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Electron Beam Facilities

PRESENTED BY

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Bench-Top to Large Scale

Benchtop (Yee)

SPHINX (Bell)

Saturn

Hermes III

Bench Top Electron Beam (v. 1) – B. Yee

Transmission-line pulser, spark gap triggered

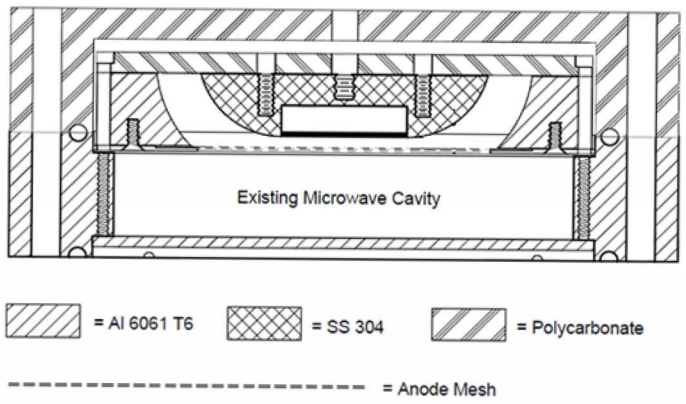
20 kV switching, operated in self-breakdown

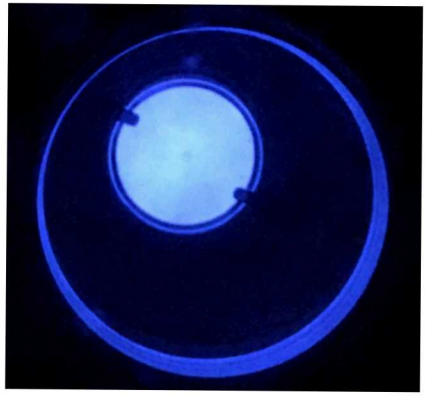
Challenges

- No beam observed with rounded cathode
- Lack of reliable trigger generator for sparkgap
- Alignment of A-K gap difficult

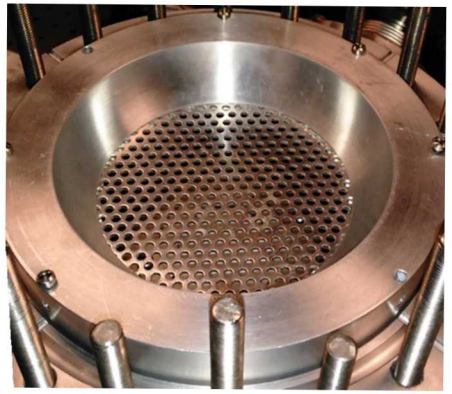
Results

- Successful operation of transmission line pulser, clean 40 ns pulse
- Beam detected with phosphor screen





Anode



Cathode

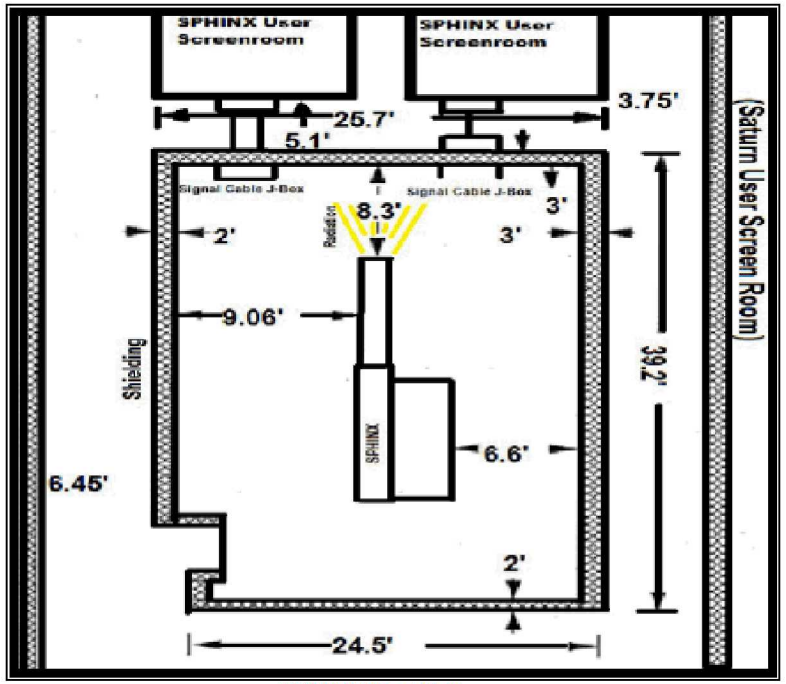
Short Pulse High Intensity Nanosecond X-ray (SPHINX) Accelerator

FWHM 3-10 ns

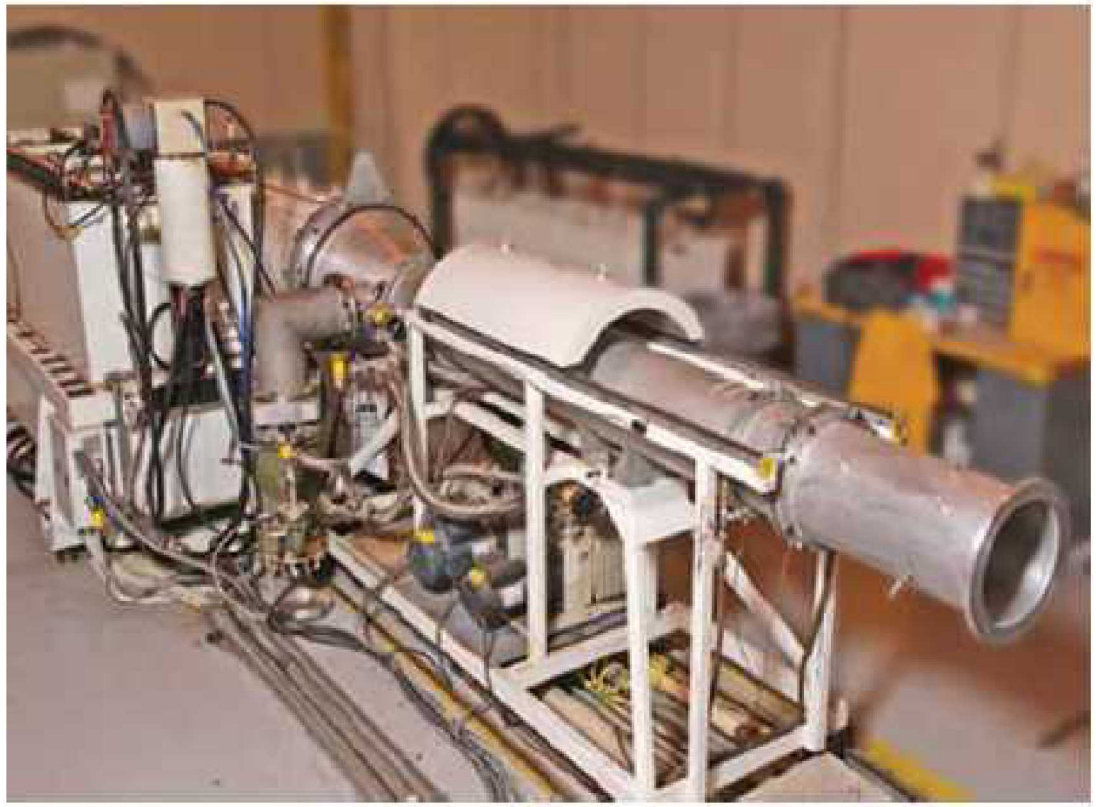
Endpoint 500 keV – 2 MeV

Run in Brems or e-beam mode:

