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LARGE AREA ELECTRON BEAM SOURCE ON THE SATURN ACCELERATOR

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PRESENTATION CONTENTS

- The Saturn Accelerator
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- Overview of Saturn E-beam source
- Load diagnostics
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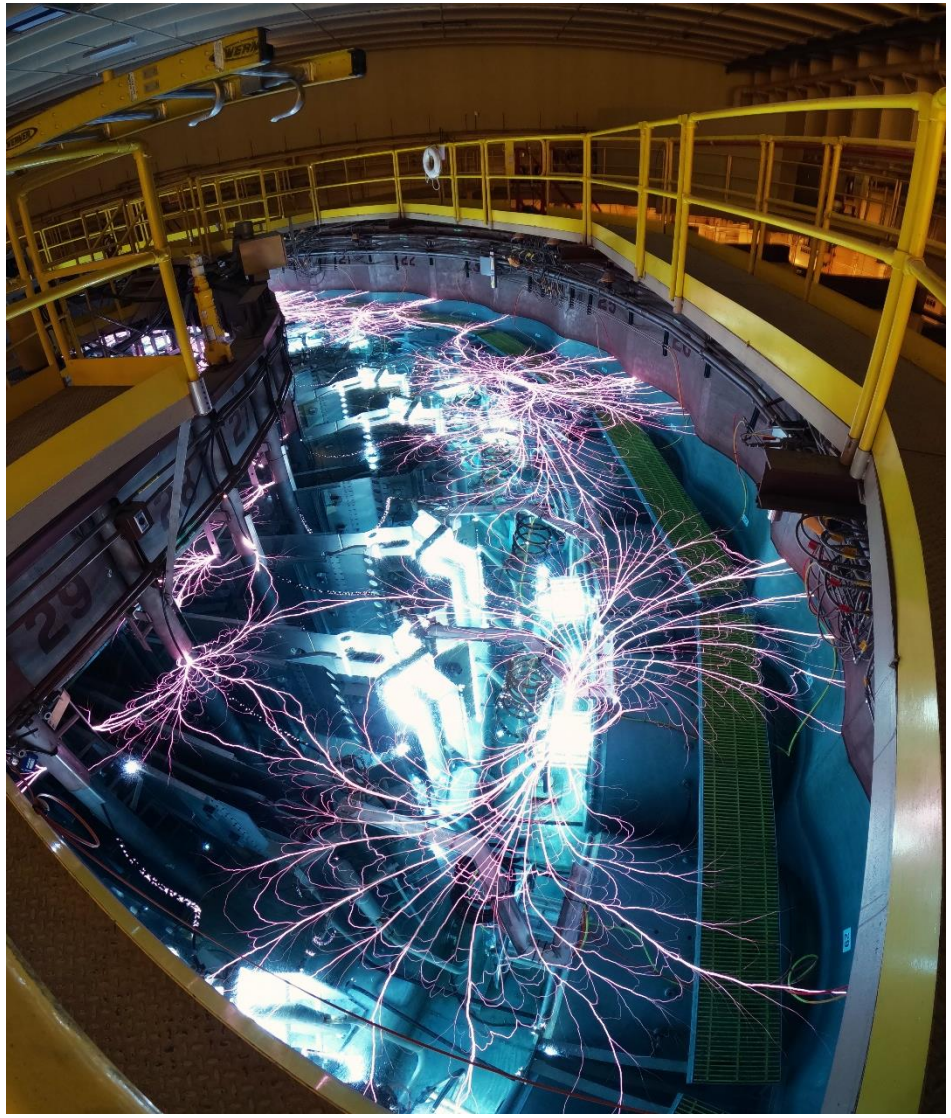
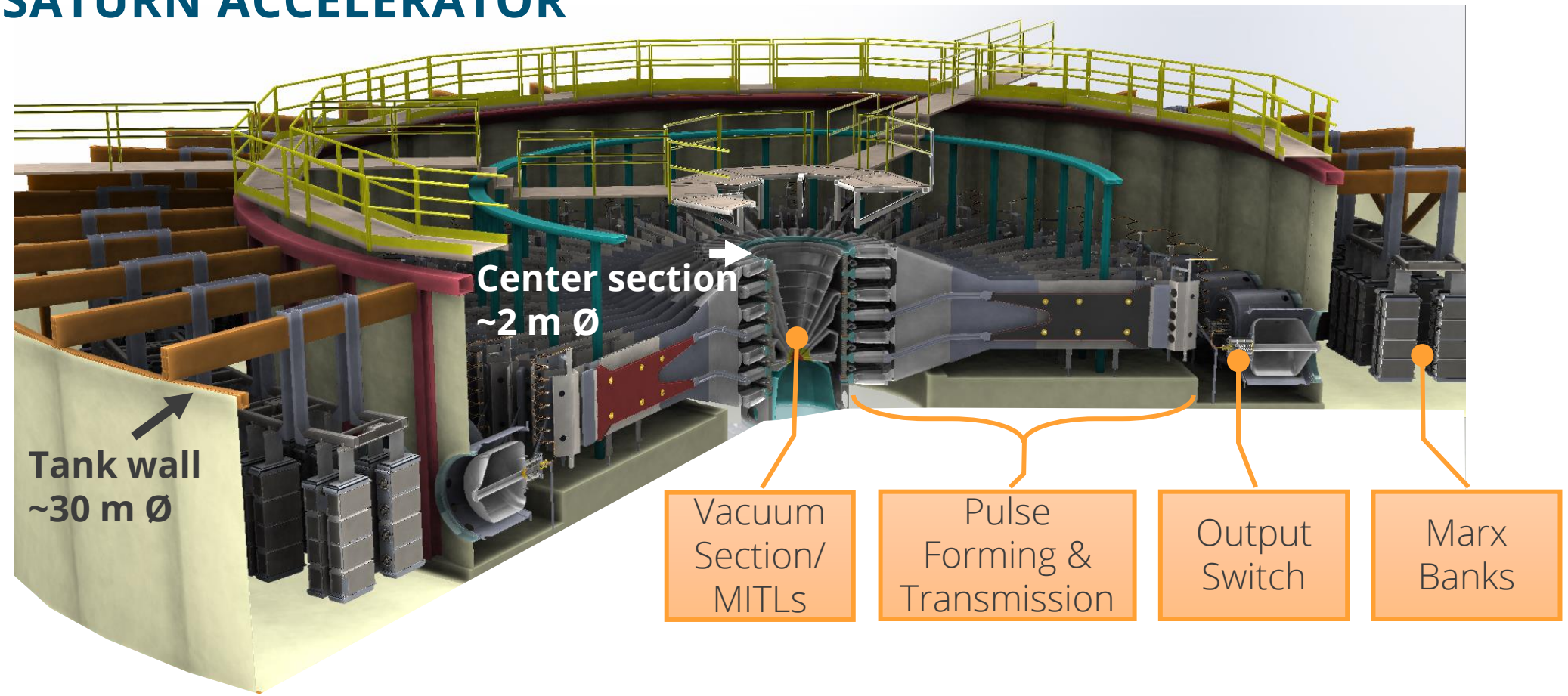
- Output of the E-beam source



