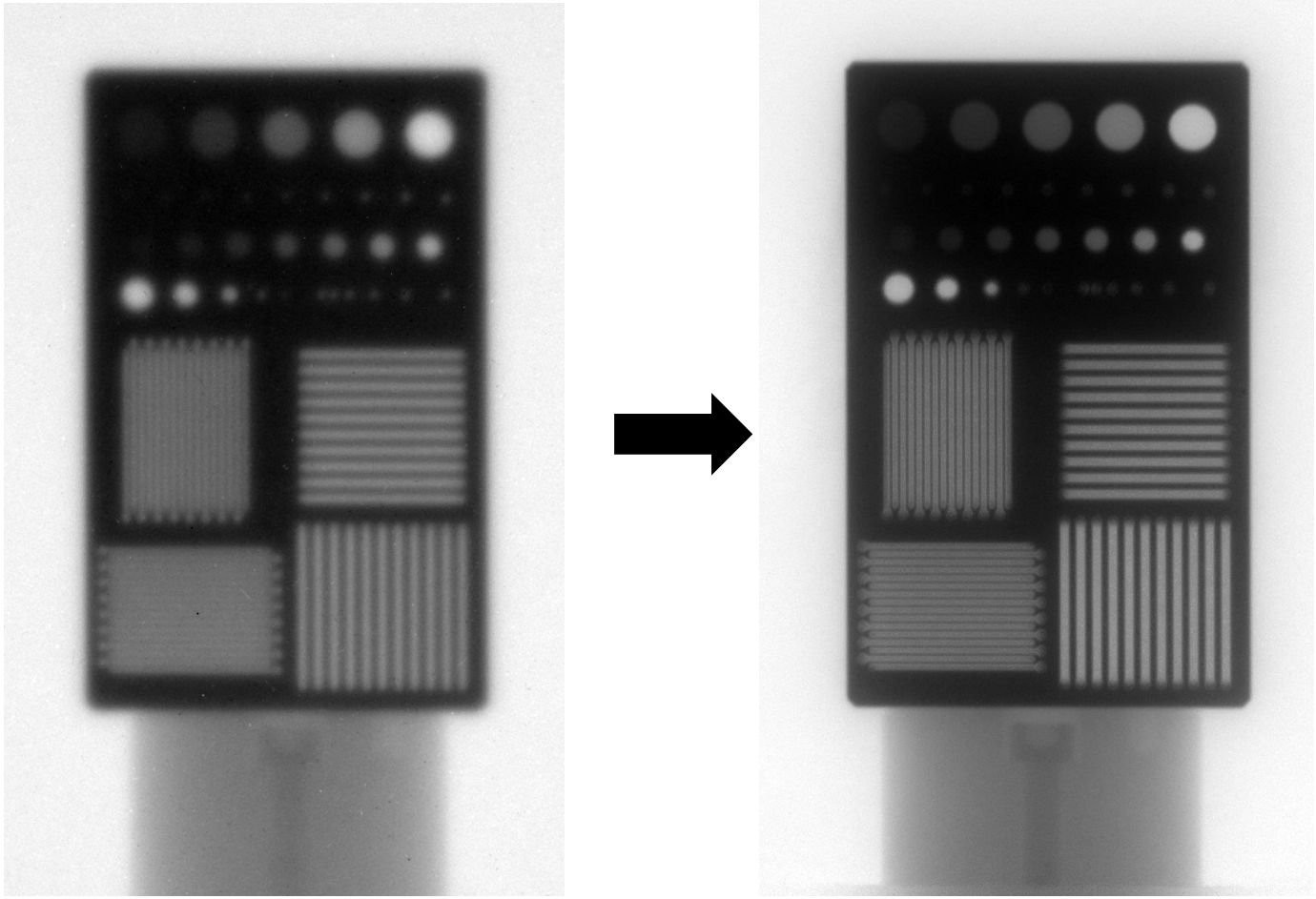
Imaging with fast Neutrons

Improved spatial resolution by new ZnS based scintillator concept



B. Walfort RC Tritec AG

Thank you…

LANSCE (Los Alamos):

Sven Vogel, Danielle Schaper, Alexander Long, Darcy Newmark: For your trendsetting measurements in Oct. 2019!

