Performance Study of an Amorphous-Silicon Flat Panel Detector for Fast Neutron Imaging of Nuclear Waste

April 2015 | Manuel Schumann[1], R. Engels[2], G. Kemmerling[2], E. Mauerhofer[1], M. Willenbockel[2]

[1]Institute of Energy and Climate Research – Nuclear Waste Management and Reactor Safety, Forschungszentrum Jülich GmbH
[2]Central Institute for Engineering – Electronics and Analytics, Forschungszentrum Jülich GmbH

Introduction

Motivation

- Historical waste (mixed waste) is still a challenging issue
- Heterogeneous, massive and dense structural components
- ➢ Need detailed information from radiography to improve non-destructive radiological and chemo-toxic characterisation
- ➢ Neutron radiography is complementary to X-Ray radiography

Challenges

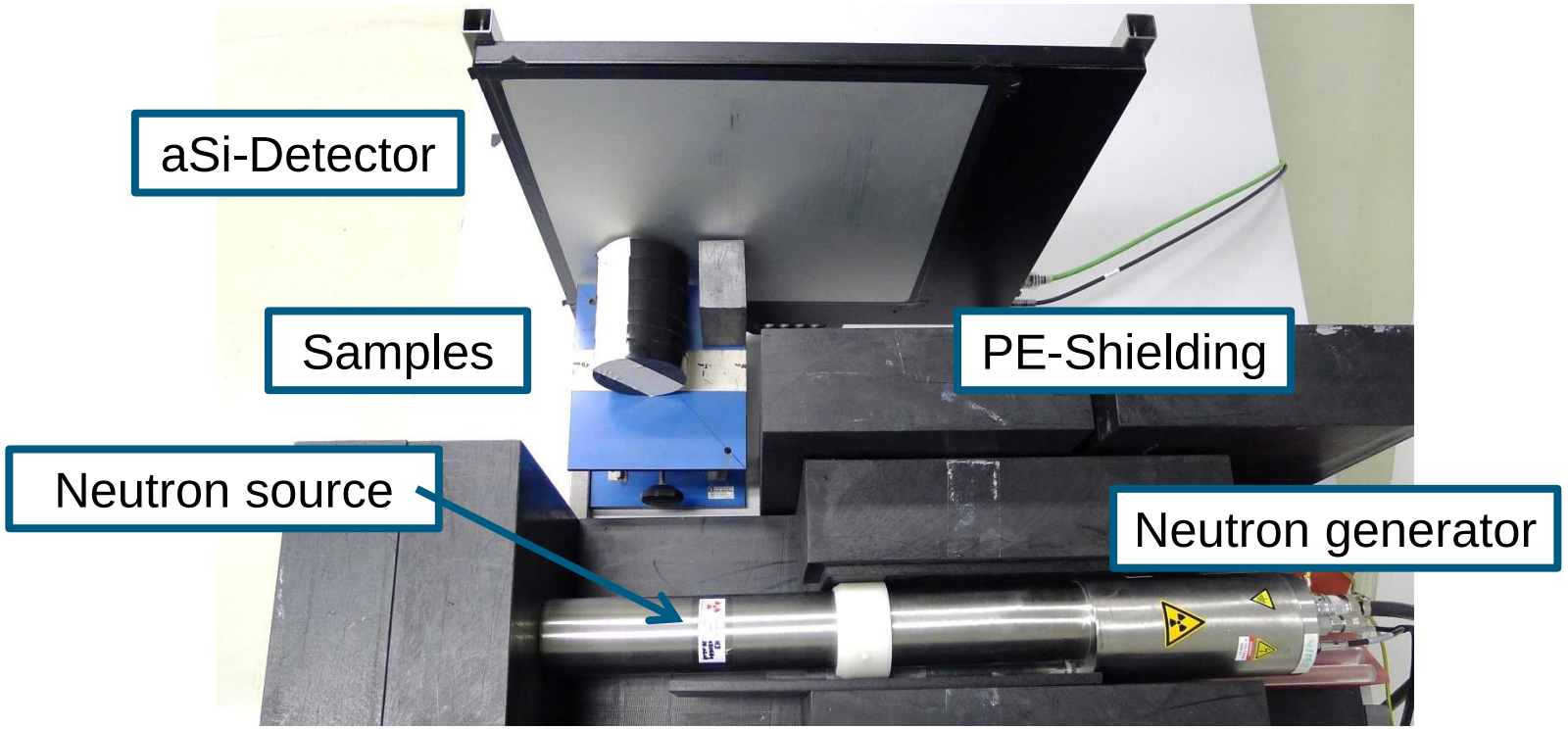
Build a compact fast neutron radiography system
Focused on detector development

