Analytical performance of the FIPPS facility in Grenoble

Zsolt Révay[1], Michael Jentschel[2], Caterina Michelagnoli[2], Giacomo Colombi[2], Lorenzo Domenichetti[2]
[1]Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching, Germany
[2]Institute Laue-Langevin (ILL), Grenoble, France

Objectives

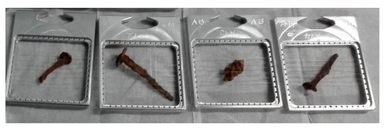
To lower the Detection Limits using the high-efficiency Clover detector system (FIPPS) and multiple γ-γ coincidence

Compare the analytical performances of the high-efficiency Clover-detector system with the high-flux standard PGAA facility

Test case: detection limit of chlorine traces in iron.

The standard PGAA (with Compron-suppressed HPGe) has an inherent limitation for its dynamic range: $n_1\,\sigma_1 / n_2\,\sigma_2 \sim 10^{-3}$–$10^{-4}$, many applications need better than that.

In Garching: DL ~ 40—60 ppm



Capture Gamma Facilities in Grenoble and in Garching

FIPPS facility at Grenoble

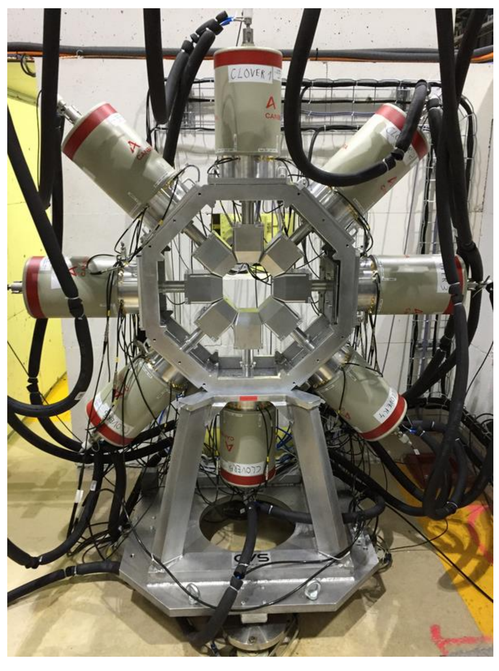
One of the largest gamma detector system at a neutron beam

Strongly collimated thermal beam

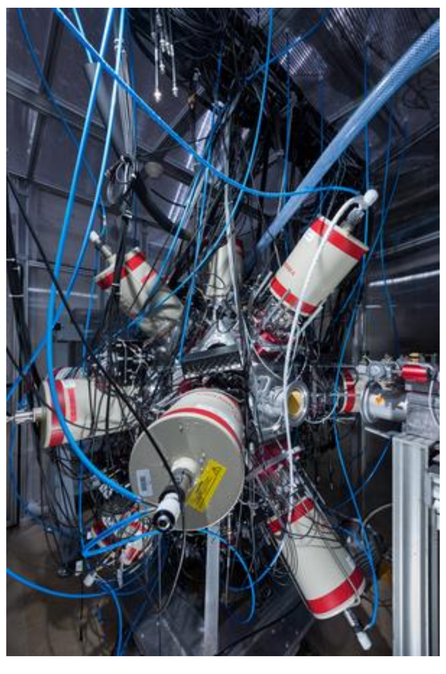
th. eq. flux: **10^8 cm^{-2} s^{-1}**
Ø1.5 cm

Detector system

2×8 Clover detectors (64 HPGe)
Compton suppression
multi-channel spectrometer
geom efficiency ~ **3%**



FIPPS detector system



FIPPS + IFIN

PGAA facility at Garching

Strongest cold beam in the world

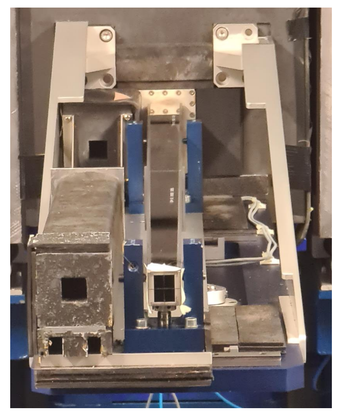
Two operation mode:

