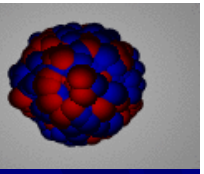
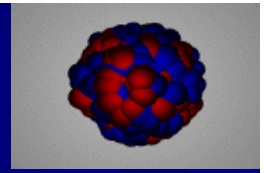
GSI Helmholtzzentrum für Schwerionenforschung GmbH



Observations, and preliminary results with a novel Low Energy ToF Neutron Array (LENA) in the S408 experiment

A. Krasznahorkay, ATOMKI, Debrecen
for the R3B and EXL collaborations



Sum rule for the GDR strength

Neutron-skin thickness

$$\Delta R = < r^2 >_n^{1/2} - < r^2 >_p^{1/2}$$

$$S_{SDR}^{-} - S_{SDR}^{+} = \frac{9}{2\pi}\left(N\langle r^2\rangle_n - Z\langle r^2\rangle_p\right)$$

Bohr, Mottelsson Nuclear Structure (1969) Vol. 2

$$< r^2 >_n^{1/2} - < r^2 >_p^{1/2} = \frac{\alpha\sigma_{\exp}(1-B)-(N-Z)<r^2>_p^{1/2}}{2N<r^2>_p^{1/2}}$$

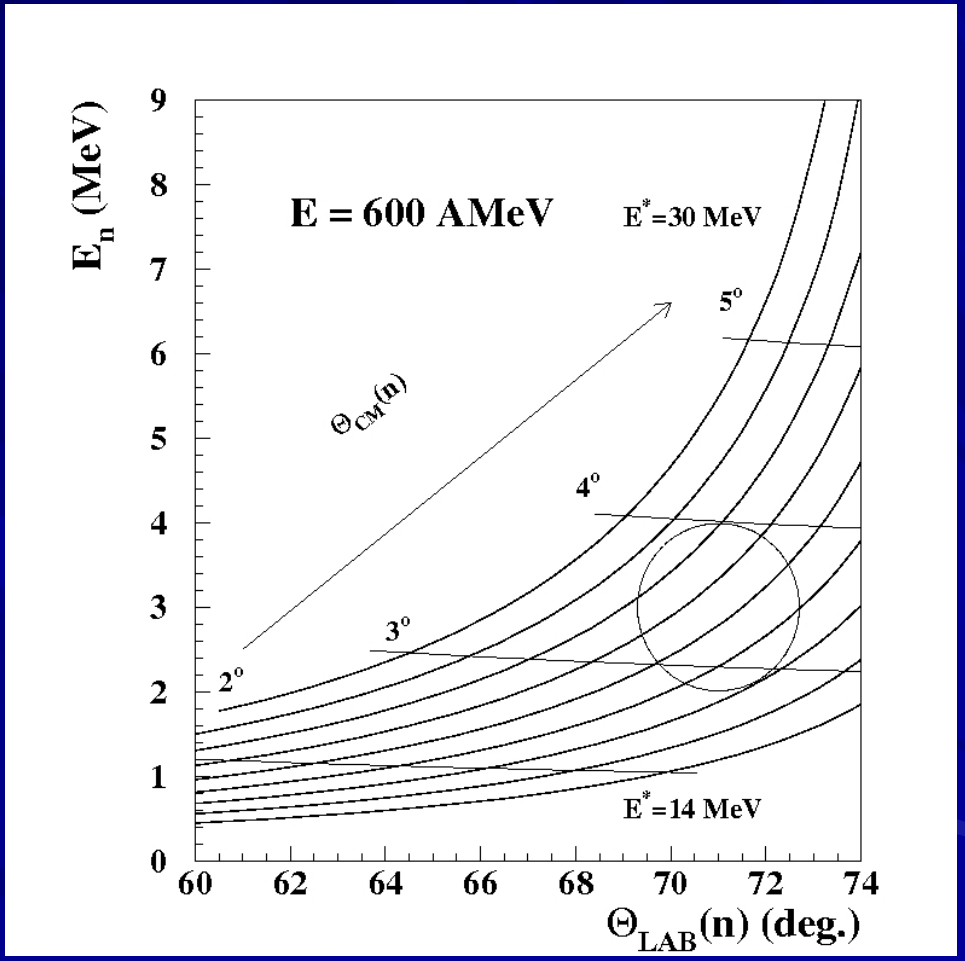
$$B = S^{+} / S^{-}$$

A. Krasznahorkay et al., Phys. Rev. Lett. 82 (1999) 3216.

The ^{124}Sn(p,n) reaction in inverse kinematics

Relativistic calculation of inverse kinematics

- E_{beam}=600 MeV·A
- ^{124}Sn
- E_x(GDR)=18-24 MeV
- Θ_{cm}=3°-4° (L=1)



