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# Neutron Irradiation Facilities at AWE

Neville Bainbridge

Neutron Science Group  
ESD



VIPER  
FAST BURST REACTOR  
U-235 fission spectrum

ASP  
D-T ACCELERATOR  
14 MeV

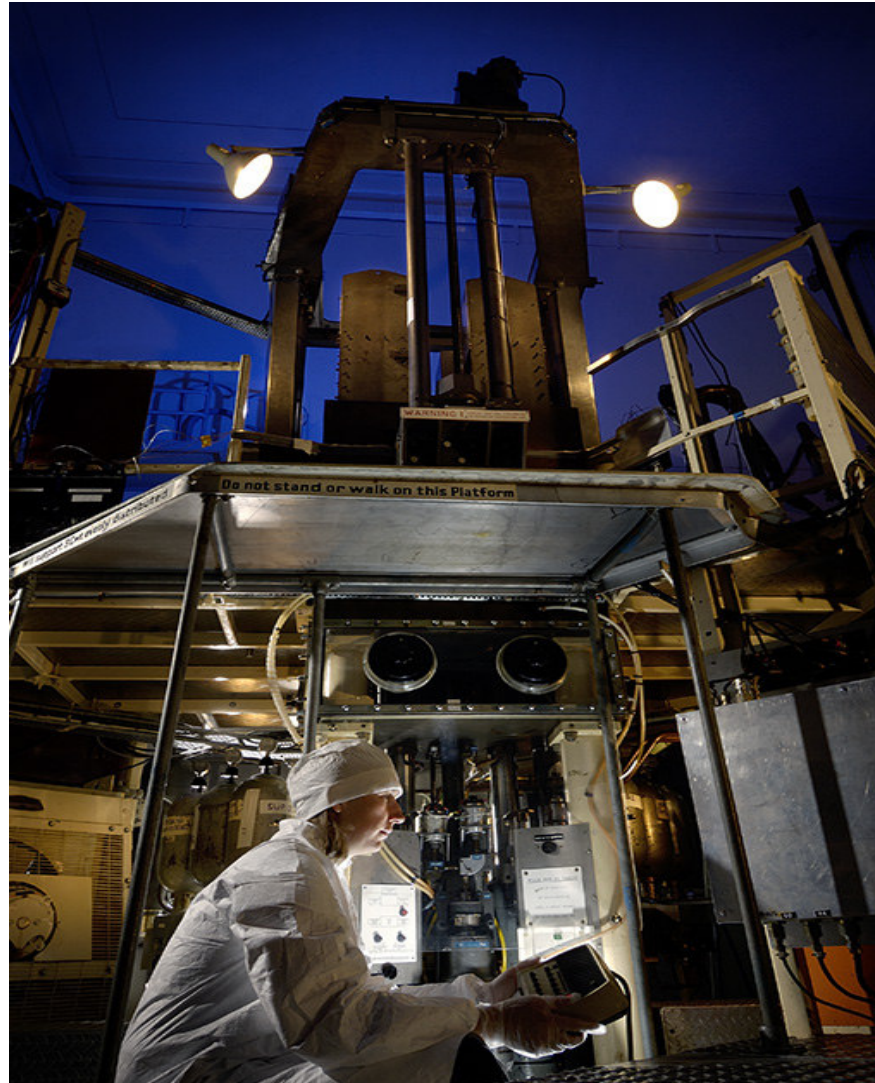


## VIPER – Versatile Intermediate Pulse Energy Reactor

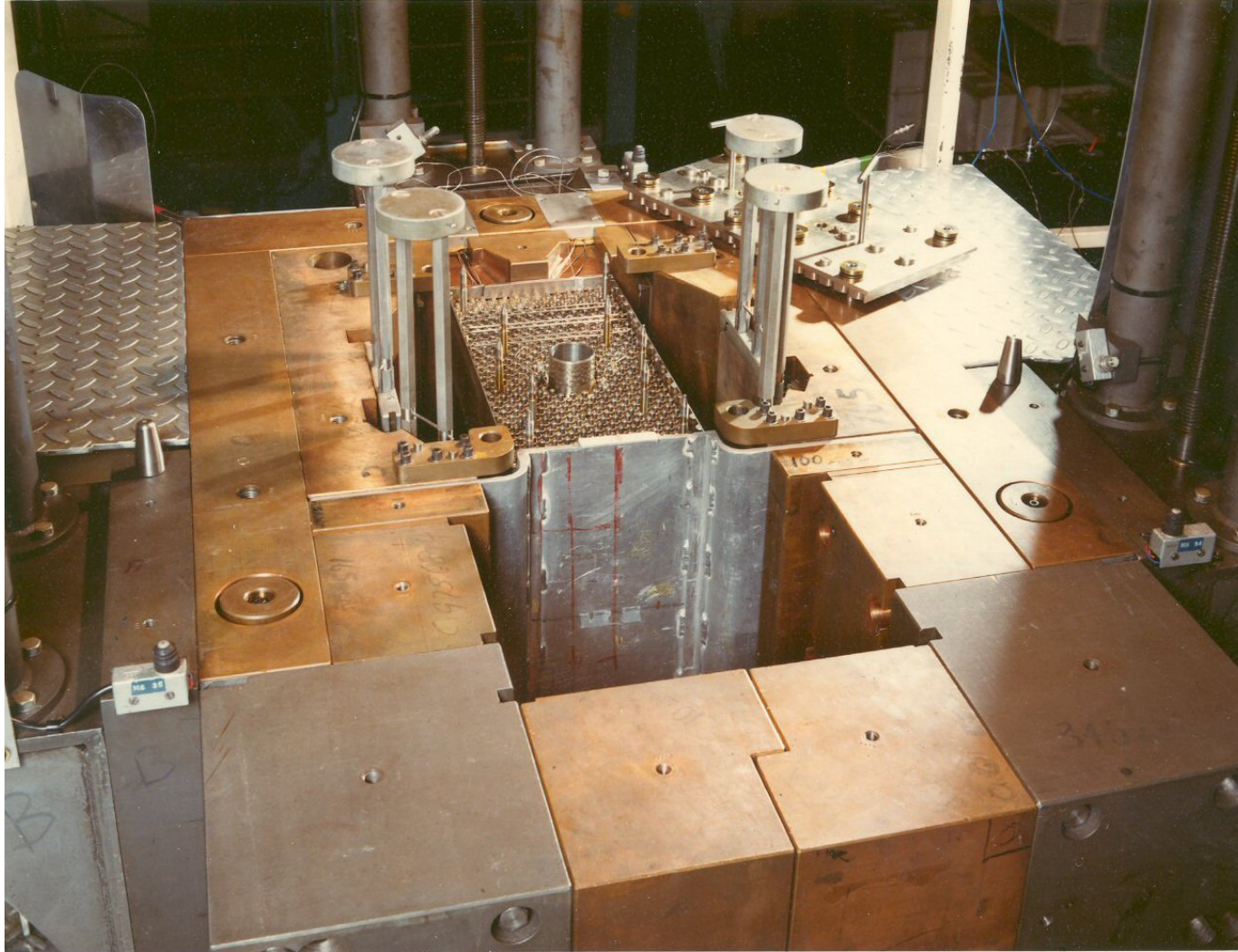
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- Commissioned in 1967 VIPER is a super prompt critical reactor capable of producing 20,000 MW in a fraction of a millisecond
- The reactor therefore produces a radiation field that can be used to test materials under nuclear burst environments
- Materials include both nuclear and non nuclear weapon components. TREE effects – response of semi-conductors to defined neutron displacement damage at 1MeV Si equivalent
- Additional capabilities include health physics and criticality trials on instrumentation
- **Substantial upgrade over next 10 years**

