Progress in IEC Research at the University of Wisconsin Since the 7th US-Japan Workshop

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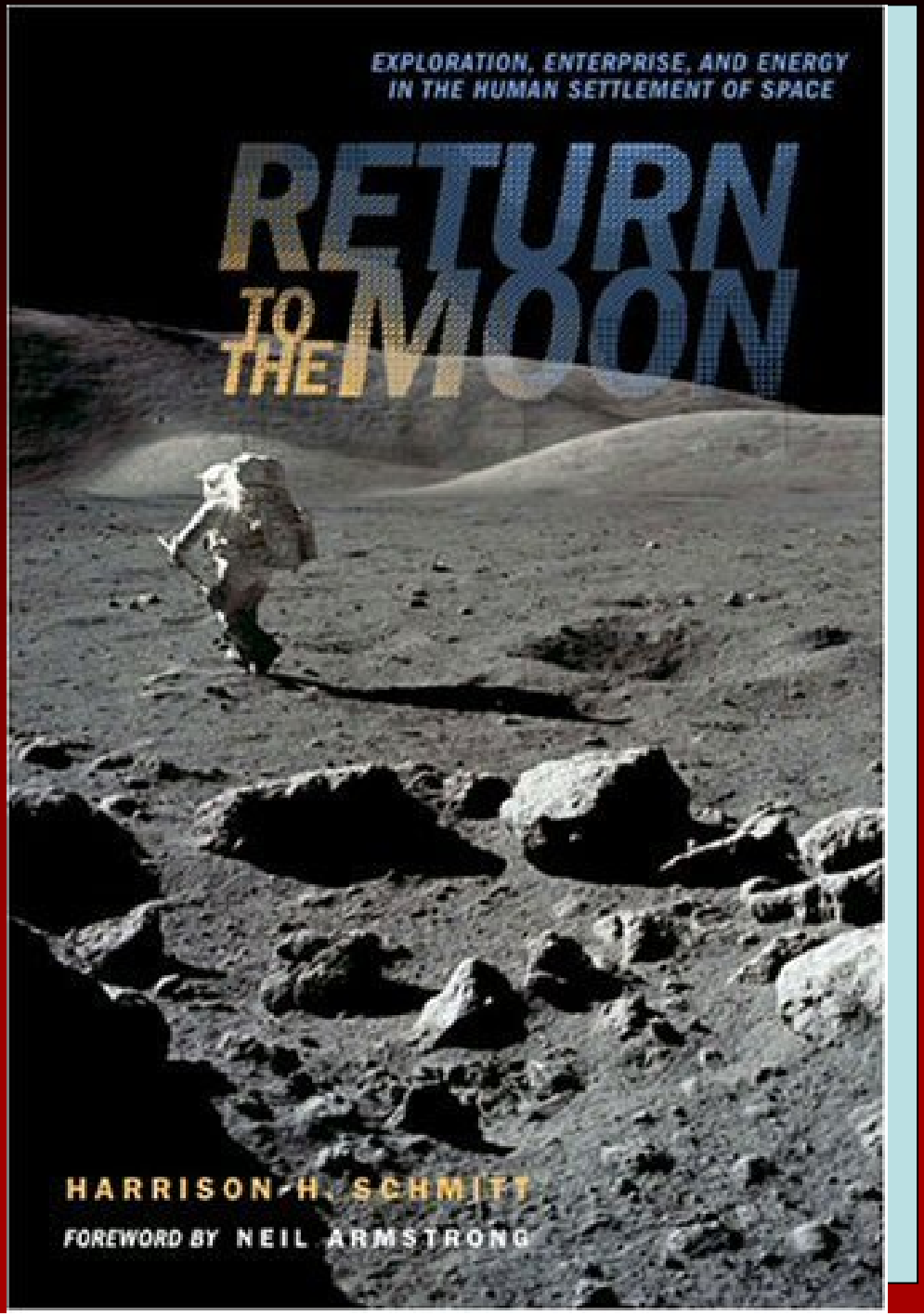
8th US-Japan Workshop
Kansai University
May 10th, 2006

THE UNIVERSITY of WISCONSIN MADISON

Outline

- Personnel Update
- Overall Progress Since the 7th US-Japan Workshop-LANL-March, 2005
- Specific Advances from Students Not Attending the 8th US-Japan Workshop
- Future Directions

The **UW-IEC** Group Has Grown to 14


EXPLORATION, ENTERPRISE, AND ENERGY
IN THE HUMAN SETTLEMENT OF SPACE
RETURN TO THE MOON
HARRISON H. SCHMITT
FOREWORD BY NEIL ARMSTRONG

Previous UW IEC History Timeline

1995
- 1st@LANL
- IEC device constructed

1999
- 1st Steady State D-^{3}He fusion
- 1st Published results (Thorsen)
- 75-200kV Capability

2000
- 2nd@Kansai Univ.
- 10^7 neutrons / sec steady state

2001
- Fusion source regions identified
- 3rd@MSFC
- 10^8 D-D neutrons/sec steady state

2002
- Medical Isotopes Produced
- 4th@Kyoto Univ.