State of the art for neutron imaging is:

- CCD camera
  - Camera is neutron sensitive
  - ➢ Needs a mirror (huge setup)

Setup

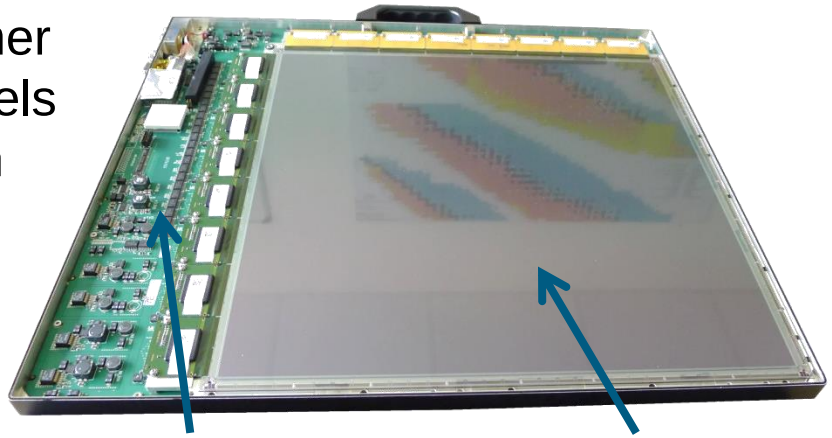
- Commercial neutron generator from Sodern (GENIE16GT)
- D-T reaction for 14 MeV neutron production
- $1.56 \cdot 10^8$ n/s (4π)
- aSi-Detector with plastic scintillator



Detector Design

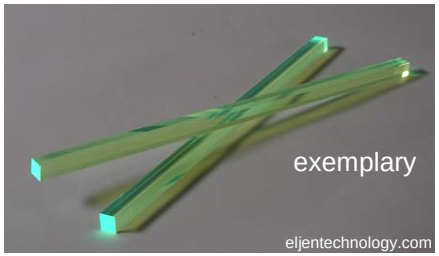
aSi Flat Panel detector

- Commercial X-Ray detector, PerkinElmer
- 40x40 cm^2 active area, 1024x1024 pixels
- Thickness of the scintillator: max. 3 mm
- Max. absorption: 400-700 nm



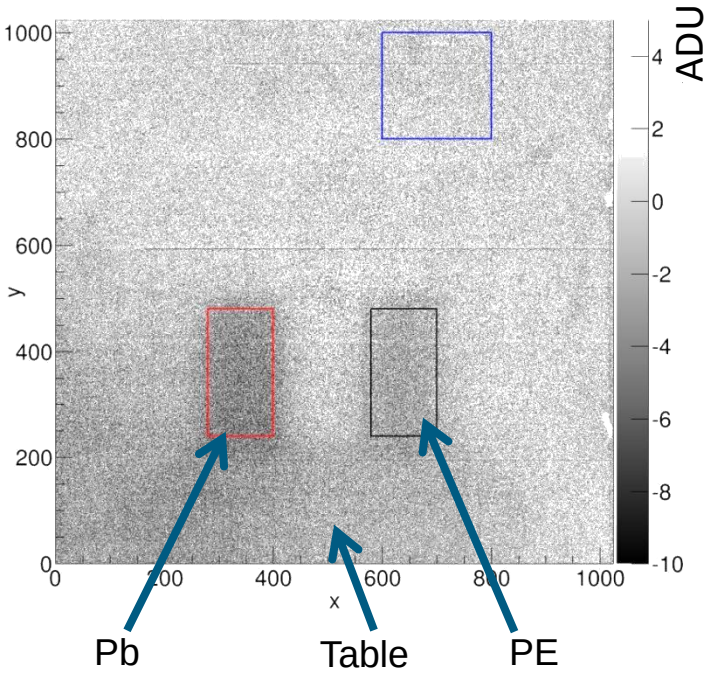
Scintillator

- EJ-260 by Eljen Technology
- Thickness 3 mm
- General purpose scintillator
- $5.2 \cdot 10^{22}$ H atoms per cm^3
- Max. emission at 490 nm

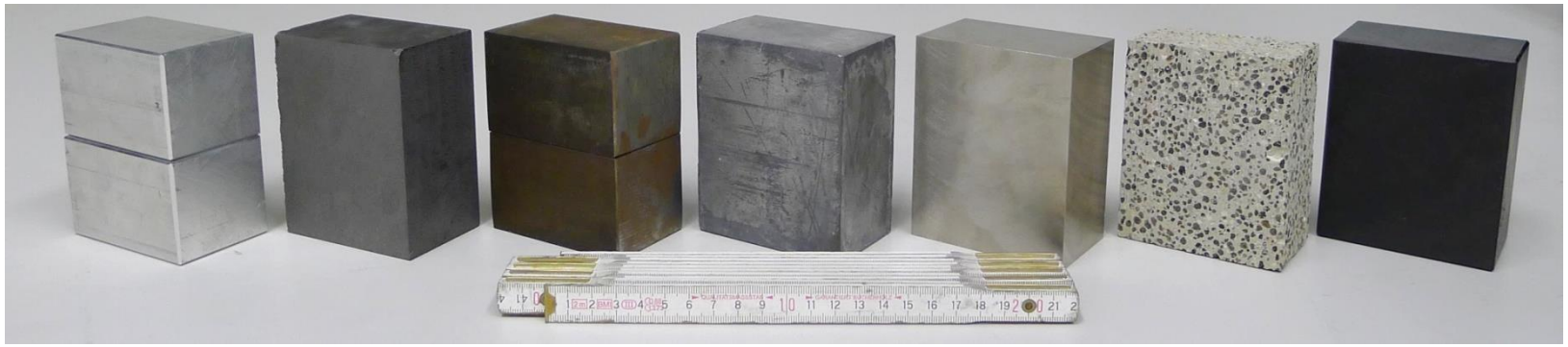


Reference Measurements

- Radiography with test samples:
  - Size: 5x8x10cm³
  - Al, C, Fe, Pb, W, concrete, PE
- PE as reference
- Combination of two samples

