

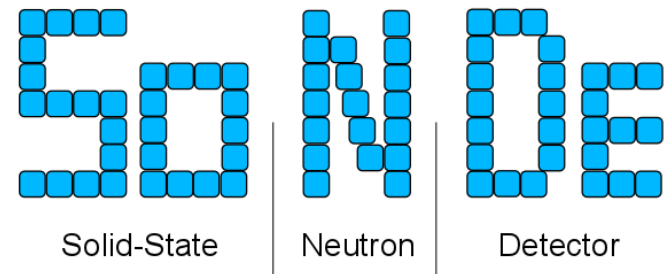
Solid-state Neutron DEtector

SoNDe Progress Report

26. November 2015 | Sebastian Jaksch

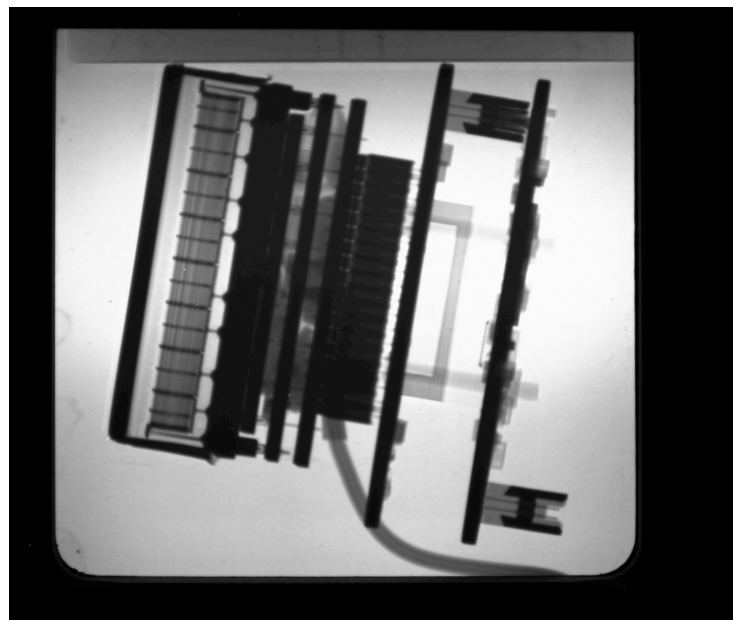
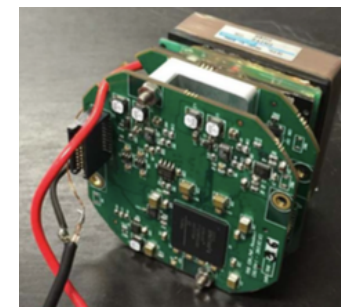
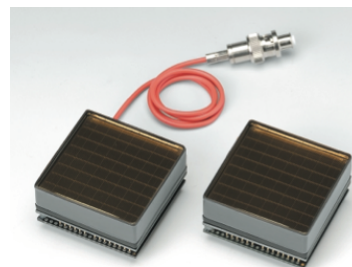
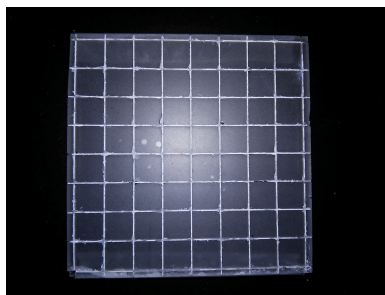
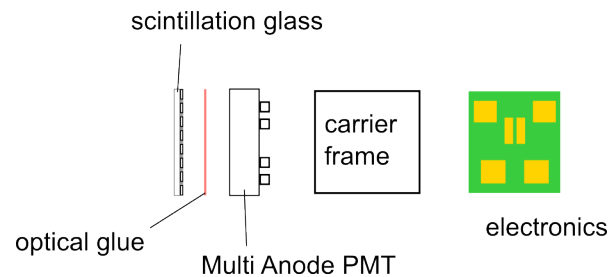
Develop a large area PSD neutron detector with:

- high-flux capability (gain factor of 20 over current detectors)
- high-resolution of at least 3 mm by single-pixel technique
- efficiency of 80 % or more
- no beam stop necessary
- strategic independence of ^3He
- time-of-flight (TOF) capability, time resolution in the μs regime
- modularity