2003
- Grid Fabrication Tooling
- 5th@U. Of Wisconsin

2004
- Helicon Ion Source
- 6th @Tokyo Inst. Tech

2005
- High Temp Materials Studies
- Explosives Detection Studies Begun

2006
- 7th@LANL
- Pulsed Operation Begun

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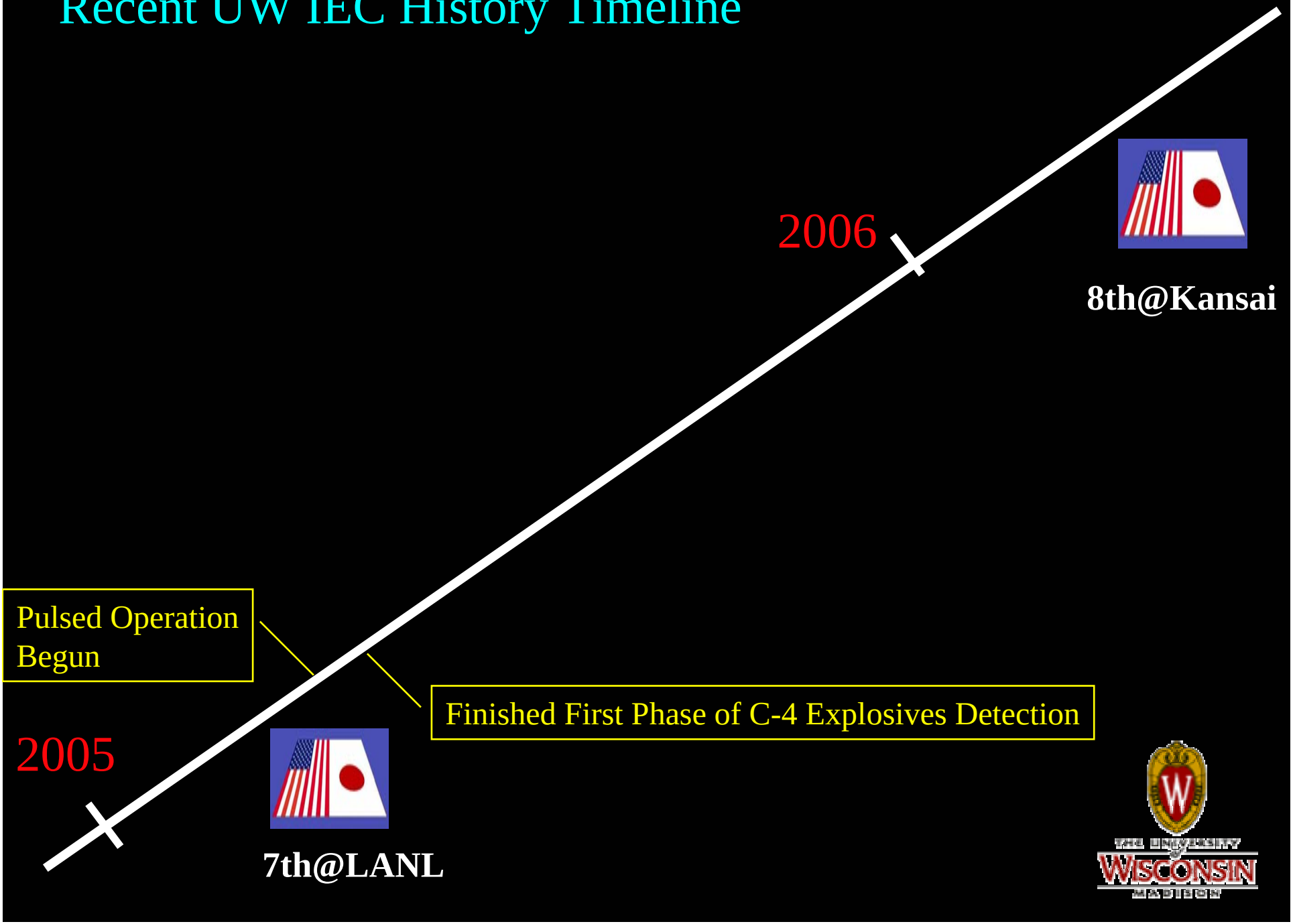
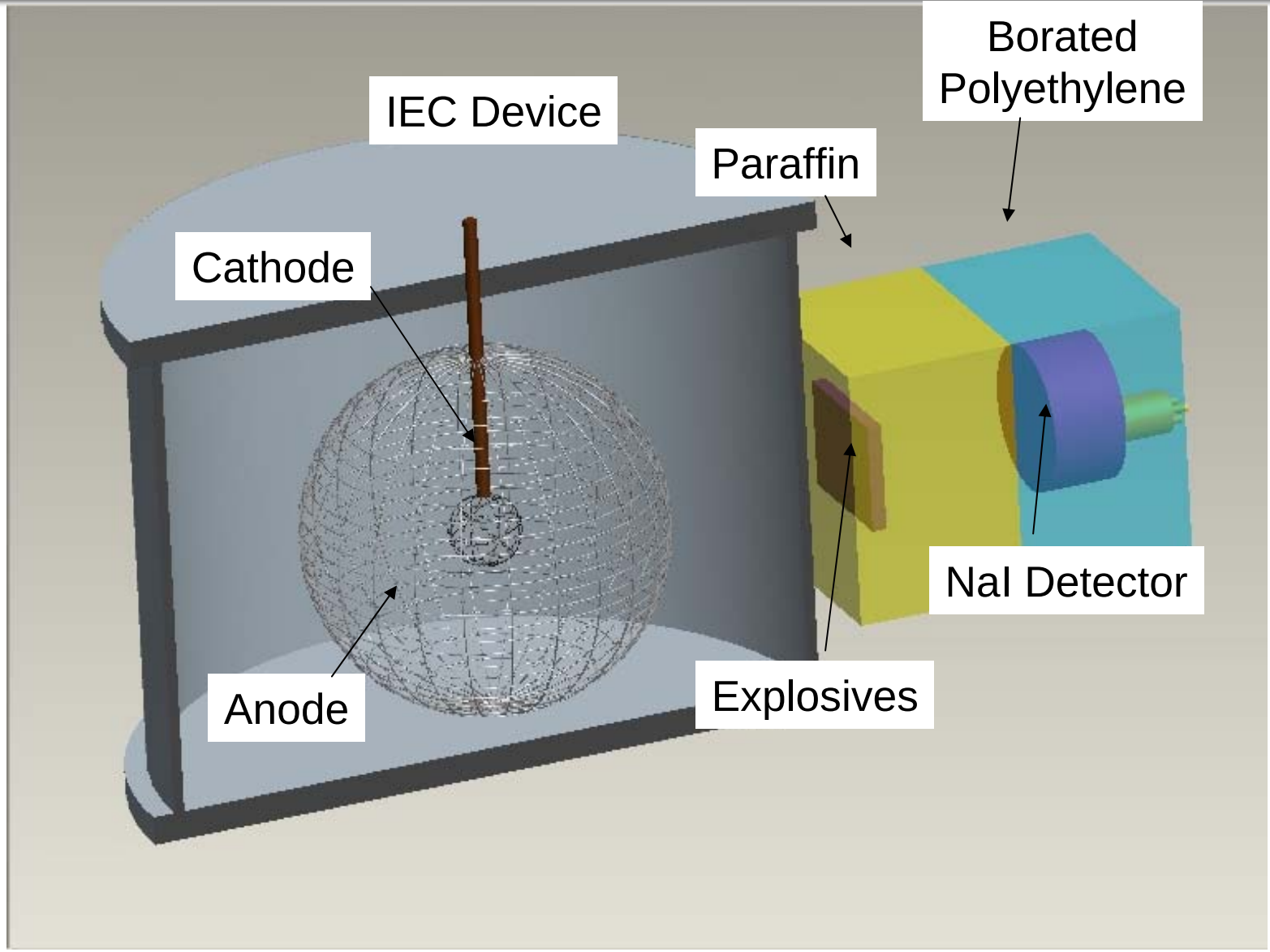
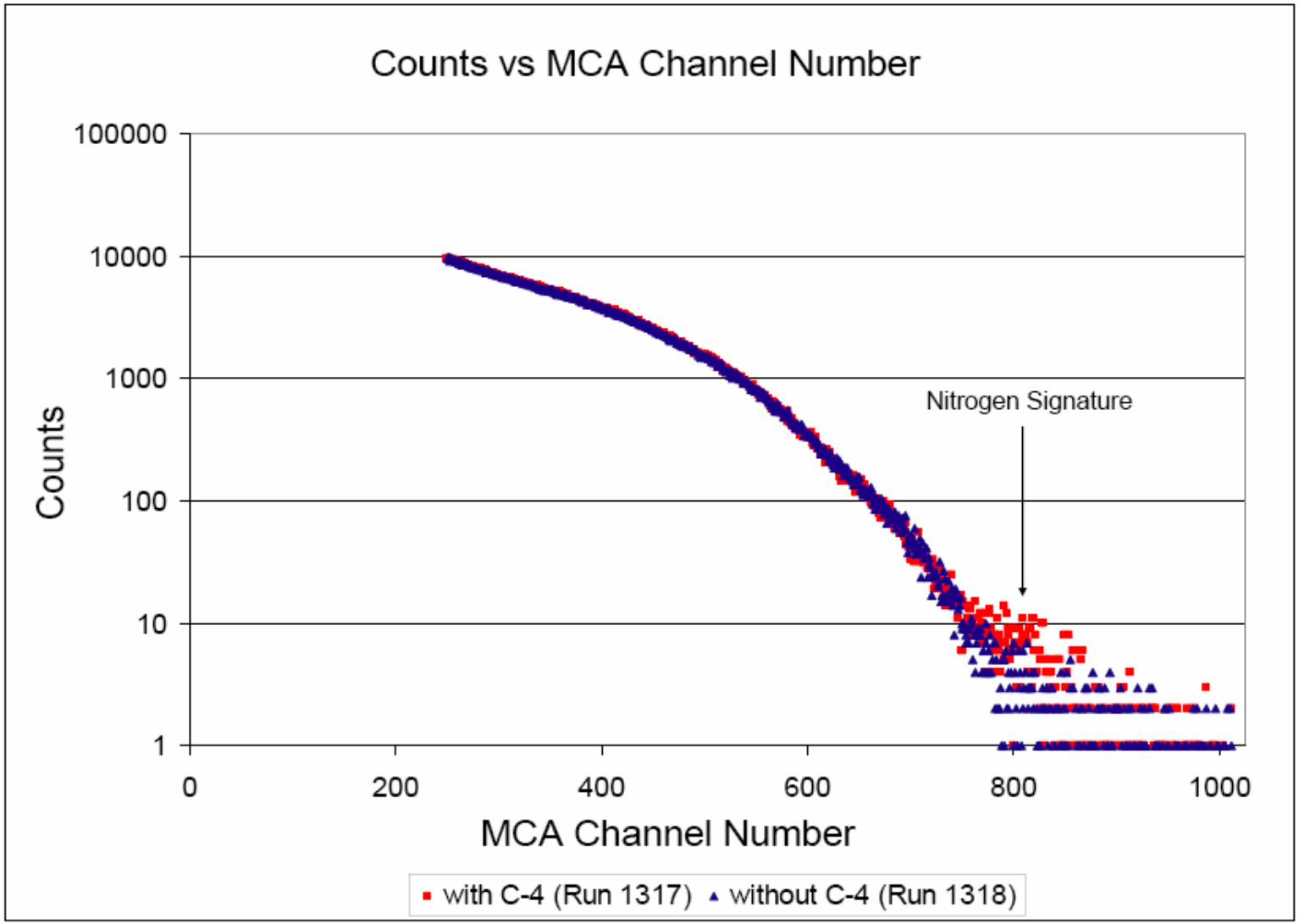
Recent UW IEC History Timeline



CAD Representation of UW Experimental Setup for Explosives Detection



The C-4 Explosive "Signature" is Clearly in Evidence



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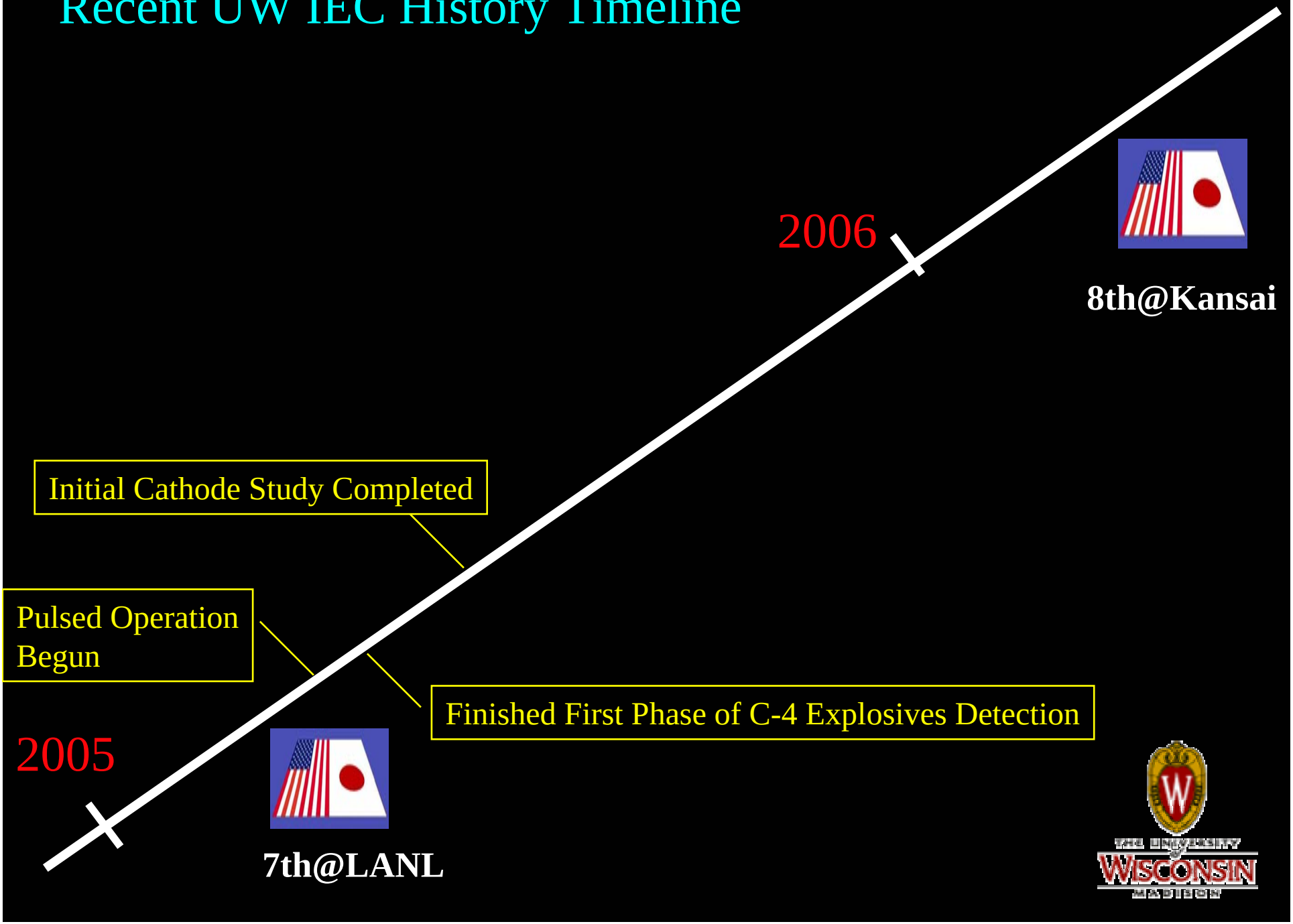