THE SATURN ACCELERATOR



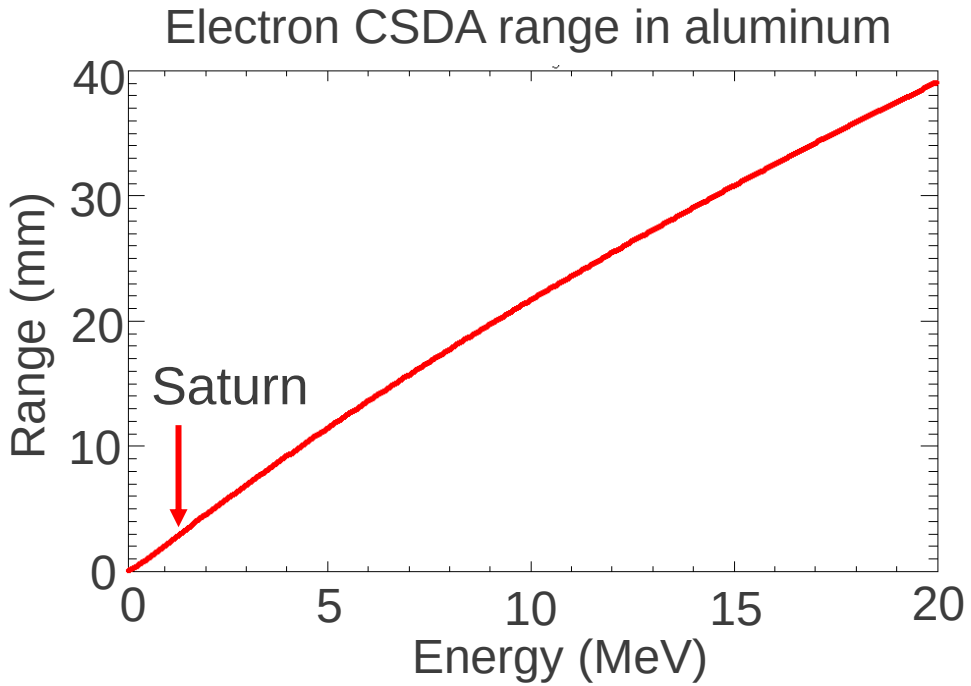
First operational in 1987, located at Sandia National Laboratories, Albuquerque, NM

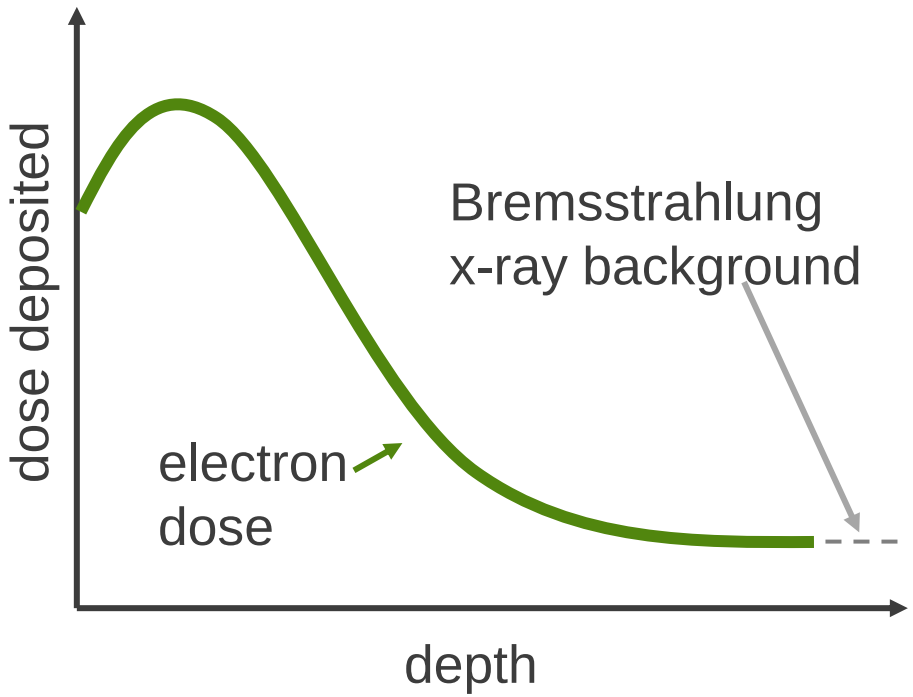
36 line, multi-terawatt accelerator designed to drive a 3-ring pinched beam diode as a high dose-rate, large area, hard x-ray source for testing electronic components and systems

Flexibility built into the machine configuration allows it to drive other x-ray and particle beam sources