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PSI (Villigen):

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Markus Strobl: Thank you very much for the organization of the measurements at LANSCE.

Experimental conditions

NECTAR beam line at FRM-2 at 20 MW

Fast neutrons (fission spectrum with Cd/B cutout

Beam size 20 cm * 20 cm

Beam collimation with L/D=200

CCD camera detector with ANDOR – L (2048*2048 pixels)

Exposure time: 80s

Scintillator properties

ZnS:Ag layer:

50 – 200 micrometer tested, Higher tickness improves light output, but reduces resolution

Polyethylen plate:

Thickness 3 mm (reasonable compromise, 1 – 10 mm tested). Increasing thickness improve the light output, but reduce the resolution slightly.

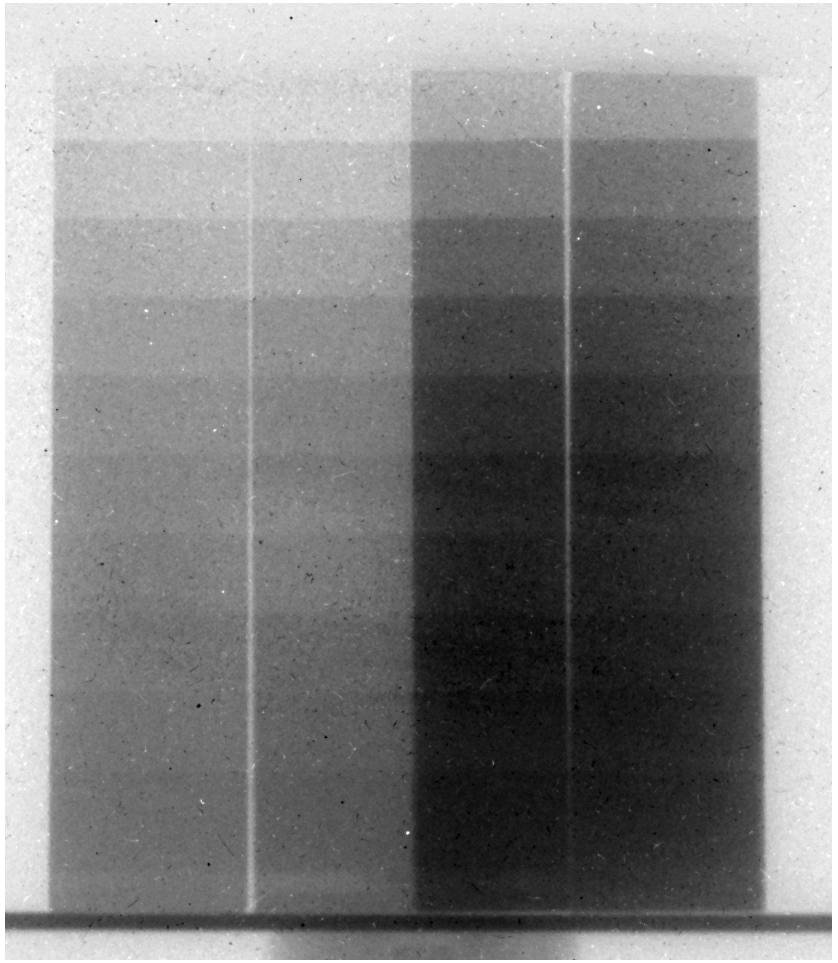
Scintillator used for below measurements:

3 mm PE with 60 micrometer scintillation layer (ZnS:Ag) on top

Gamma sensitivity:

ZnS:Ag showed in comparison to ZnS:Cu a significantly lower sensitivity for Gamma rays

Verification for fast neutrons



PE **Al** **Fe** **Pb**

Different step wedges (5 to 50 mm) have been placed into the beam to verify the measurement of fast neutrons instead of gamma rays.

