PEARL: the new neutron powder diffractometer

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Reactor Institute Delft

Figure 1: 2MW light water reactor for positrons, neutron scattering, activation analysis and isotope production research. A cold source for the experimental hall will be installed in 2018, feeding SANS, SESANS, TOF-reflectometer.

24 Sept 2015: PEARL opening workshop

Workshop Program

PEARL

The new neutron powder diffractometer at the TU Delft

09:30 hr	Registration and coffee
10:00 hr	Opening (Rector Magnificus Karel Luyben, TU Delft)
10:10 hr	Hugo Rietveld in 1971 – The Rebirth of Powder Diffraction and the Development of New Techniques (Alan Hewat, ILL/NeutronOptics)
10:40 hr	PEARL (Lambert van Eijck, TU Delft)
11:10 hr	Coffee break and poster session
11:30 hr	Probing spin, charge and orbital ordering with neutrons (Graeme Blake, RU Groningen)
12:00 hr	Neutron studies in Li battery materials (Marnix Wagemaker, TU Delft)
12:30 hr	Lunch and poster session
14:00 hr	Hydrogen and ammonia storage materials (Bill David, STFC/Uni.Oxford UK)
14:30 hr	Magnetic order in magneto-caloric Fe2P-based compounds (Luana Caron, MPG Dresden)
15:00 hr	Coffee and poster session
15:20 hr	X-rays and neutrons for better zeolite materials (Maarten Goesten, TU/e)
15:50 hr	How to set up a user community (Max Avdeev, ANSTO-Sydney)
16:20 hr	Outlook to the future use of PEARL
17:00 hr	Drinks and snacks

painting: The Girl with the Pearl Earring, by J. Vermeer, Delft (1666)

PEARL

Registration:
http://pearl.tudelft.nl/workshop
deadline 10 september 2015

Lambert van Eijck, Katia Pappas, Ad van Well, Ilse van der Kraaij-Quick, Trudy d'Elia

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PEARL design concept

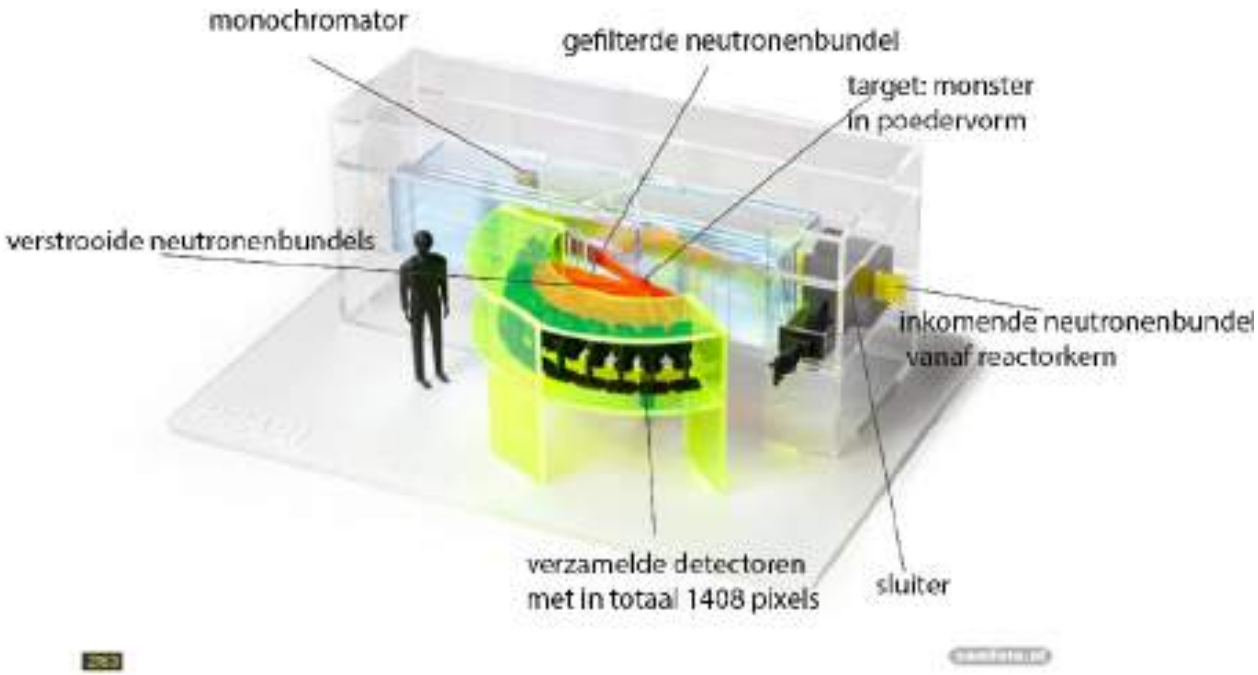


Figure 2: Using a Germanium single crystal monochromator, a specific wavelength of neutrons is selected from the reactor core, and sent to sample. The detector sits centered around the sample and collects the diffraction pattern from $11 < 2\Theta < 160$ deg.