ELECTRON BEAMS ARE USED TO STUDY MATERIAL RESPONSE TO SHOCK

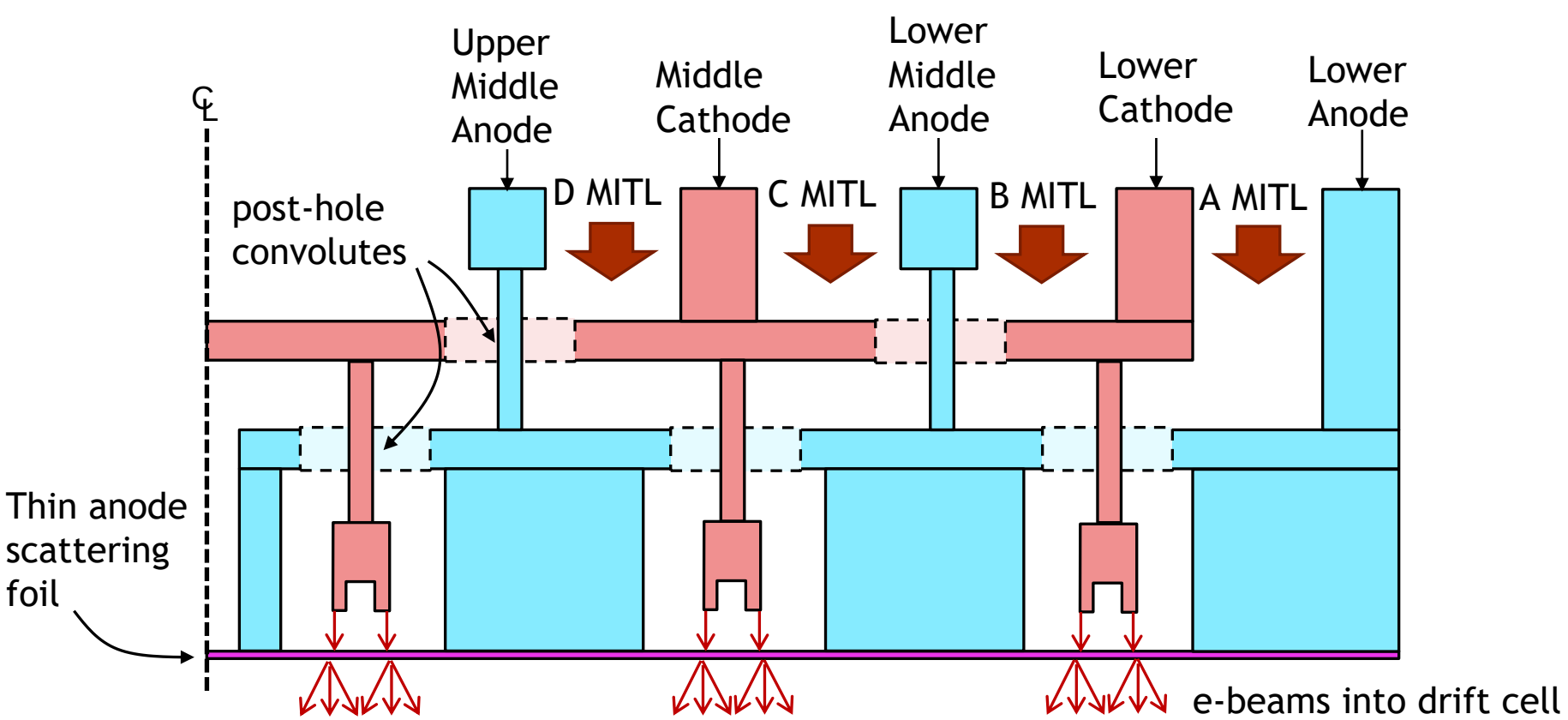
MeV electron beams are used to drive thermomechanical shock into materials to study their response.

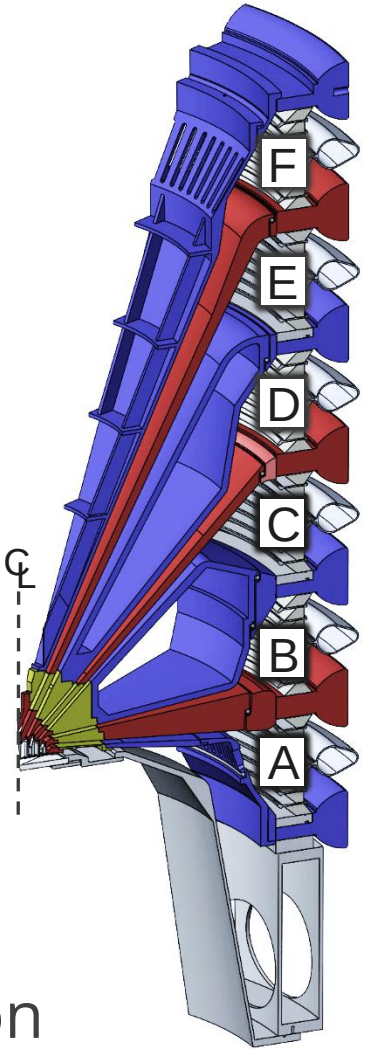




Large area electron beams sources allow for the study of thermostructural response of larger components and structures.