→ 65°<Θ_{lab}<75°

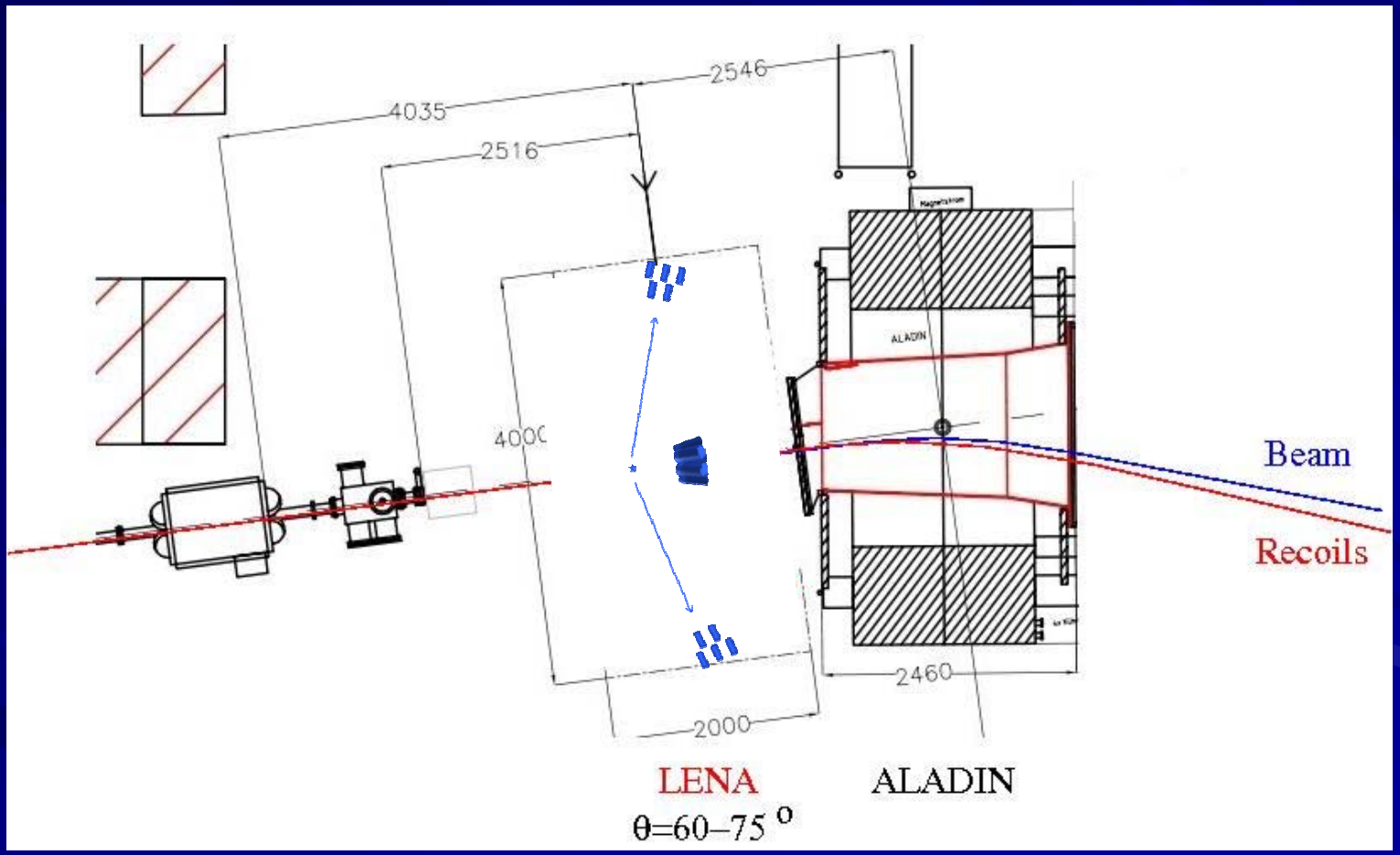
Ground-state γ-decay of the GDR

$$\int \sigma_{abs}(E_\gamma) dE_\gamma = 3\pi^2 \frac{\hbar c}{E_\gamma^2} \Gamma_\gamma$$