# VIPER PULSED REACTOR



# VIPER – Versatile Intermediate Pulse Energy Reactor



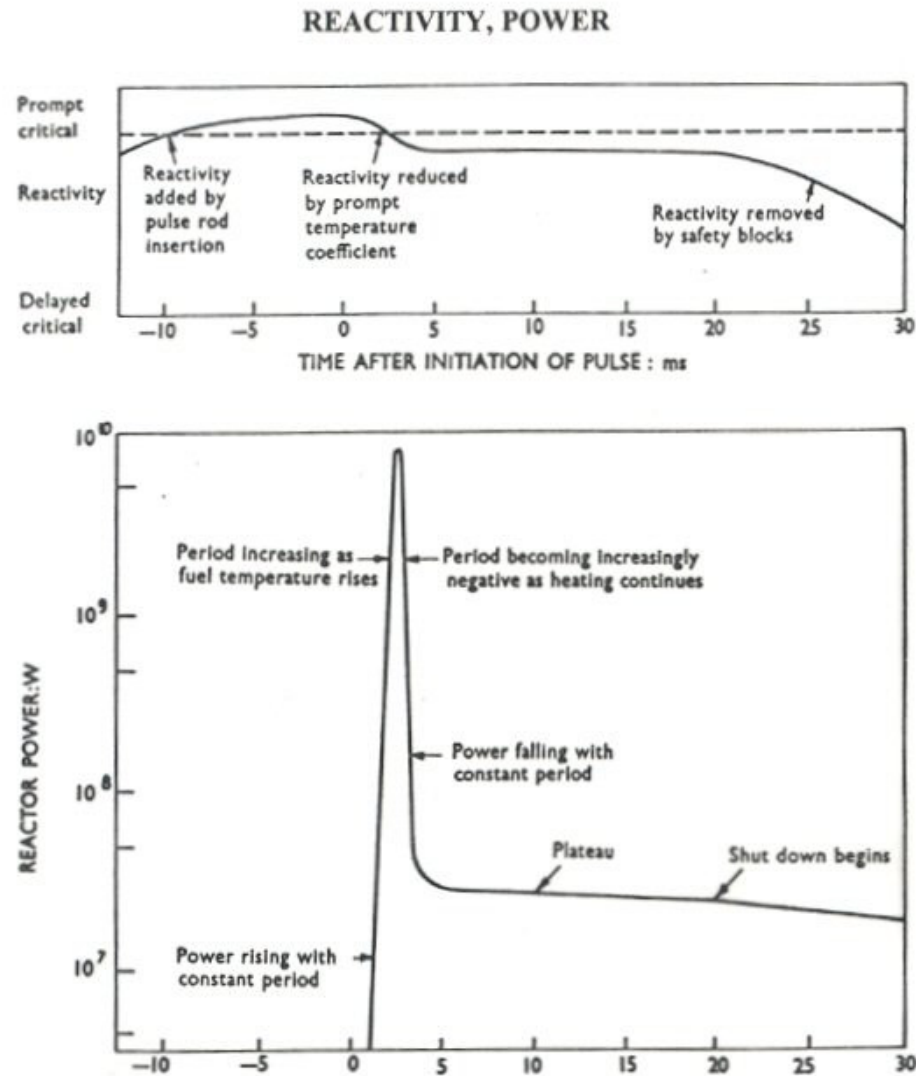
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# VIPER CORE





