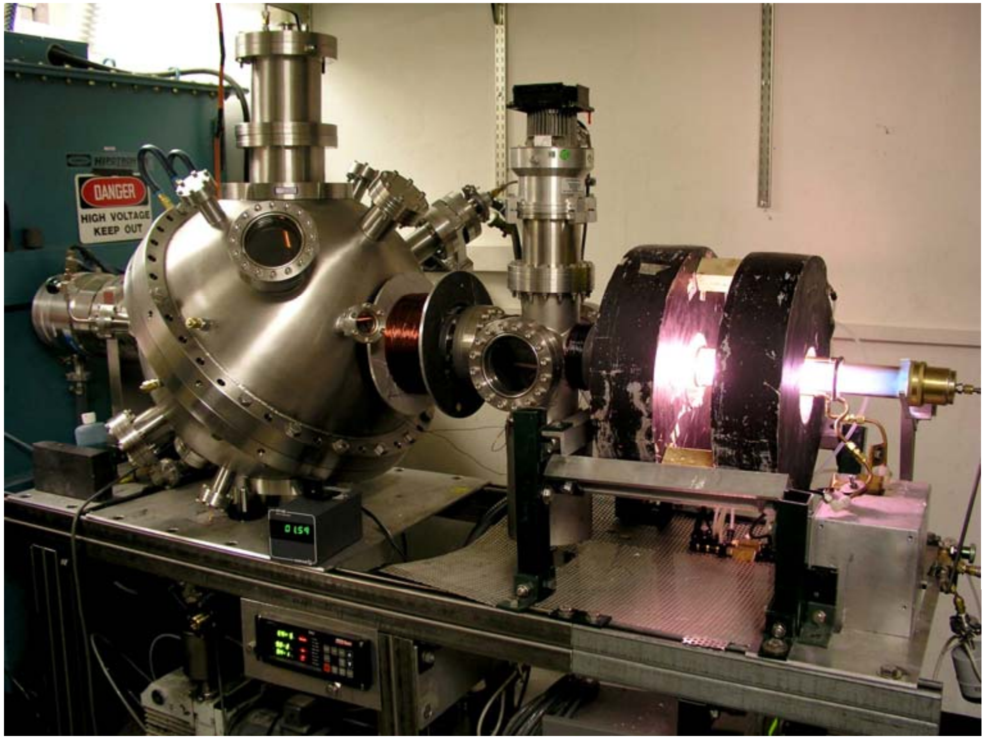
✓ Installation of a higher-frame-rate (up to 200 FPS) video camera *with X-Ray shielding*

✓ Development and deploying of Time-of-flight diagnostic (Donovan, Tues. AM)

✓ Conversion of database "back-end" from Access (MS JET) to open-source MySQL

Infrastructure Improvements

- Anticipated in the near future (postponed from last year)
  - Design and installation of glass-metal seal on HELIOS helicon ion source