PE and Al or Fe and Pb show similar attenuation.

With Gamma rays we would expect a different behavior!

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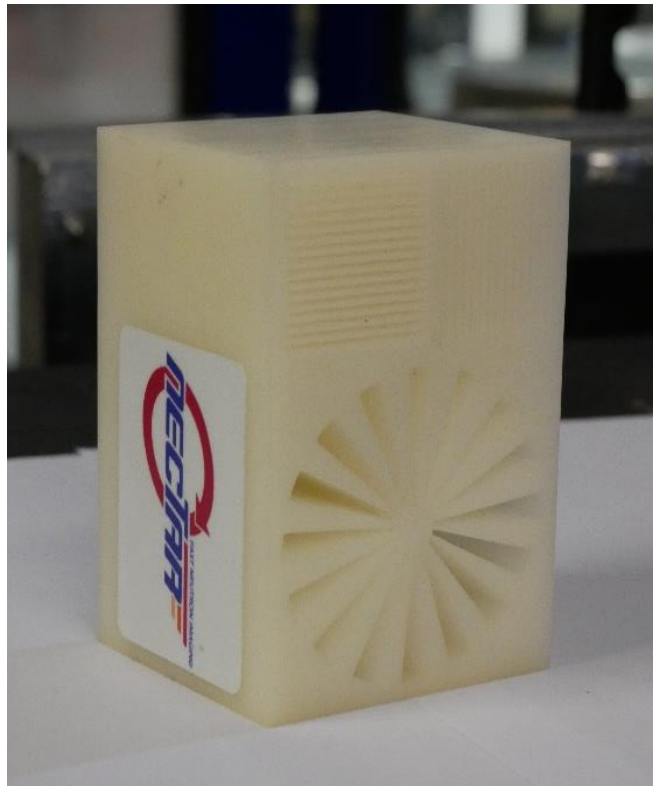
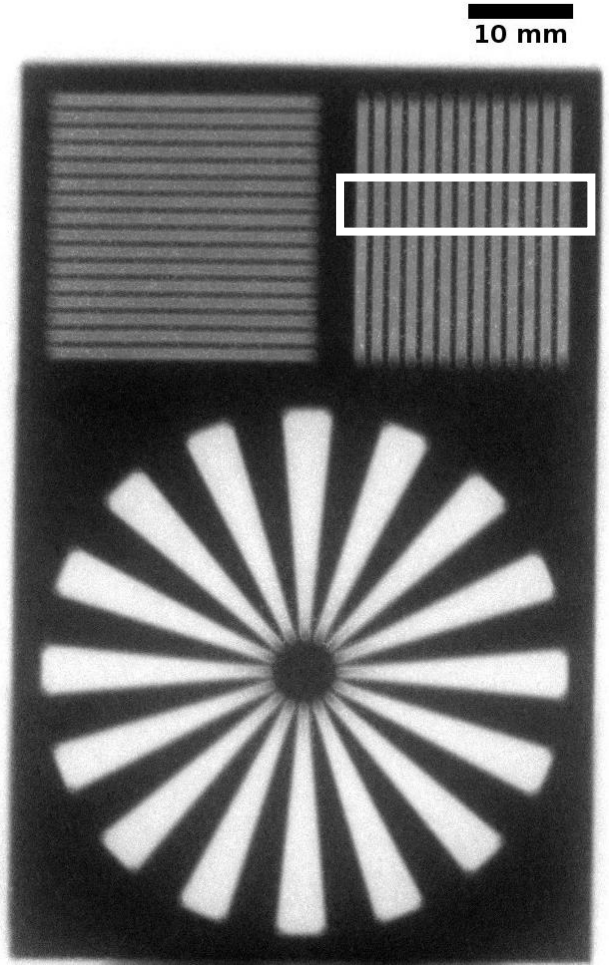
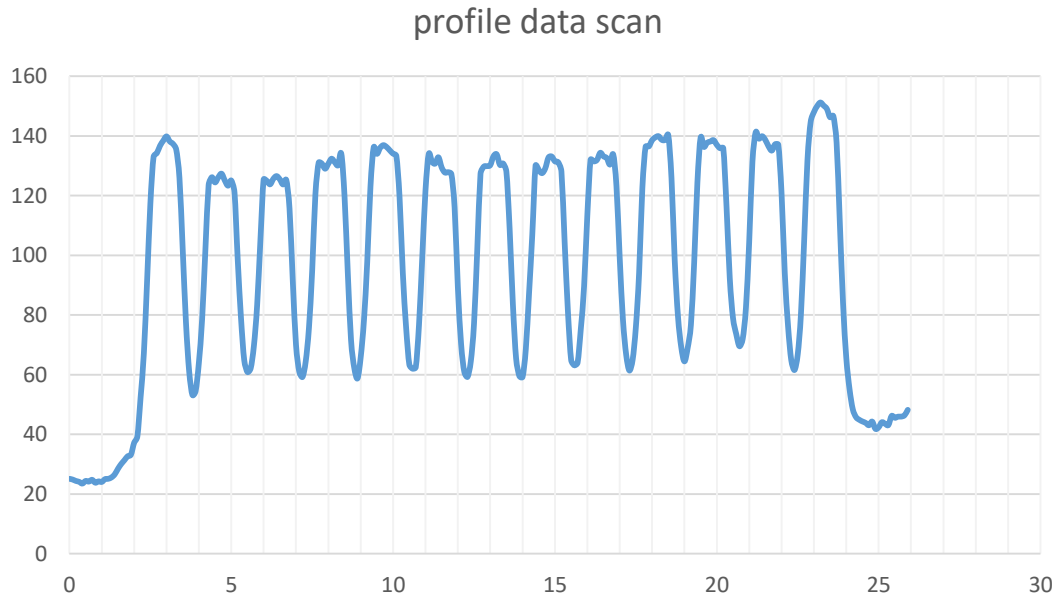
Radiography of a plastic quader







