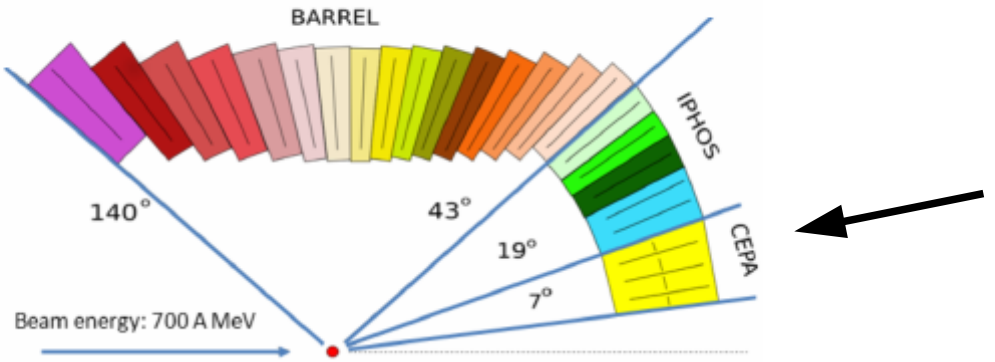
CEPA status update

CALIFA central forward endcap



Investigations by:

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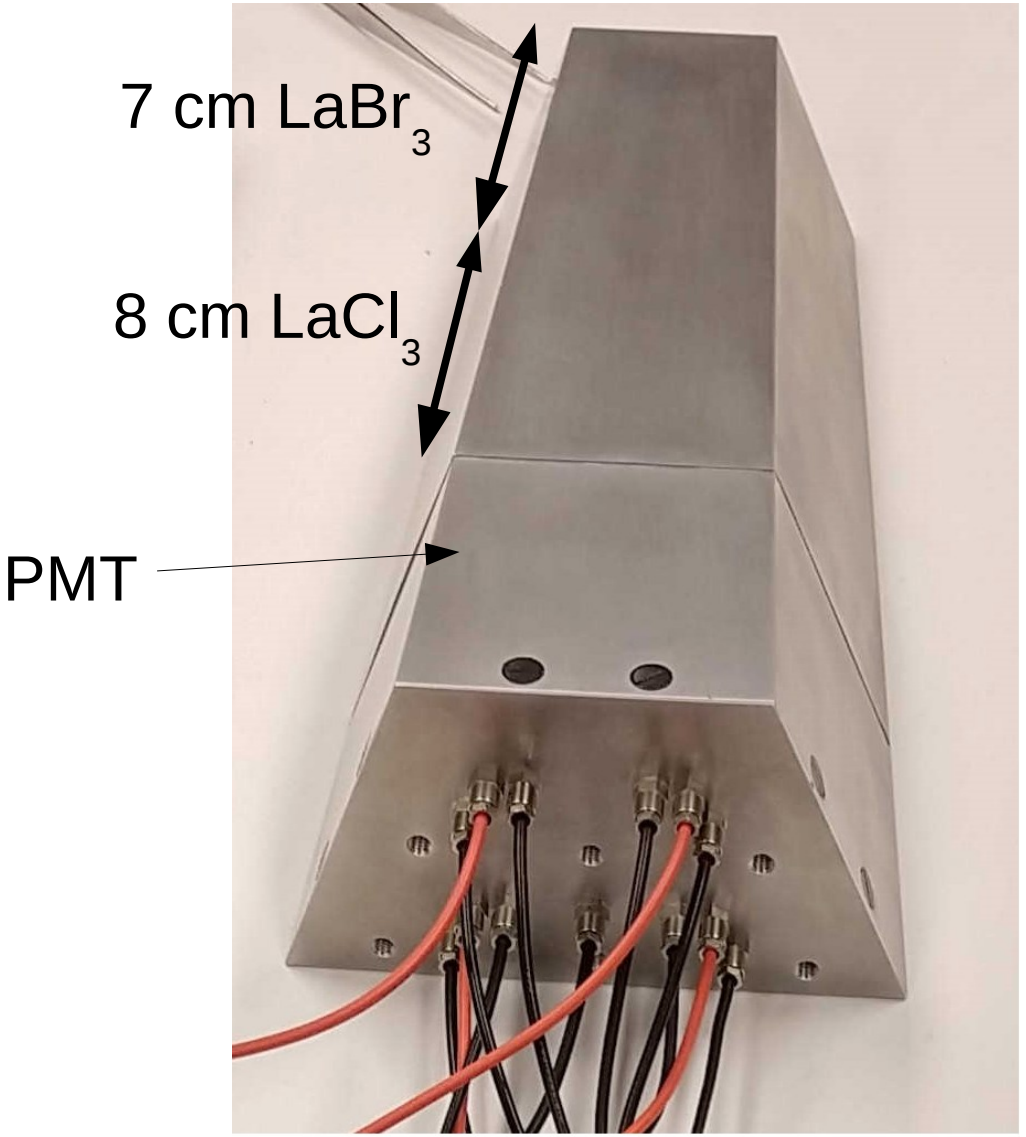
Håkan Johansson, Chalmers, Göteborg

