

ICANS XXV
13-17 April 2026



A new electronic personal dosimeter for neutron and gamma radiation

R. Bedogni, I. Castro-Campoy, L. Russo, F. Frigi, C. Balderas
INFN-LNF Frascati Italy

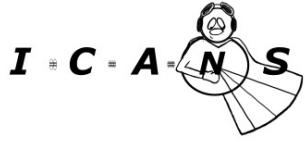
S. Turchi
DIGITECH SRL (Peccioli, Italy)

A. Pietropaolo
ENEA C.R. Frascati (Italy)

E. Mafucci, C. Fontana
EC Joint Research Centre Geel (Belgium)

C.A. Federico
IEAv São José dos Campos (Brazil)

J. M. Martí-Climent, E. Martínez-Francés, J. A. Cuesta
Clínica Universidad de Navarra (Madrid, Spain)



Talk breakdown



- State-of-art
- DOIN design and nominal performance
- Energy identification algorithm
- Minimum dose equivalent
- Performance tests
 - ENEA Frascati
 - IEAv Brazil
 - CUN Madrid
- Conclusions



State of art

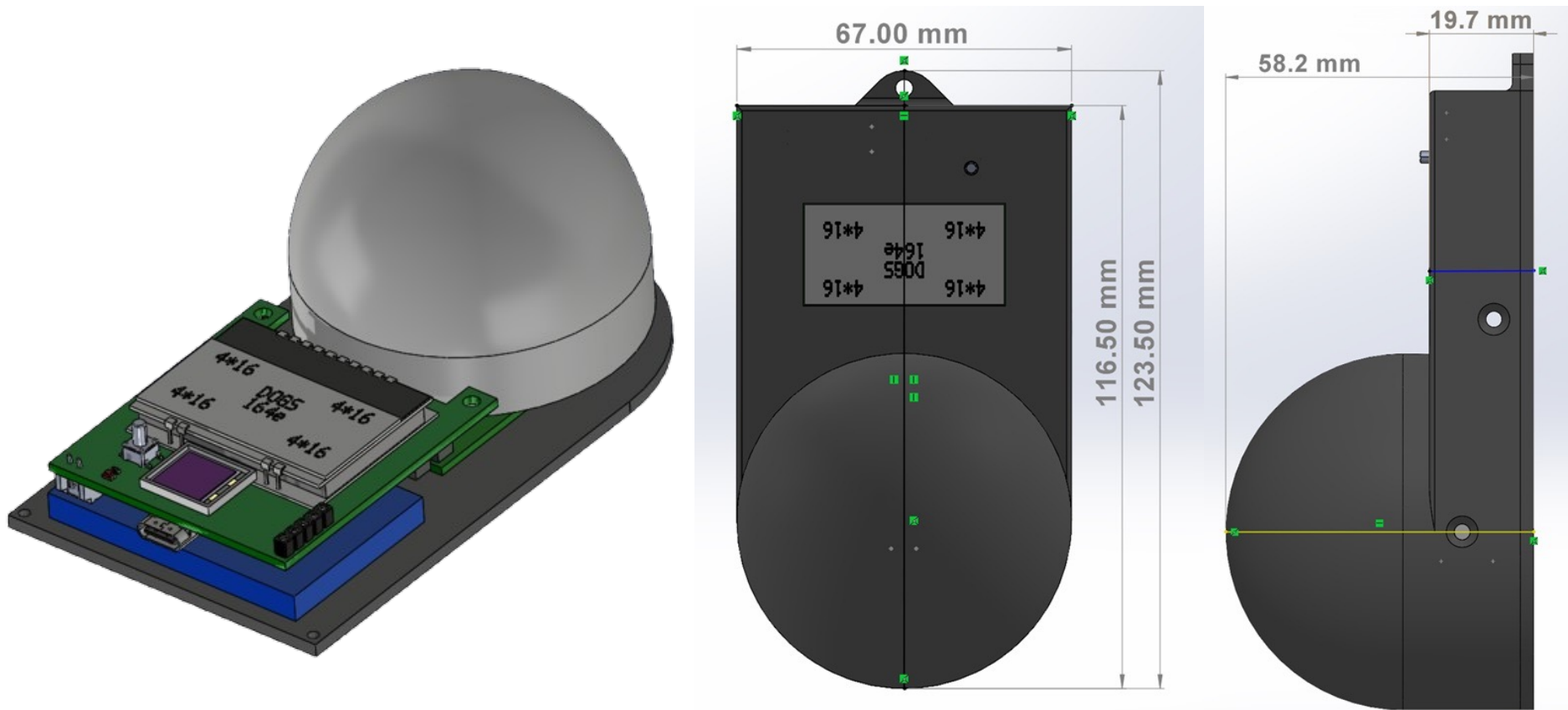


- EPD-n are desirable but considerably less developed than EPD-gammas:
 - 10+ decades in energy
 - No single sensor can mimic the fluence-to- $H_p(10)$ coefficient vs. energy
 - Very hard to reach flat dose equivalent response vs. energy/angle

IEC 61526 (2024) Radiation protection instrumentation - Measurement of personal dose equivalents for X, gamma, neutron, and beta radiations - Active personal dosimeters