THE E-BEAM SOURCE UTILIZES A DOUBLE POST-HOLE CONVOLUTE



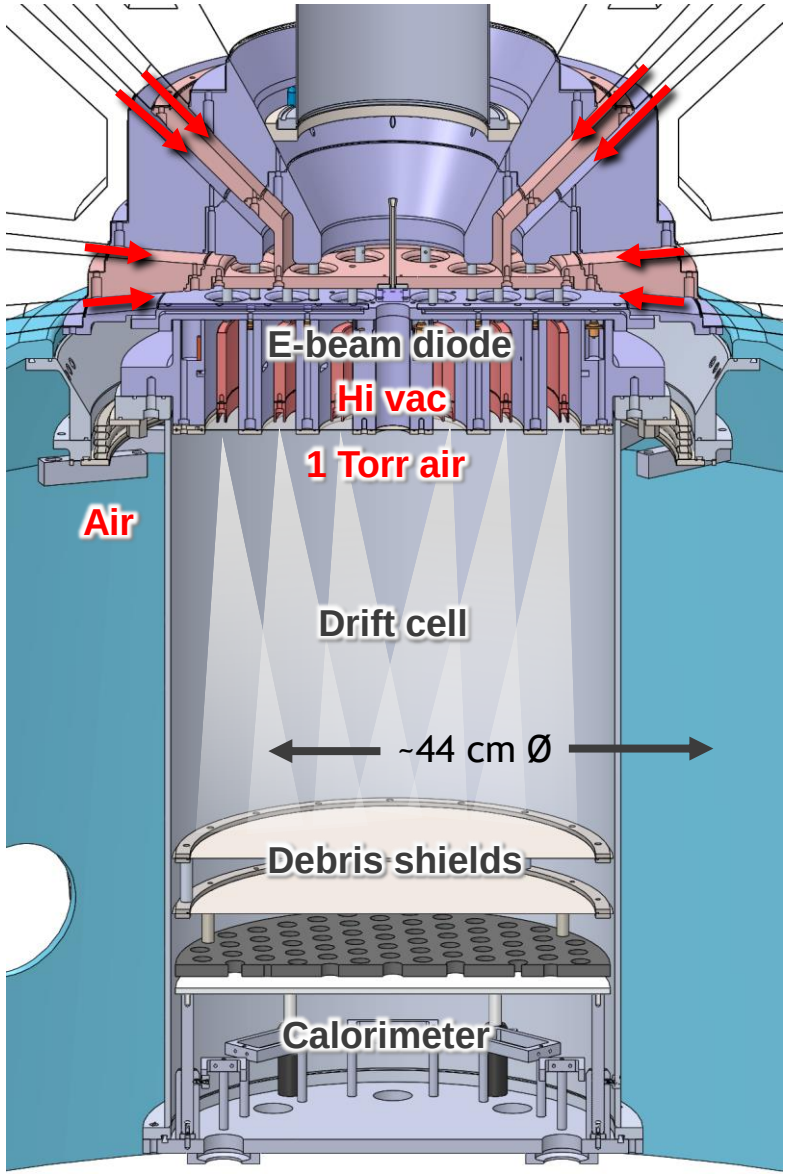


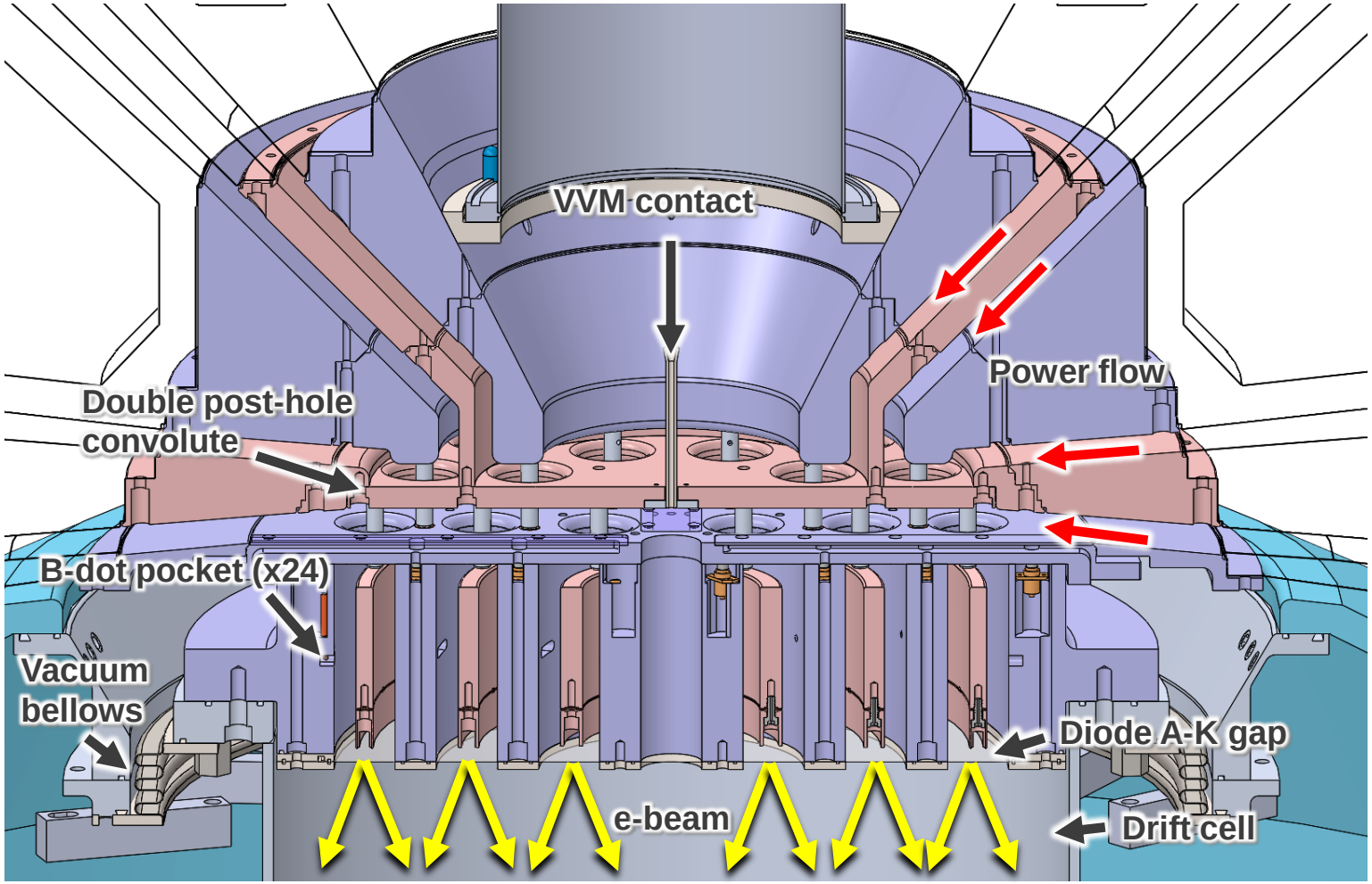
Brems MITL configuration

Uses 4 of Saturn's 6 MITLs with equal drive at the insulator stack

Double post-hole convolute needed to balance the power flow on the cathodes

THE E-BEAM SOURCE HAS A COMPLEX DESIGN REQUIRED FOR A LARGER EXPOSURE AREA THAN 3-RINGS BREMS