$$\frac{\Gamma_\gamma(E_\gamma)}{\Gamma} = \frac{E_\gamma^2}{3\pi^2 \hbar c \Gamma} \int \sigma_{abs}(E_\gamma) dE_\gamma$$

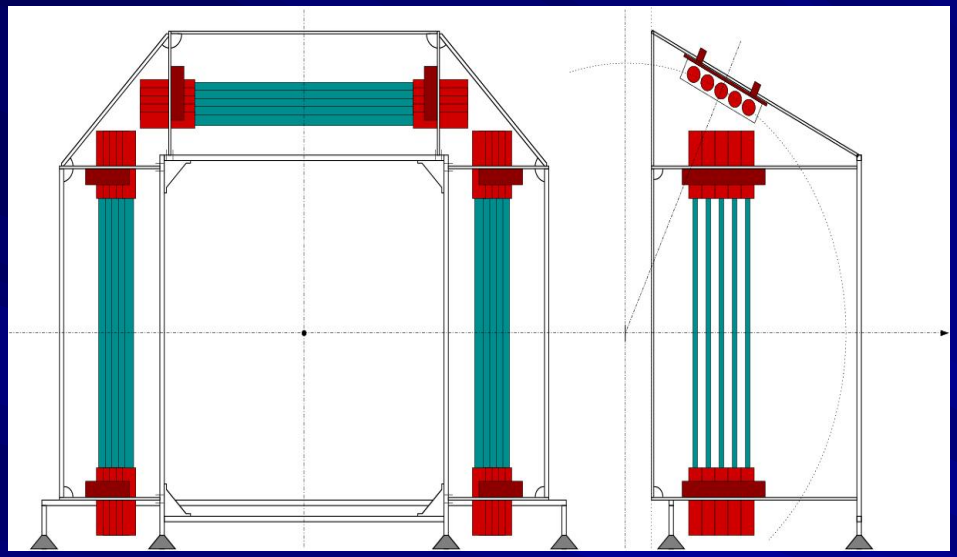
Recent publ: Utsunomiya et al., PRC 84 (2011) 055805