- 25 kA max in e-beam
- 28 kA max in Brems (22 kA) nominal



SPHINX Test Cell



Current Configuration

Saturn – E-Beam Mode Under Development

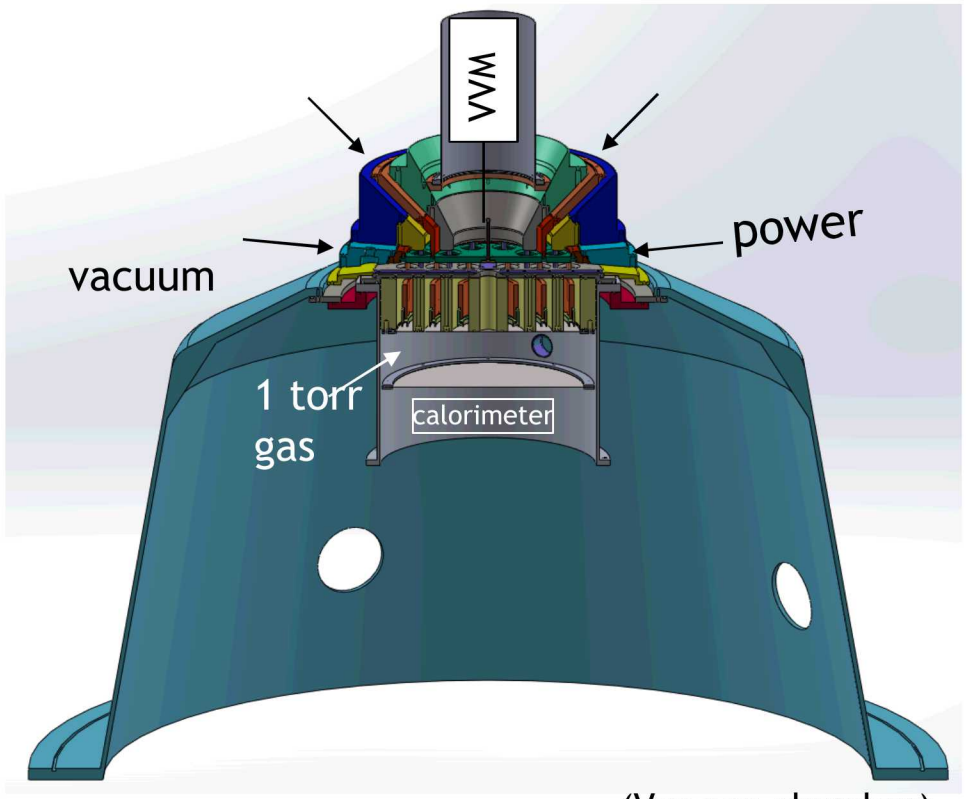
0.6-1.6 MeV

1-10 MA

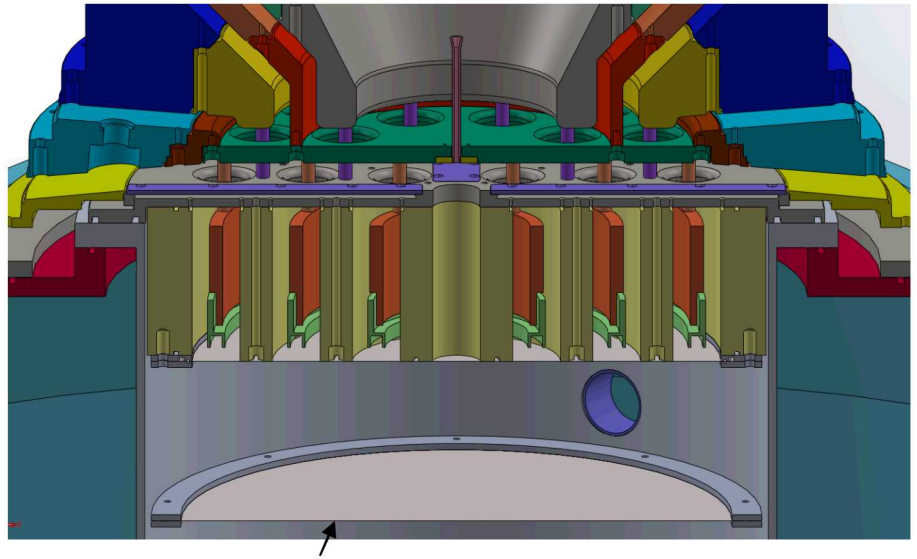
~30ns FWHM

~700 cm^2 exposure

5-35 cal/cm^2



(Vacuum chamber)