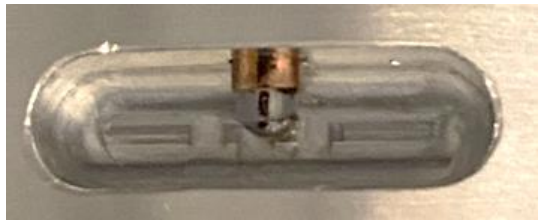


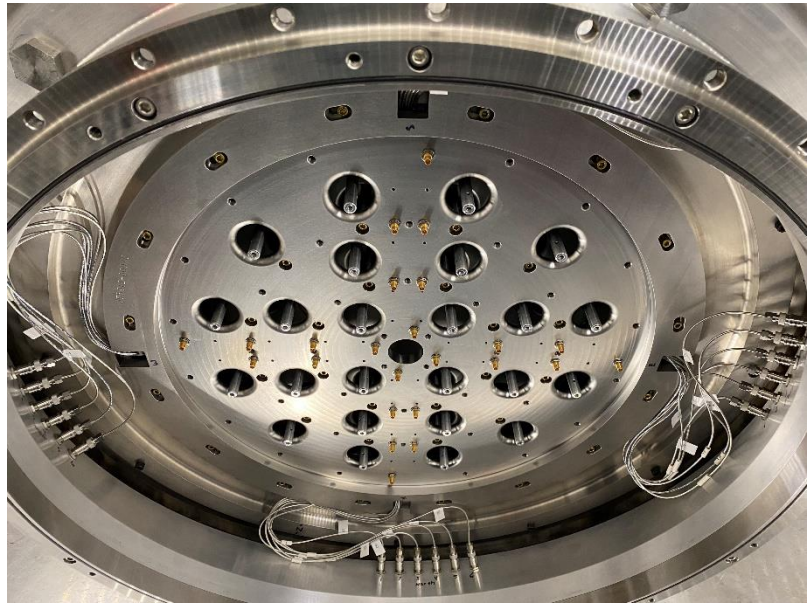
INNOVATIVE SIGNAL ROUTING ALLOWS A LARGE NUMBER OF LOAD CURRENT MEASUREMENTS

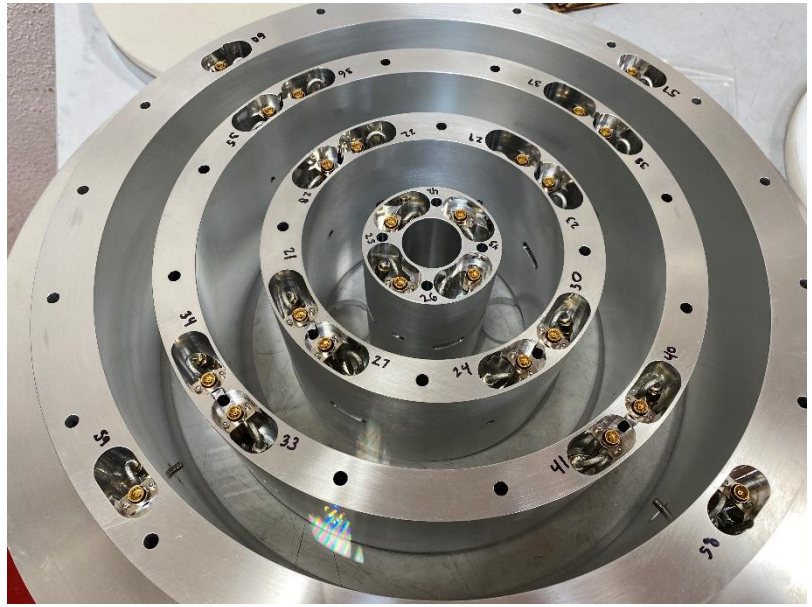
B-dots

- 24 load B-dots
- 4 azimuthal positions
- Inside and outside current paths on each cathode ring
- Use of blind-mate adapter (BMA) RF connectors greatly simplifies installation
- B-dots are RG402 Cu coax

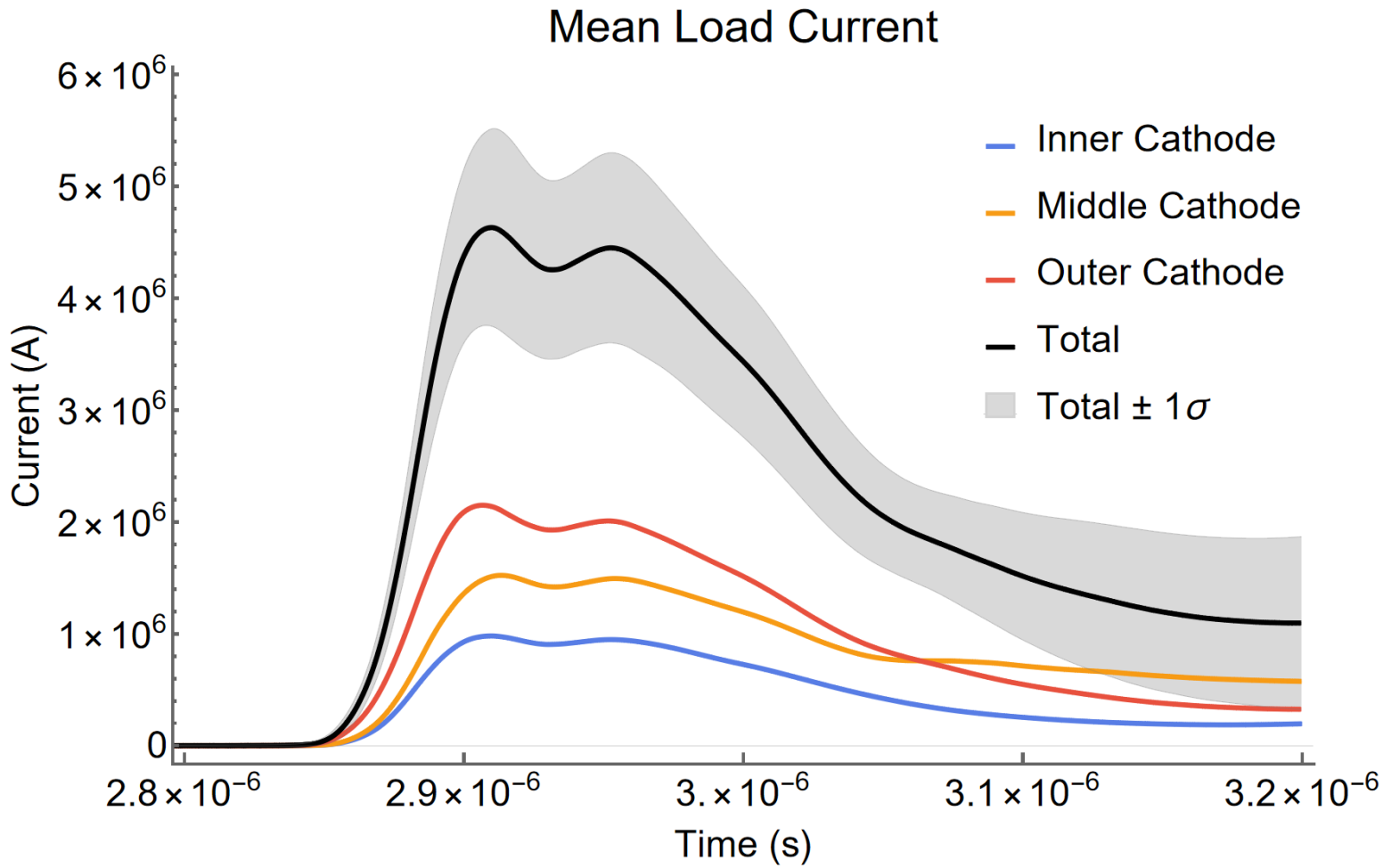
B-dot pocket







LOAD B-DOTS SHOW THE TOTAL CURRENT IS ABOUT 4.5 MA



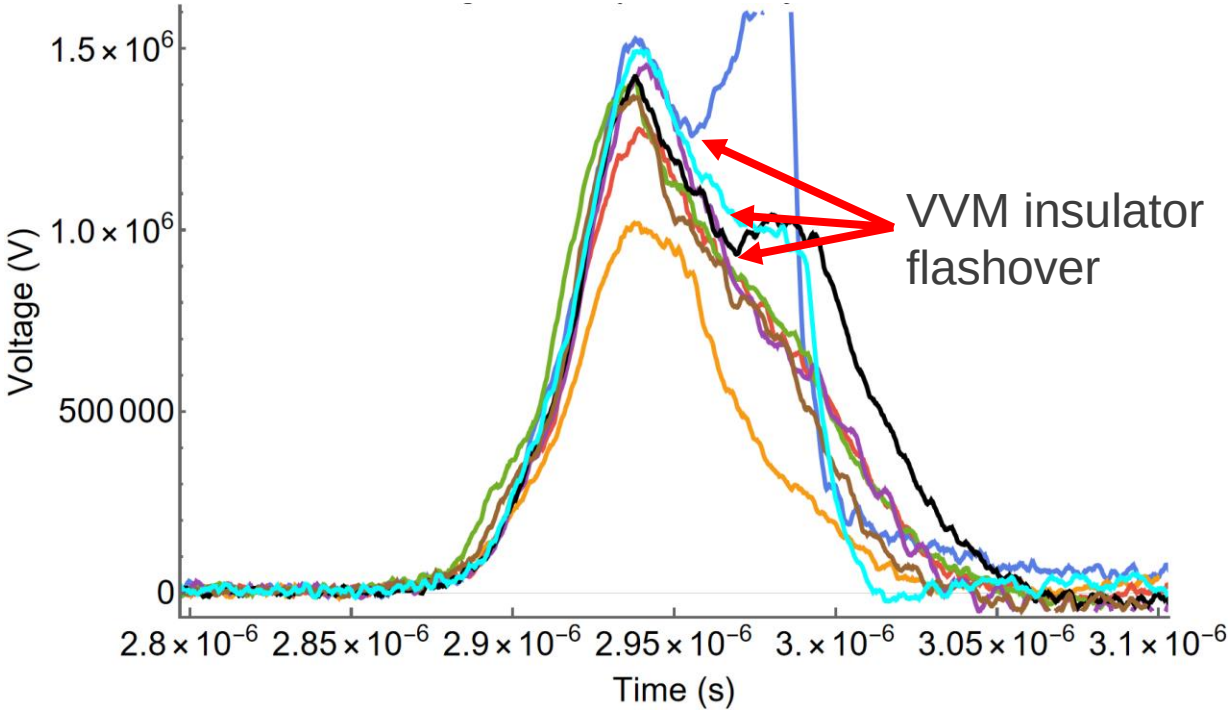
E-beam uses 2/3 of Saturn's lines. A simple extrapolation to full machine would be ~7 MA. The matched brems load is ~9 MA so we have significant losses in the post-hole convolute.

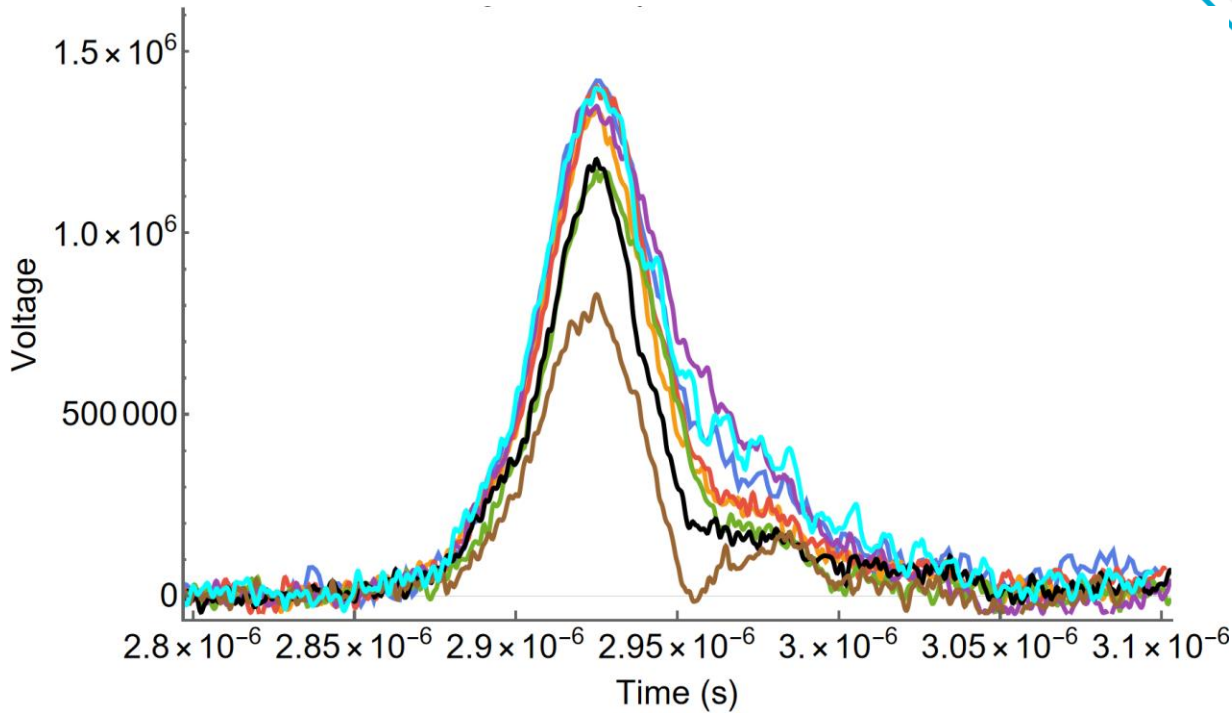
E-BEAM USES A VVM ON EVERY SHOT, UNIQUE AMONG SATURN SOURCES

Vacuum Voltmeter (VVM)