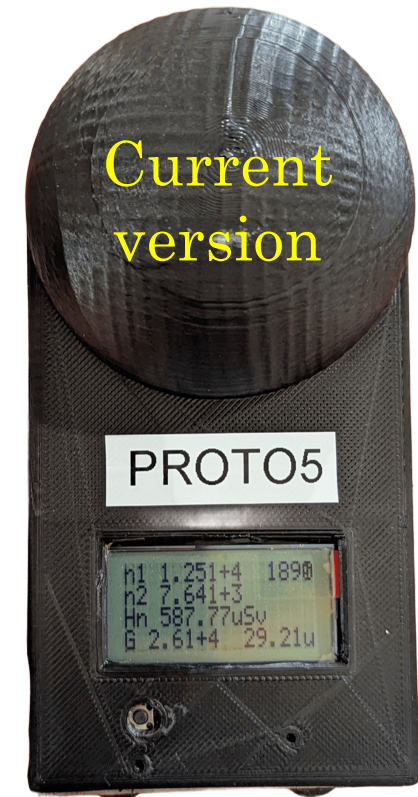
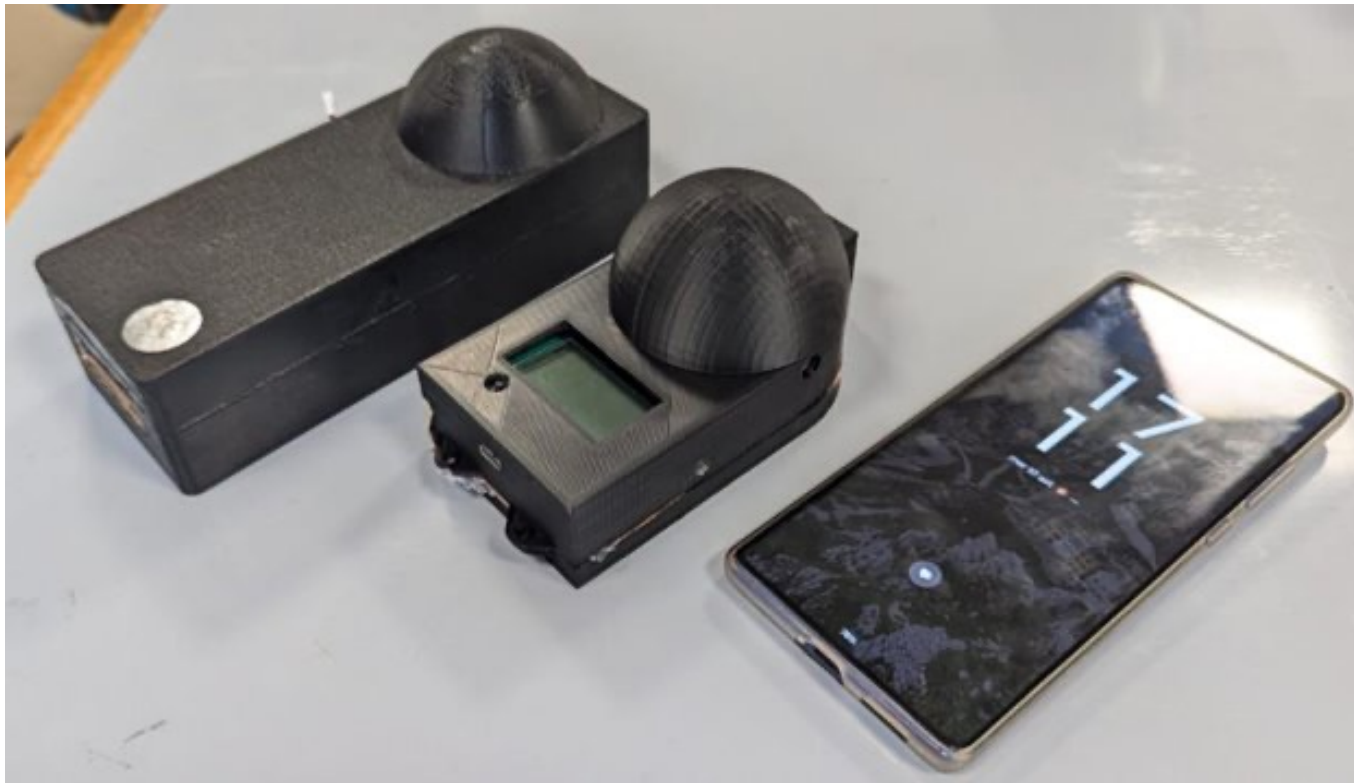
Limit of variation of the relative response (Energy and angle combined)

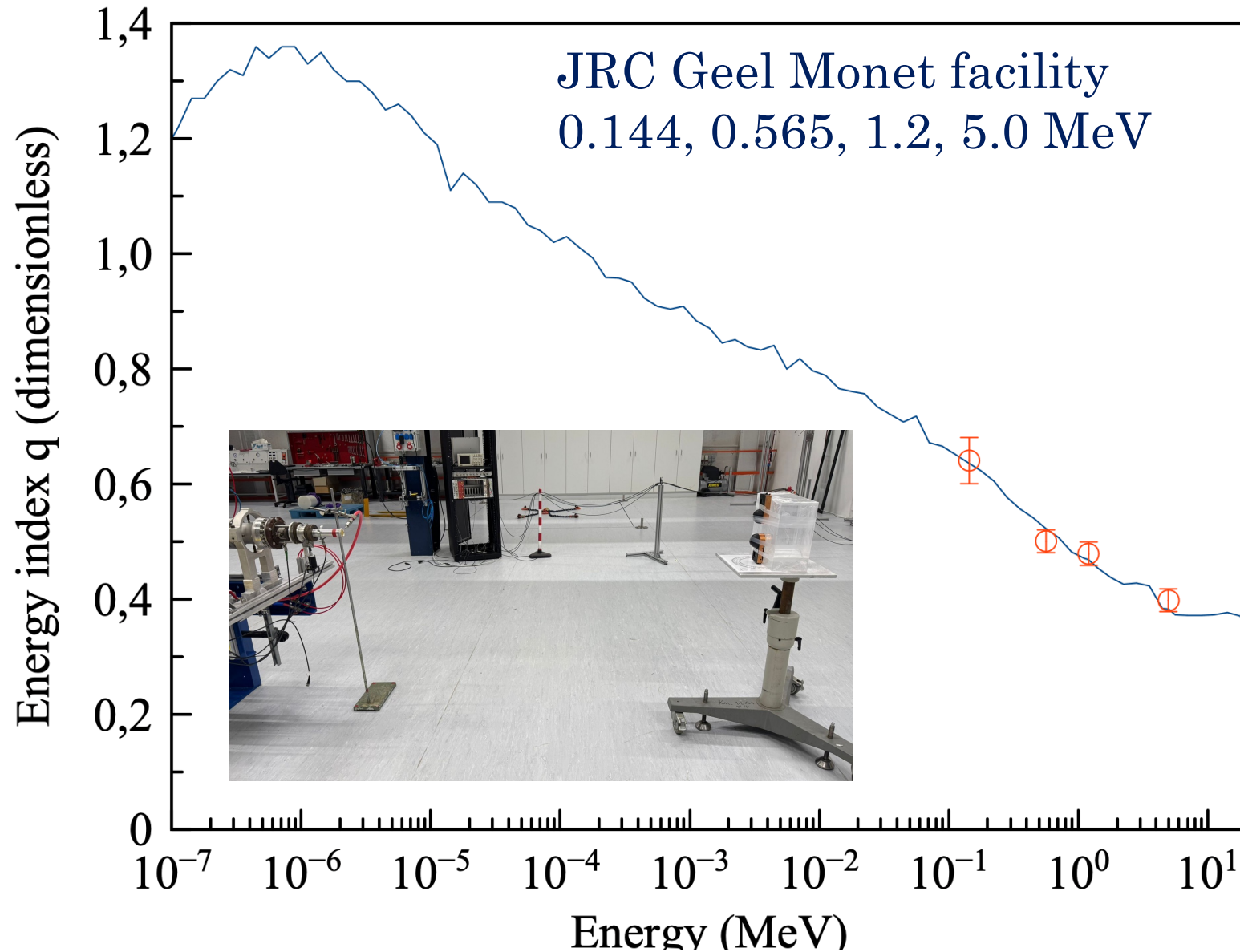
- From **-60% to +700%** in the E domain thermal to 100 keV
 - *all existing devices tend to overestimate in thermalized fields*
- From **-60% to +100%** in the E domain > 100 keV
 - *fluence to $H_p(10)$ increase x 40 from 0.1 and 1 MeV*