PEARL design realisation

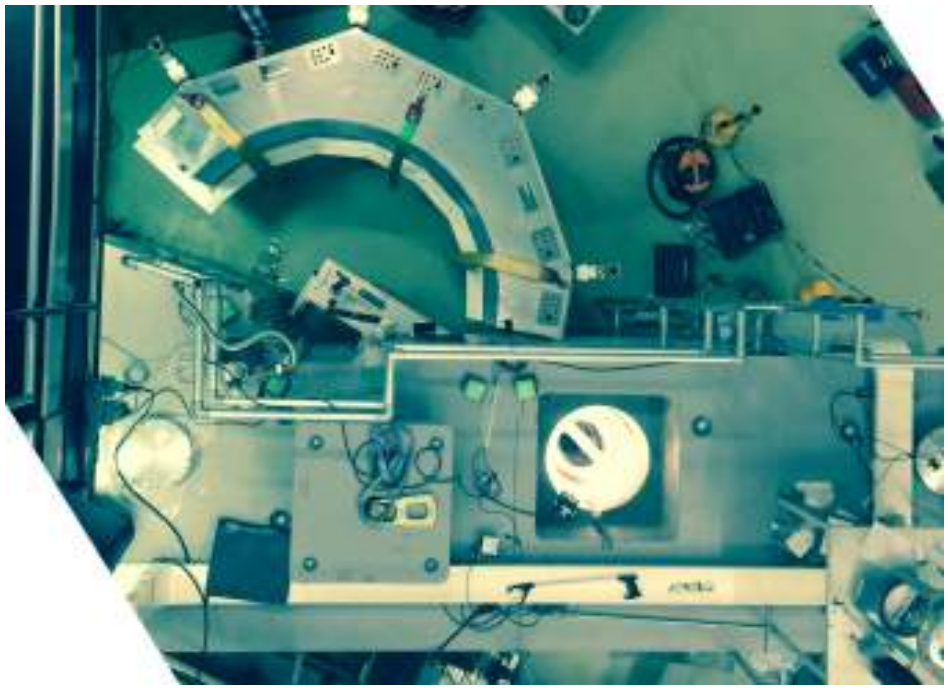


Figure 3: Compact instrument with 1 monochromator take-off angle $\Theta_M = 150\,\text{deg}$, Ge monochromator delivering 1.3, 1.7, 2.5Å. No collimators and detector covering 11-160deg.

scintillator detector for reactor-based diffractometer

Figure 4: STFC/RAL design wavelength-shifting fiber ^{6}LiFZnS detector consisting of 1408 pixels of 2.1mm wide, 200mm tall. Gamma/neutron discrimination better than 10^{-6} (**Sykora et al.** IEEE Nucl.Sci.Symp. (2012) p.1567)

The first results: 1 hour measurement "NAC standard"