- Field-graded Rexolite insulator stack
- Measures up to -2 MV pulses

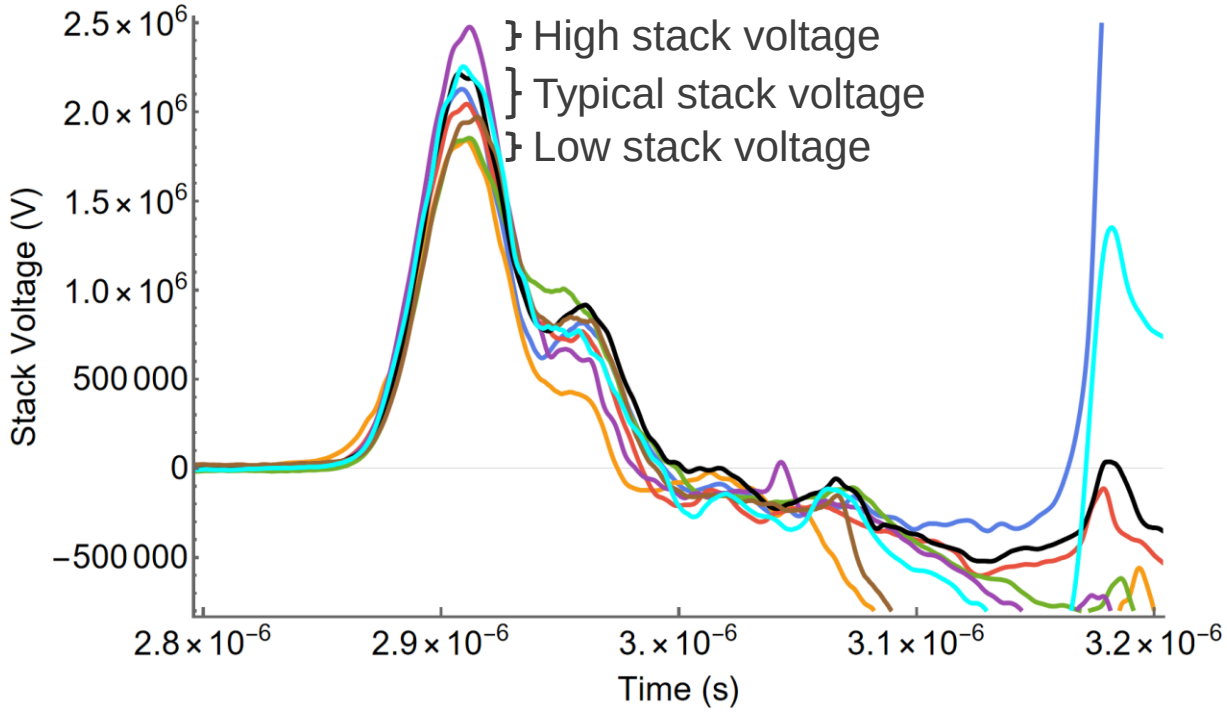
PEAK LOAD VOLTAGE IS TYPICALLY ~1.4 MV BUT CAN BE ADJUSTED

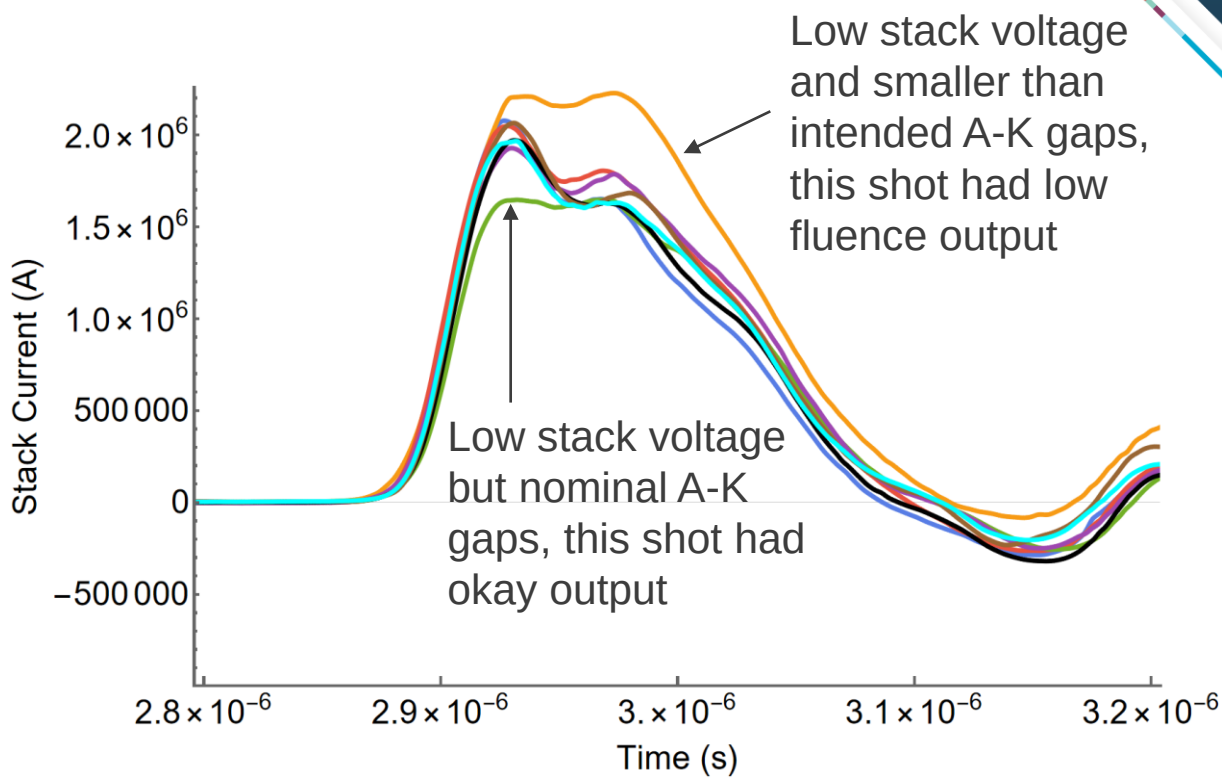




- Load voltage is adjustable through shimming the anode-cathode (A-K) gap
- Occasional flashovers seen in the VVM after peak voltage