# VIPER – Versatile Intermediate Pulse Energy Reactor



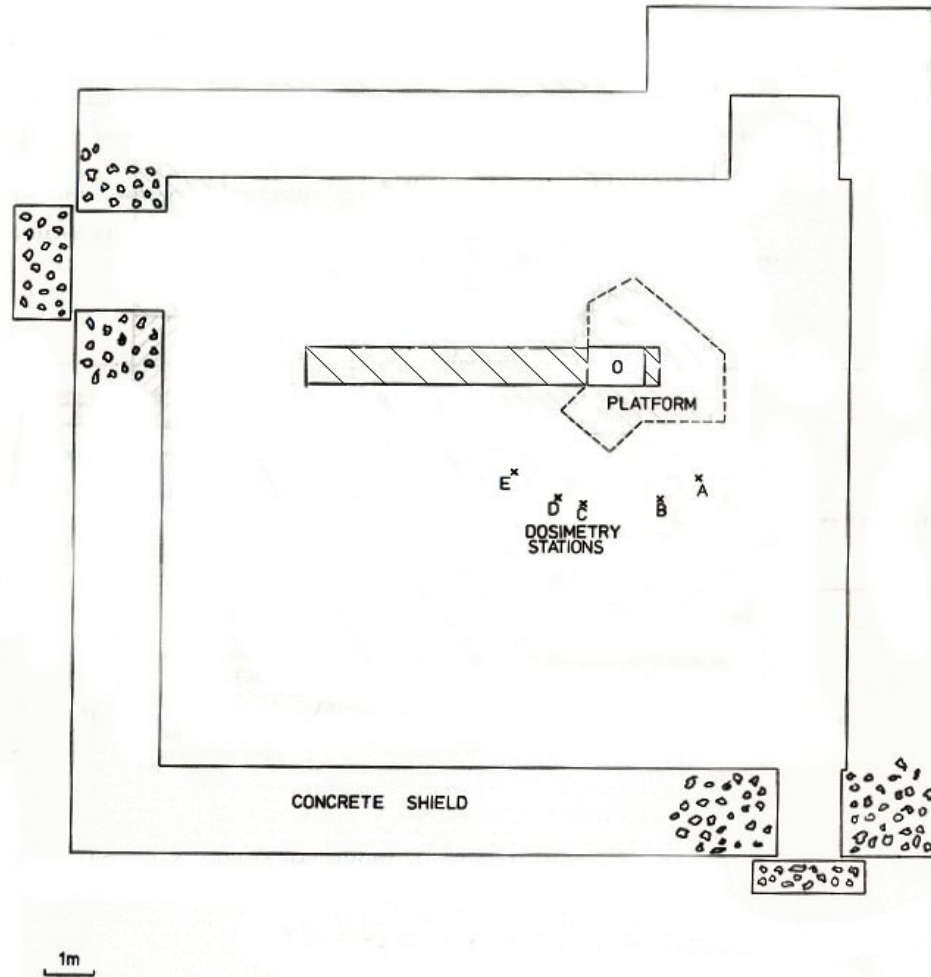


# VIPER – Neutron Output Characteristics

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- Peak neutron flux  $1 \times 10^{18} \text{ cm}^{-2}\text{s}^{-1}$  or  $1 \times 10^{15} \text{ cm}^{-2}$
- Radiation Absorbed Dose up to 10 kGy. Equivalent dose rates down to  $\mu\text{Sv/hr}$  at steady state.
- Neutron spectrum at north face characterised by combination of expt and computation to 52 energy groups. Often converted to 1 MeV equivalent Si displacement damage
- Specific dose points for health physics trials with phantoms.