Lichtenberghaus, Darmstadt, May 2019

CEPA phoswich crystals



6-dynode PMT

Parameter	Required	R11187 HG 650 V	R11187 LG 650 V	R7600_6dy HG 700 V	R7600_6dy LG 700 V
Ranges					
Energy at 2 V (MeV)	30–200	20* ✗	33* ✗	54 ✓	120 ✗
Energy Saturation (MeV)	200	300* ✓	300* ✓	>400 ✓	>1000 ✓
Energy Resolution (%)					
Gammas at 1.17 MeV	≤ 6	4.69±0.13 ✓	5.36±0.14 ✓	4.98±0.04 ✓	6.16±0.06 ✗
Gammas at 1.33 MeV	≤ 6	4.50±0.07 ✓	4.63±0.08 ✓	4.77±0.05 ✓	5.50±0.05 ✓
Time Resolution (ps)					
Coincidence	–	72	85	106	115
Single crystal	–	51	60	91	101

About energy ranges:

- * : These values are extrapolated from 750–800 V measurements;

About time resolution values: all the values reported are NOT time resolution of a single PMT/crystal, but rather the time resolution of coincidence measurements. In more detail:

- **R11187**: the coincidence is done between two R11187 PMTs. Therefore, you just need to divide the values by $\sqrt{2}$ to get the time resolution for a single crystal.
- **R7600_6dy**: the coincidence is done between an R7600 with 6 dynodes and an R7600 with 10 dynodes (this one biased at 600 V). Using the same method to extract the time resolution as used in the current case, the R7600 biased at 450 V with 10 dynodes showed a time resolution of 78 ps (coincidence), or 55 ps (single crystal).

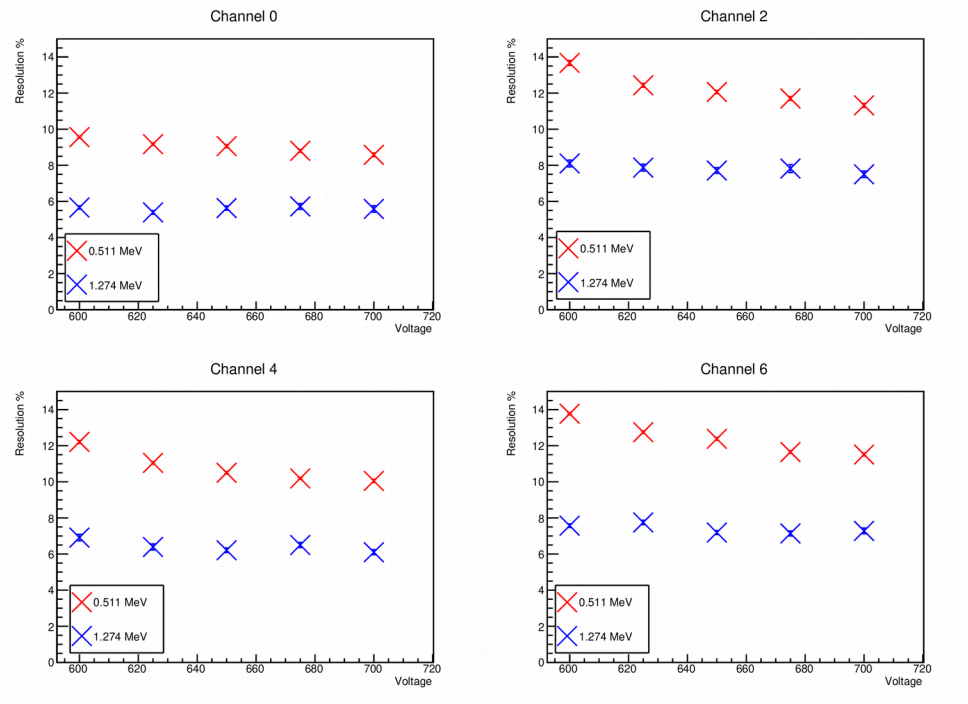
PMT history

Do **not** look at the details...

History of CEPA PMTs

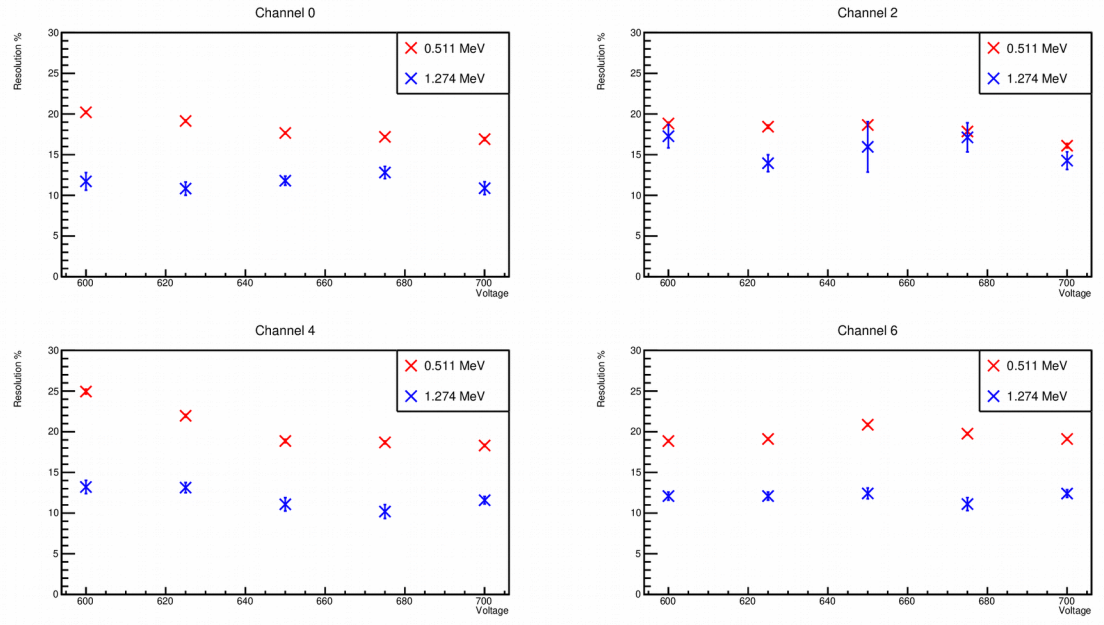
1. **R5380 (pre-TDR era)**: used in the first Krakow experiment and with both CEPA4 and the Saint-Gobain cylindrical demonstrator, it features 6 dynodes (in the article by Nacher, the pmt has 8 dynodes) and a current gain of 6×10^3;
2. **R7600-200 (TDR choice)**: 10 dynodes PMT with a monstrous current gain of 2×10^6. Used in Chalmers, it was source of several discoveries, such as saturation, the need to reduce the HV and split the signal in order to see above a few MeV of deposited energy, and the idea of dual (last dynode) readout.
3. **R7600-200 dual readout (Sept-Oct 2017)**: 10 dynodes PMT as the previous one, but with a dual readout from the anode and the last dynode. CEPA4 was full equipped with such PMTs for the second Krakow experiment (Nov 2017), though with no positive results.
4. **R11187 (Jan 2018)**: 1 single and 1 dual readout version of this 8-dynodes PMT were order right after the second Krakow experiment. The current gain is at 1.9×10^5. Because of the increased range of non-saturation, it seems more promising than the 10-dynodes R7600. However it still requires signal splitting or other tricks. The dual version of this PMT was chosen to be the one mounted on the first CEPA sector.
5. **R7600 6 dynodes (Oct 2018)**: together with the first sector, we got 2 samples of this version of the R7600 PMT, featuring only 6 dynodes and dual readout. Due to the fact that the case of the PMT is not insulated, only one was mounted in CEPA4, next to the only dual-readout R7600-200 left. The other 6-dynodes R7600 went to Madrid with Olof.