Studies to Determine the Effect of Cathode on Neutron Production Rate

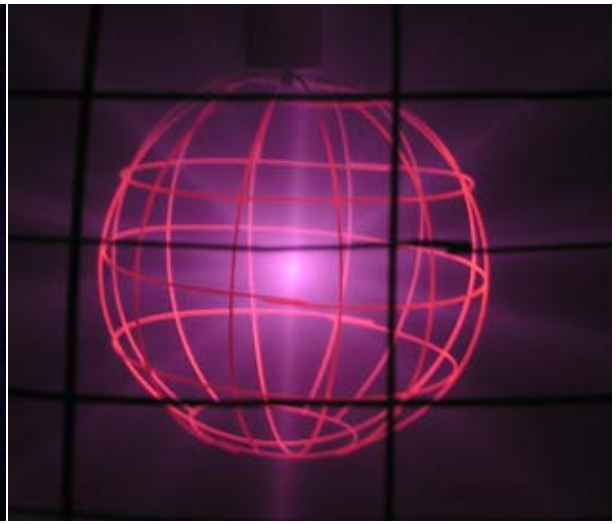
Cathode Size

10 cm Inner Cathode Grid Diameter

20 cm Inner Cathode Grid Diameter

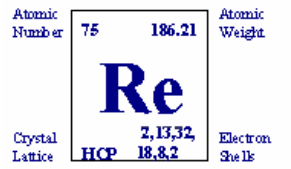
Cathode Geometry

10 cm Symmetric Inner Cathode Grid

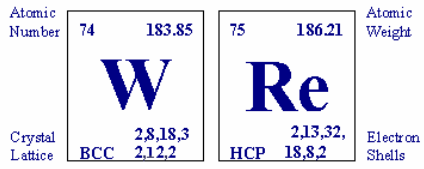


10 cm Lat/Long Inner Cathode Grid

Cathode Material



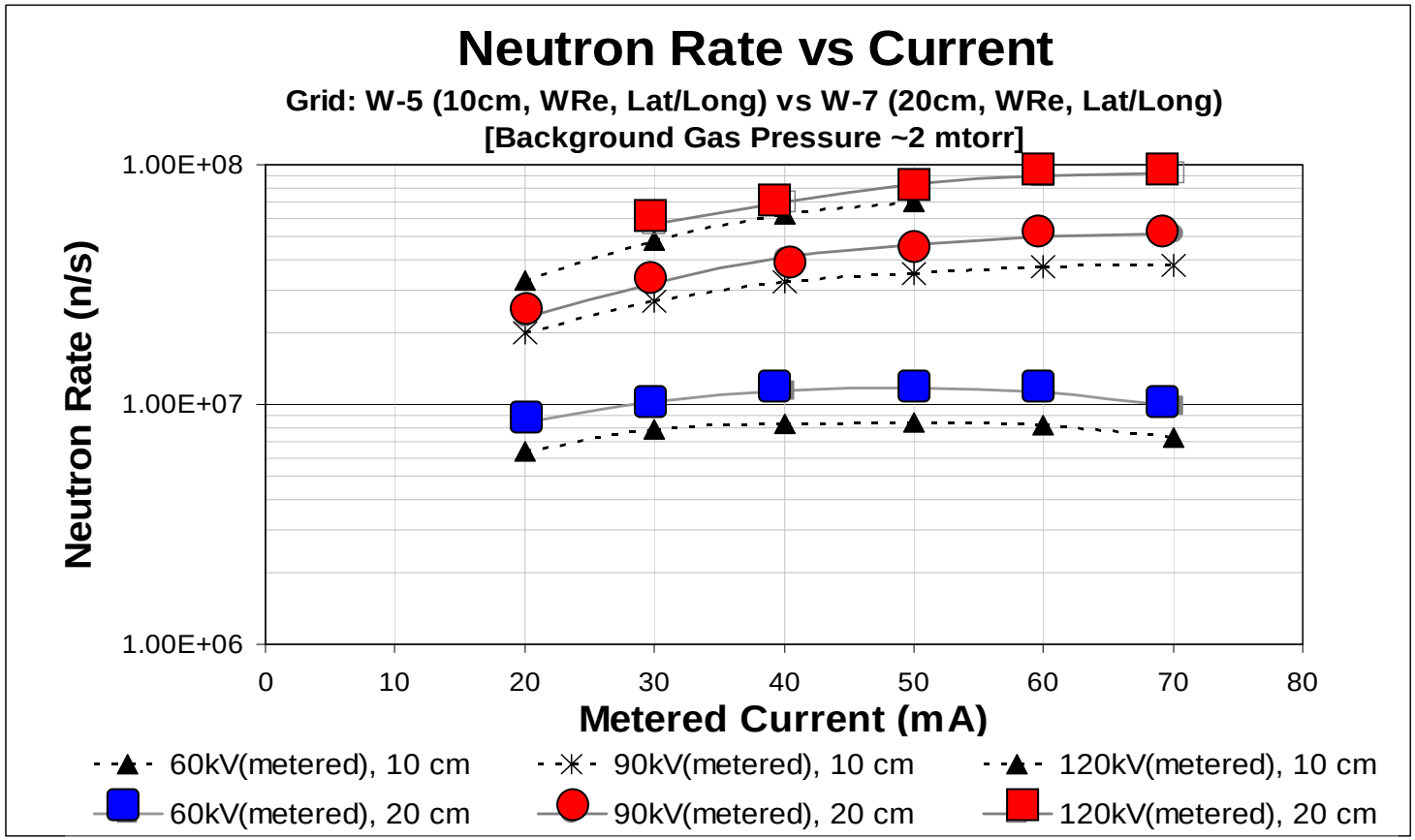
10 cm Inner Cathode Grid (Re)



10 cm Inner Cathode Grid (WRe)

No Significant Difference Seen

Doubling the Cathode Size Increased the Neutron Production Rate by ≈ 20%



Constant voltage, background D-D gas pressure, geometry, material, and 50 cm anode diameter

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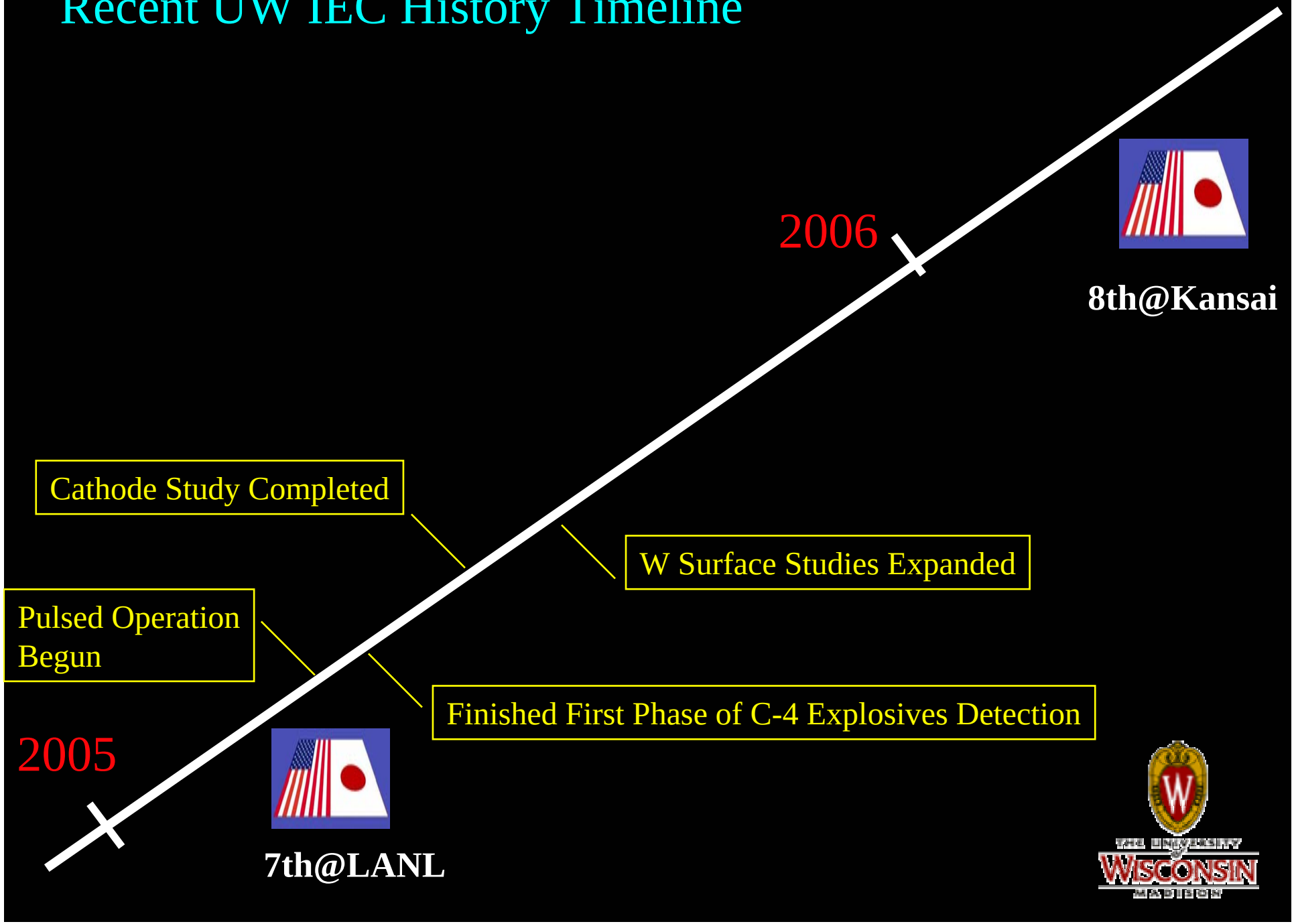
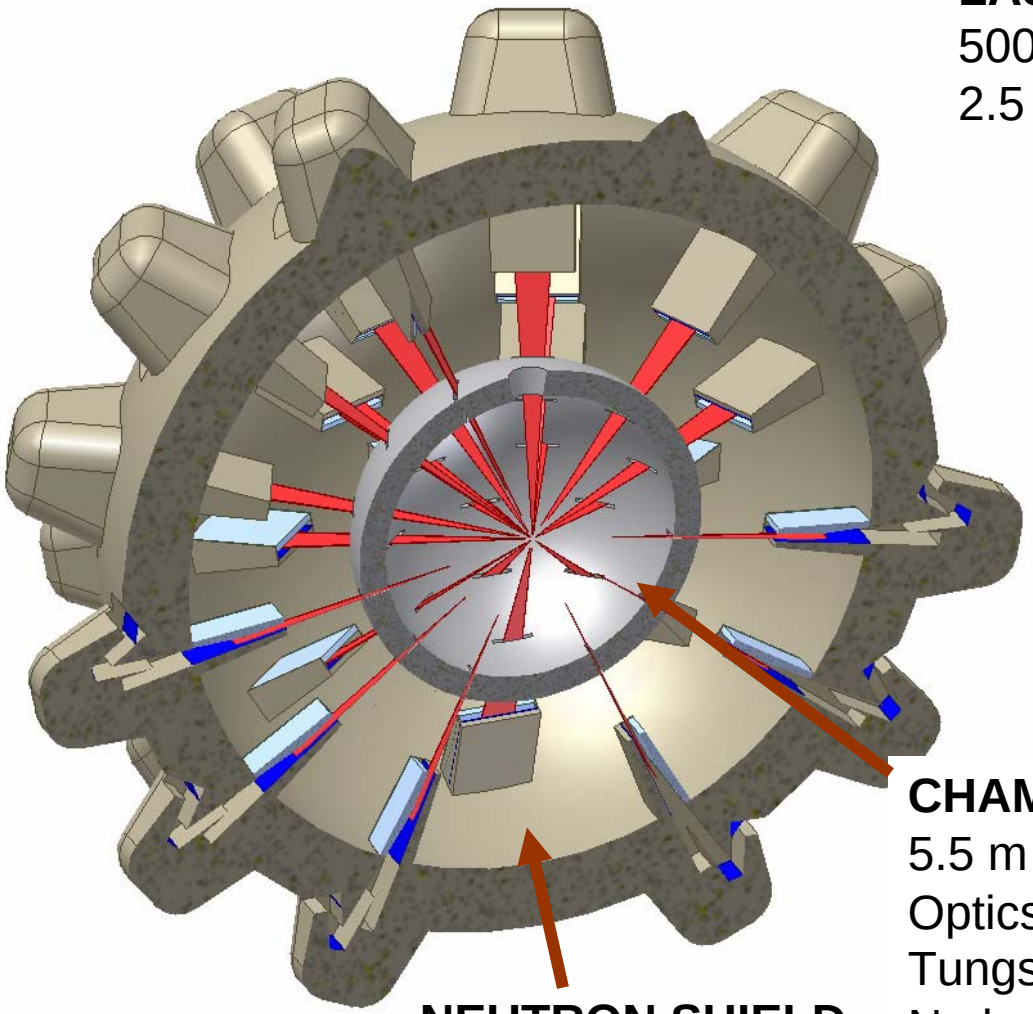


The First Wall of a Laser Fusion Reactor Will Undergo Significant Helium Bombardment



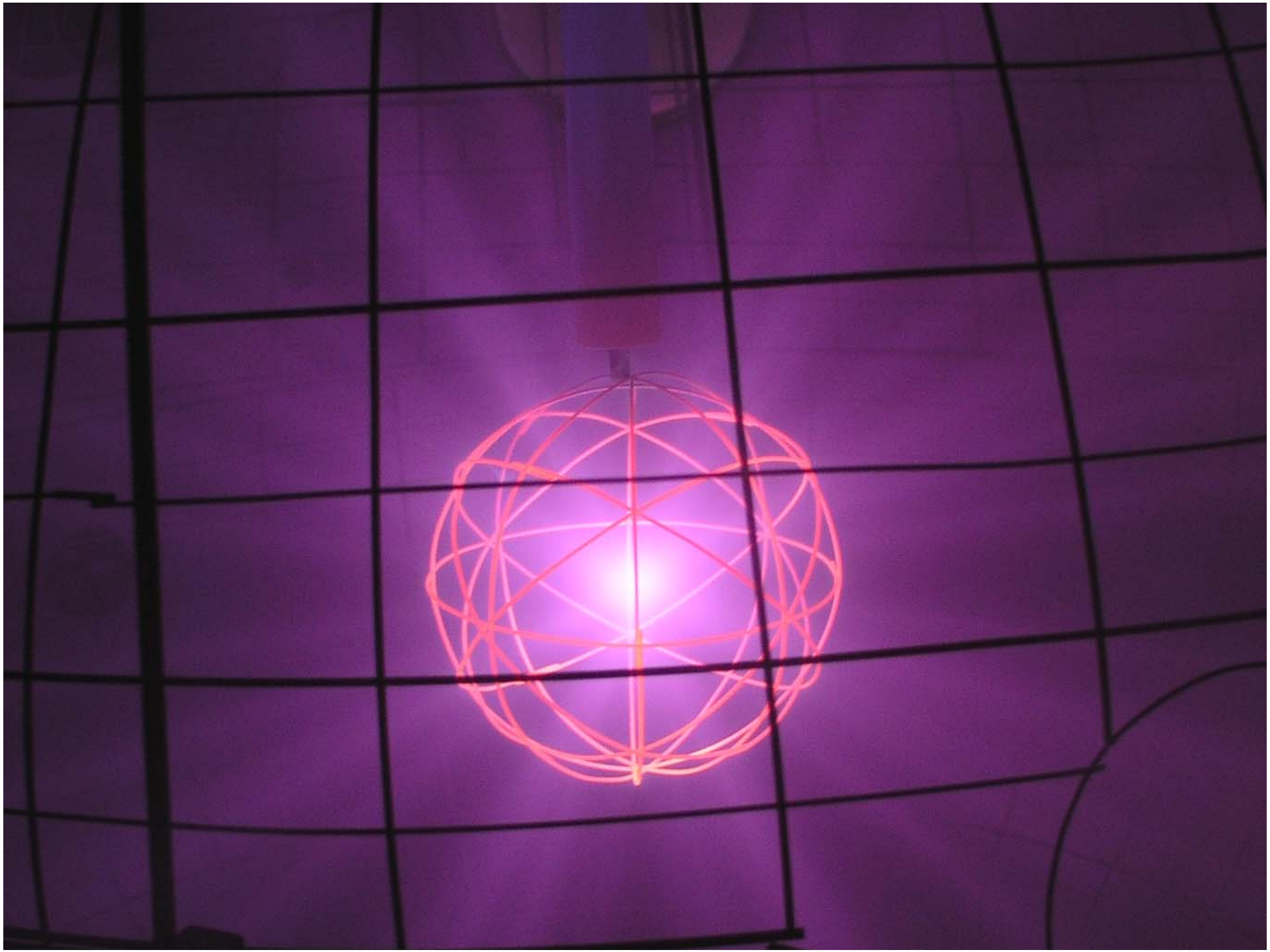
NEUTRON SHIELD
13 m inner radius

LASER ENERGETICS
500 kJ *on target*
2.5 nsec drive pulse

OPTICAL ARCHITECTURE:
20 KrF amplifiers (28 kJ each)
90 beams/amp = 1800 beams
40 beam ports, each 45 beams

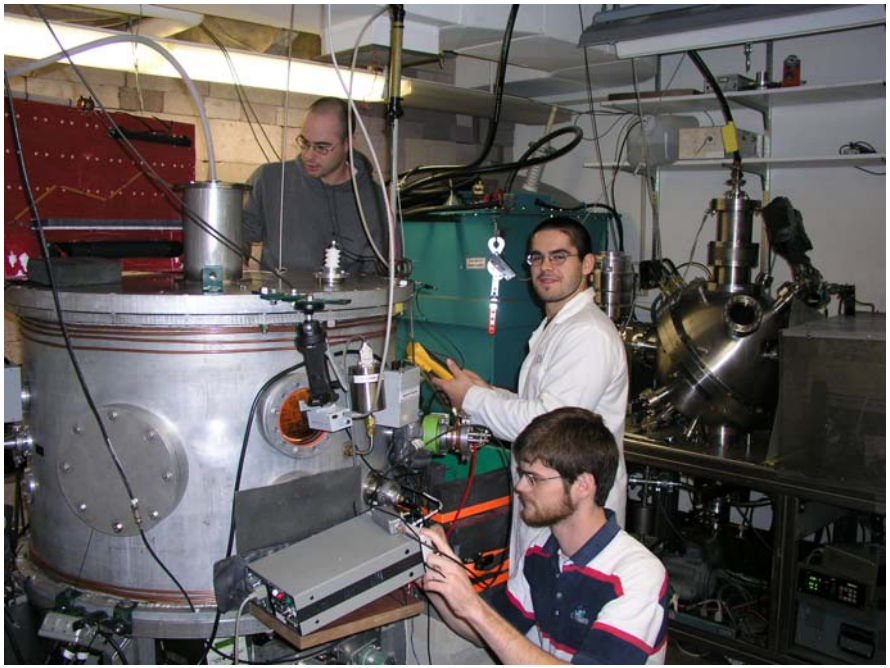
OPTICAL TRAIN
< 1.1 J/cm^2 on optics
GIMM (or dielectric) final mirror
Window shielded from neutrons

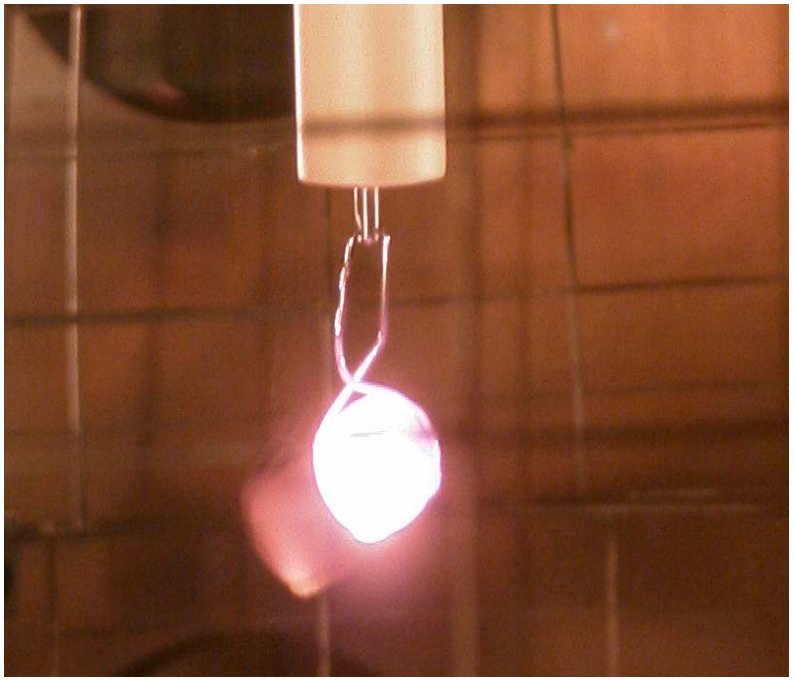
CHAMBER
5.5 m inner radius
Optics ~ 2% solid angle
Tungsten armor/steel base (provisional)
No buffer gas in chamber
Blanket for thermal management/breeding



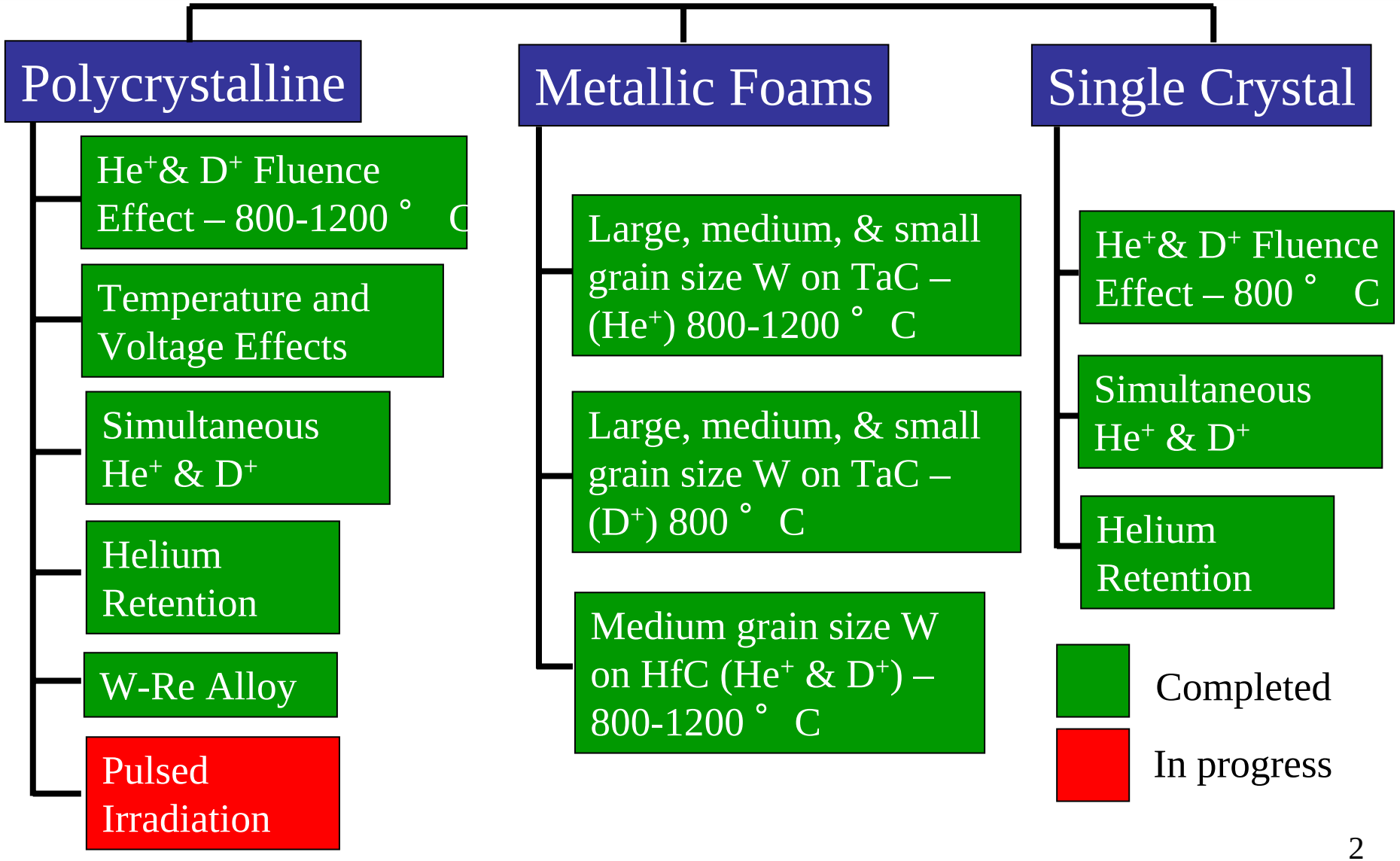
New Design Allows Pulsed IEC Operation For Surface Damage Studies

- Currently able to pulse up to 110 kV
- Operation has been performed with pulses as short as 100 μs
- Capable of running D_2 and He fuel gas

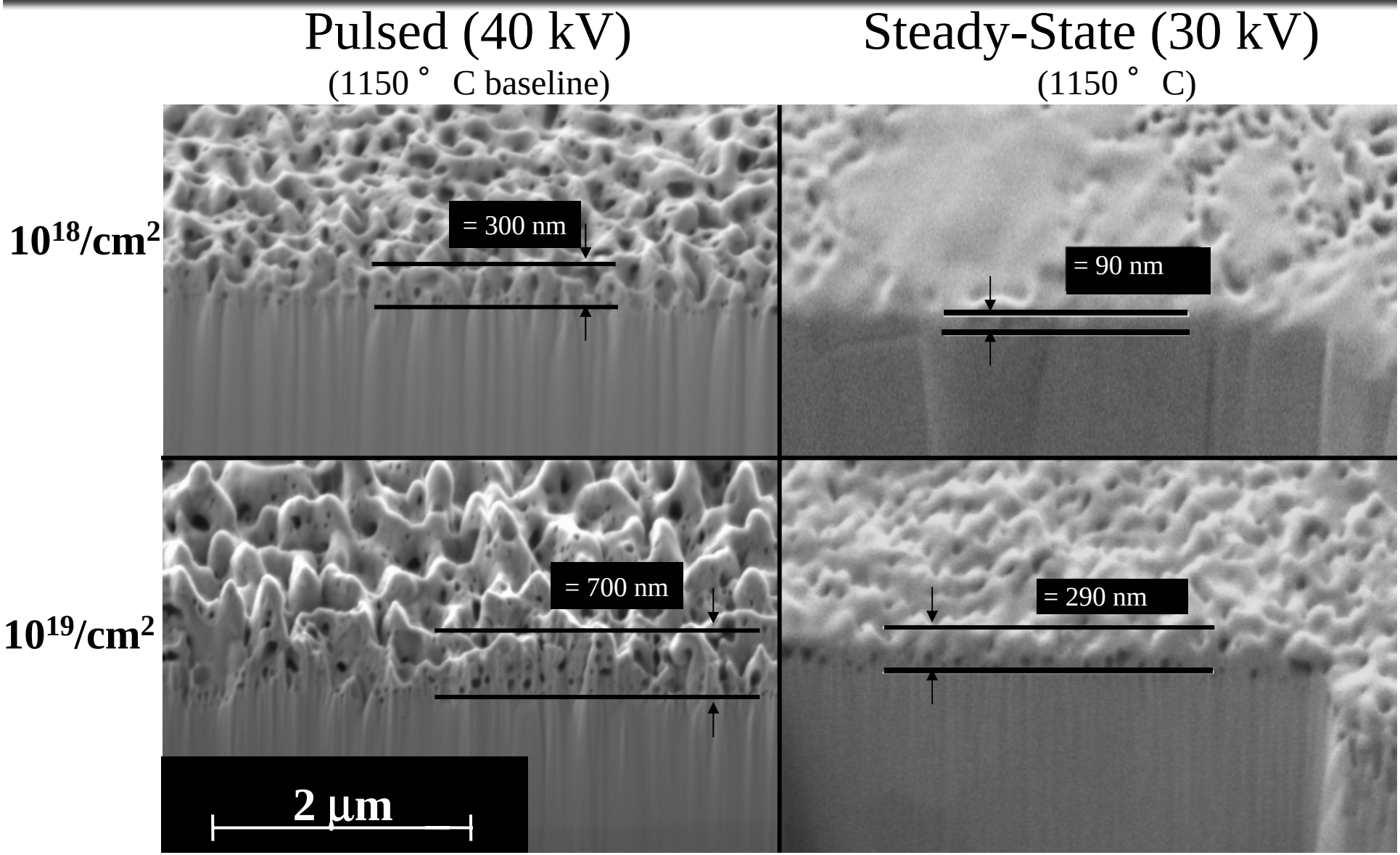




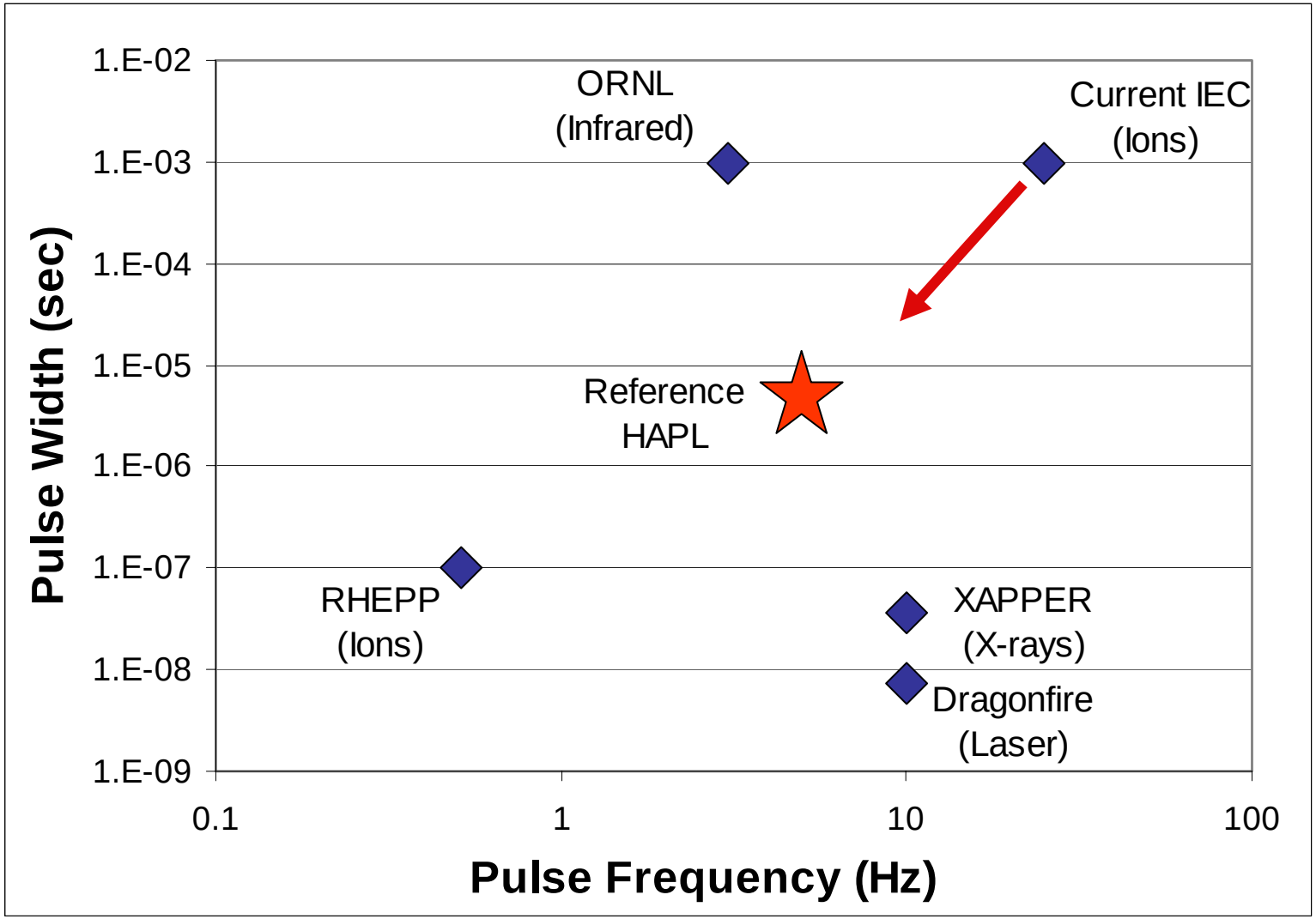
The Campaign to Assess Ability of W Coatings to Operate in HAPL Environment is Proceeding



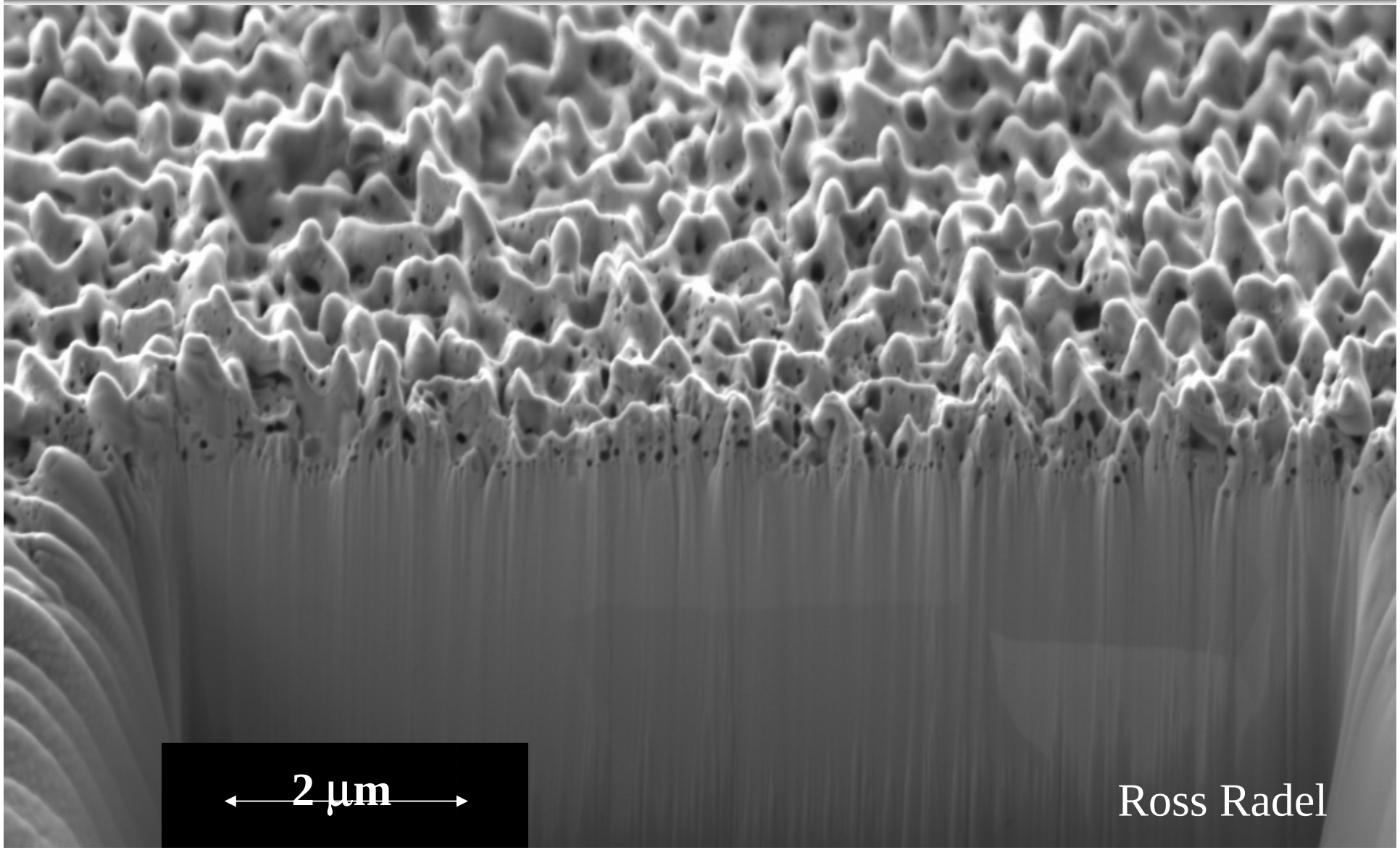
FIB Analysis Reveals Increased Porous Layer in Pulsed Samples



Pulsed IEC Irradiation Better Simulates HAPL Flux



Example of Pulsed He Ion Damage in W at ≈1,150 ° C (10^{19}/cm^2)



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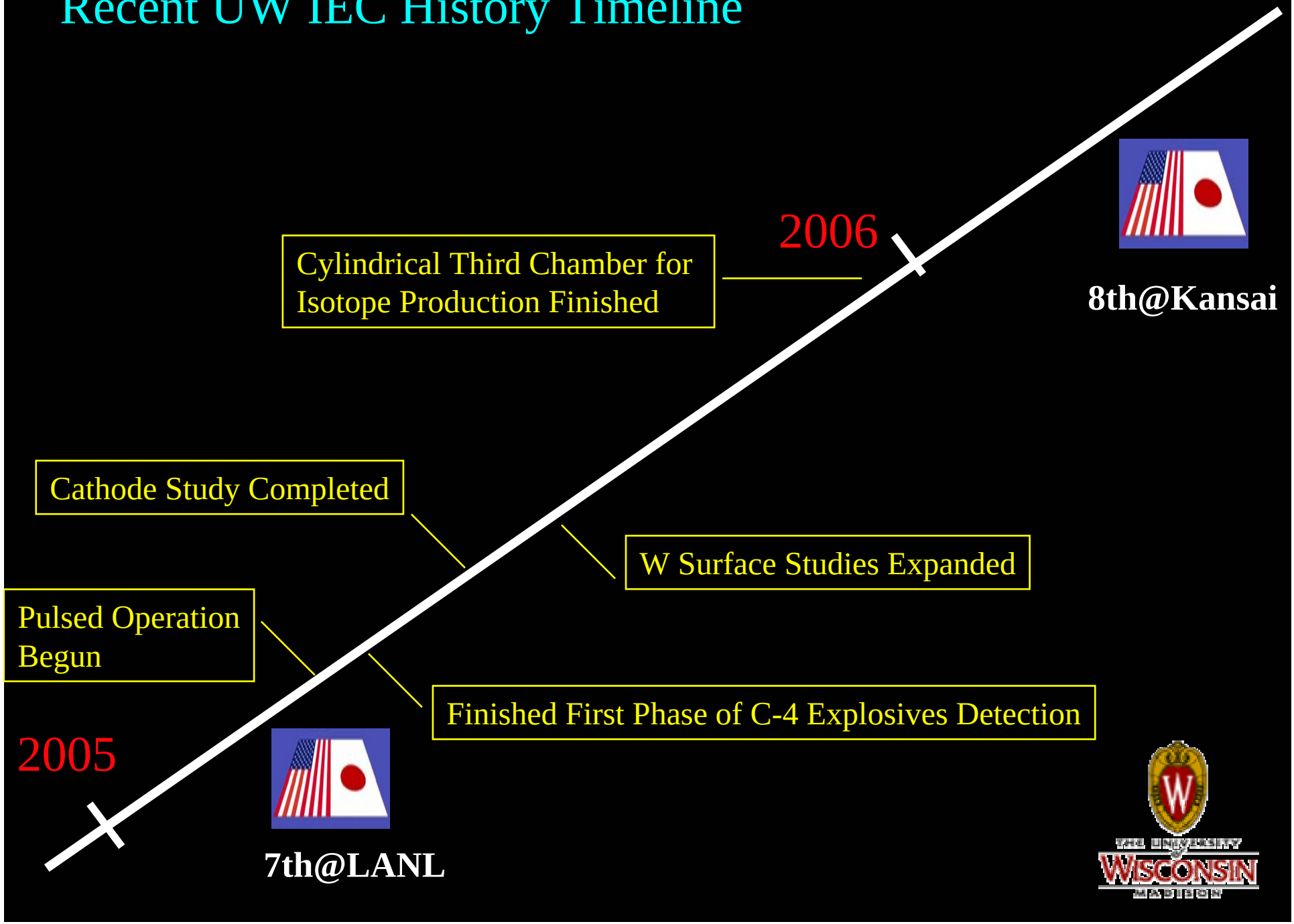
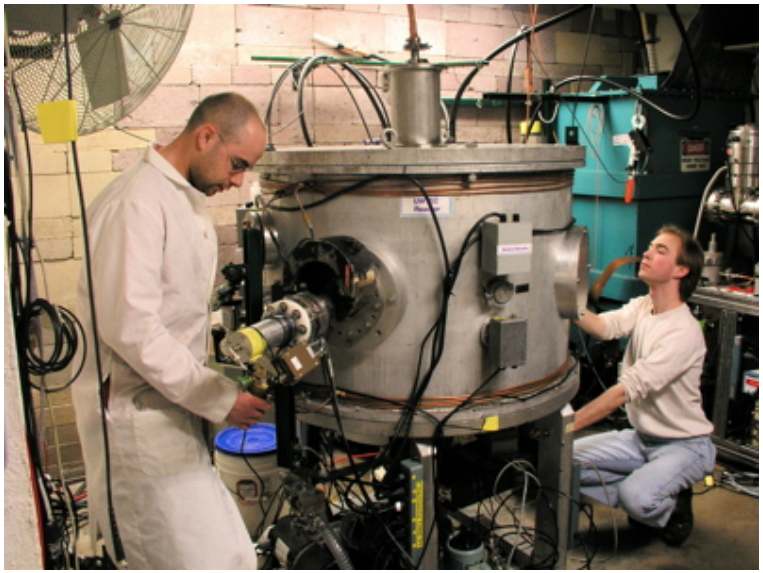
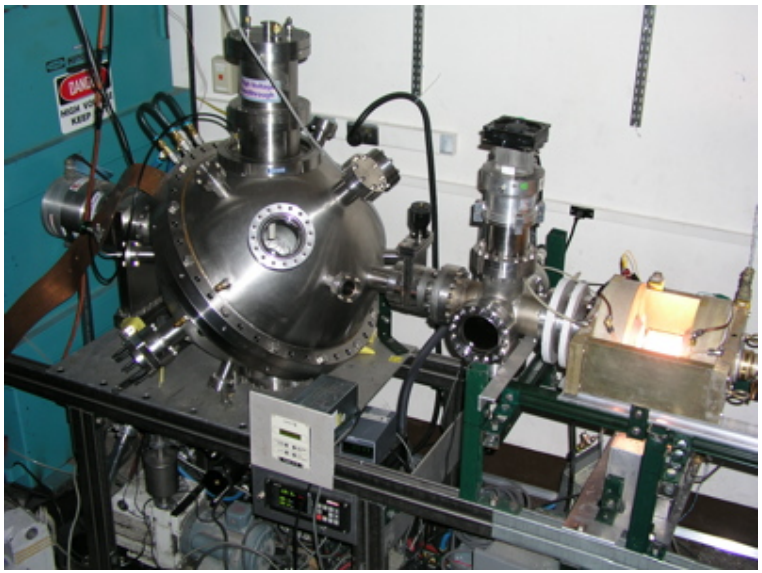
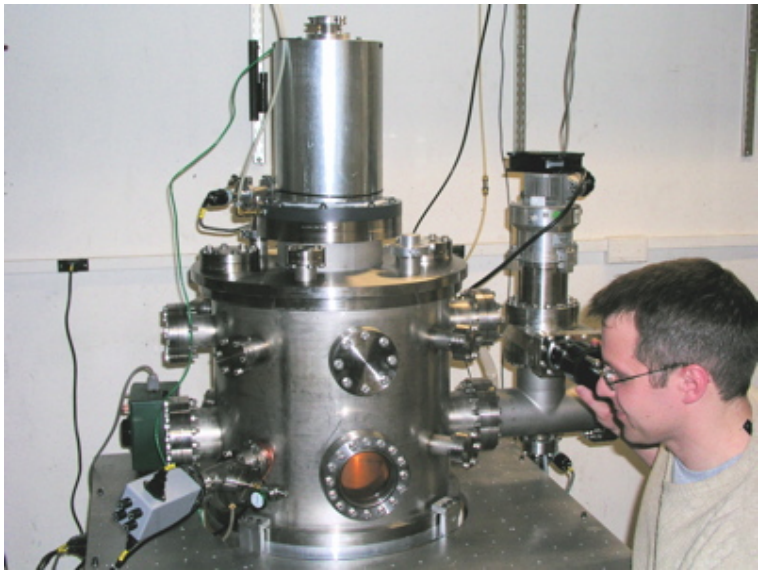


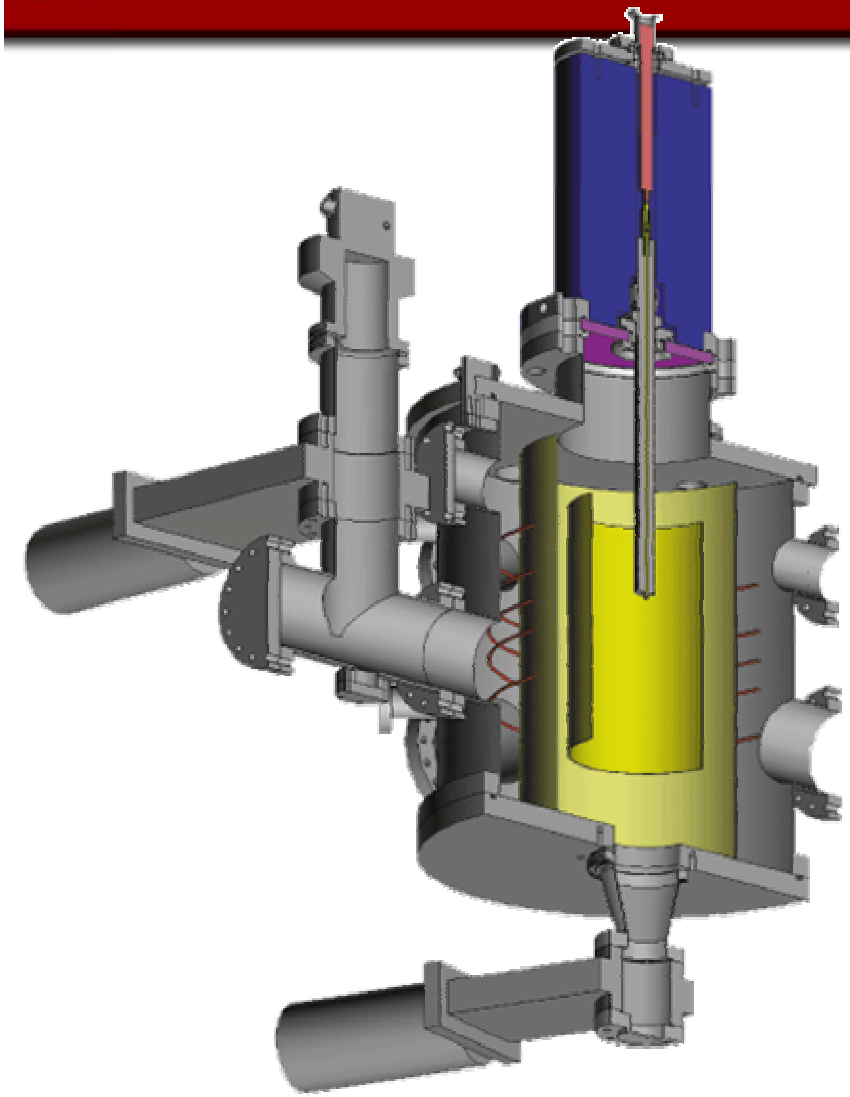
Three IEC Chambers Are Now in Operation at the University of Wisconsin