Debris shield

6, 12, 18 cm radius ring diodes
Gamble II convolute dimensions

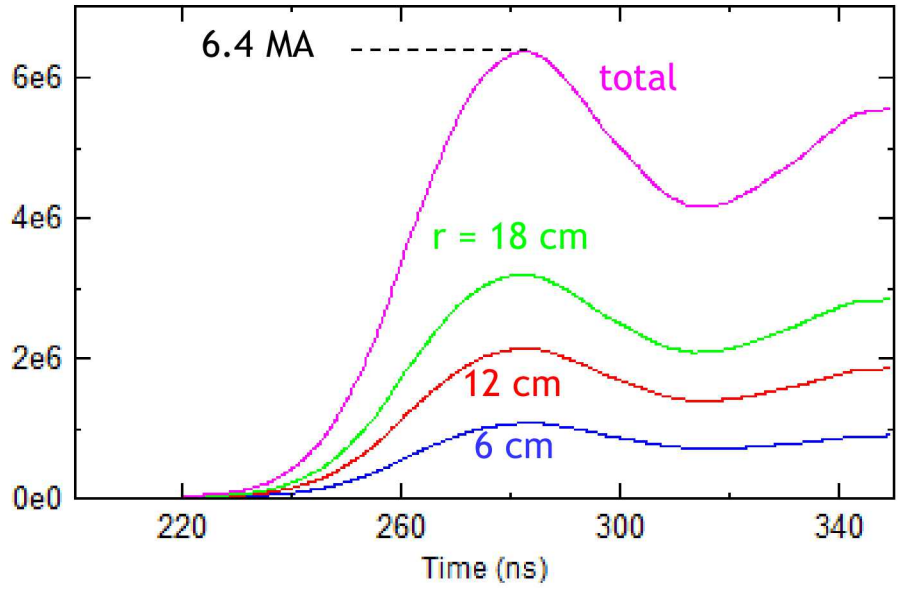
3D model by Andrew McCourt, Sandia

Work by B. Weber (NRL) & B. Ulmen (SNL)