# VIPER – Versatile Intermediate Pulse Energy Reactor



PLAN OF VIPER REACTOR CELL

# THE FUTURE



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VIPER IN PROCESS OF MAJOR  
REBUILD FOR OPS TO 2016

LONG OUTAGE PERIODS OVER NEXT  
5 YEARS

OPERATIONAL WINDOWS TO BE  
ANNOUNCED

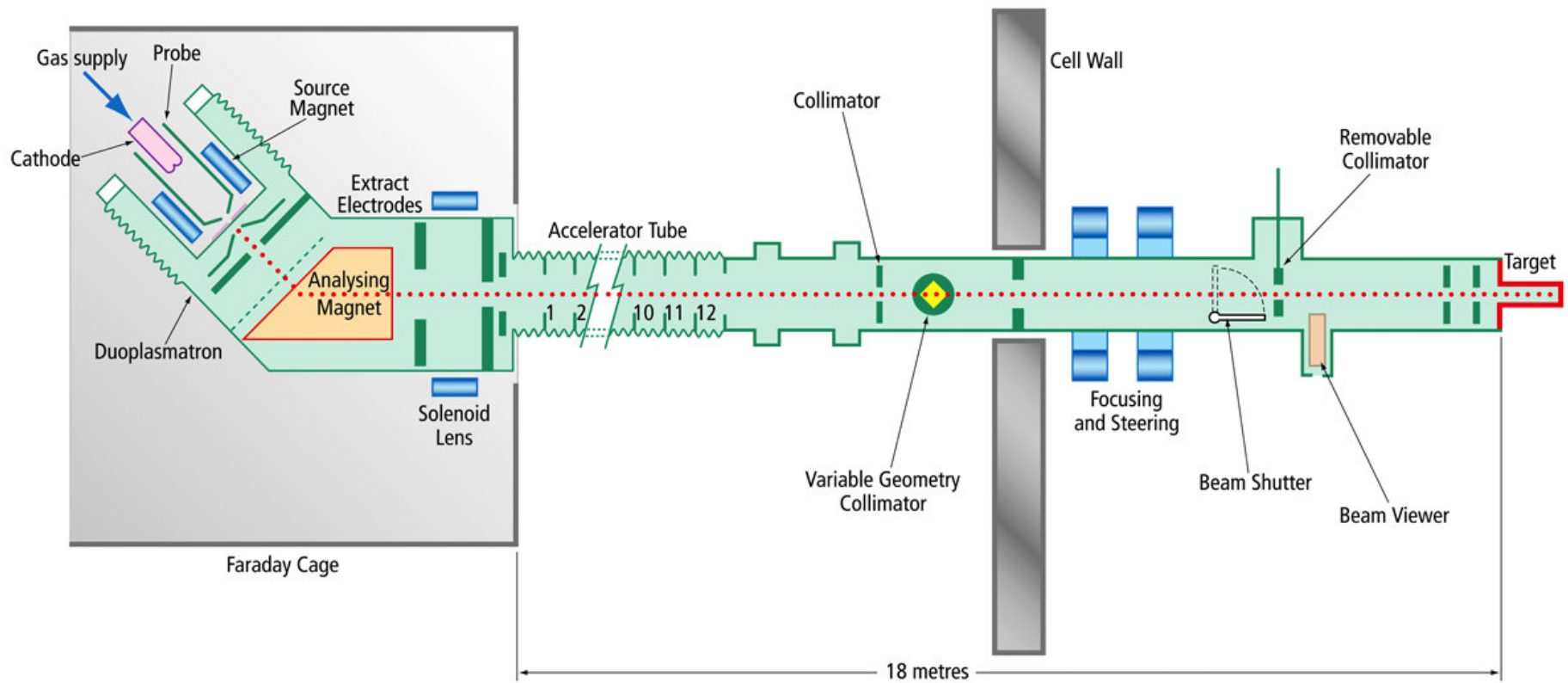


## ASP – 14 MeV Neutron Generator

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- Commissioned in mid-60's. Based on D-T reaction using tritium targets. D-D reaction also utilised
- Neutron calibration and overload tests.
- Precise TREE measurements
- UK primary standard for 14 MeV neutrons – quarterly NPL check
- Recent overhaul & improvement in calibration techniques