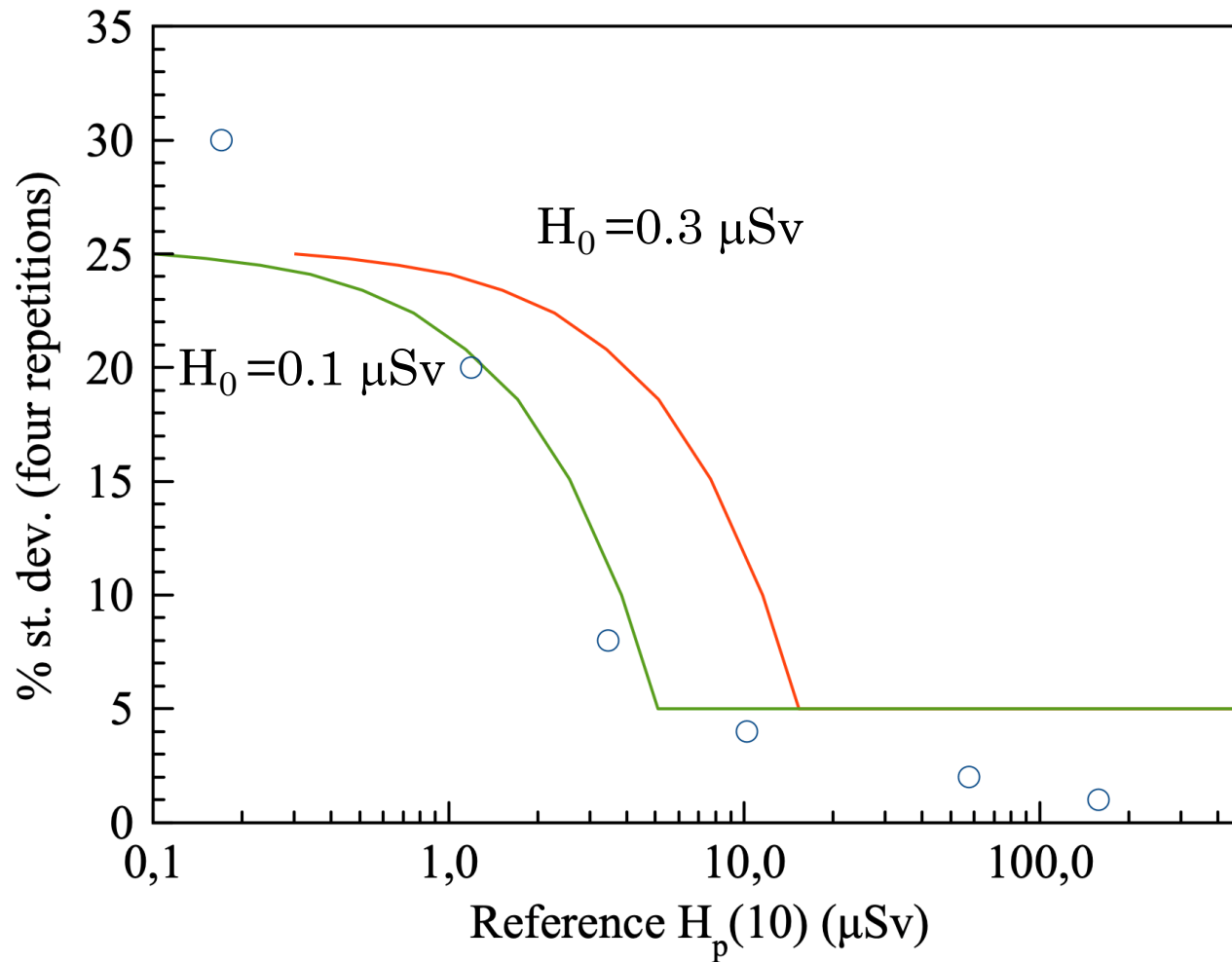


- Solid state multi-sensors (patent pending)
 - energy “identification” algorithm for selecting appropriate calibration factor
- Measurement range in Energy: thermal – 15 MeV
- Measurement range in dose equivalent: from below 1 μSv to 100 Sv
- Linear in dose rate up to 1.3 Sv/h (10% linearity correction) (IEC says 1 Sv/h)
- Nearly isotropic Hp(10) response

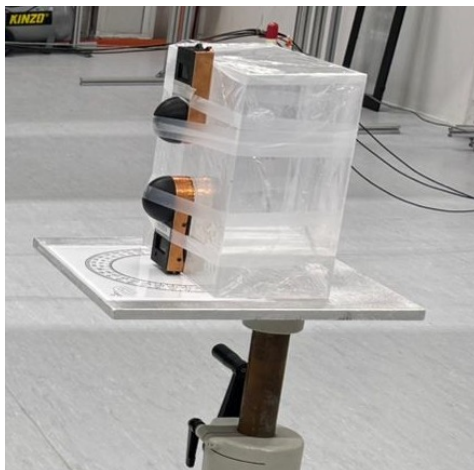
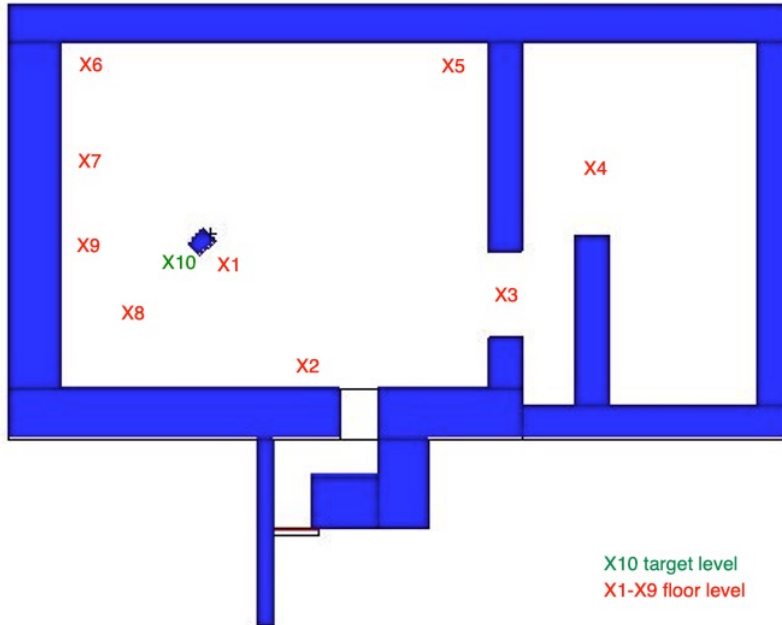
The DOIN dosemeter