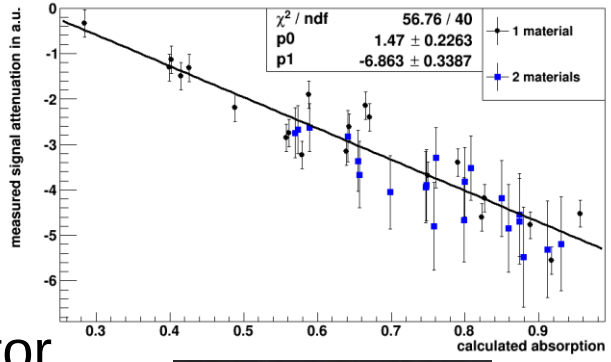


Al C Fe Pb W concrete PE

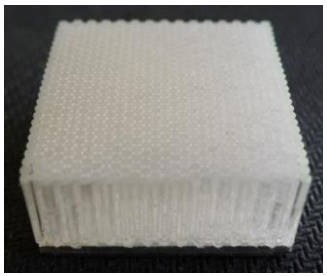


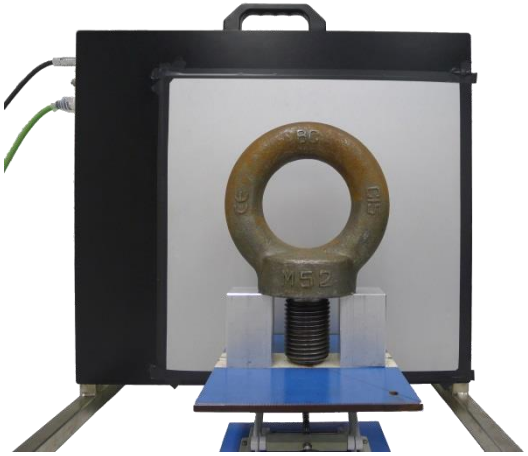
Summary

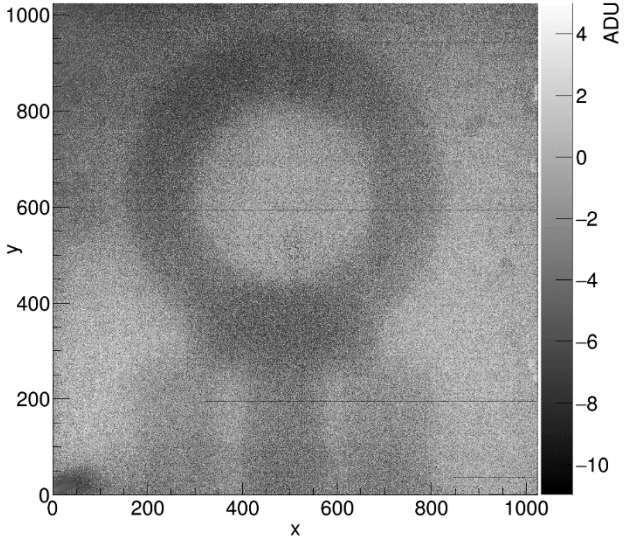
- First radiography with test samples successful, despite low detector efficiency and neutron intensity
- Discrimination between light and heavy objects
- Correlation between detector signal and absorption properties



- New scintillator

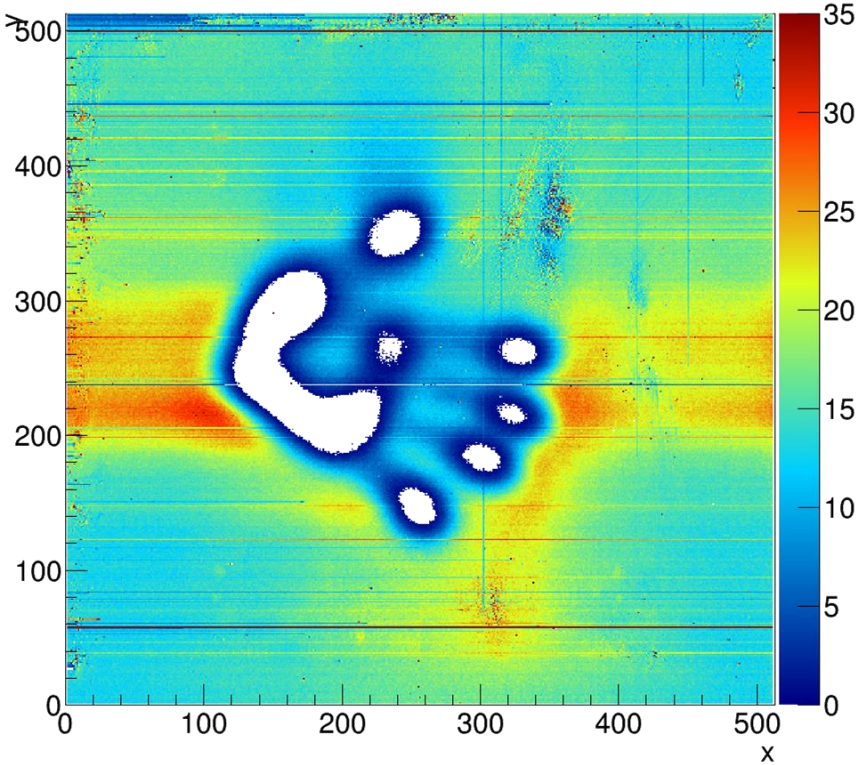






Eyebolt M52

Thank you for your attention!



See you in front of poster #115!