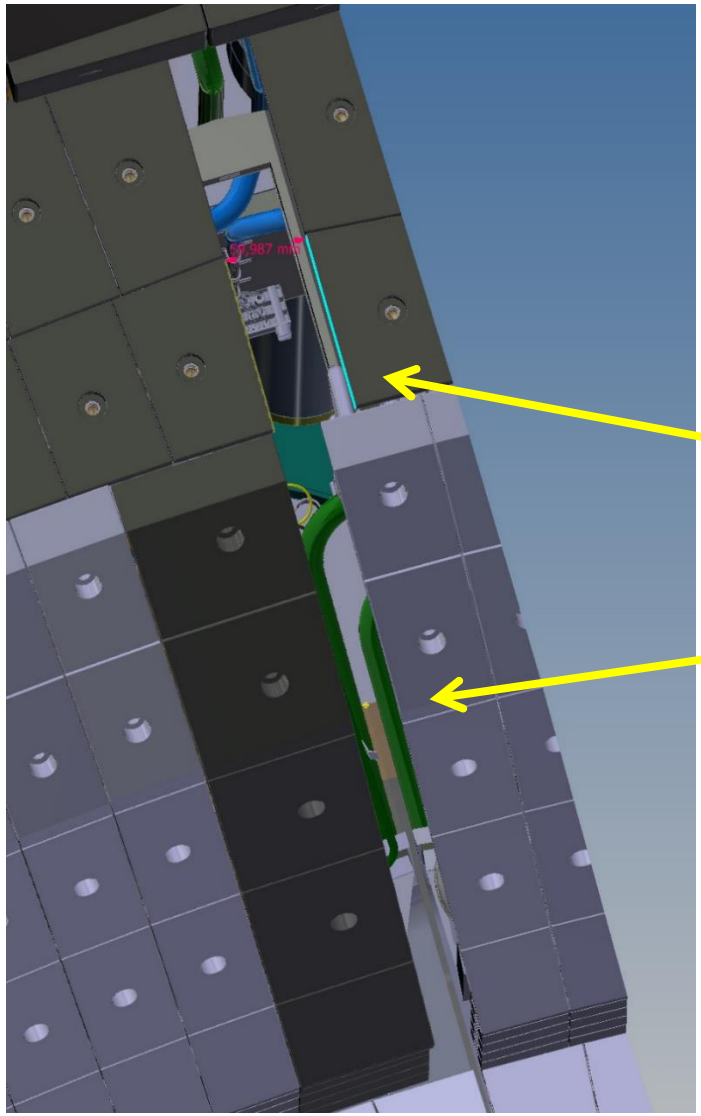
WPSA – JT-60SA Exploitation: Design of Neutron Diagnostics



Requirements (from Sumida et al., *Rev. Sci. Instrum., 91 (2020) 113504):*

- spatial resolution:
  < 0.1a (20 cm)
- statistical resolution:
  < 3% (10^3 counts / timebin)
- temporal resolution:
  < 100 ms (@10^5 cps)

Main challanges:
Narrow divertor slit above P10-lower port restricts FoV

Vertical Neutron Camera in P10-lower port

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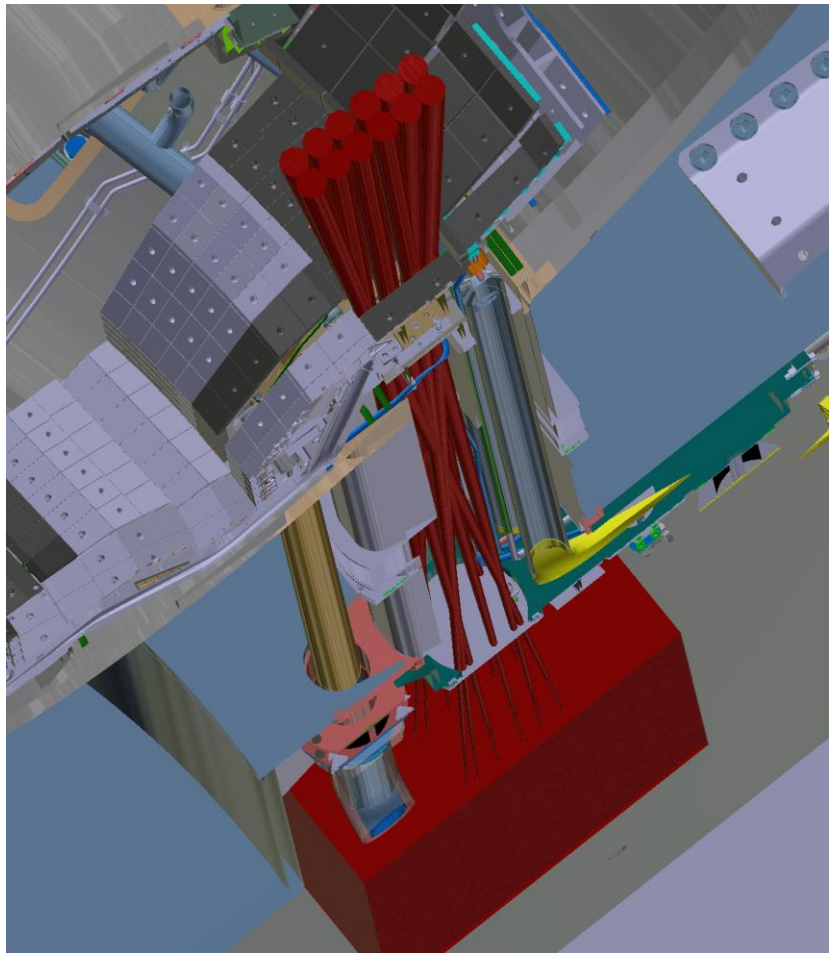
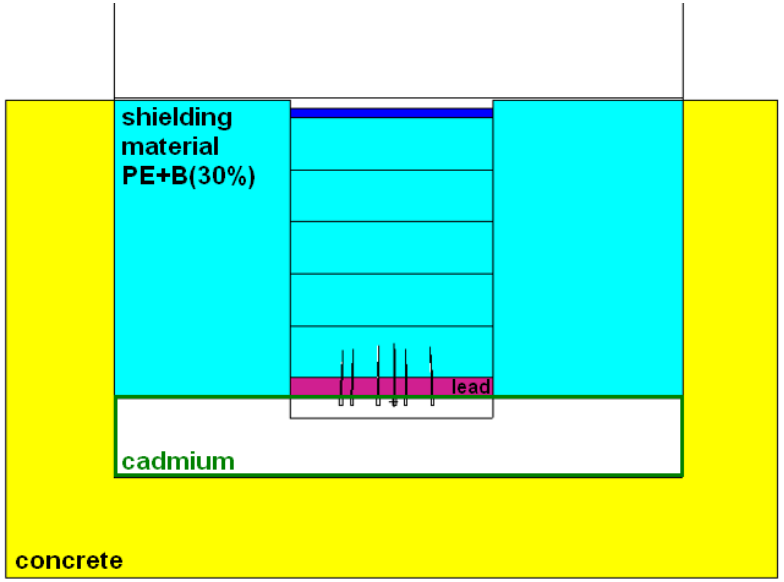
Proposed solution:
2 rows × 6 channels (Ø6.6 mm)

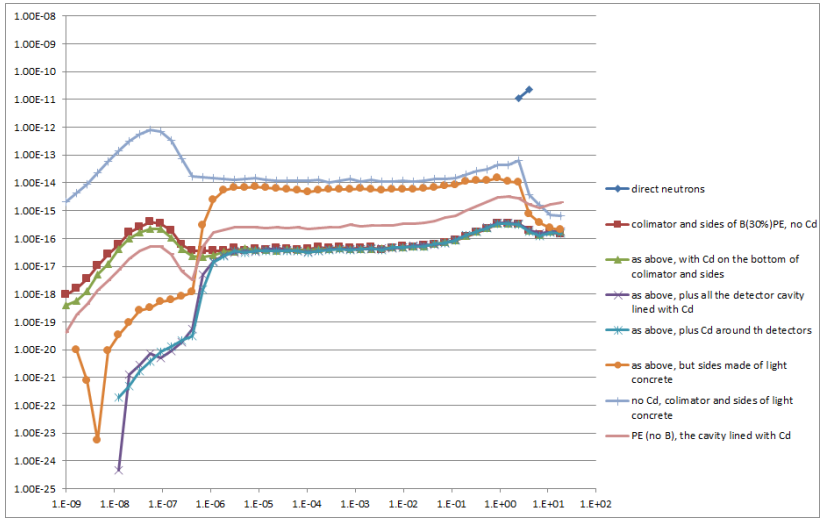




Vertical Neutron Camera in P10-lower port

Collimator thickness in total is 150 cm, composed of shielding material made with:

- polyethylene with boron-10 at 30% (5 blocks with thickness 26 cm + sides),
- lead plate above the detectors (thickness 10 cm),
- cadmium sheet around the detectors pocket (thickness 2 mm).



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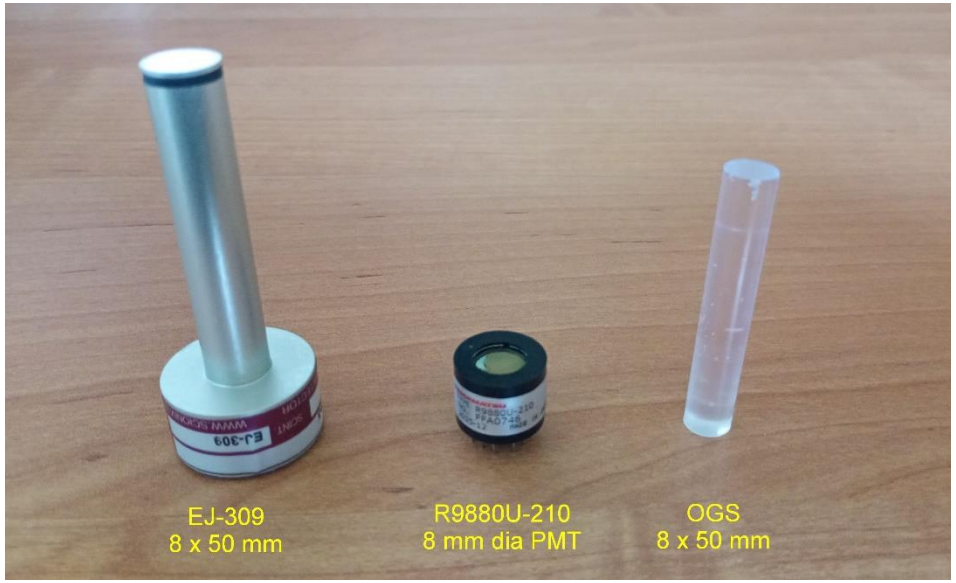


Laboratory test:
OGS (Ø8mm × 25mm)
+ R9880U-210 (PMT Ø8mm)

superb n/g discrimination
>200 keVee

Vertical Neutron Camera in P10-lower port

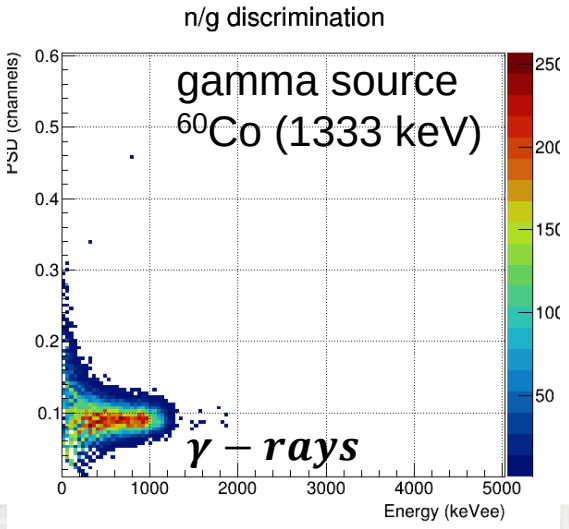
Proposed detector (12 channels):

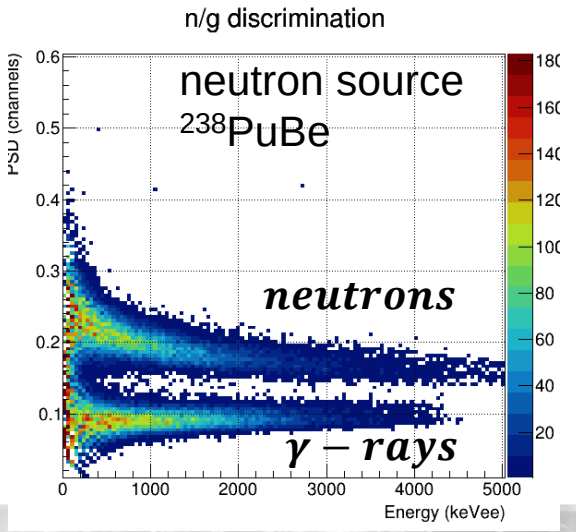
Equat. plane – VNC distance:	8 m
Collimator length:	150 cm
Collimator diameter:	6.6 mm
Scintillator: OGS or EJ309	bars Ø8mm × 50mm
R9880U-210 metal package PMT:	outer size Ø16mm × 13mm

active voltage divider
anti-magnetic shield (μ-metal + soft iron)

Performance estimates:

Neutron detection eff.:	~32% (2.5 MeV)
Energy resolution:	~11% (0.2−1 MeVee)
Spatial resolution:	~7cm (at equat. plane)
Temporal resolution:	~10-30 ms (3% stat. res.)





Back-up slides

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Workplan 2026

Calculations:

Evaluation of yields(*) at detector location for selected collimator configurations:

- direct 2.5 MeV neutrons
- scattered neutron background
- γ/X-ray background

(*)requested input:

SSW from models developed by Alvaro Cubi and Marco Cecconello for relevant scenarios.

Hardware:

Detector tests to verify neutron response:

- with 2.5 MeV neutrons from DD generator
- in magnetic field (μ-shield design)
- under high counting rate (active VD)
- comparison with SiPM photodetector readout

Design:

- VNC performance assessment
- technical design of the collimator and detectors
- cost evaluation