- Started in May 2015
- Consortium of FZJ, LLB, U Lund and ESS
- First tests in October
- All deliverables achieved

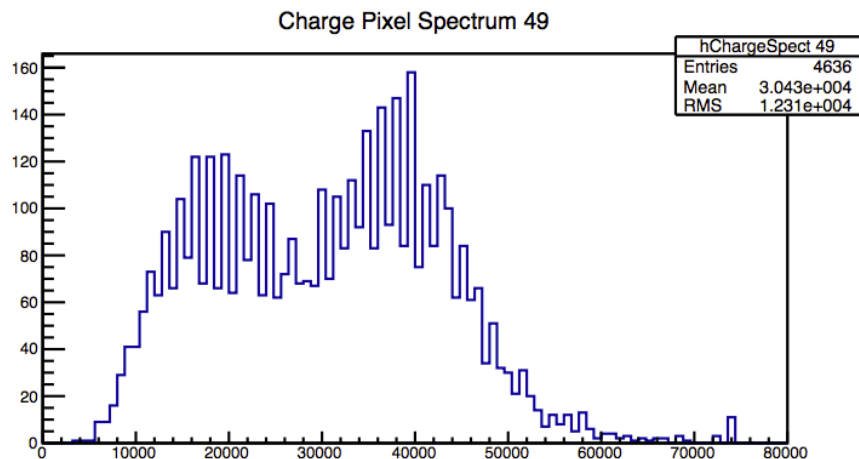
The current setup



- Scintillator / H8500 / ROSMAP module sandwich
- 8 Bit resolution
- Modbus connection over USB
- Dynode triggered
- Spectroscopic/counting mode
- PCB slightly larger than MaPMT

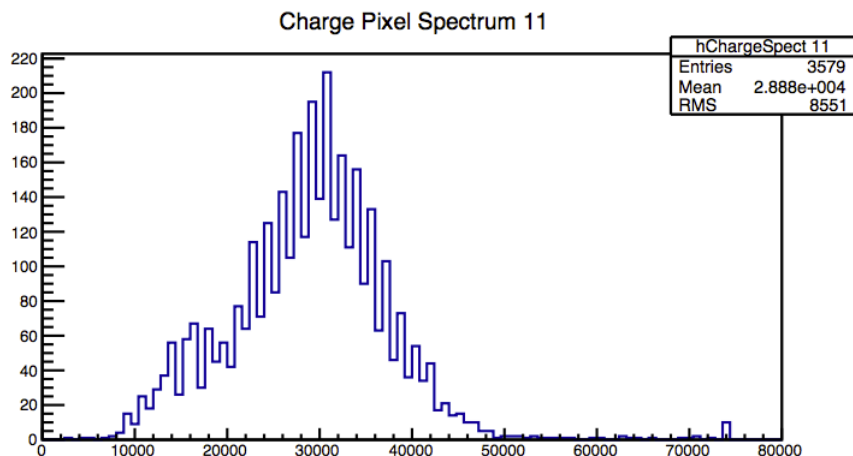
February 15, 2016

The Charge / Pulseheight Spectrum



Results:

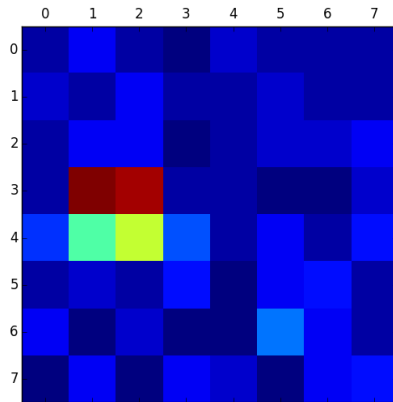
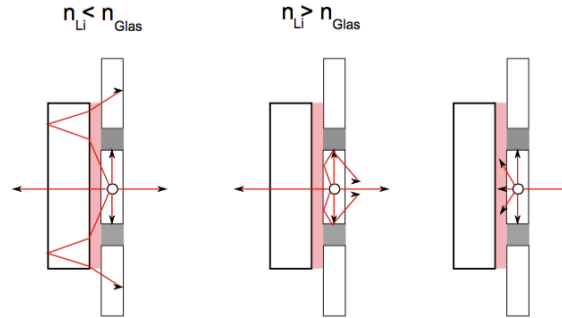
- Gammas/Neutrons distinguishable
- Non-uniform pixel sensitivity