Resolution



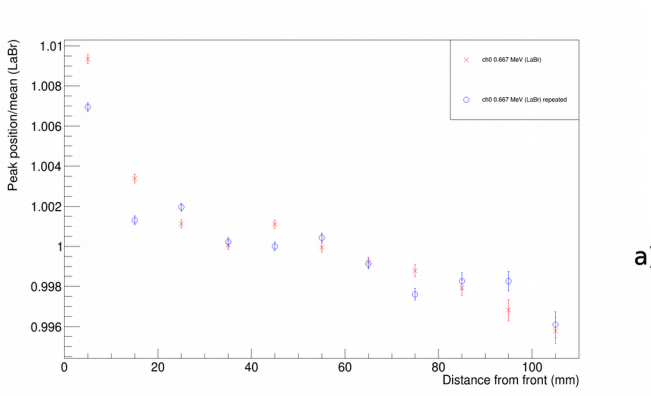
$LaBr_3$: ~7 % @ 1.274 MeV

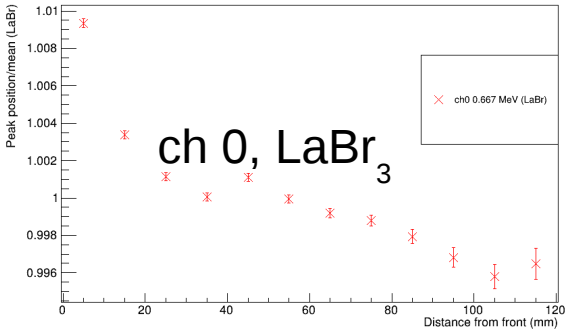
$LaCl_3$: ~11 % @ 1.274 MeV

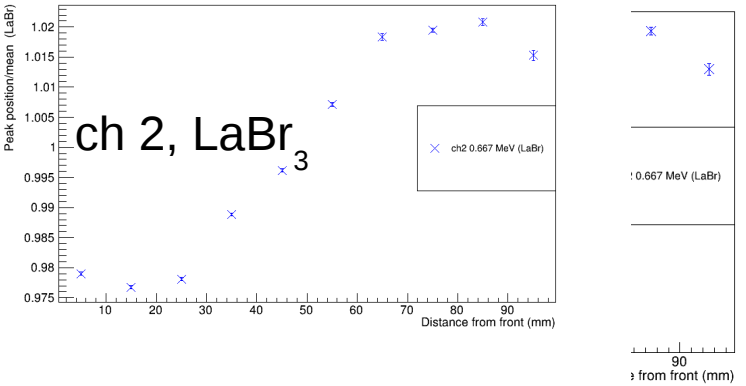


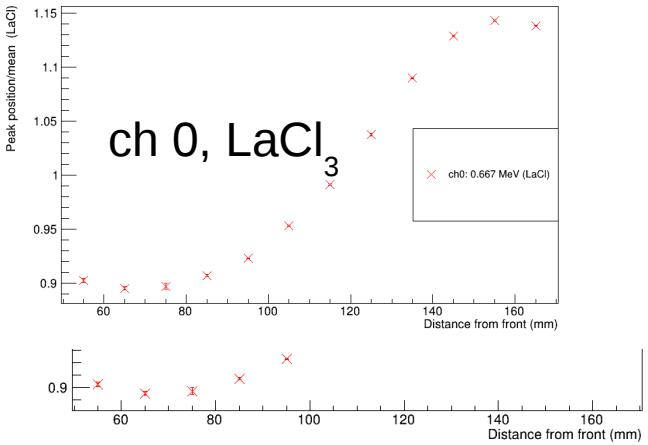
Position dependence

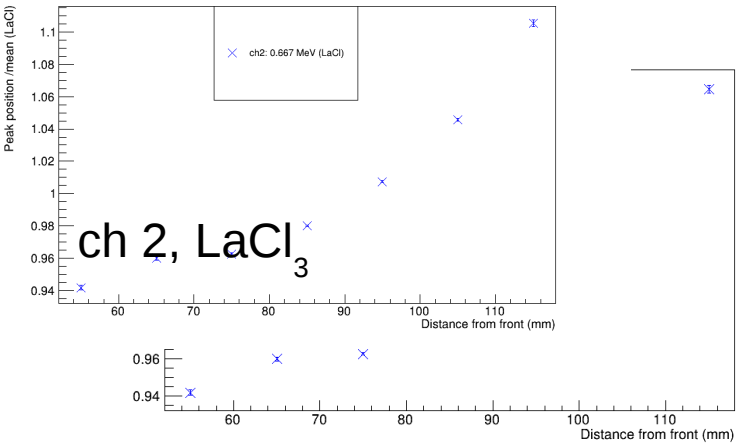
Just to be sure,
Repeated measurement

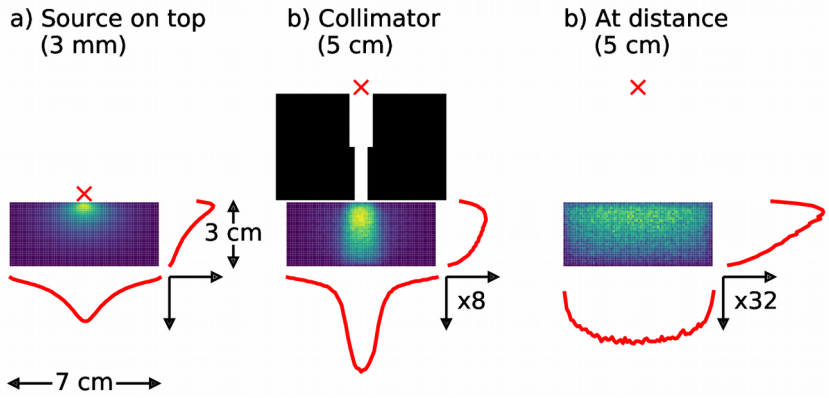


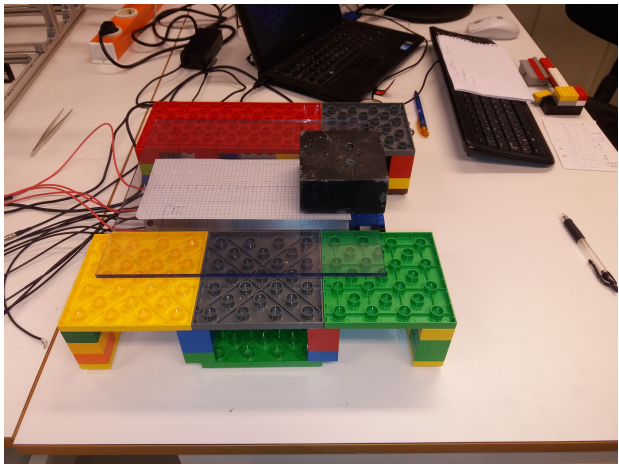












We are hiring...

The division of Subatomic and Plasma Physics has now an opening for a position as *postdoctoral researcher in experimental nuclear physics.*

Information about the division
The Subatomic Physics group at Chalmers has a long-standing leading experience within experimental nuclear physics, having pursued a long, successful scientific program in particular at the international infrastructures GSI/FAIR and CERN-ISOLDE. We have in particular a strong involvement in the construction of the international FAIR facility and its prime experiment for radioactive beams, R3B at NUSTAR. We also coordinate a major grant covering the Swedish in-kind contributions towards FAIR-NUSTAR instrumentation.

Major responsibilities
The position calls for a dual focus on both the final stages of analysis of experiments with light nuclear systems, as well as developing and completing instrumentation and methods for the R3B experiment (Reactions with Relativistic Radioactive Beams) at FAIR.

The investigations on light nuclear systems will draw conclusions about weakly bound, correlated systems governed by the strong force. The successful candidate will also, within an international team of collaborators, make a significant contribution towards making instrumentation ready for future experiments.

Detector development, experiment preparation, data analysis, preparation of publications.

Position summary
Full-time temporary employment. The position is limited to a maximum of two years (1+1).

Qualifications
To qualify for the position of postdoc, you must have a doctoral degree in physics, preferably in subatomic physics or other relevant field; the degree should generally not be older than three years. You are expected

Thank you!