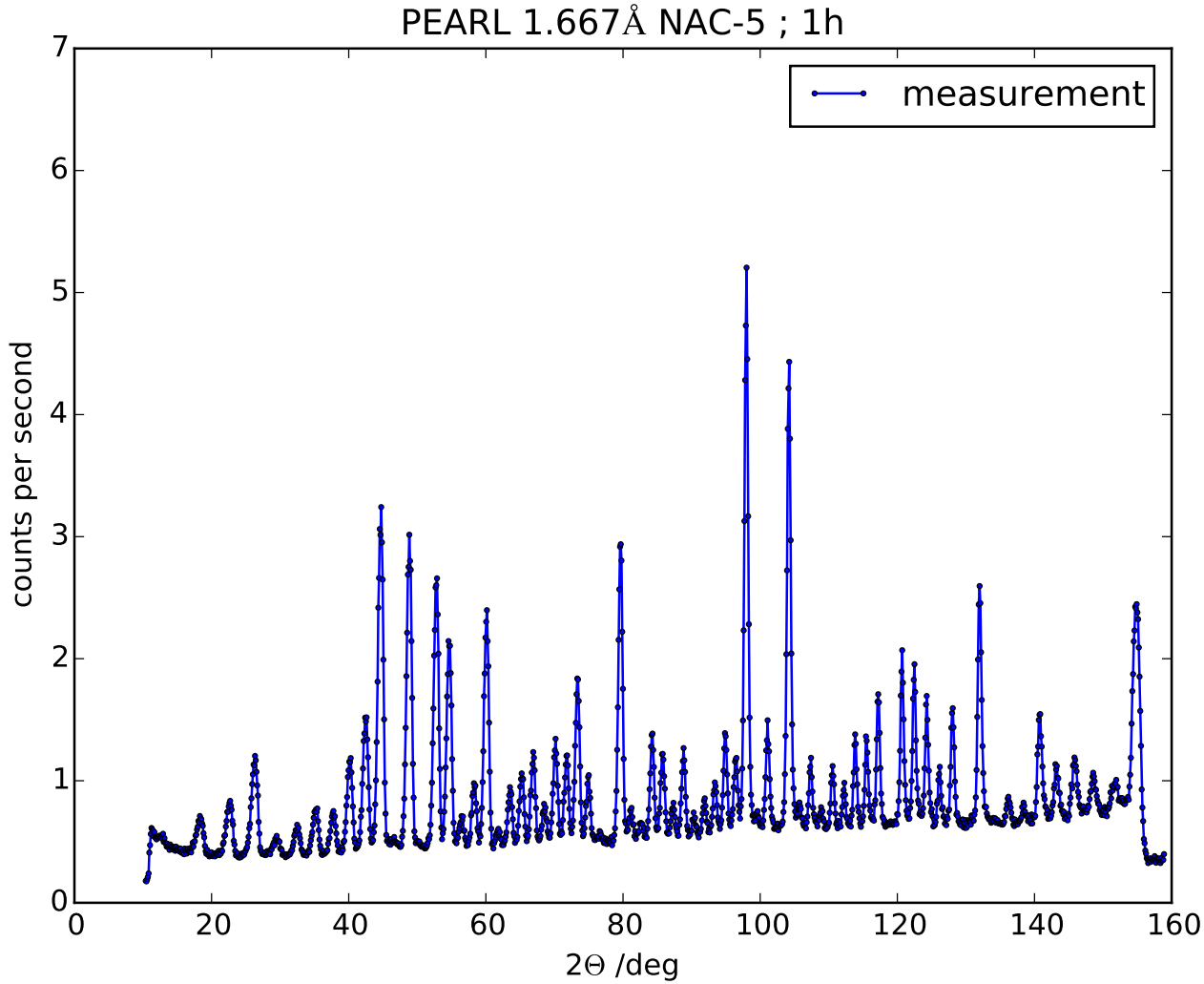
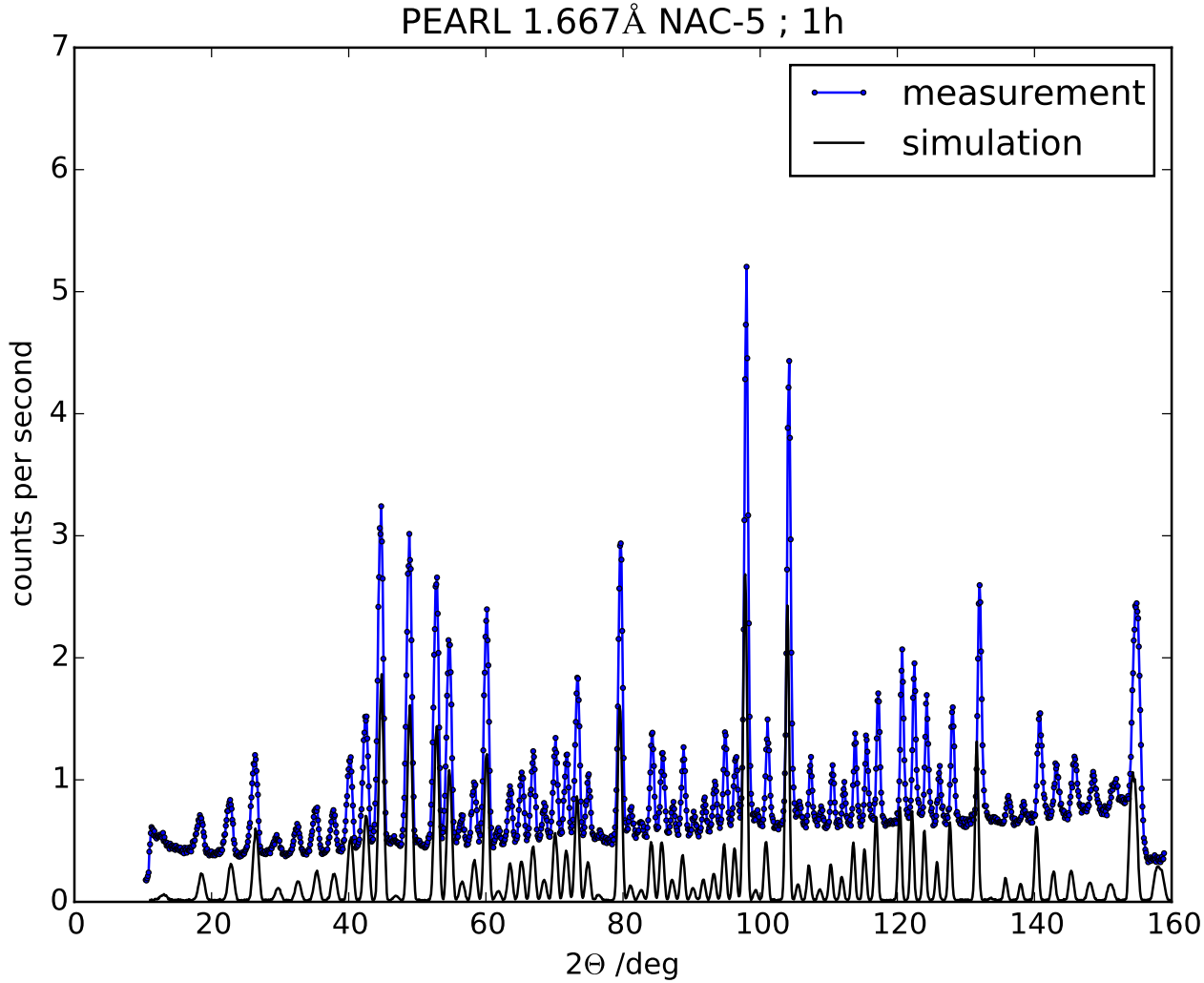
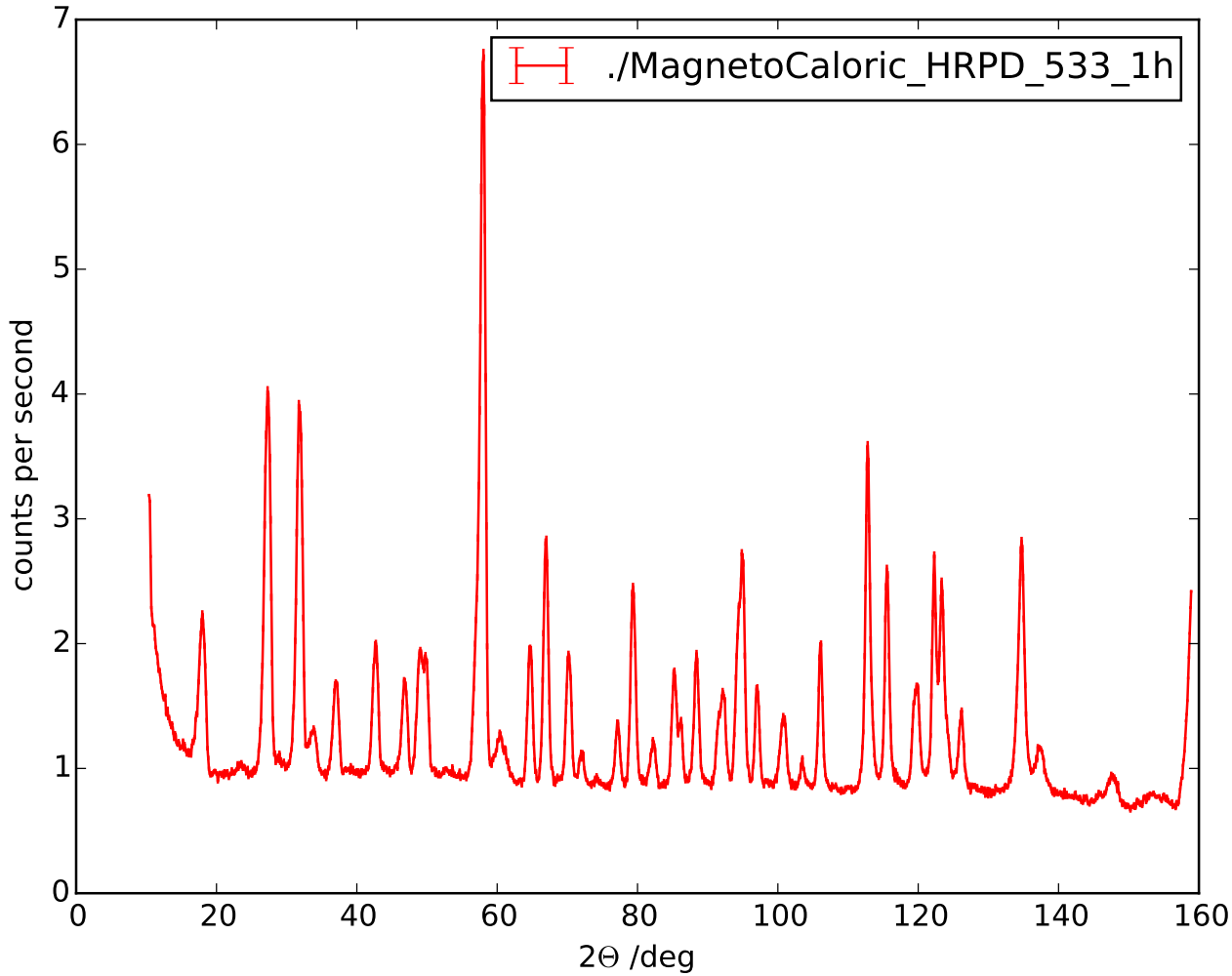


Figure 5: $Na_2Ca_3Al_2F_{14}$ powder at room temperature

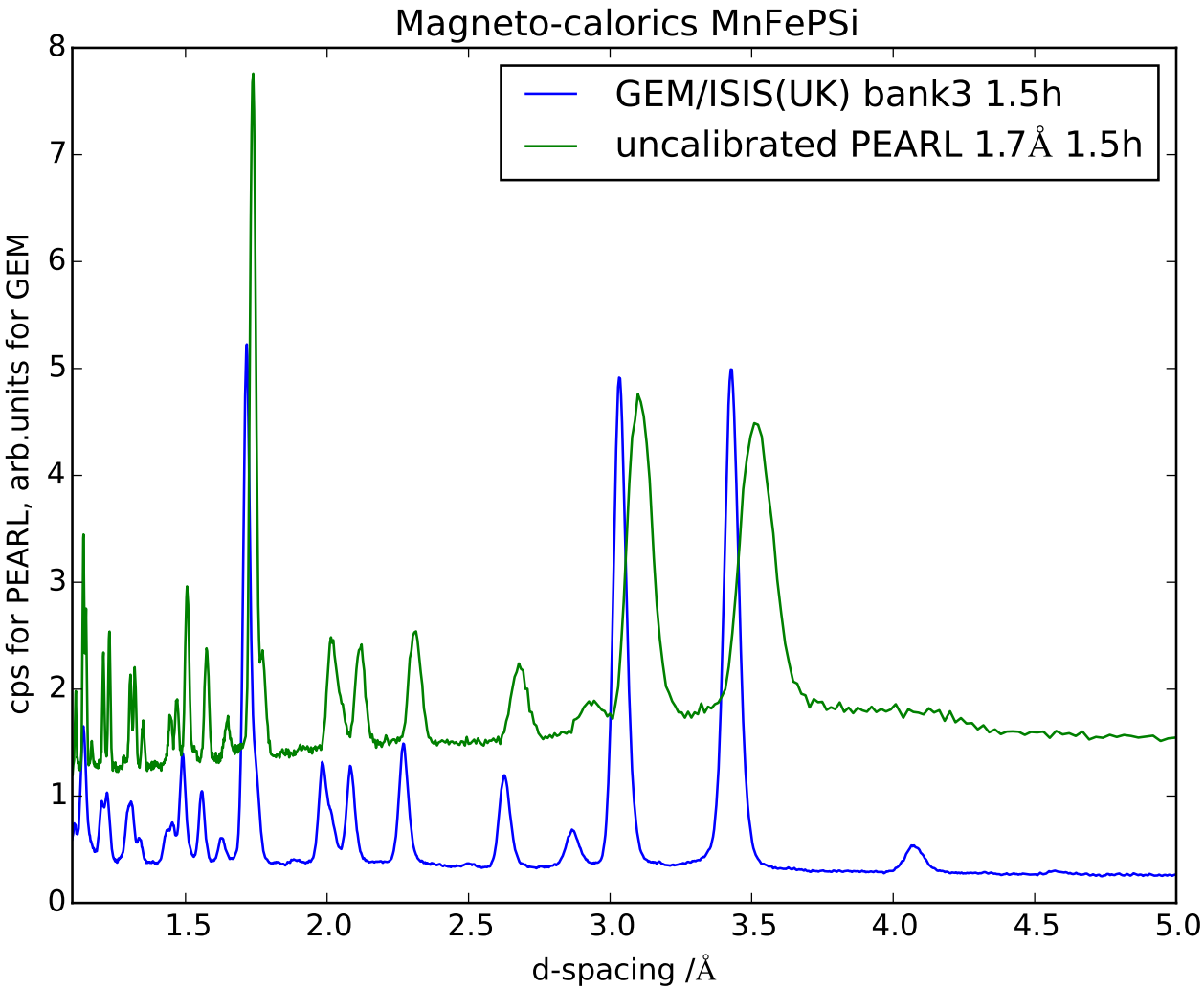
The first results: compared to the McStas simulation