TODO:

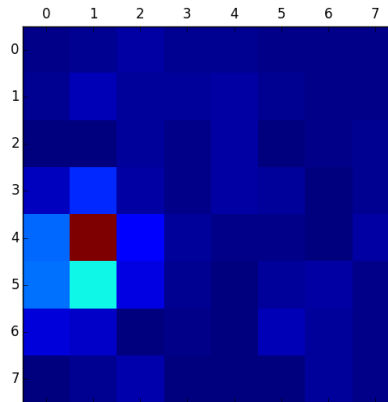
- At the moment working with a 10:1 charge splitter
- Up to 20 pC are possible, range is not fully used
- set chargesplitter to 4:1

Resolution and Crosstalk



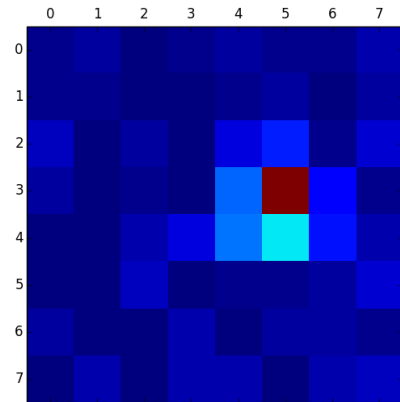
no grooving:
30.6 % Crosstalk

Average crosstalk:
20.0 %



grooving:
16.1 % Crosstalk

Average crosstalk:
18.1 %



filled grooves:
16.7 % Crosstalk

Average crosstalk:
14.4 %

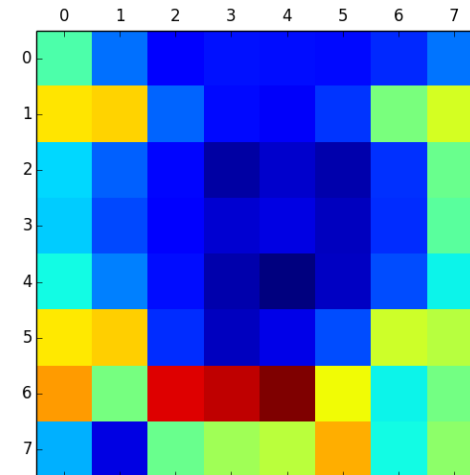
Resolution and Crosstalk



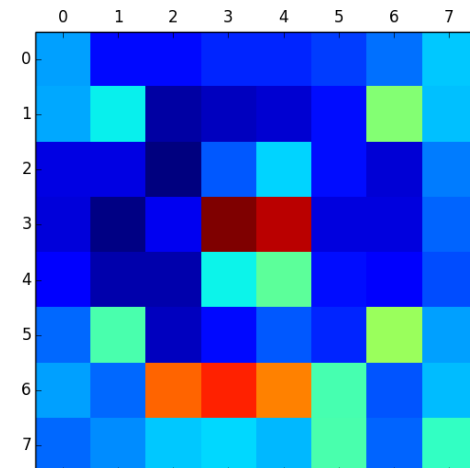
41,000 counts integrated

→ Approx. 1 μ s ESS beam

as measured

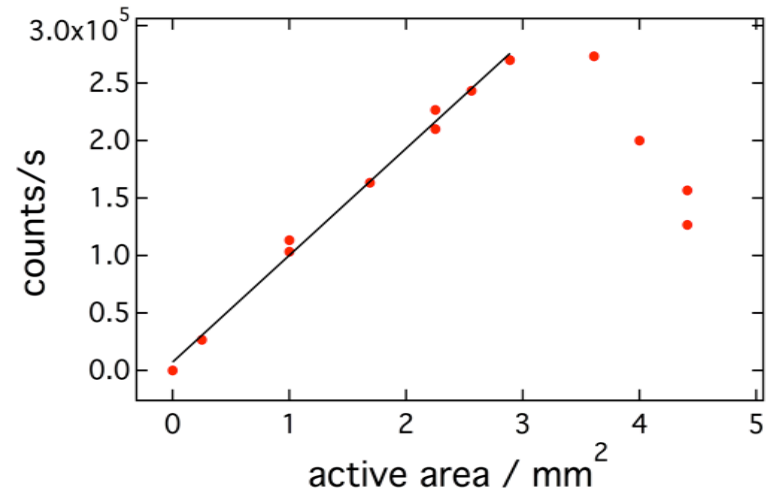


corrected sensitivity



Flux, Flux, Flux

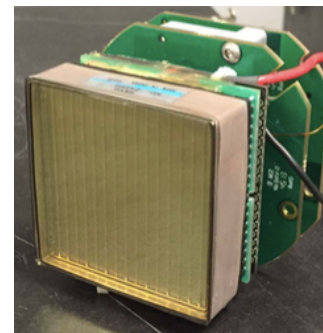
- Linear well up to 250 kHz on 5x5 cm² module (6x6 pixels)
 - Single pixel linearity up to 125 kHz
- 100 MHz on full 1x1 m²
→ at 20% dead time 20 MHz counting
→ May still be improved, single pixels are better



5.4E13/day for 10 days:
→ 5E14 neutrons integrated flux

→ 10 years ESS operation

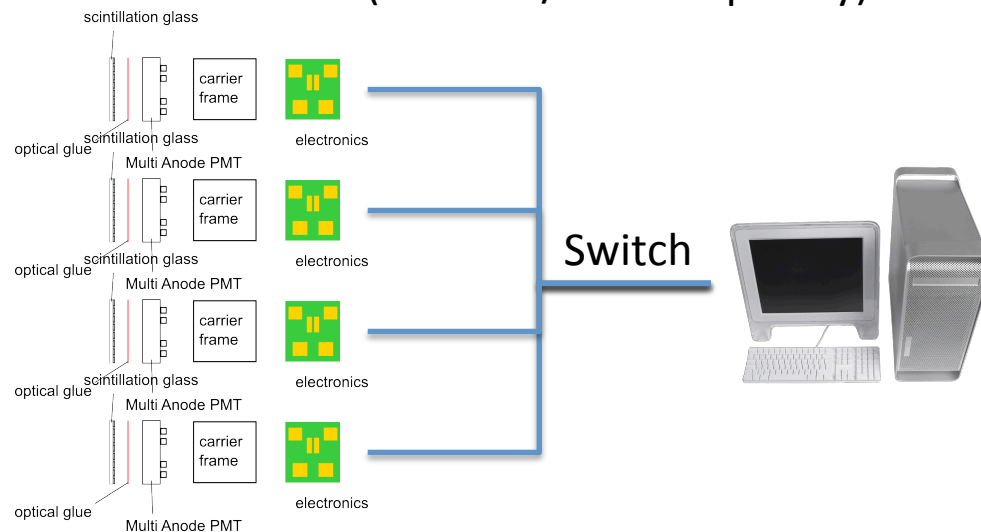
Module is still
working, no
degradation found



- Build a 2x2 demonstrator
- Learn about the interaction between several module
- After this has been achieved, upscaling to 1x1 m² can commence

Current feature set

- Countrate capability of 50 kHz @ 10% deadtime per module (only for neutrons)
- Synchronization with ESS timing signal
- Power consumption below 1.25 W per Module
- Simple connection via Ethernet (low cost/low complexity)



Thanks to ...

Experimental Team

- Günter Kemmerling, JCNS
- Sylvain Désert, LLB
- Hanno Perrey, U Lund
- Petter Oya, IDEAS



SoNDe Team

- Henrich Frielinghaus, JCNS
 - Kalliopi Kanaki, ESS
 - Richard Hall-Wilton, ESS
 - Kevin Fissum, U Lund
 - Codin Gheorge, IDEAS
-
- **JCNS technical team**



This project is funded by the Horizon 2020 Framework Programme of the European Union. Project number 654124.

... and you, for your kind attention!