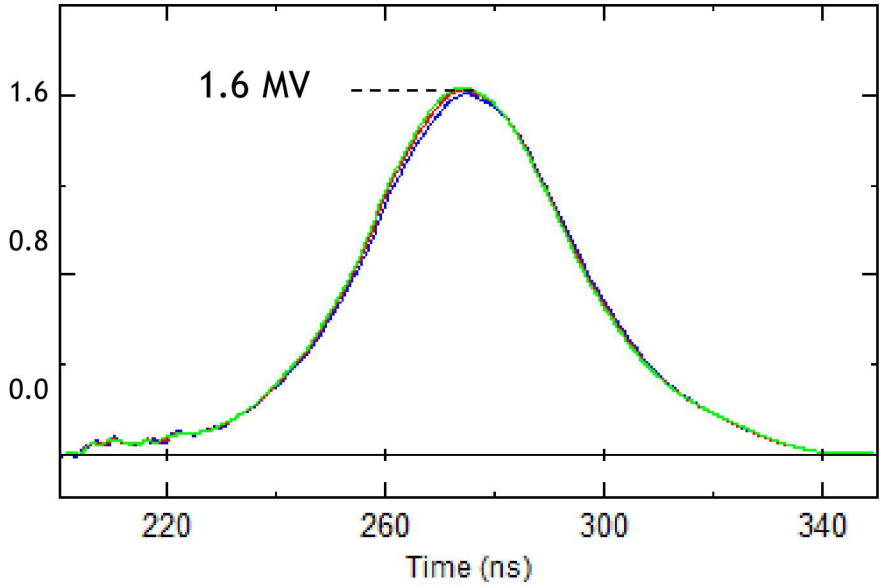
Saturn – E-Beam Mode Under Development

Calculated currents and voltages for Saturn with convoluted ring diodes

Diode Currents



Diode Voltages



36 modules charged (out of 36), AK gaps = 6 mm

Equal diode voltages

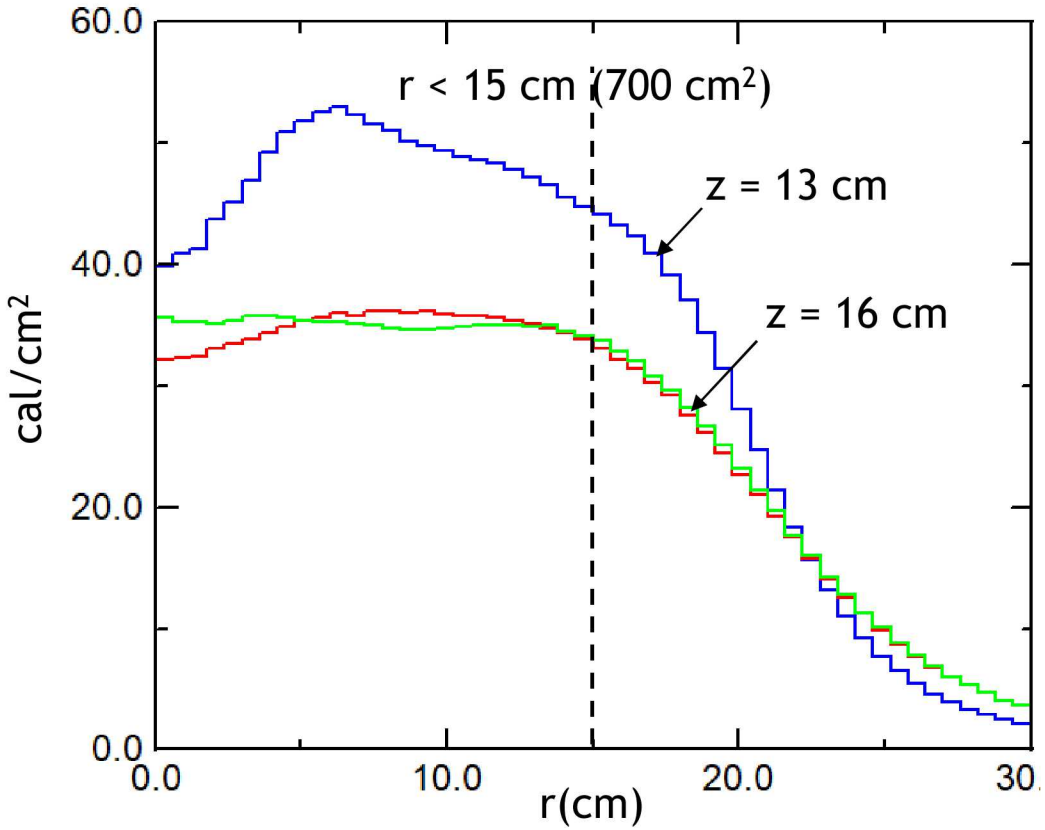
32 ns FWHM of power pulse

Can vary AK gaps, number of modules, calorimeter location

Work by B. Weber (NRL) & B. Ulmen (SNL)

Saturn – E-Beam Mode Under Development

Uniformity can be improved significantly by adjusting AK gaps and cathode radii



- Blue (6.4 MA, 1.6 MV)
  - r = 6, 12, 18 cm
  - AK = 6 mm
  - **48.5** cal/cm² ± 5.5%
- Red (6.8 MA, 1.4-1.5 MV)
  - r = 6, 12, 18 cm
  - AK = **7, 6, 5** mm
  - 35.2 cal/cm² ± **2.6%**
- Green (6.8 MA, 1.4-1.5 MV)
  - r = **5**, 12, 18 cm
  - AK = 7, 6, 5 mm
  - 34.9 cal/cm² ± **1.1%**

Work by B. Weber (NRL) & B. Ulmen (SNL)

High Energy Radiation Megavolt Electron Source – HERMES III

Gamma ray simulator

18 MeV

650 kA

30ns FWHM

MITL Extension for Outdoor test cell:

- Gamma rays interact with atmosphere to produce high energy particles, including electrons and strong EM fields.

Good platform for diagnostic development:

- Air conductivity
- E & B field probes
- Breakdown
- Graphite DAS
- Optical Dose Mapping