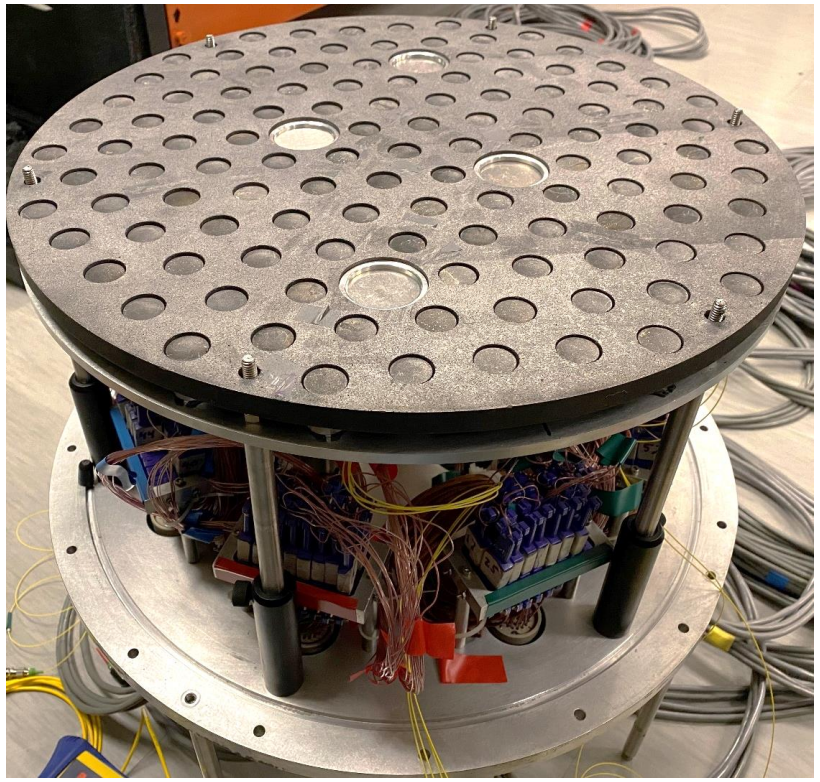
UPSTREAM V-DOTS AND B-DOTS CAN INFORM US ABOUT POWER FLOW SENSITIVITIES IN THE LOAD

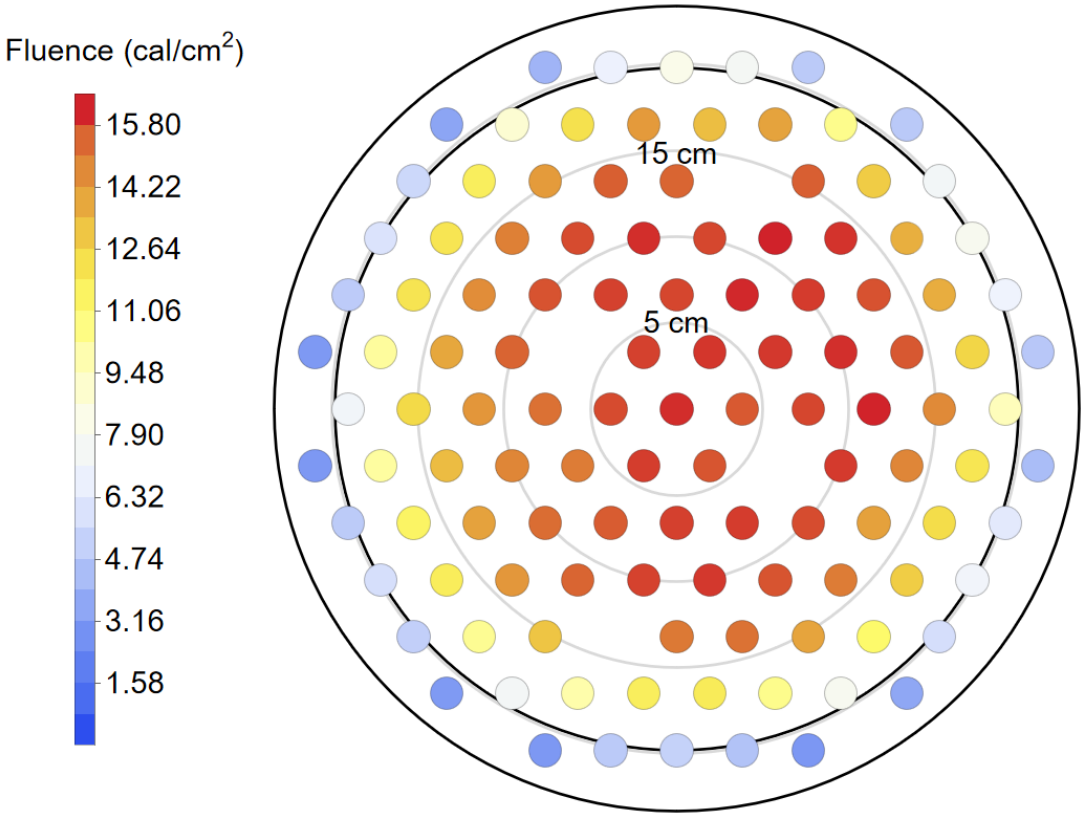




- The drive voltage is less critical to the output E-beam fluence on the test plane, than having the correct desired load A-K gaps
  - e.g. Having A-K gaps 10% too small resulted in 75% loss in typical fluence but having a lower driving stack voltage and current just decreased the output by the fractional power decrease

THE E-BEAM SOURCE PRODUCES A UNIFORM FLUENCE OVER A LARGE AREA





- Fluence as measured on a 117 element large format calorimeter shows a uniform source over 1000 cm^2
- Fluence at the test plane controllable via vertical position in the drift cell

TAKEAWAYS

- Fast pulse, high energy electron beams are a useful tool for studying thermomechanical shock material properties
- Saturn now has the largest uniform area, highest fluence E-beam source available for testing large material structures

QUESTIONS?