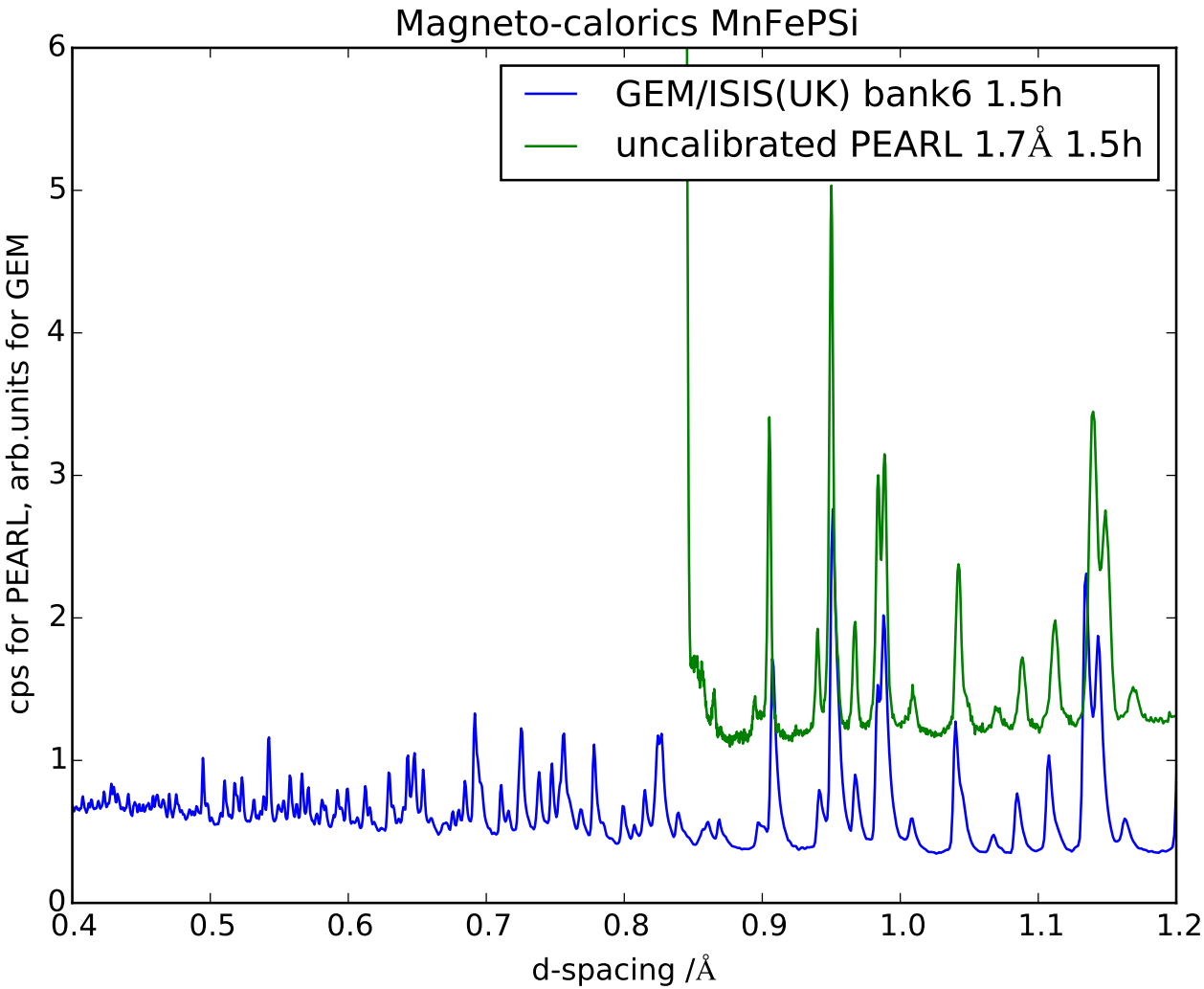
The first results: in-house materials



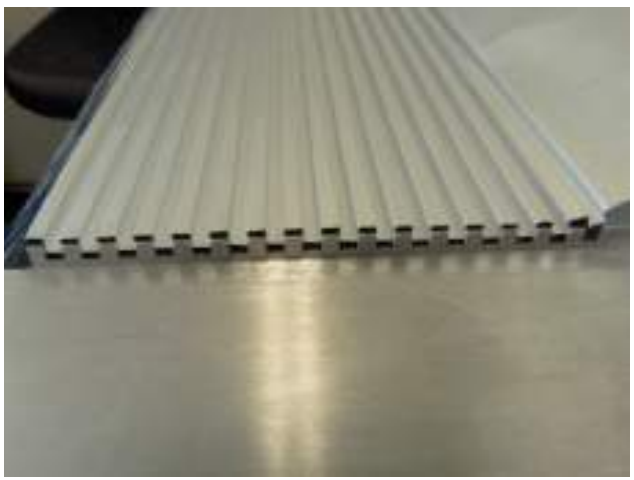
The first results: in-house materials



The first results: in-house materials