Plastik quader with dimensions 85mm*55mm*50mm, containing structures of lammella with 1 mm distance and Siemens Star

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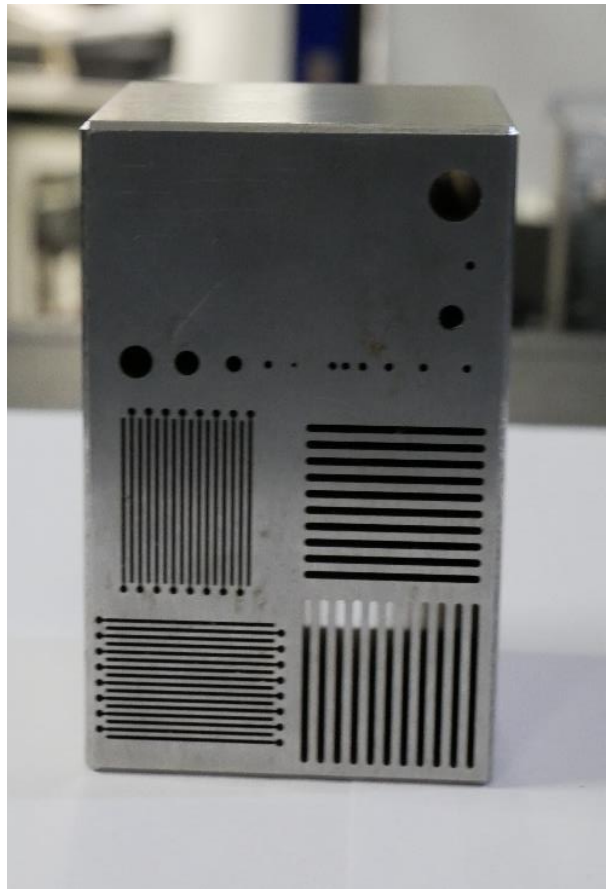
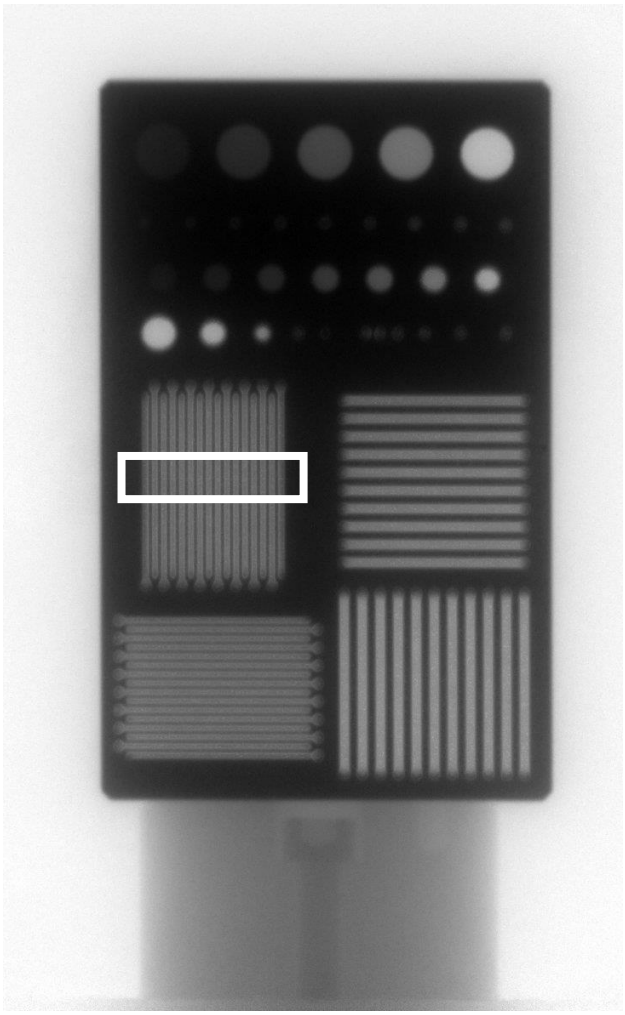
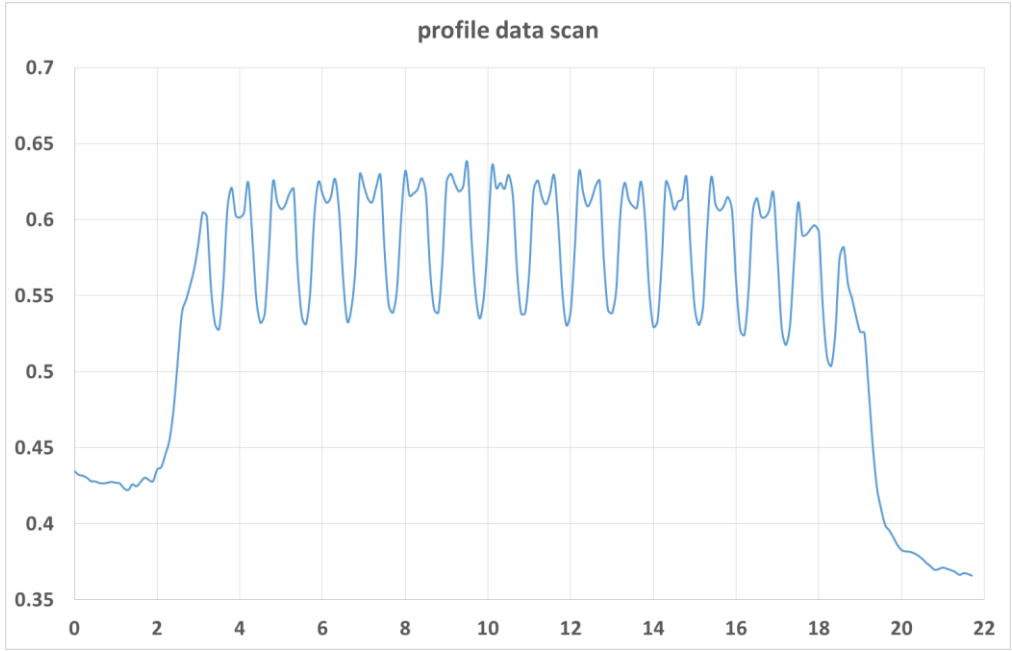
Radiography of an Fe quader