1) High-flux, focused beam

th. eq. flux: **4×10^{10} cm^{-2} s^{-1}**
8×16 mm^2
focused beam

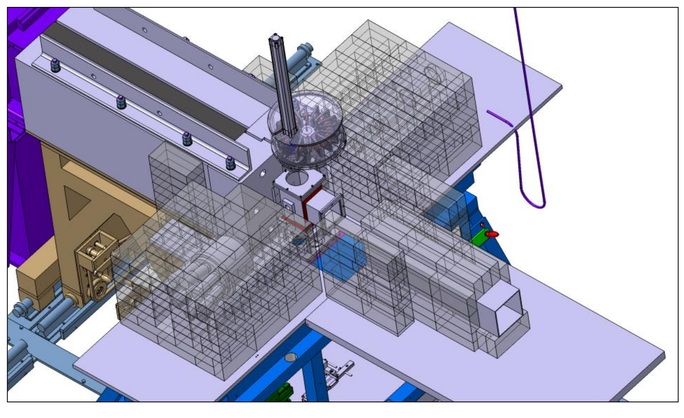
2) Medium flux, homogeneous beam

th. eq. flux: **2×10^{9} cm^{-2} s^{-1}**
2 × 2 cm^2
homogeneous profile



Detector system

2 HPGe detectors
Compton suppression
Digital spectrometer
geom efficiency ~ **2×10^{-4}**



First results

Grenoble

- **Measurement 2 weeks ago**, evaluation still goes on
- 0.3 mg PVC in ~2g Fe

Peak of Cl on the Compton plateau of Fe from 64 detector

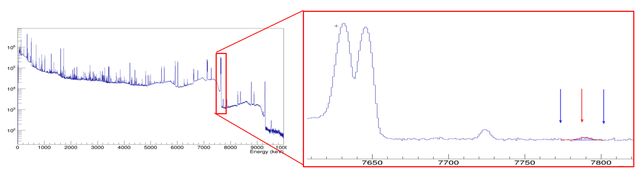
- DL(50%) ~ 15 ppm, only because 64x more detectors

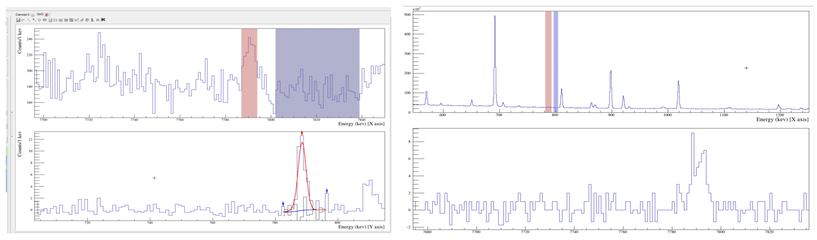
7790 keV+ 788 keV γ-γ coincidence for Cl

- Better S/N ratio, significant peaks
- Further improvement in DL

Fe at 7631+7645 keV
~$2.27\times10^6\pm0.1\%$
Baseline: 0.16/keV/s

Cl at 7790 keV
$1540\pm5\%$





Garching

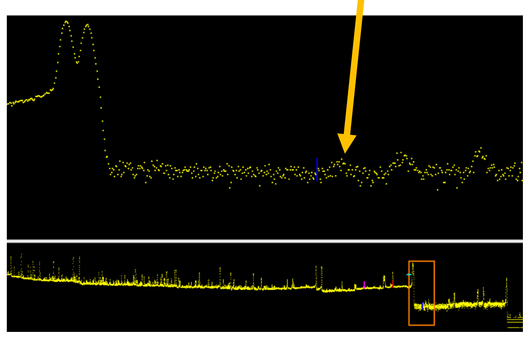
- Archeological iron objects witrh different Cl content were analyzed

Peak of Cl on the Compton plateau of Fe

- DL(50%) ~ 40 ppm

Fe at 7631+7645 keV
~450000±0.2%
Baseline: 0.0025/keV/s

Cl at 7790 keV
89±35%



Conclusion and plans

Inreasing the counting efficiency via greater number of detectors and also using coincidence lowers the DL significantly
Quantitative interpretation of coincidence data, reduction of background, attenuation of beam, determination of oxygen

Contact: **Zsolt Révay**
E-mail: zsolt.revay@frm2.tum.de

Michael Jentschel
E-mail: jentsch@ill.fr

FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz