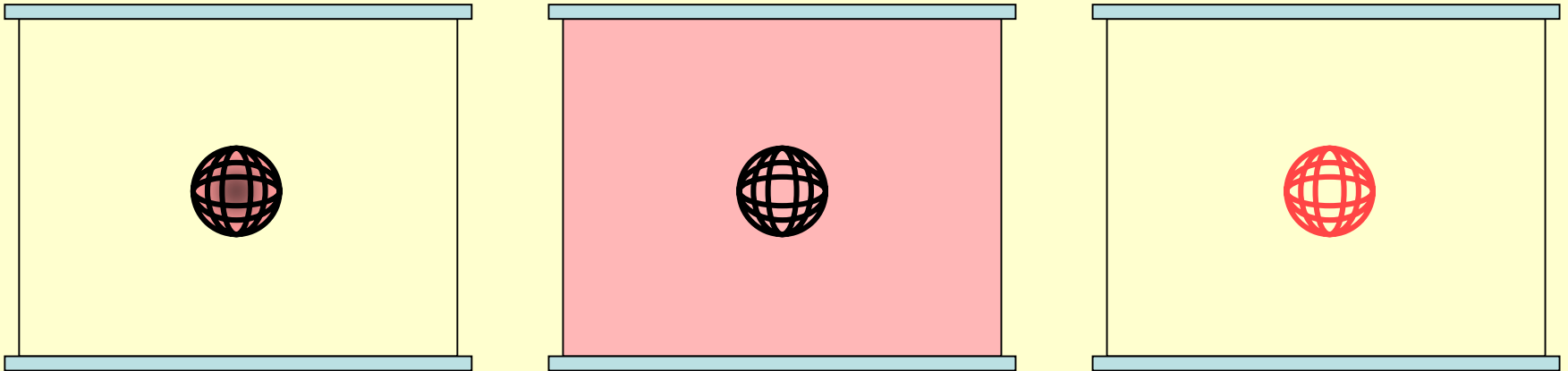


Fusion Product Source Regions in the IEC Fusion Reactor

5th US-Japan IEC Workshop, 9-11 Oct. 2002



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Summary of Activities at the UW IEC Facility

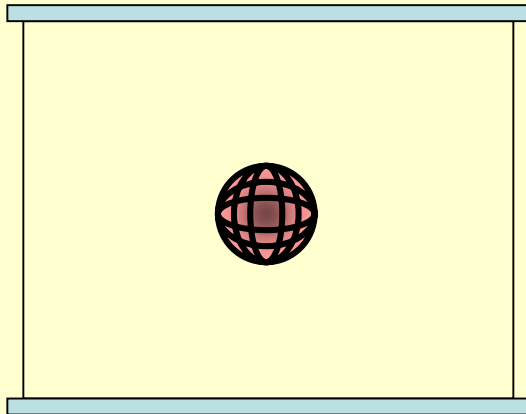
Jan. -Oct. 2002

- Designed new stalk and operated device to 156 kV
- Produced first detectable ^{94m}Tc medical isotope
- Operated helicon mode ion gun using Argon
- Investigated thermionic electron emission from cathode
- Initial study of small portable source for space applications
- Produced first plasma in water cooled chamber
- Operated device with two wire carbon grid
- **Developed source region diagnostic for fusion protons**



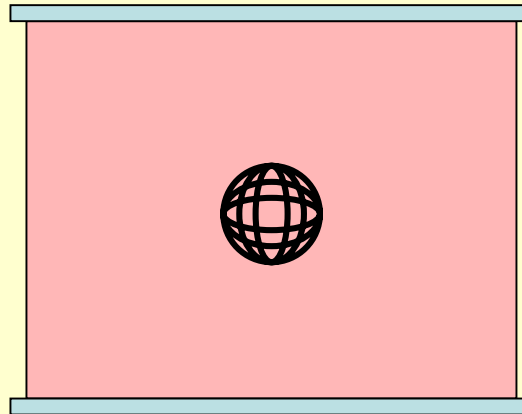
Three Sources of Fusion Reactions in an IEC Device Have Been Identified

Converged Core



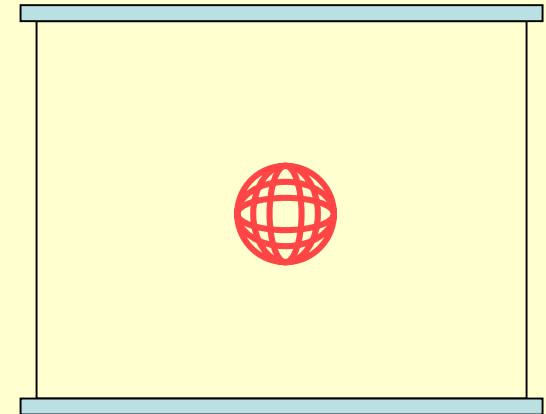
Fusion Occurs
Inside the Cathode

Charge Exchange



Fusion Occurs Throughout
Entire Volume of the Chamber

Embedded Ion

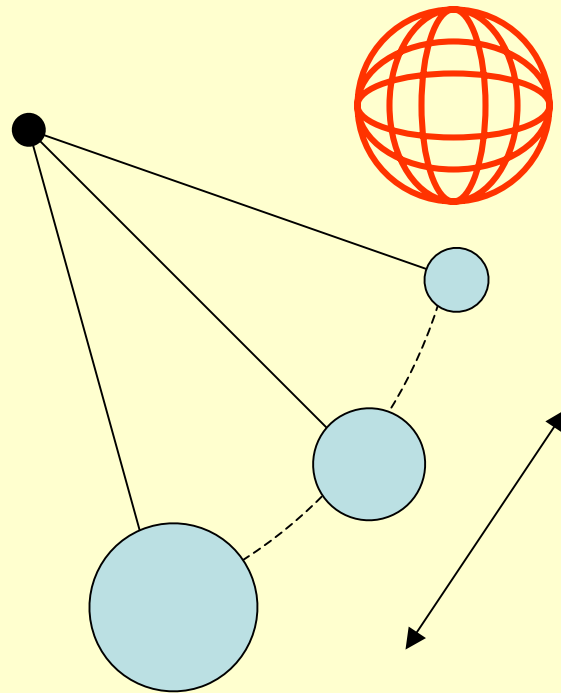


Fusion Occurs on the Surface
of the Cathode Grid Wires

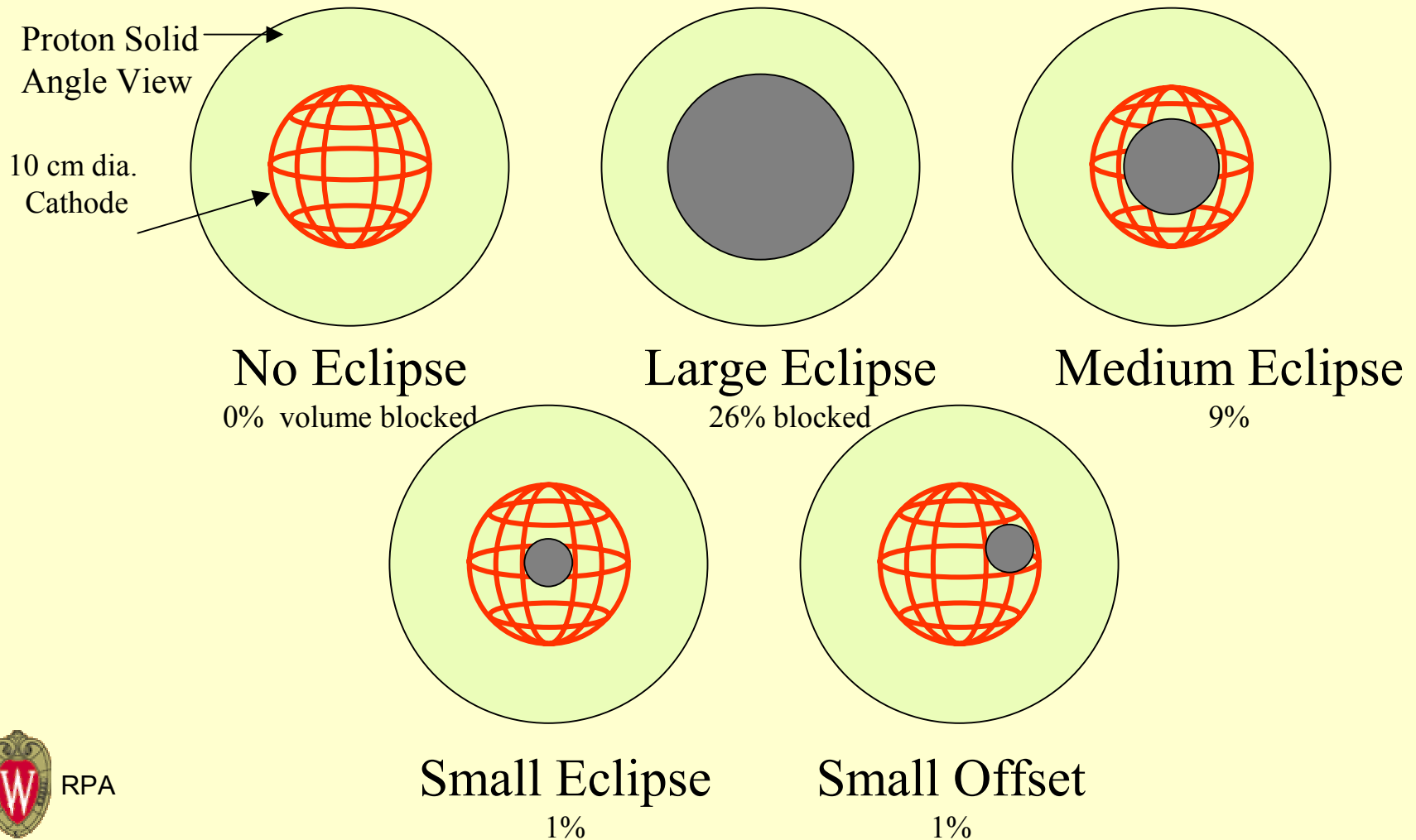
- All three sources can be present at the same time
- Fraction depends on voltage, fuel, pressure, and past history



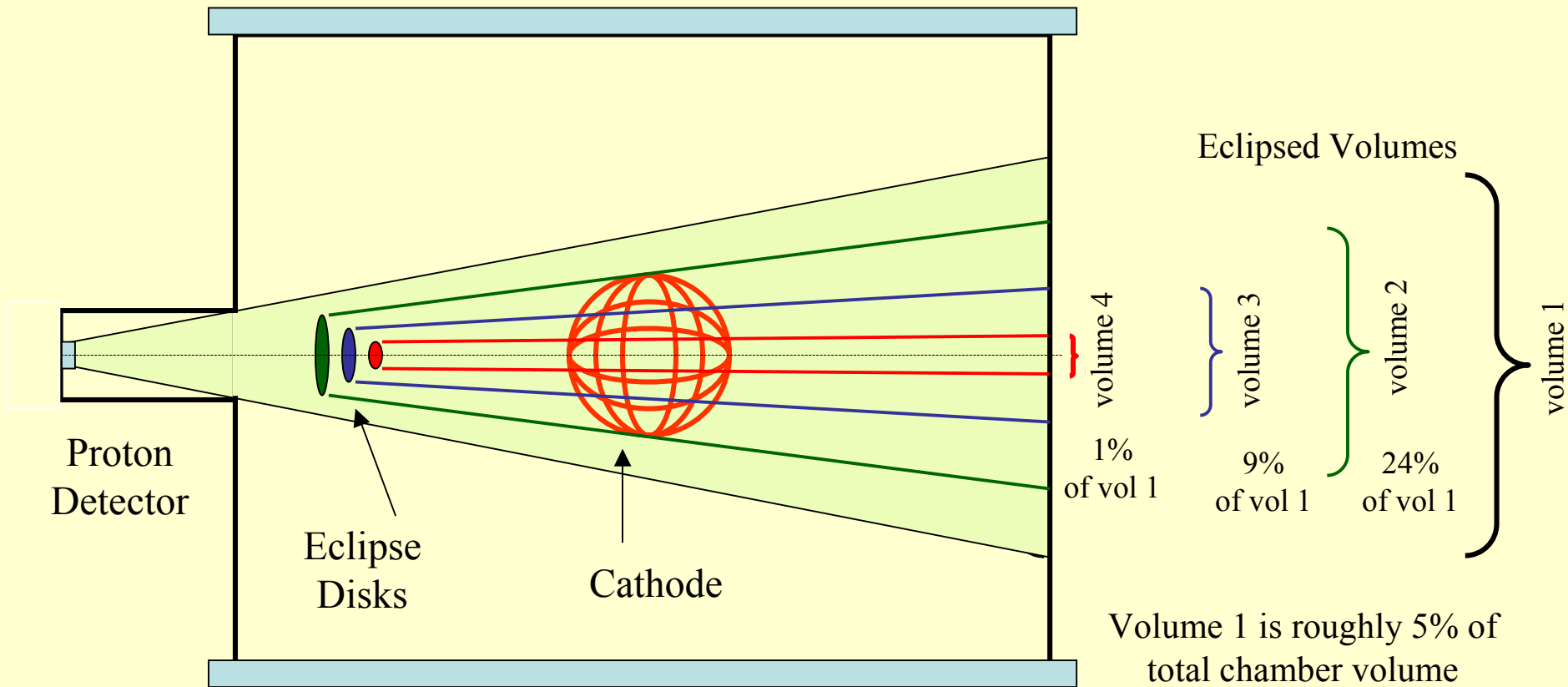
Three Eclipse Disks are Mounted Inside the Chamber on a Rotating Support



The Eclipse Blocks the Cathode Source Protons



Eclipsing the Cathode from the Proton Detector Reveals the Source Distribution

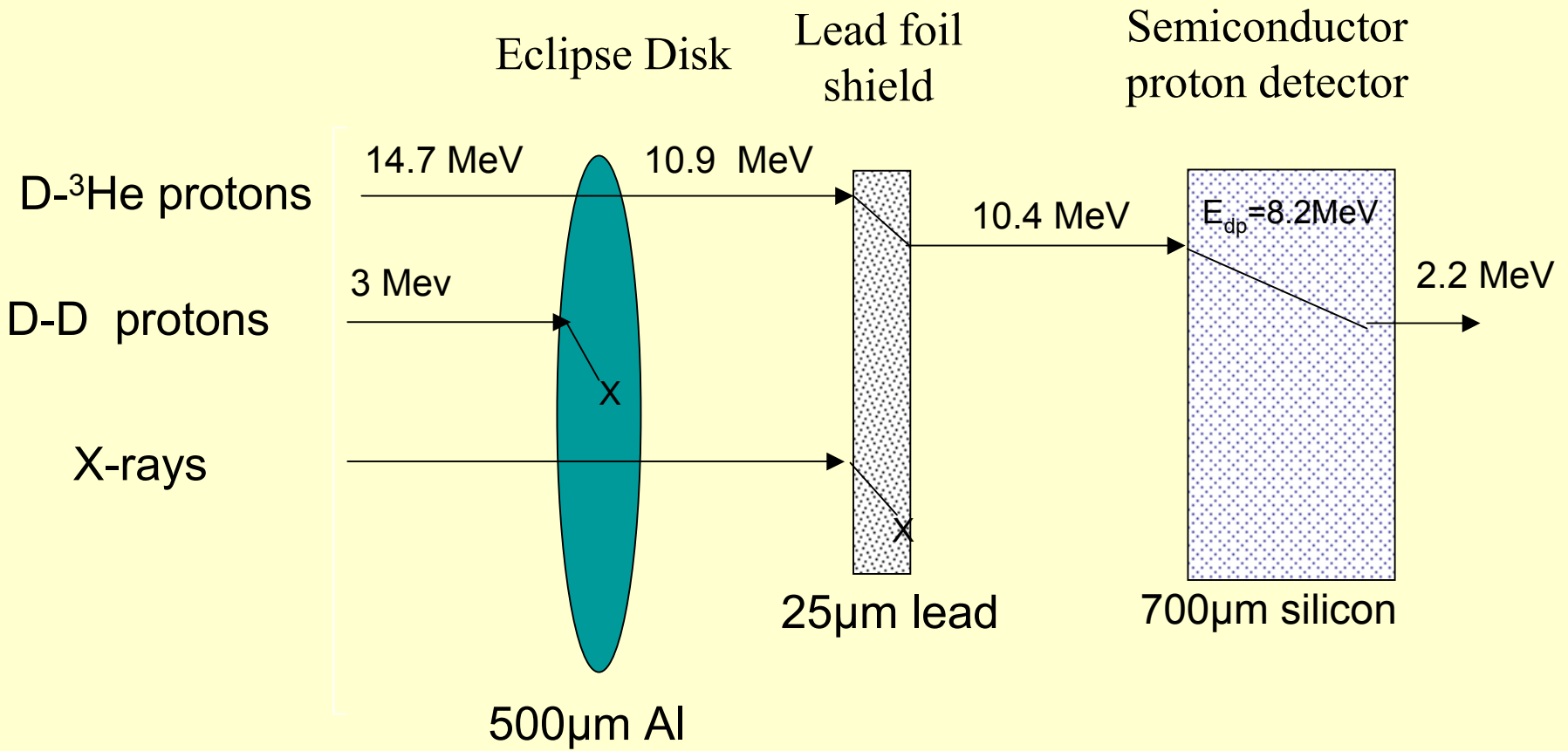


Not to scale

Volume 1 is roughly 5% of total chamber volume

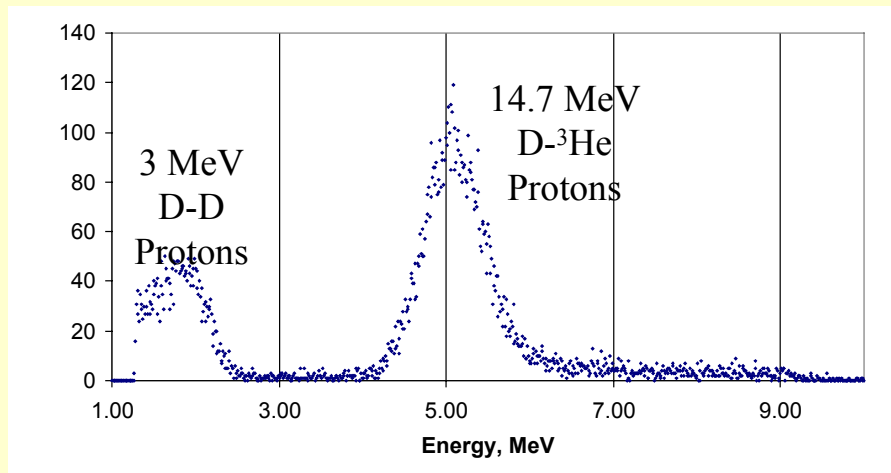


Lead Foil Shields the Proton Detector from the X-rays and Slows Down the Protons

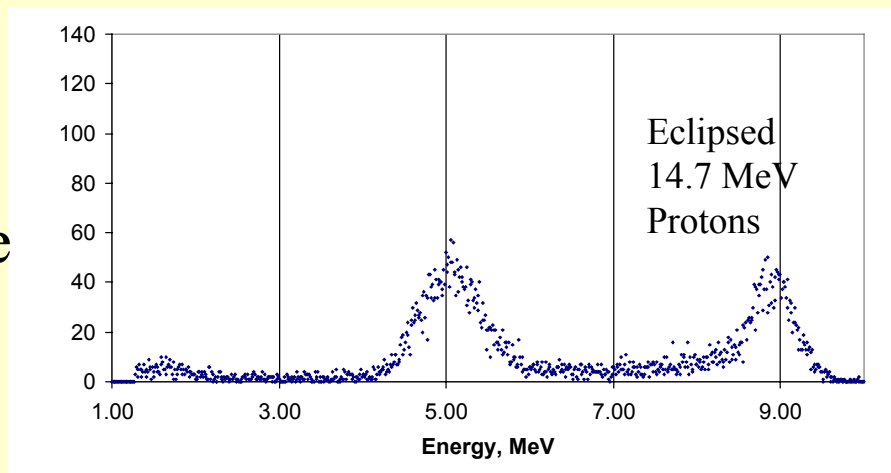


Eclipsed Protons Are Either Blocked or Slowed Down

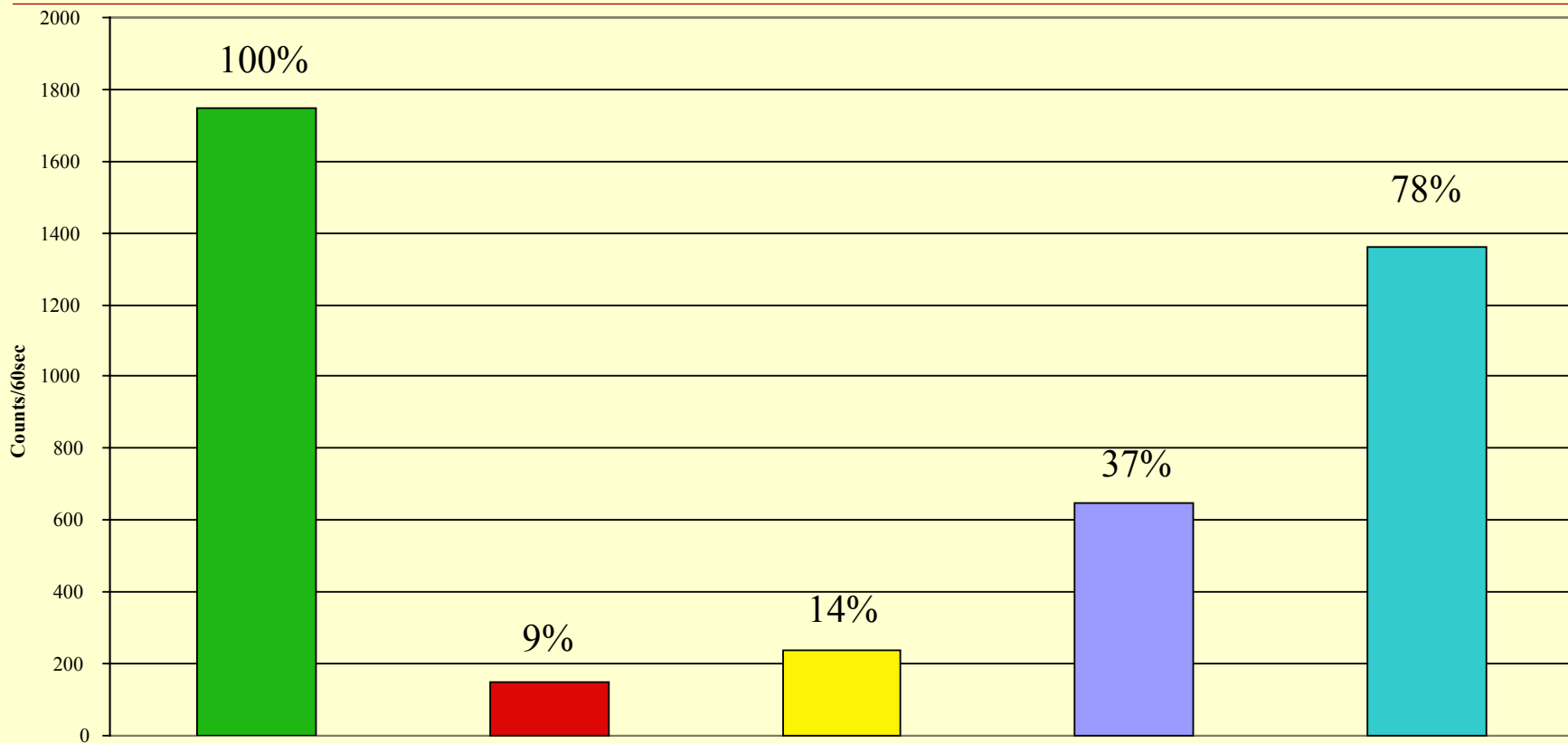
Run 655 D-3He
100 kV. 30 mA
**No Eclipse
Disk**



Run 655 D-3He
100 kV. 30 mA
**Medium Eclipse
Disk In Place**



Eclipsed Data Suggests Significant Converged Core D-D Reactions



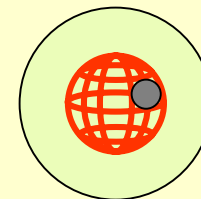
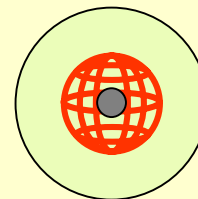
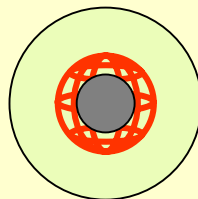
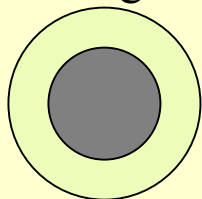
No eclipse

Large

Medium

Small

Small Offset



24%

9%

1%

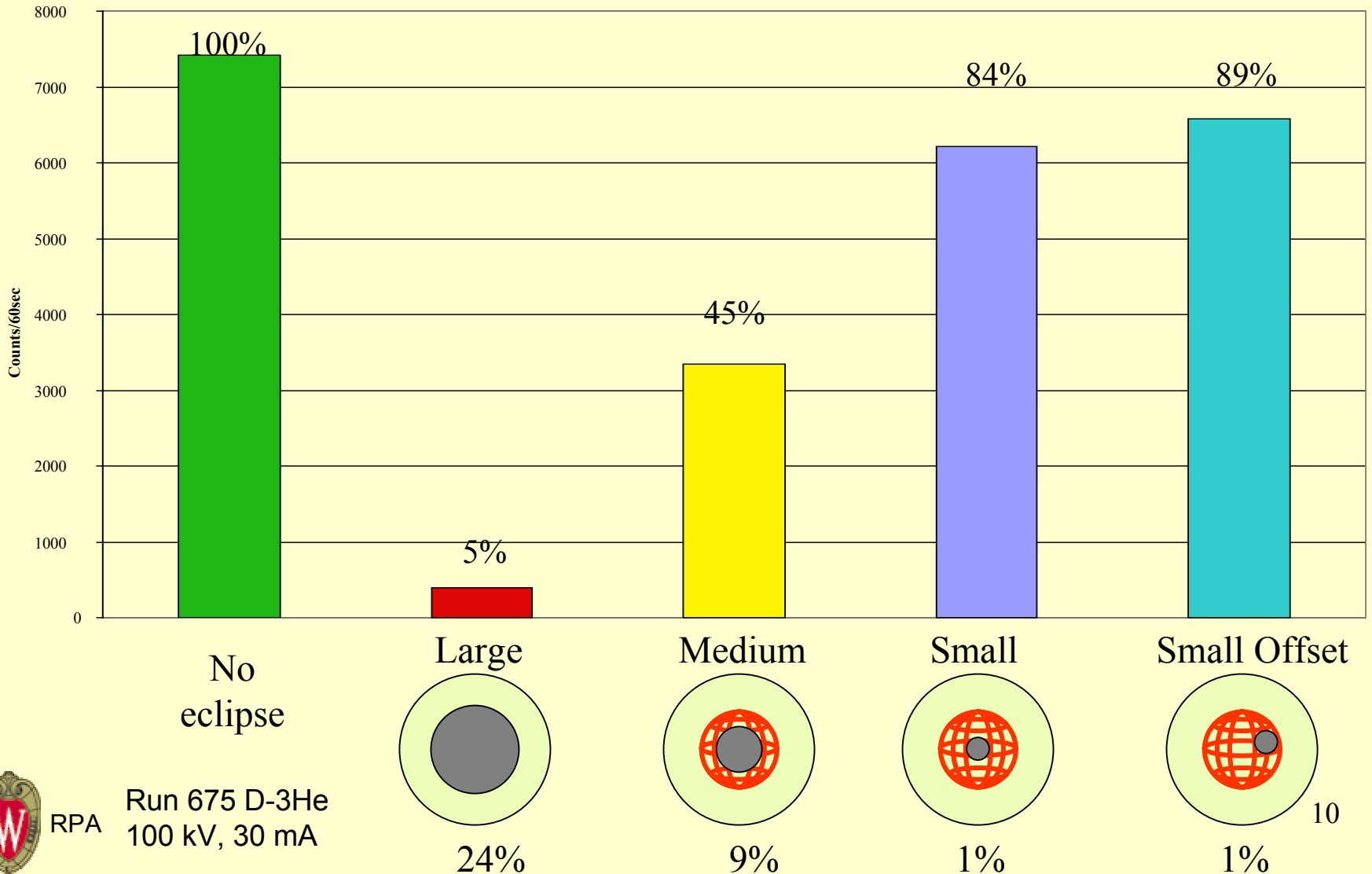
1%

9

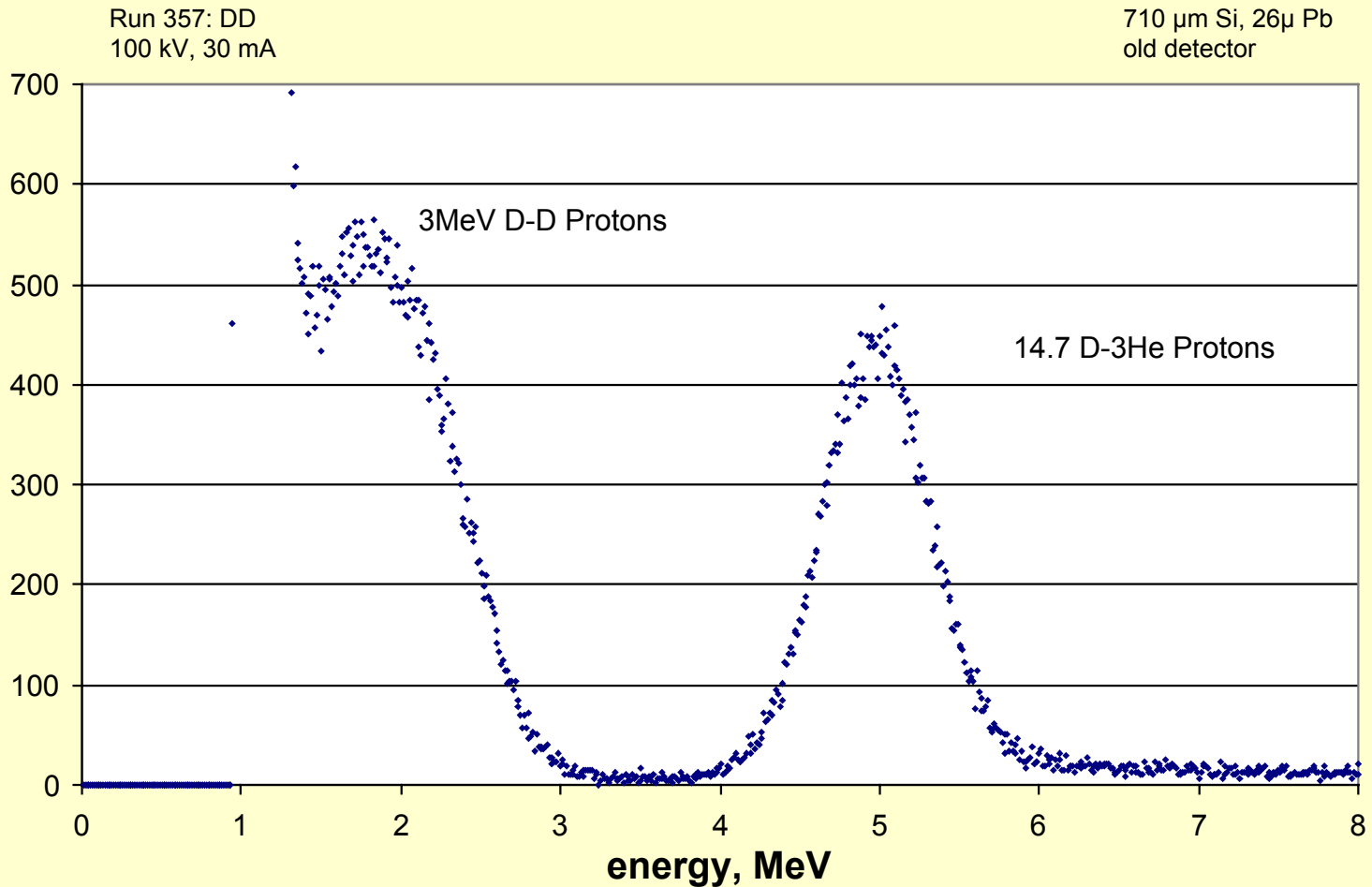
Run 675 D-3He
RPA 100 kV, 30 mA



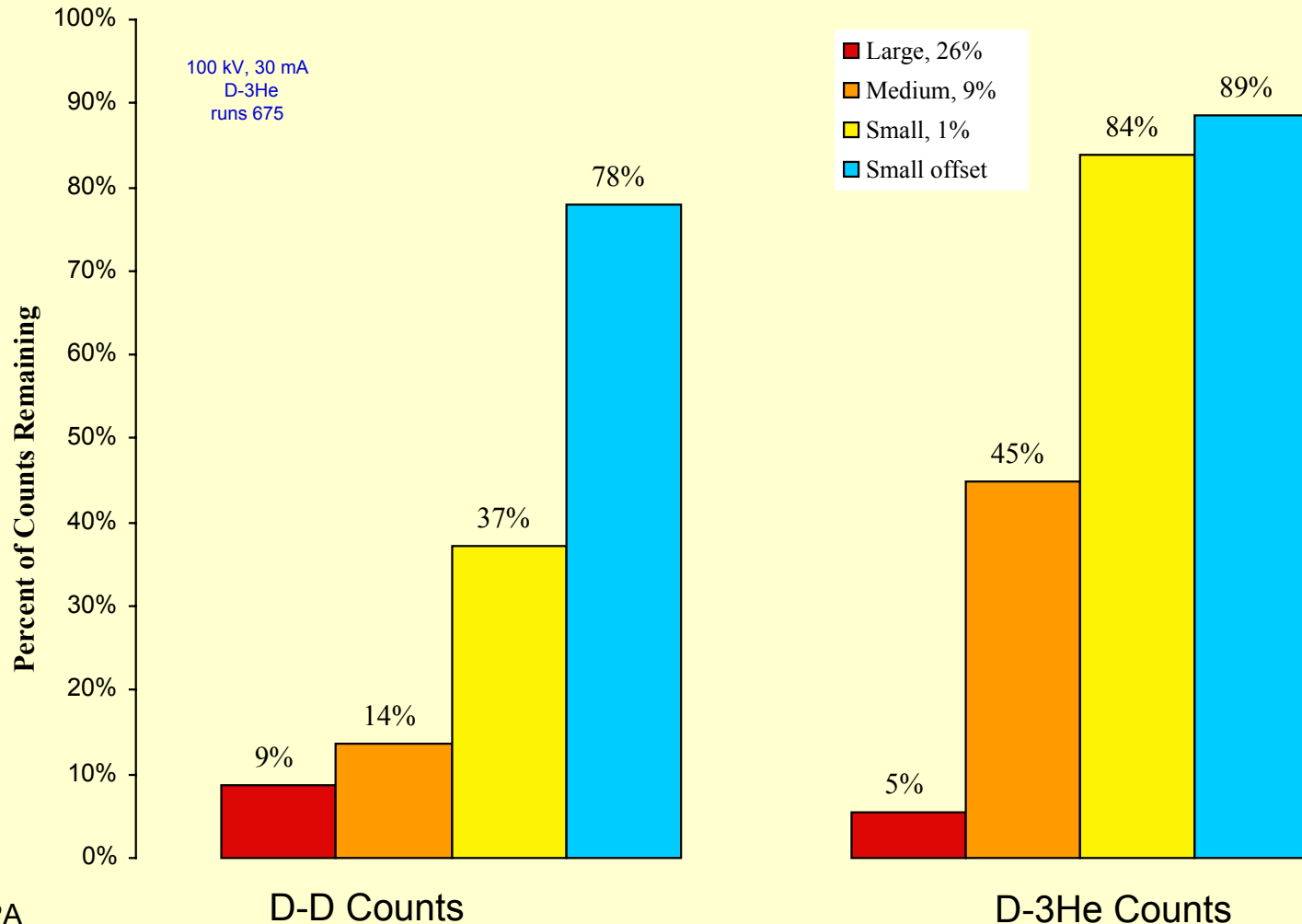
Eclipsed Data Suggests an Embedded Fusion Source for D-³He Fusion



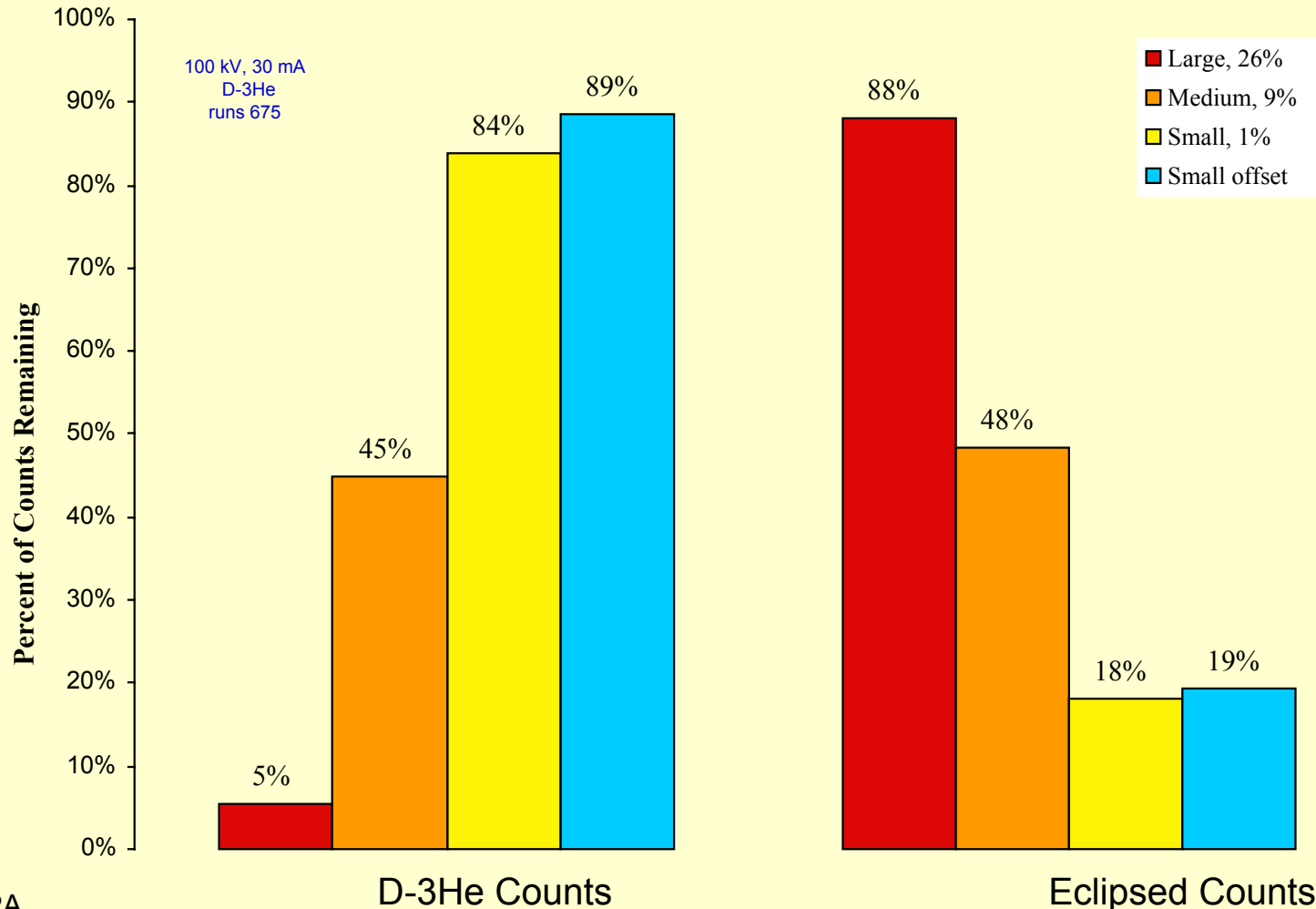
D-D Fuel Still Produces D-³He Protons, Indicating Embedded ³He Ion Fusion



Offset Eclipse Shows Difference Between Converged Core and Embedded Fusion Source



Eclipsed D-³He Counts Complement the Uneclipsed Counts



The Volume Source Dominates D-D Fusion in the UW IEC

- The proton detector sees only 5% of the chamber volume, therefore the data represent 5% of the volume source.
- The proton detector sees 100% of the core volume, therefore the data represent 100% of the core source.
- At 100kV and 30mA the eclipse data suggest 10% of the total D-D reactions occur in the core, and 90% in the charge exchange volume source.



Conclusions

@100kV

- The density of D-D fusion reactions in the UW IEC device is highest in the central volume inside the cathode, indicating the presence of a converged core, but the source volume still dominates D-D reactions.
- Significant D-³He fusion reactions occur uniformly distributed over the cathode grid area, indicating embedded fusion in the grid wires (see talk by Ben Cipiti).