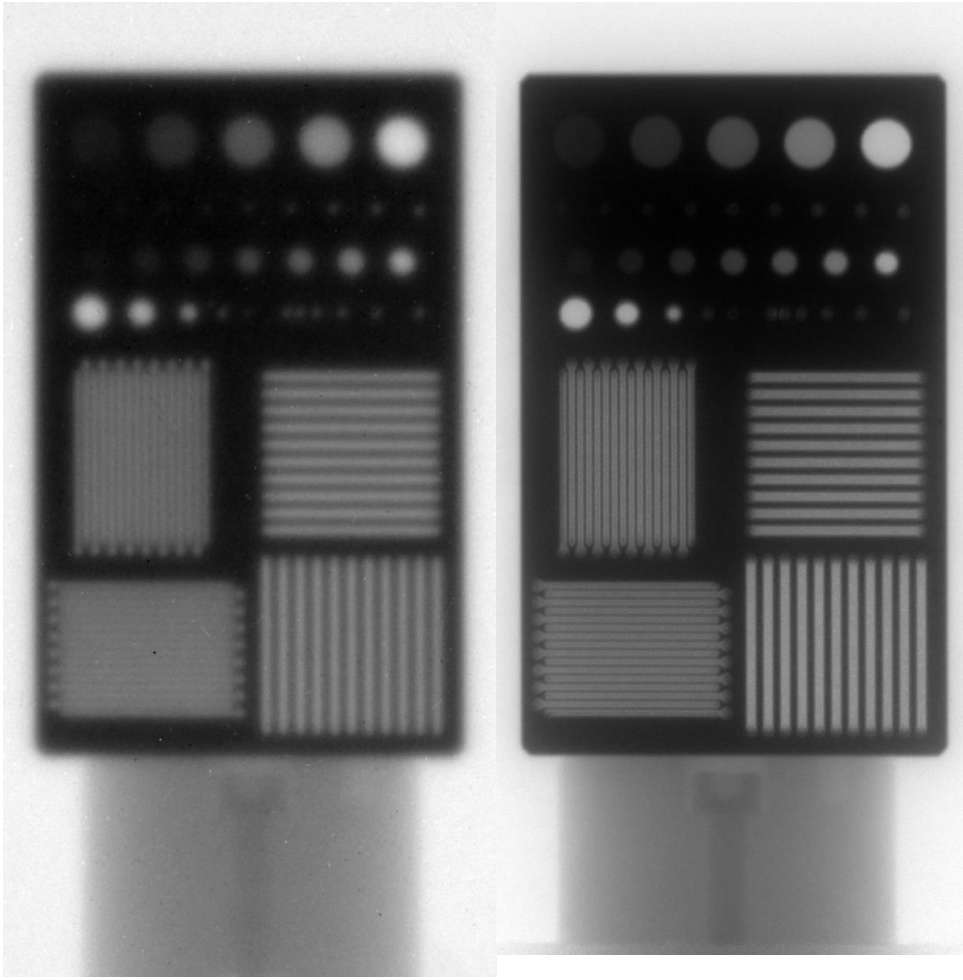




Fe quader with dimensions 85mm*55mm*50mm, containing structures of lammella with 0.5 mm distance, holes of different size and depths

Comparison to the «standard Szintillator»

Standard PP/ZnS:Cu based scintillation screen (2.4 mm).