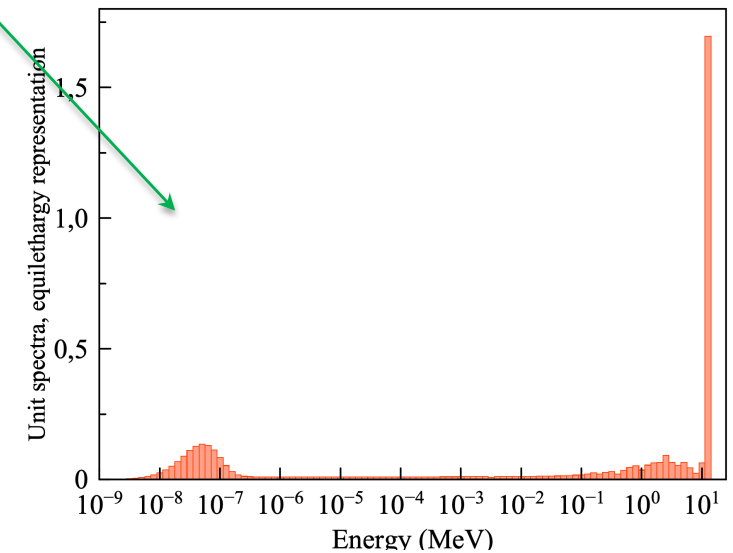
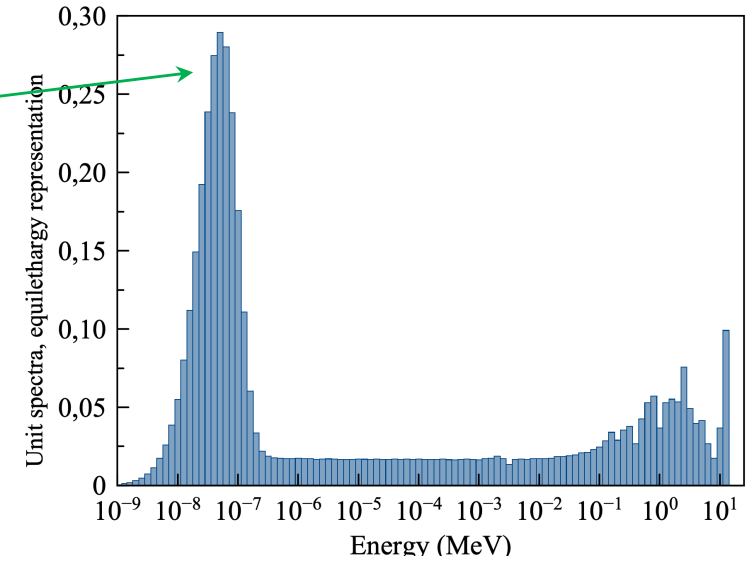
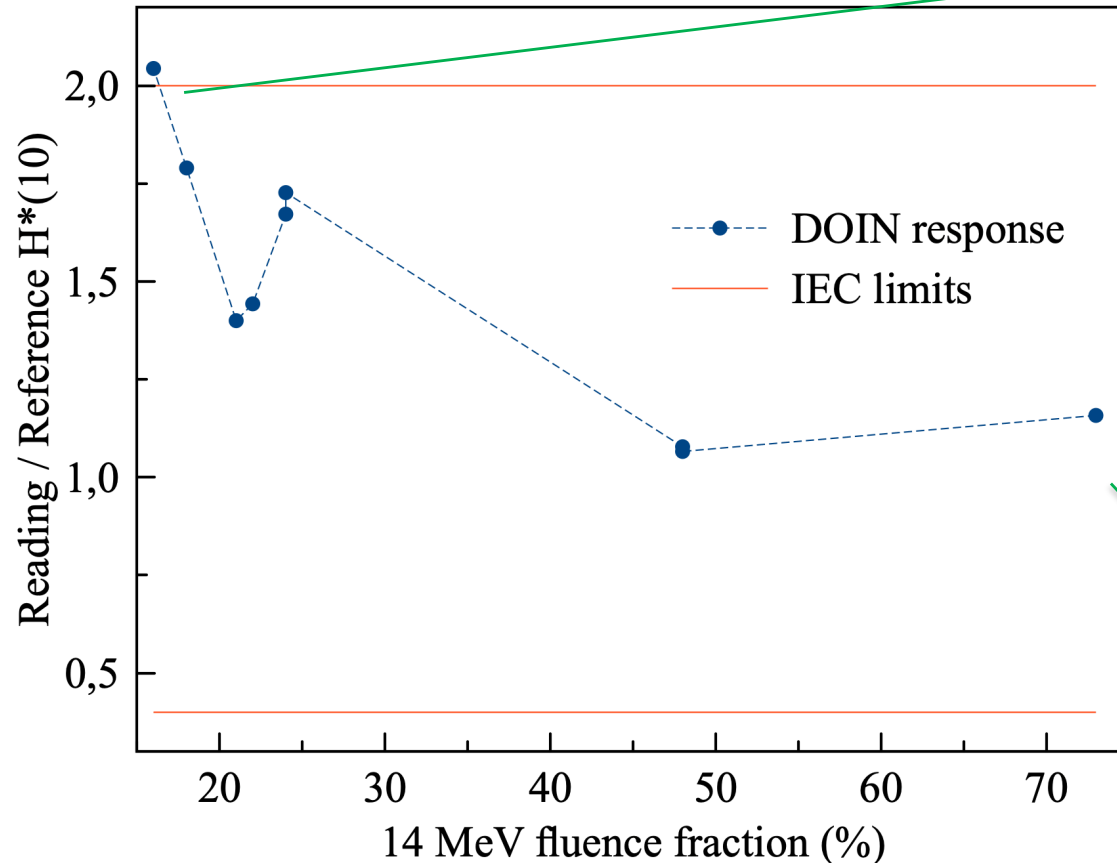


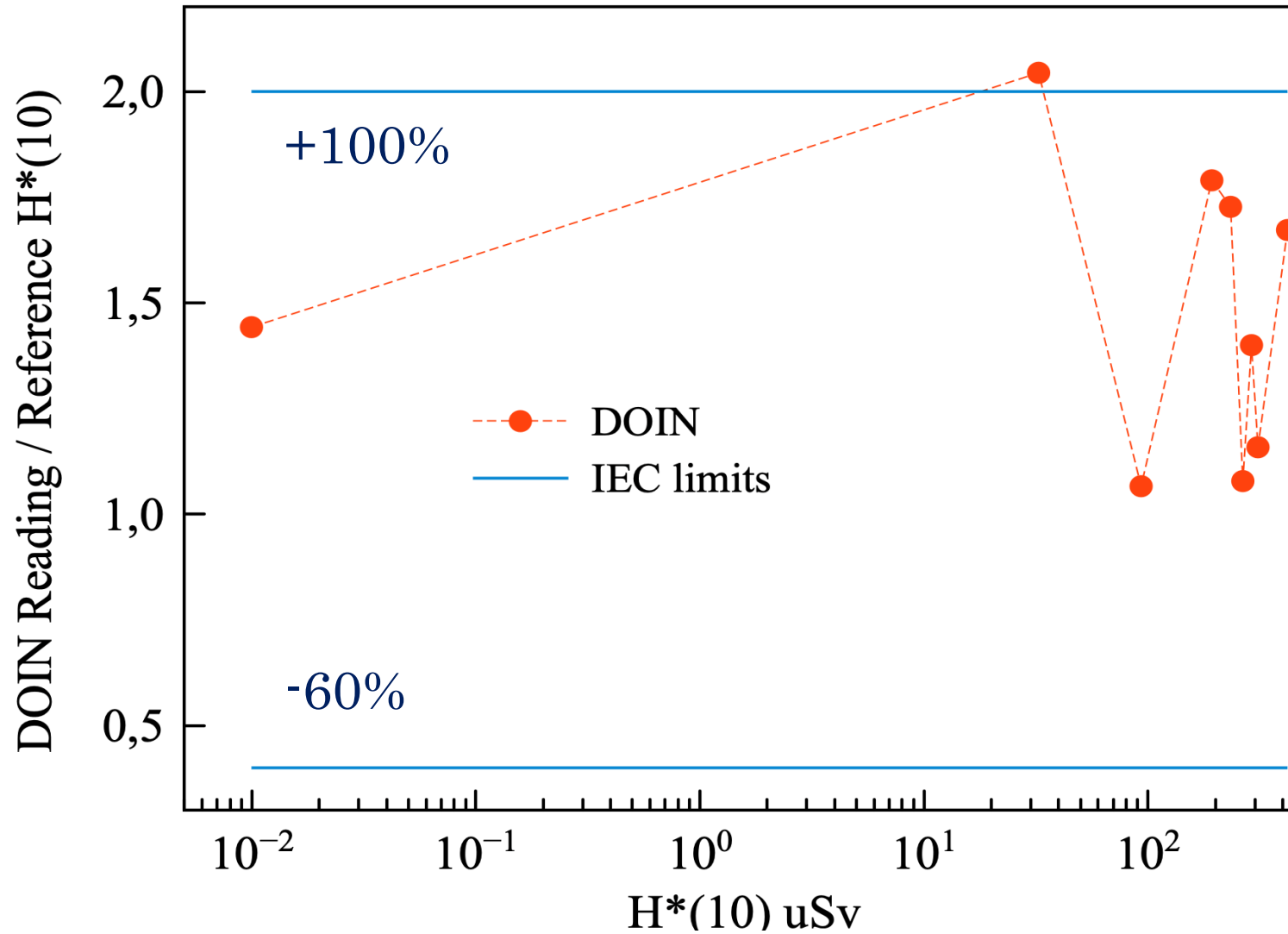


Repeated measurements. IEC criterion on minimum dose / reproducibility of measurements

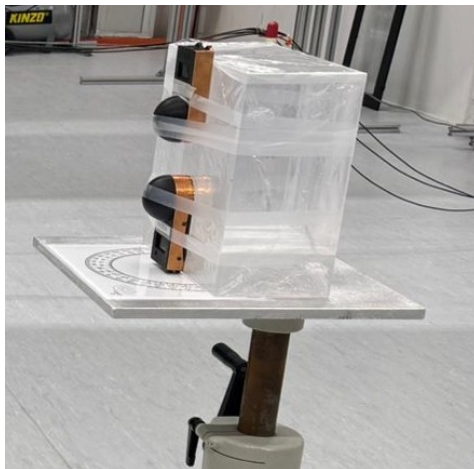


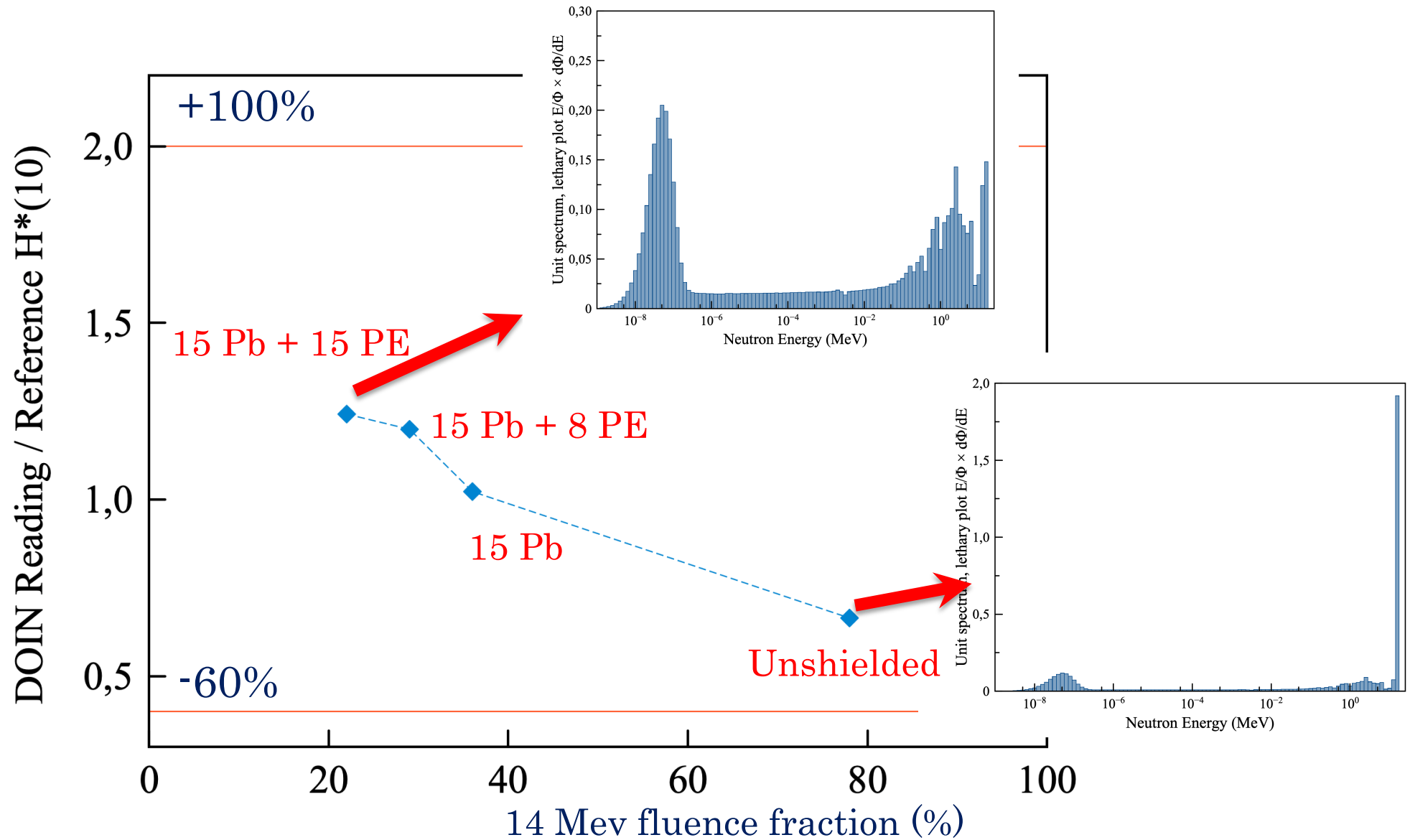
- 14 MeV neutrons up to 10^{11} s^{-1} through $\text{D}(\text{T},\text{n})\alpha$
- Large 12 x 12 x 9 room
- Reference quantity $\text{H}^*(10)$ *Berthold LB6411*

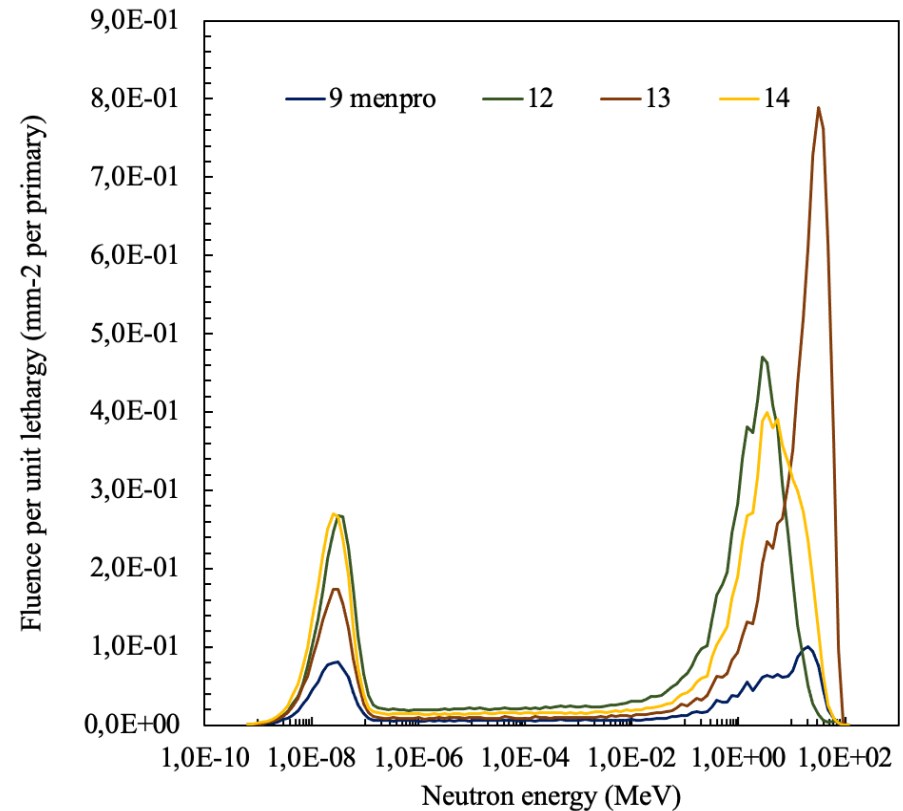




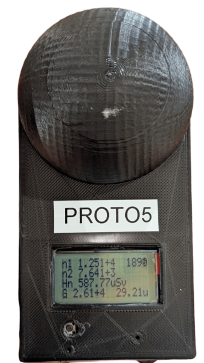
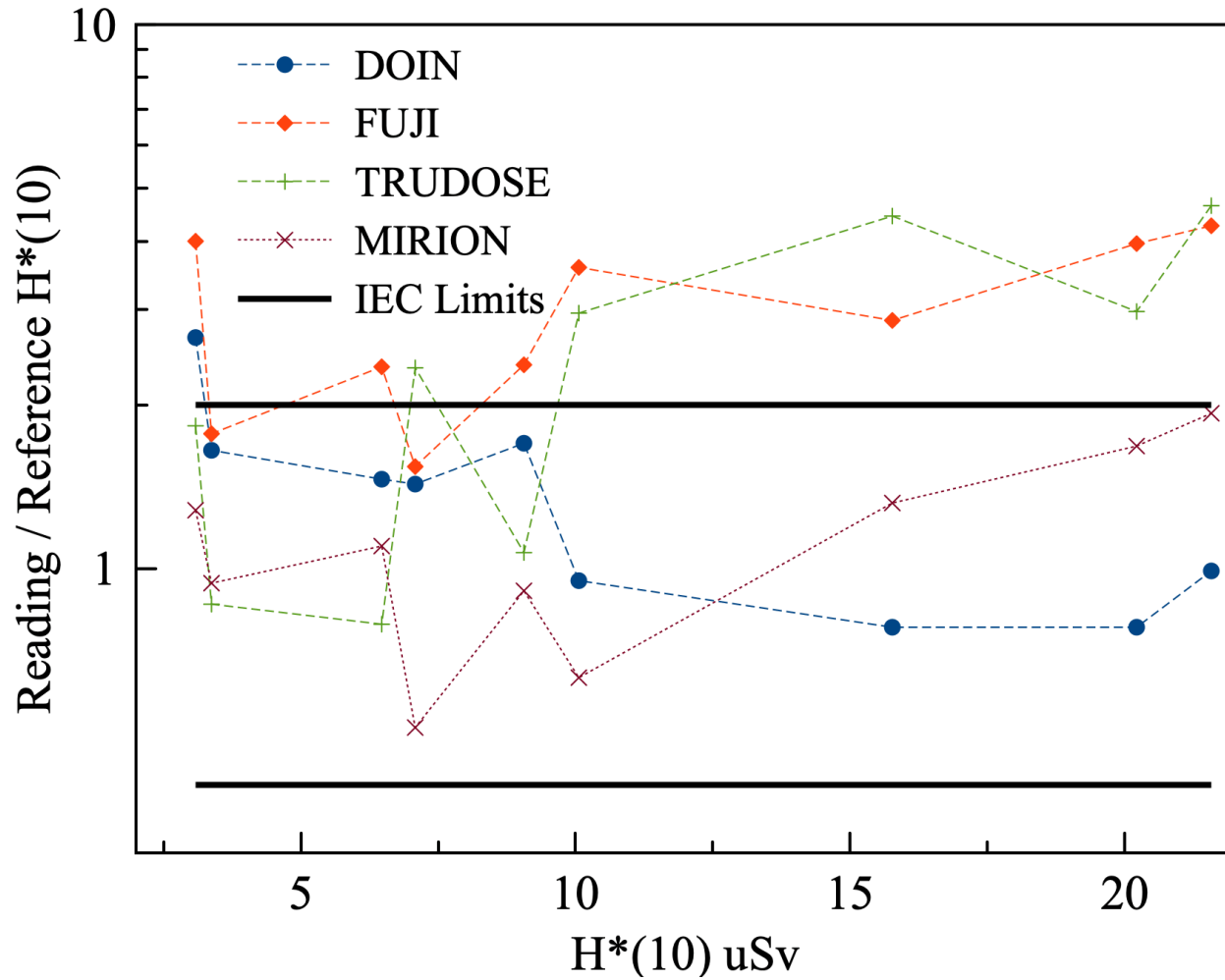
- 2.6 m forward direction from a portable 14 MeV neutron generator, with different shielding:
 - Unshielded
 - 15 cm Pb
 - 15 cm Pb + 8 cm HDPE
 - 15 cm Pb + 15 cm HDPE
- Large 15 x 10 x 5 room
- Reference quantity $H^*(10)$ *Wendi II*

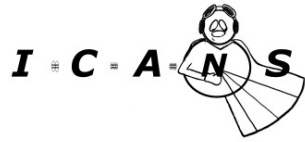






- Proton energies 70, 150, 229 MeV
- DOIN, FUJI, Thermo, Mirion mounted on ISO phantom in various directions
- Reference H*(10) obtained by commercial extended range rem-counters (NECH, LUPIN)
- Fraction of H*(10) below 15 MeV obtained by simulation





Conclusions



- Innovative design – energy algorithm
- Energy range thermal to 15 MeV
- 0.3 μSv minimum dose equivalent
- IEC compliant in all performance tests with various energy/angle distributions
- Further size reduction ongoing
- Time-to-market 1 y
- Looking for more testing workplaces