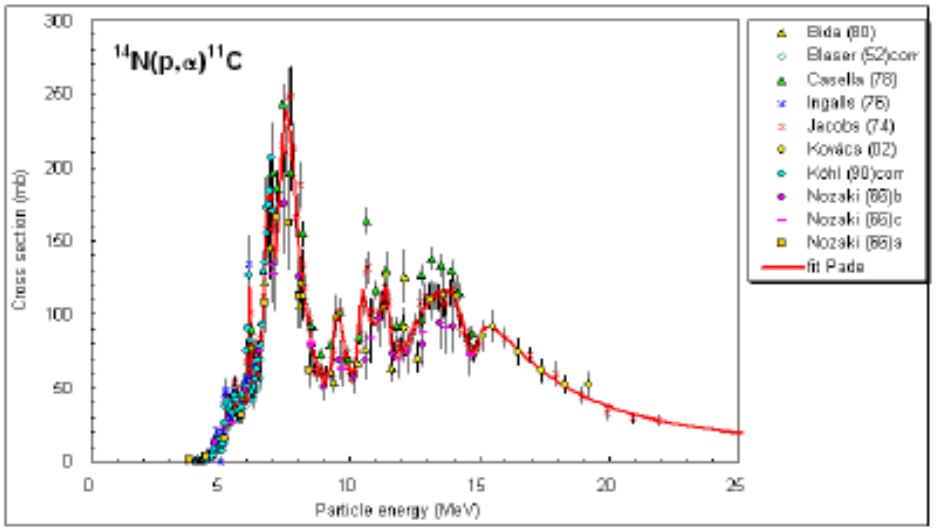


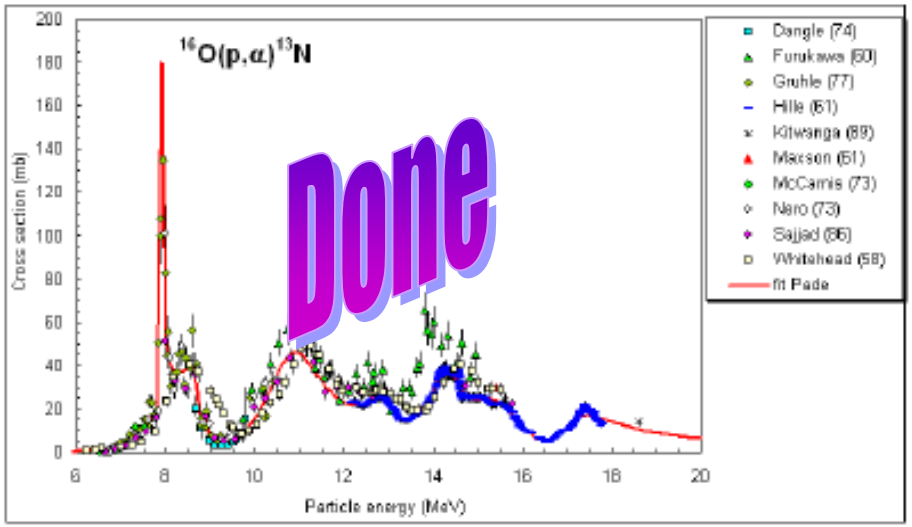
3rd Chamber Construction

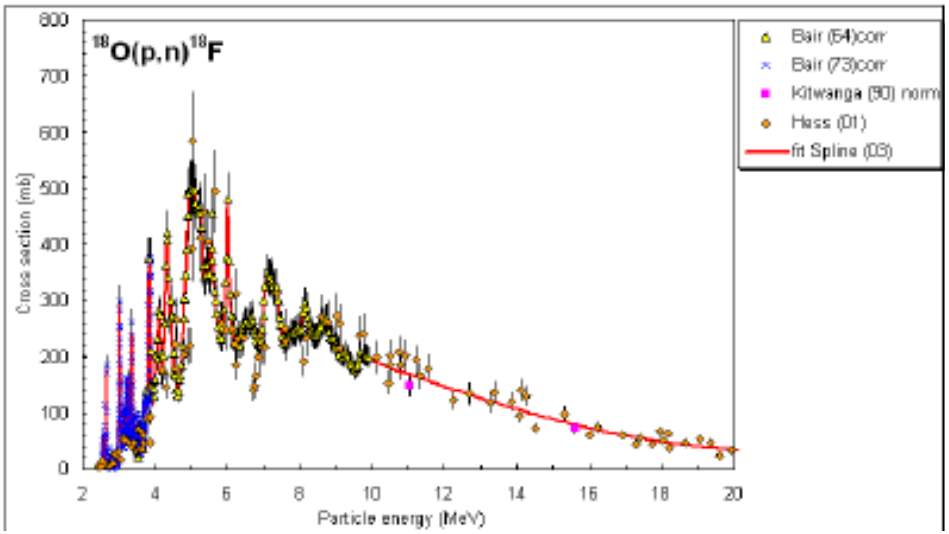


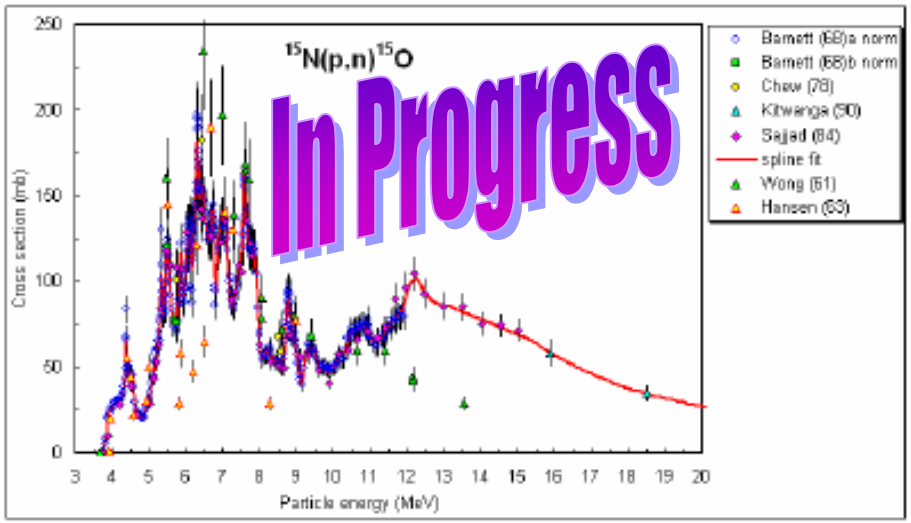
- **Design Features**
  - 75 liter Stainless Steel Cylindrical Vacuum Chamber
  - *Isolated Nut* High Voltage Feed-through design
  - Cylindrical Cathode, Anode, and Filament design
- **Milestones**
  - Vacuum Achieved September 2005
  - New High Voltage Feed-Through installed February 2006. High Pot Tested in March 2006 to 130kV with virgin spherical grid and virgin stalk.
  - First Neutrons produced April 5, 2006 at 30kV and 60mA.

PET Isotopes to be Produced in UW IEC Chamber









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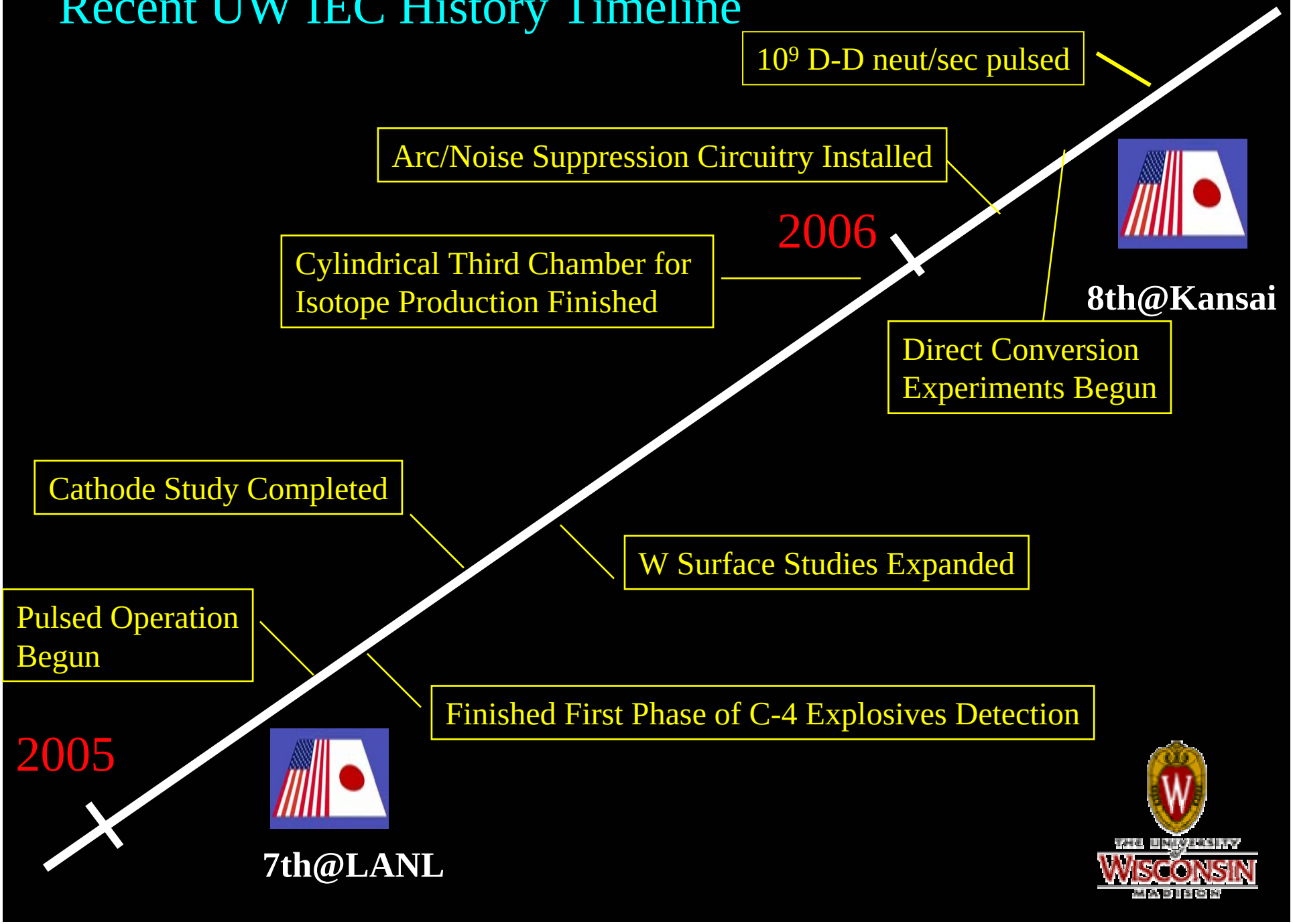
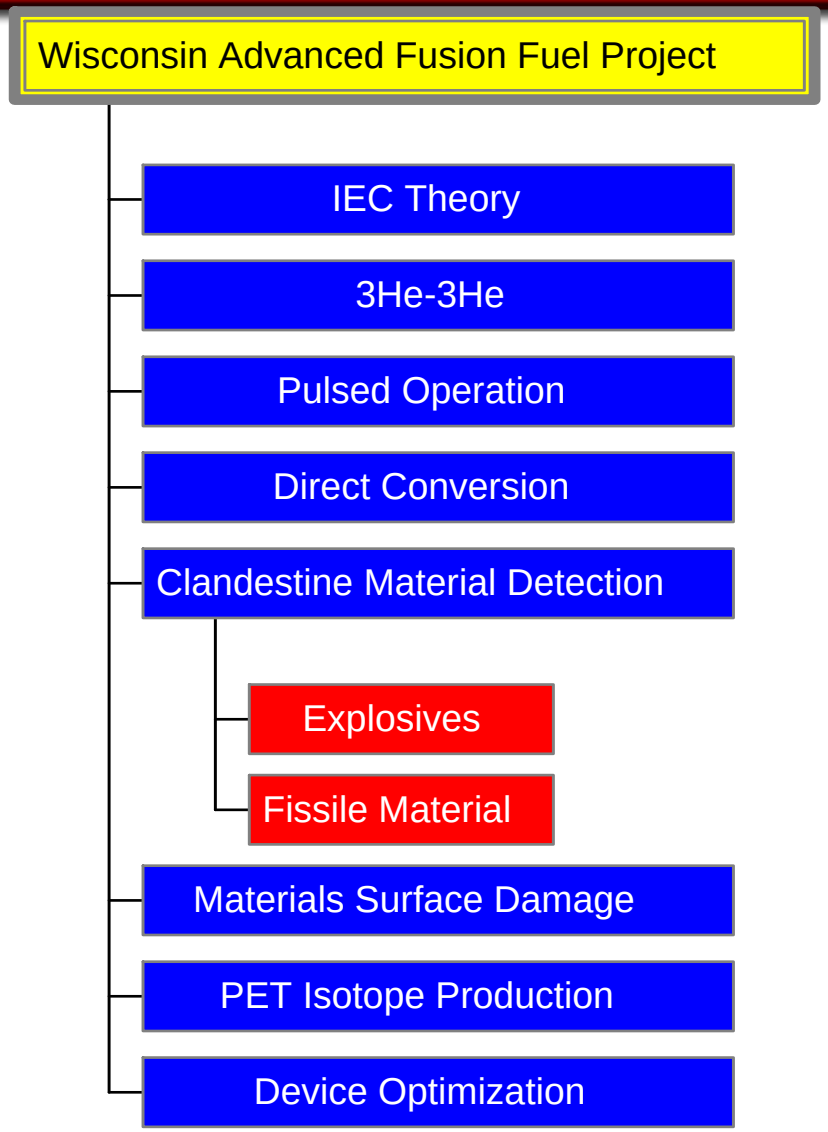


Activities at the University of Wisconsin Will Continue to Expand in the Future



Lead Investigator(s)

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