Production of the detector: template for 32pixel production

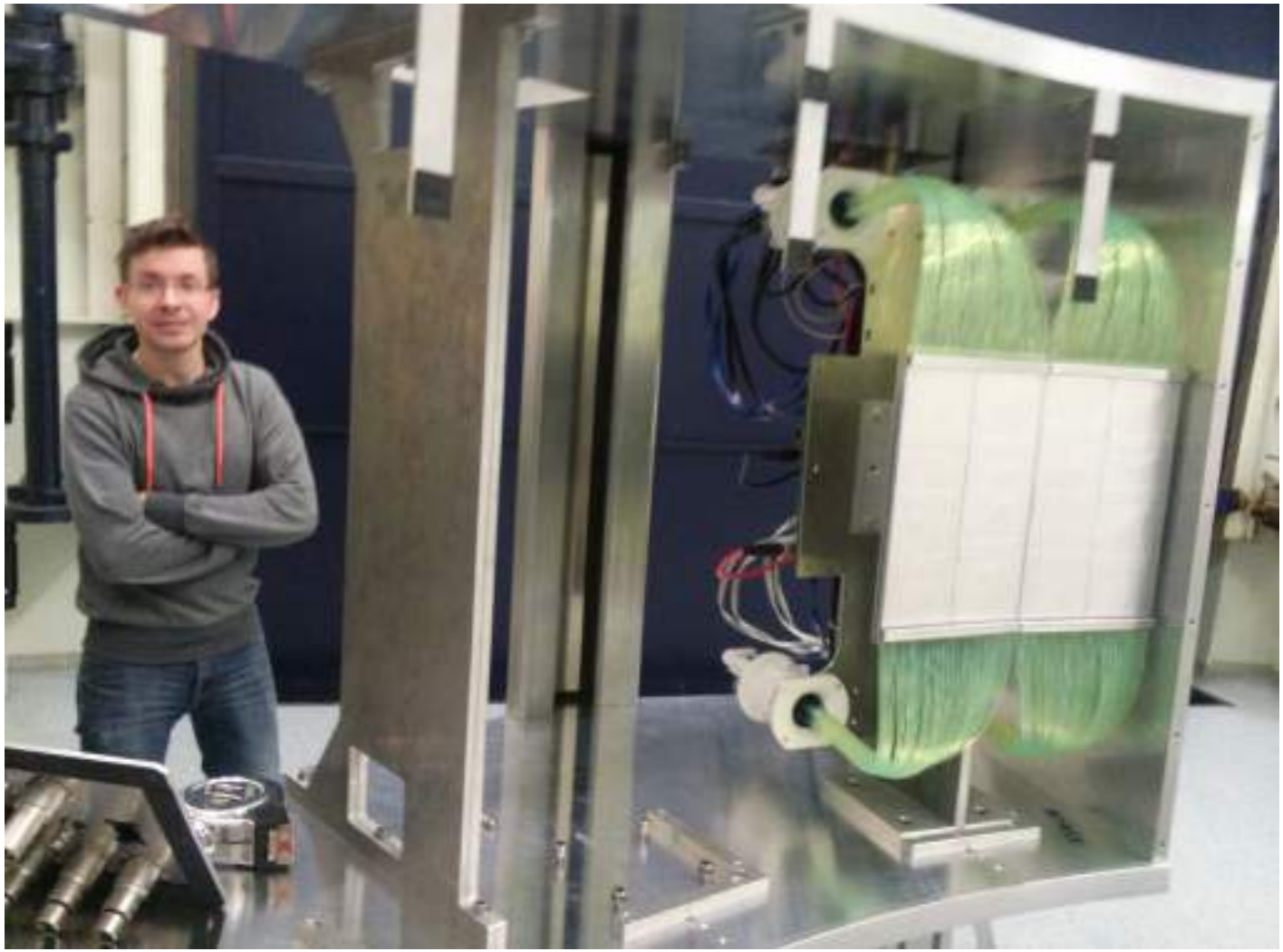


Production of the detector: 44 32pixel packages

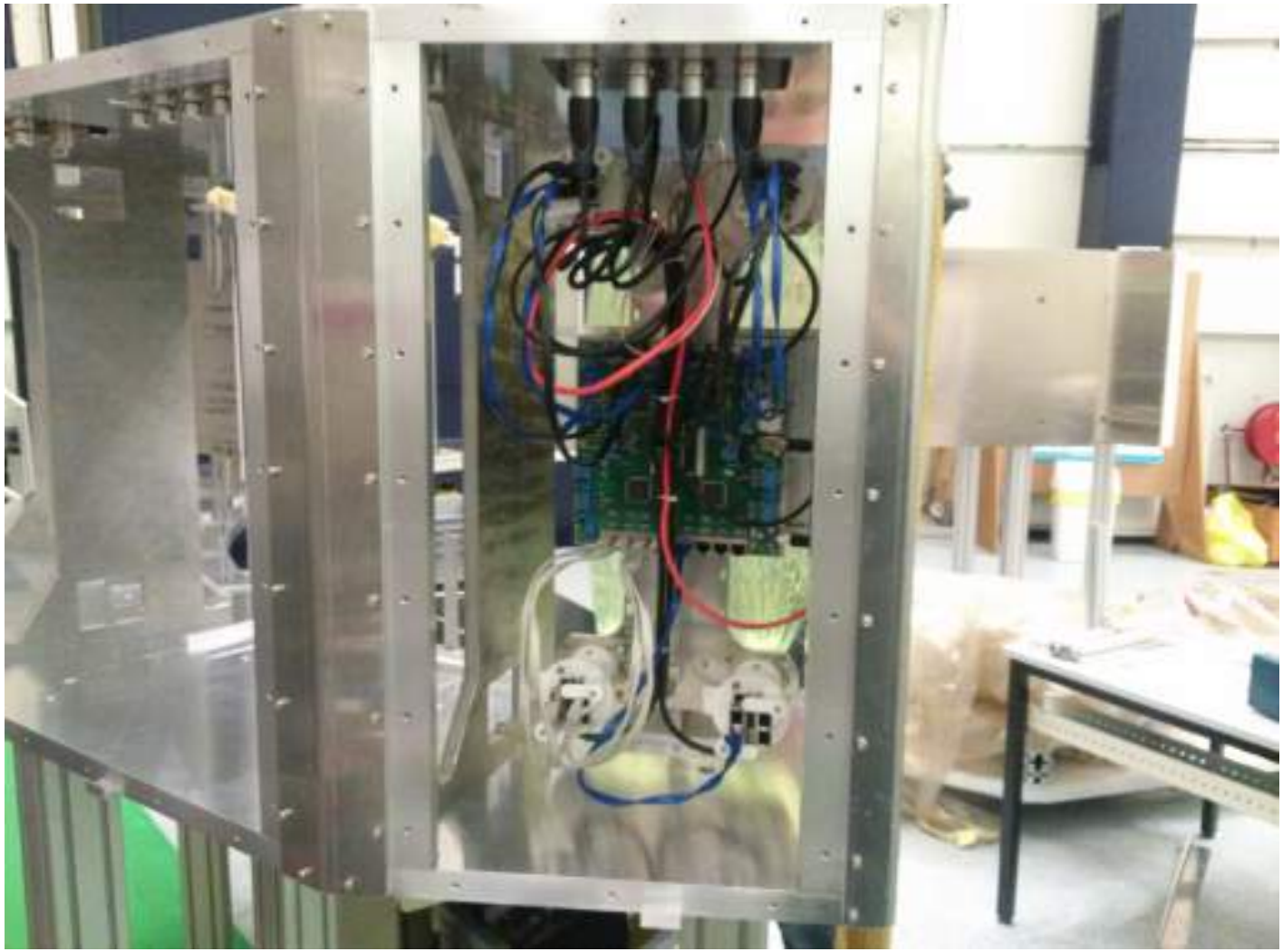
Production of the detector: 1 64pixel bank assembled

Production of the detector: 11 128pixel banks

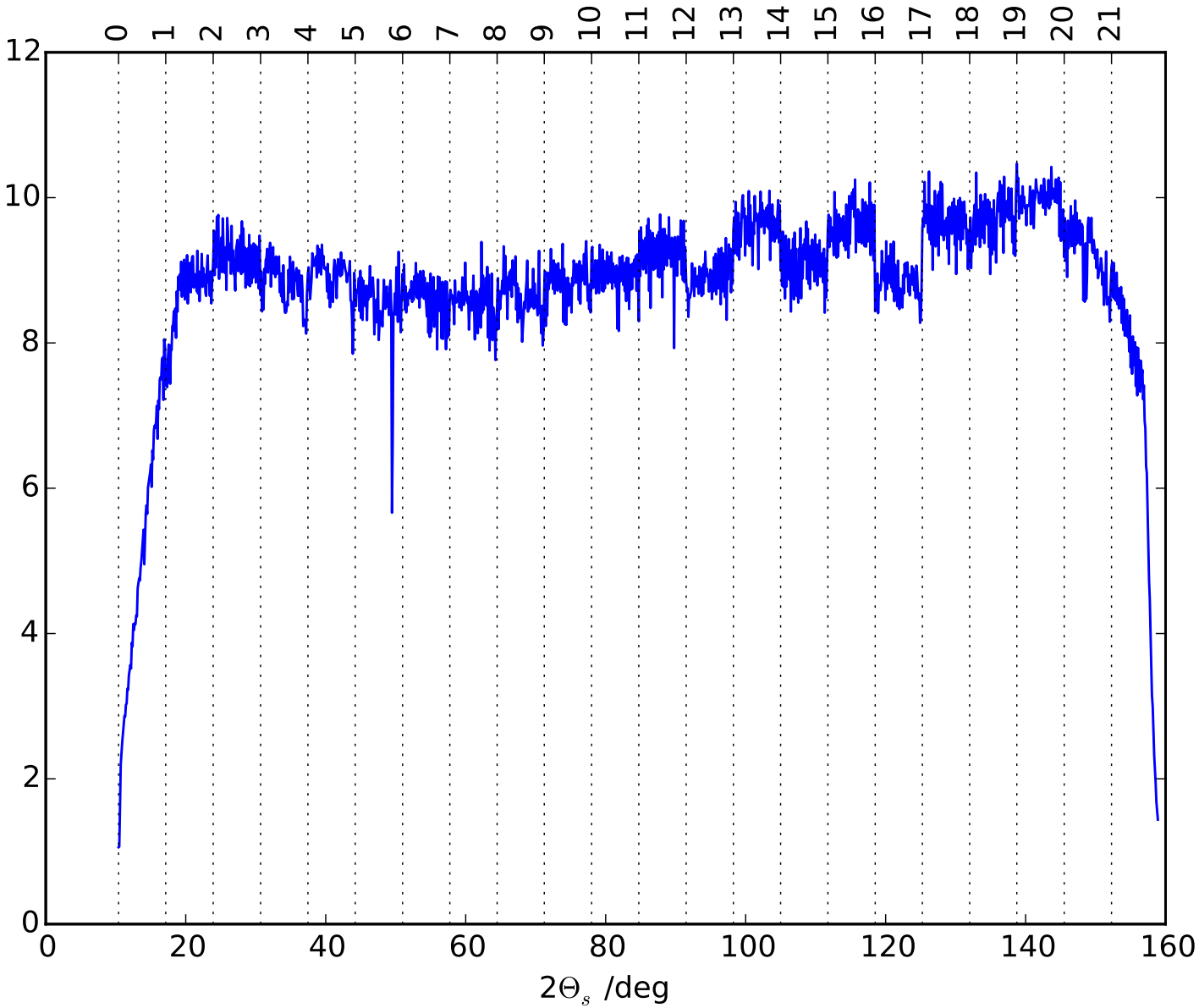
Production of the detector: 1 128pixel bank installed