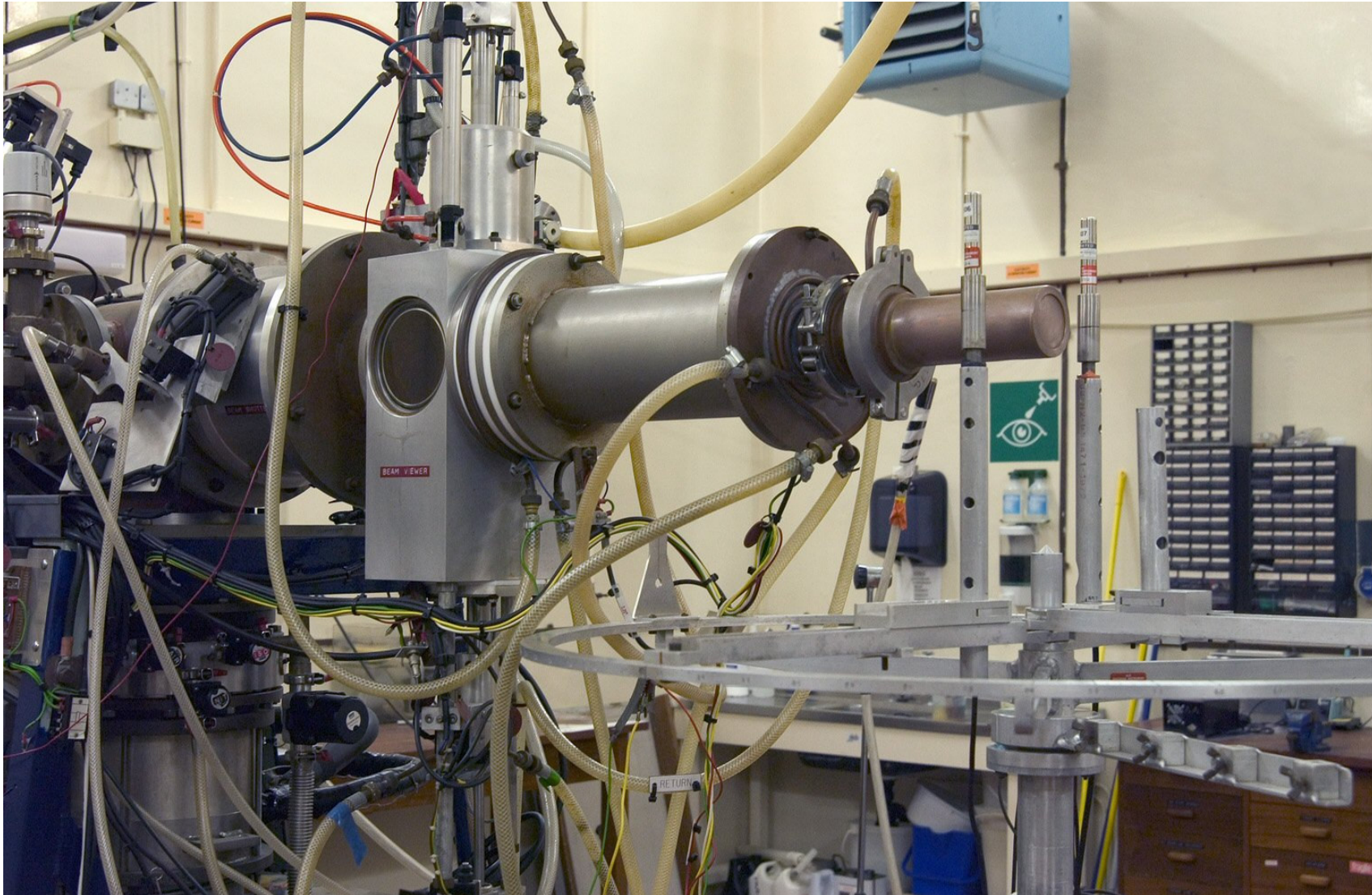
# ASP – 14 MeV Neutron Generator



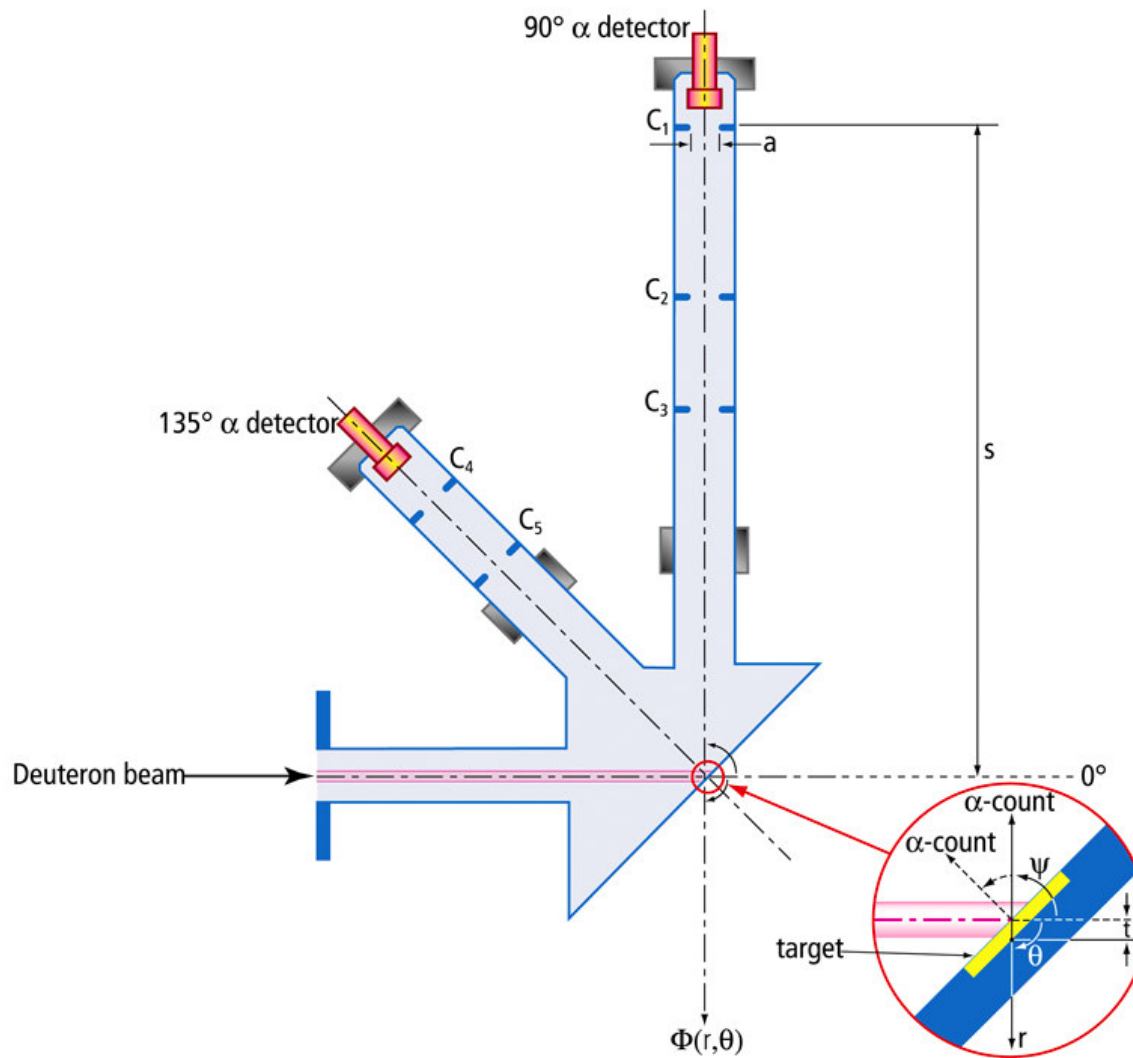
# ASP Particle Accelerator



# ASP – 14 MeV Neutron Generator



# ASP – Alpha Arm





# ASP Neutron Characteristics

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- Neutron output up to  $10^{12} \text{ s}^{-1}$ .
- Flux at 1 cm from target  $8 \times 10^{10} \text{ cm}^{-2} \text{ s}^{-1}$
- Pulsed option to 0.2 kHz
- U-238 fission counter measurement
- $\alpha$ -count measurement for neutron output (AAPM technique)
- Tritium & deuterium target production capability