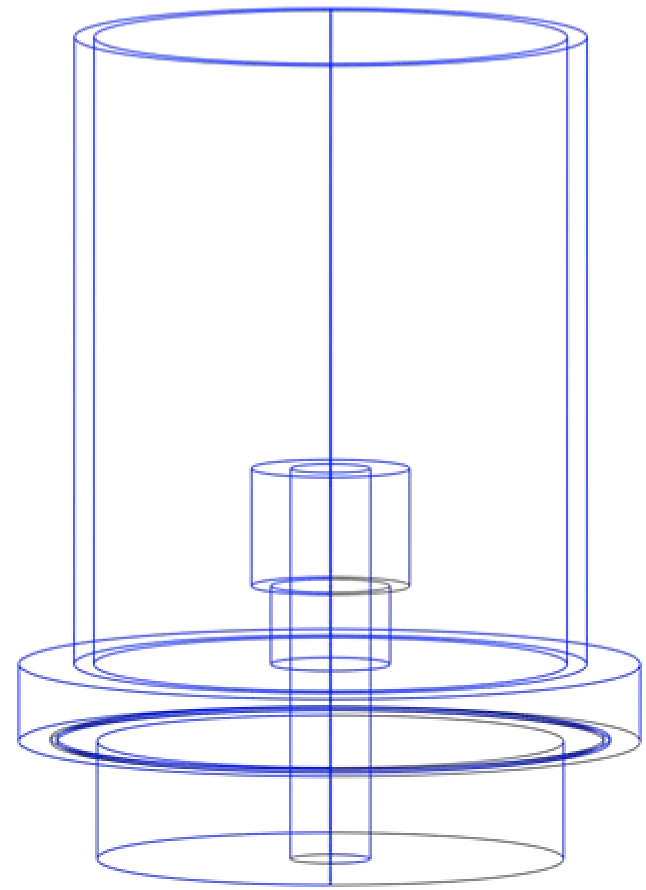


Infrastructure Improvements

- Anticipated in the near future (postponed from last year)
  - Re-configuring of experiment grounds and power connections

Infrastructure Improvements

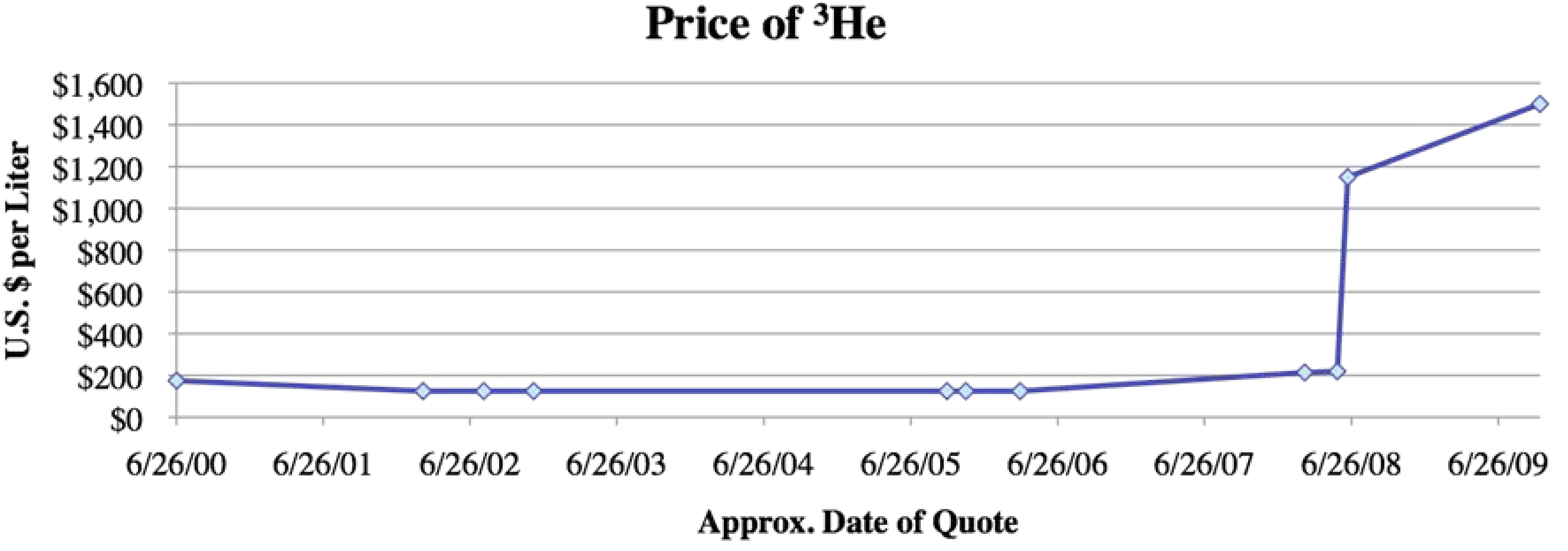
- Anticipated in the near future (postponed from last year)
  - Fabrication of new metal-free HV feed-throughs, and installation on HOMER and HELIOS.



Infrastructure Improvements

- Anticipated in the more distant future:
  - Design and installation of a ^{3}He recovery system.

Motivation:



Concluding Remarks

- IEC Laboratory staff continues to improve experimental apparatus, infrastructure and methodologies, and to design innovative experiments.
- The laboratory should be able to expand the operating regime (cathode current and voltage) in a very substantial way in the course of the next two years.

Questions?