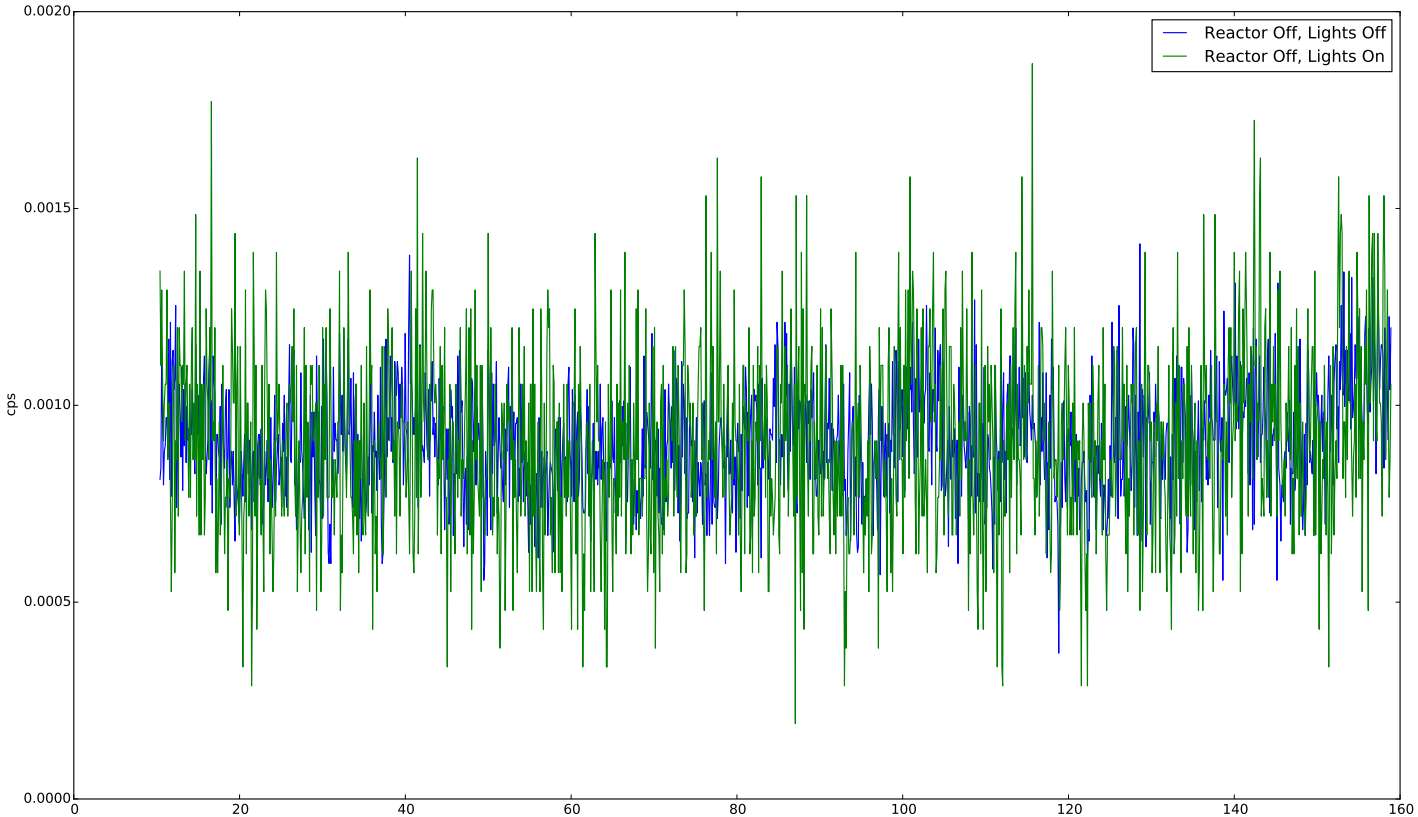
Production of the detector



Data: efficiency from PMMA



Data: electronic / cosmic background



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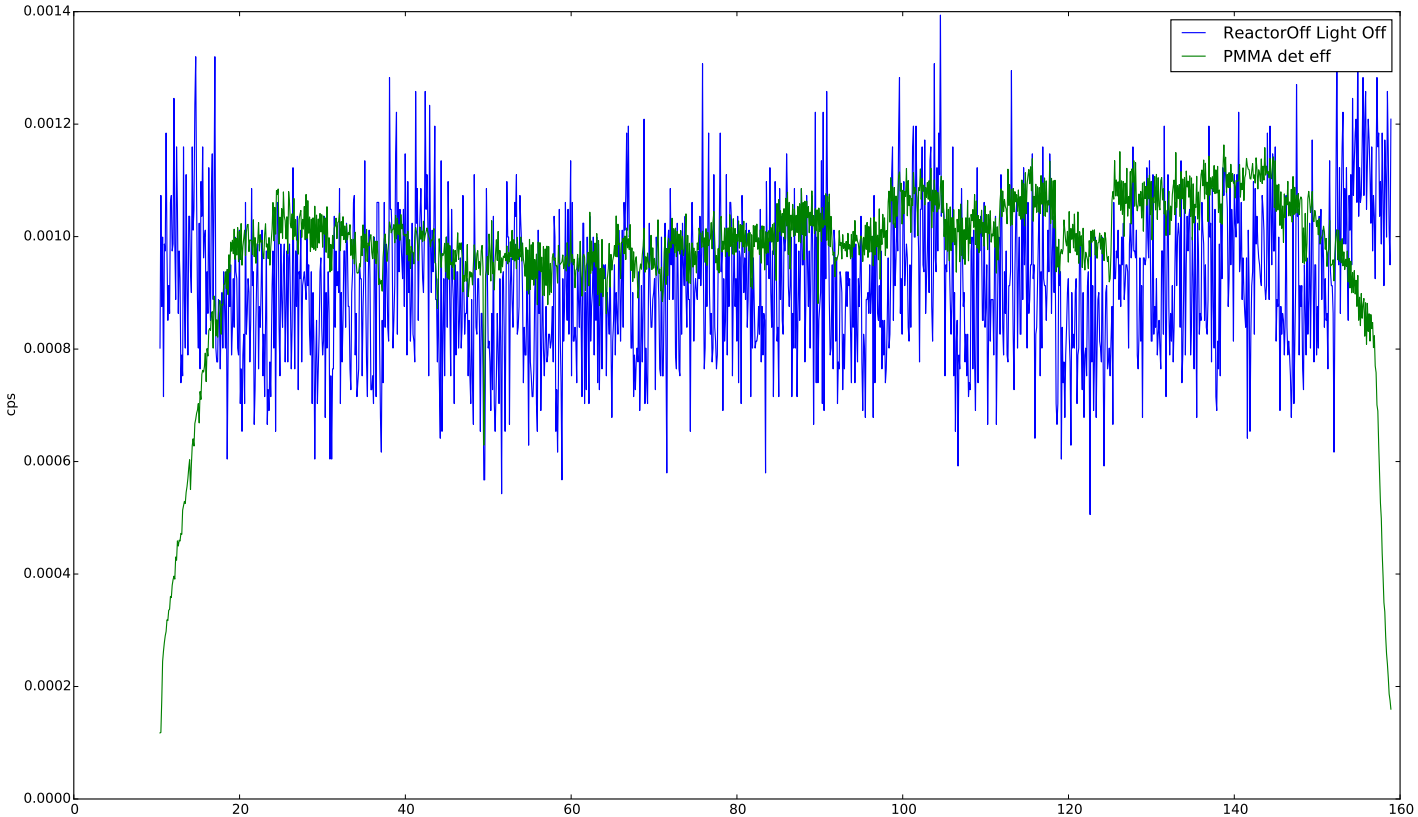

Many thanks to:

- **Leo Cussen**
  for the suggested design!
- **Nigel, Erik & Jeff** for the detector!
- **Hugo Rietveld**
  for Rietveld Refinement

A compact medium resolution instrument

Next detector project: TOF reflectometer

Figure 6: Cold source and new primary spectrometer will yield 1 to 2 orders of magnitude in flux. A 1D detector for off-specular will be needed in 2019.