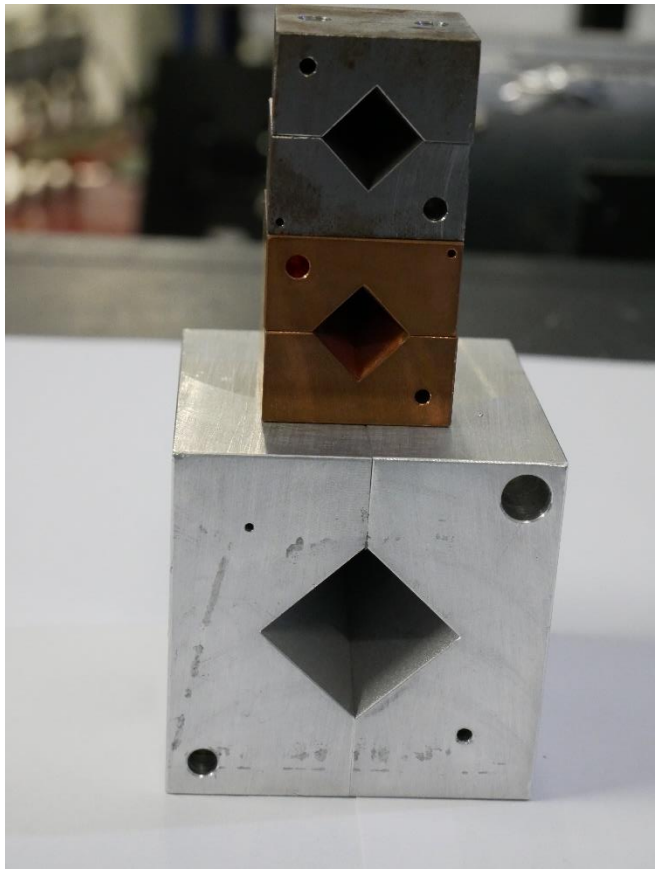
New PE/ZnS:Ag based scintillation screen.

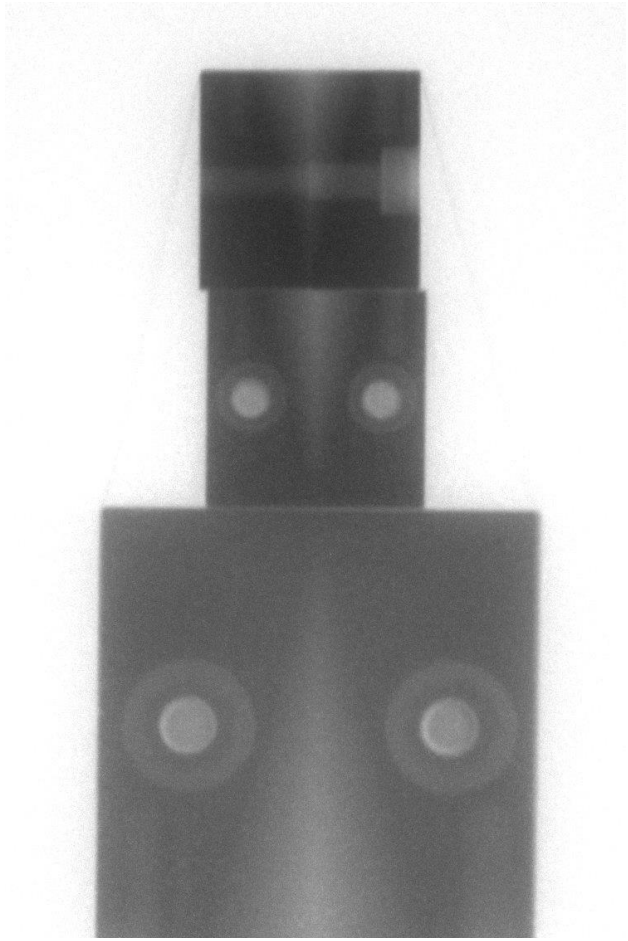
Significantly improved spatial resolution (~200 mu),

but half to 1/4th of light output, dependent to required resolution.

Tomography of metal cubes

Cubes of Al, Fe, Cu with pyramidal cutout (4 x 4 or 8 x 8 cm3)





Tomography of different metal parts have been tested and work fine.

Due to round edges the resolution seems to be lowered.