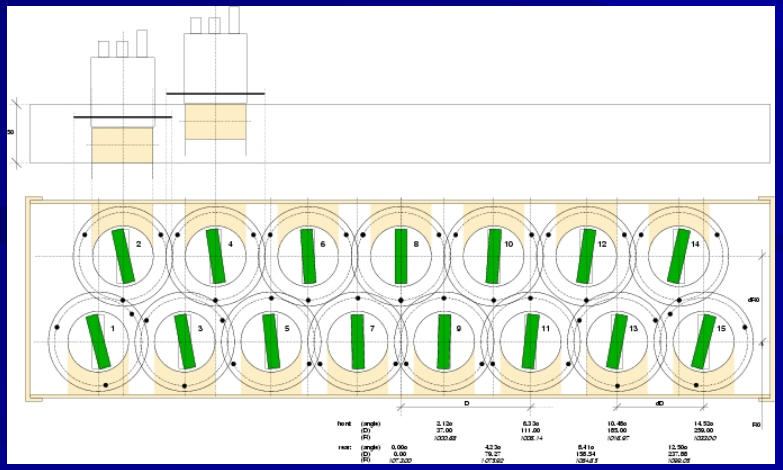
Schematic layout of the setup



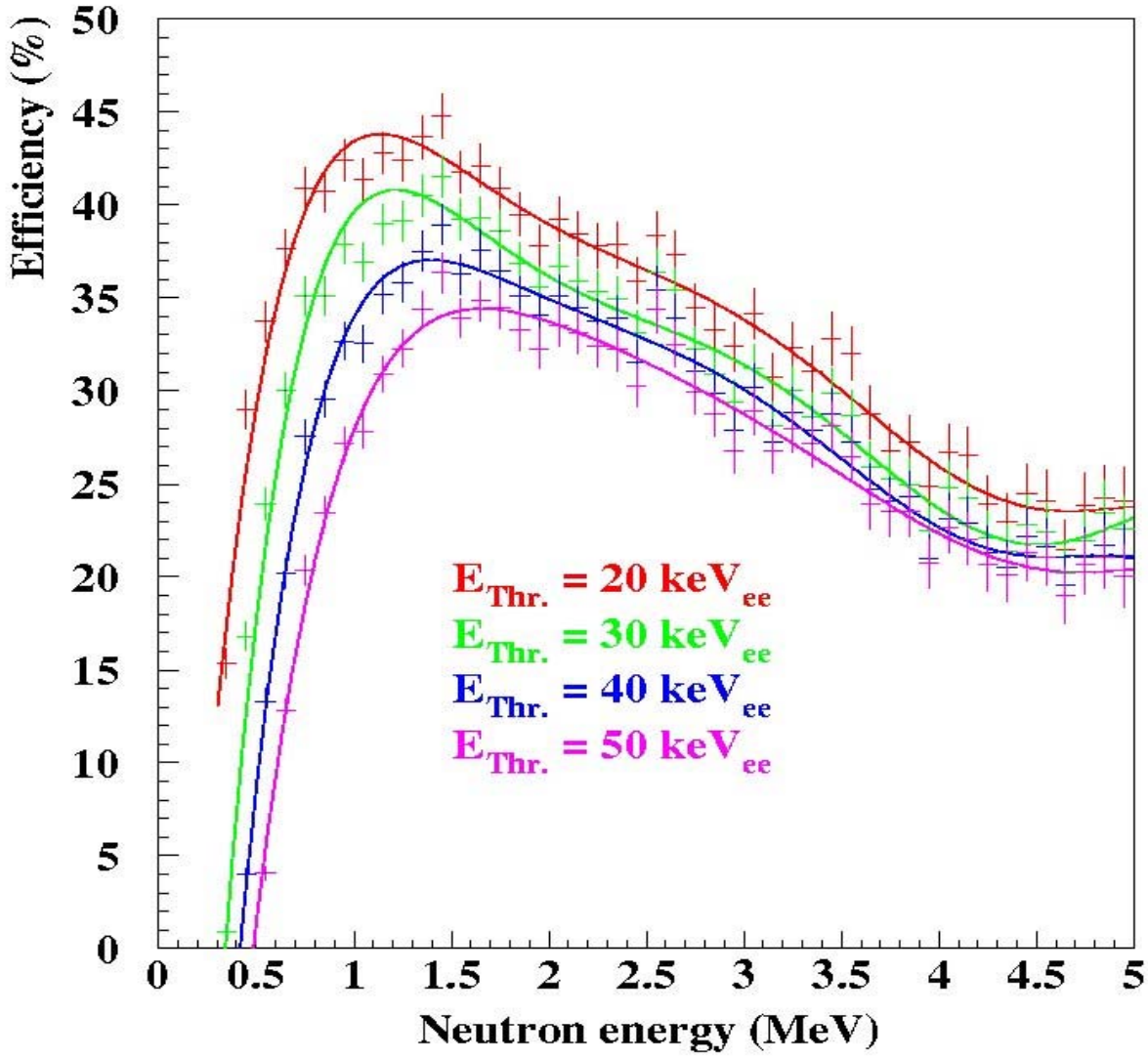
LENA neutron detectors

3x5 Det.

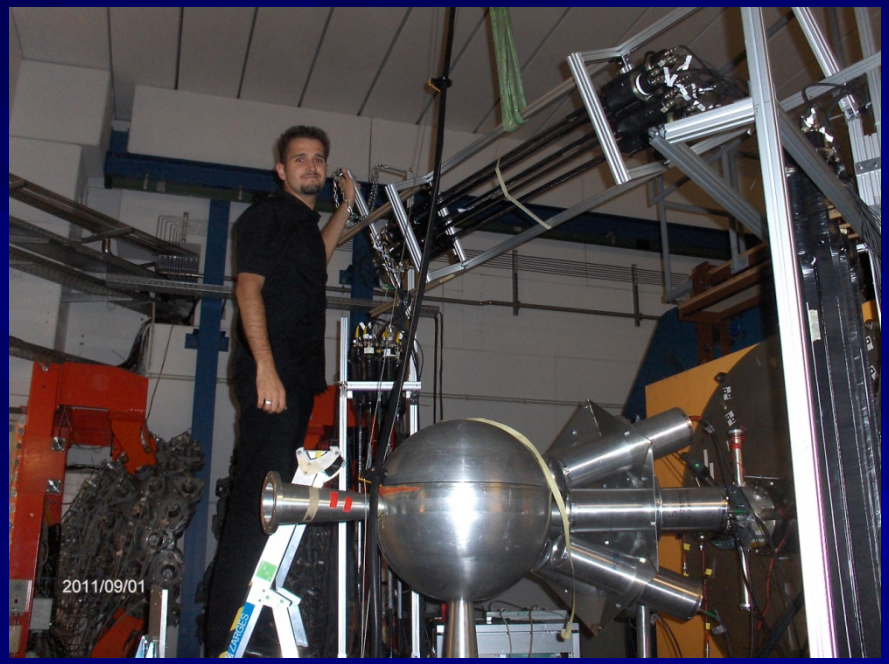


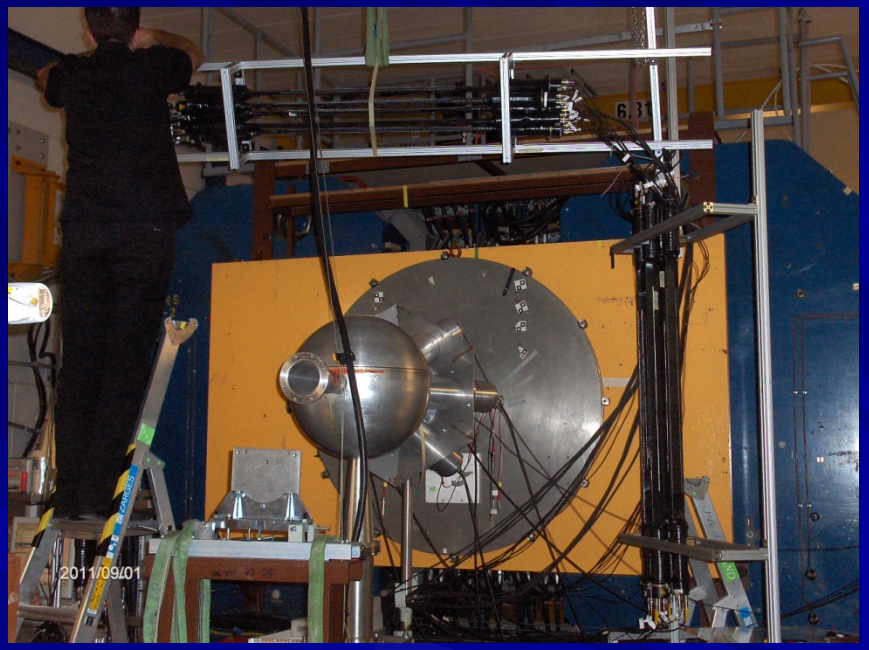


Efficiency for neutrons

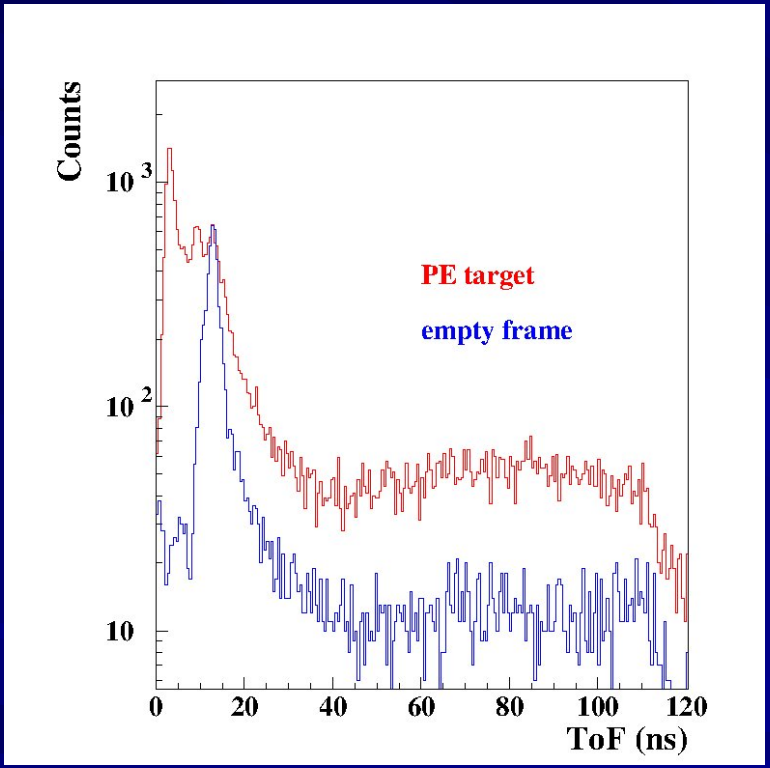


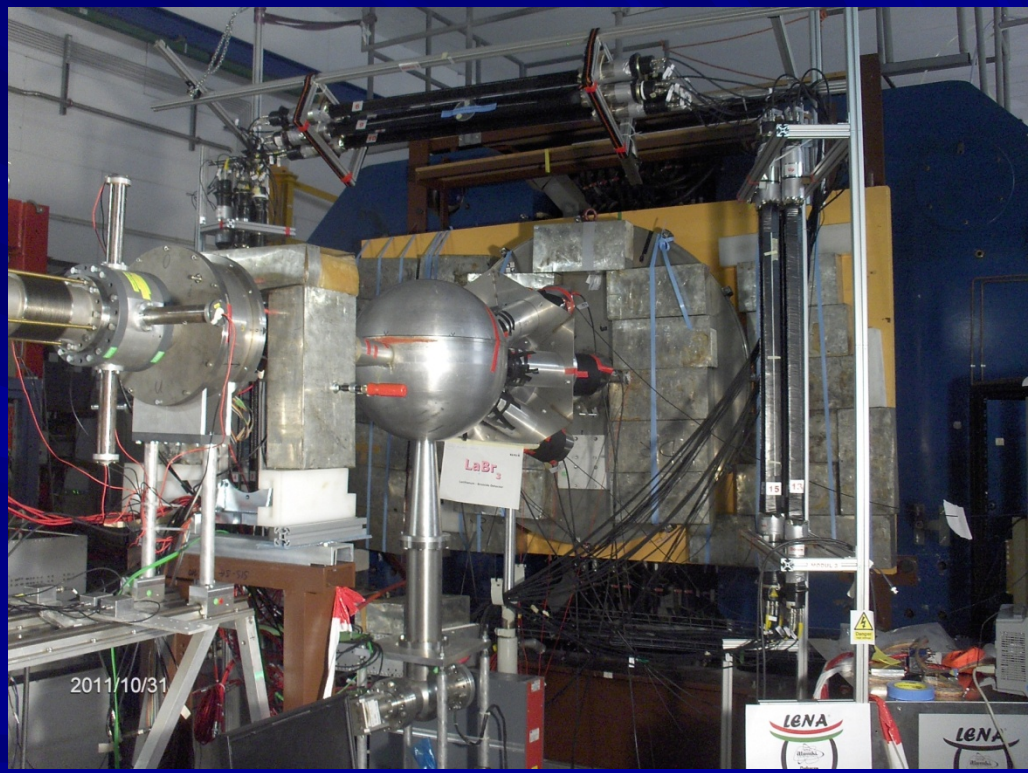
Installation of the LENA detector



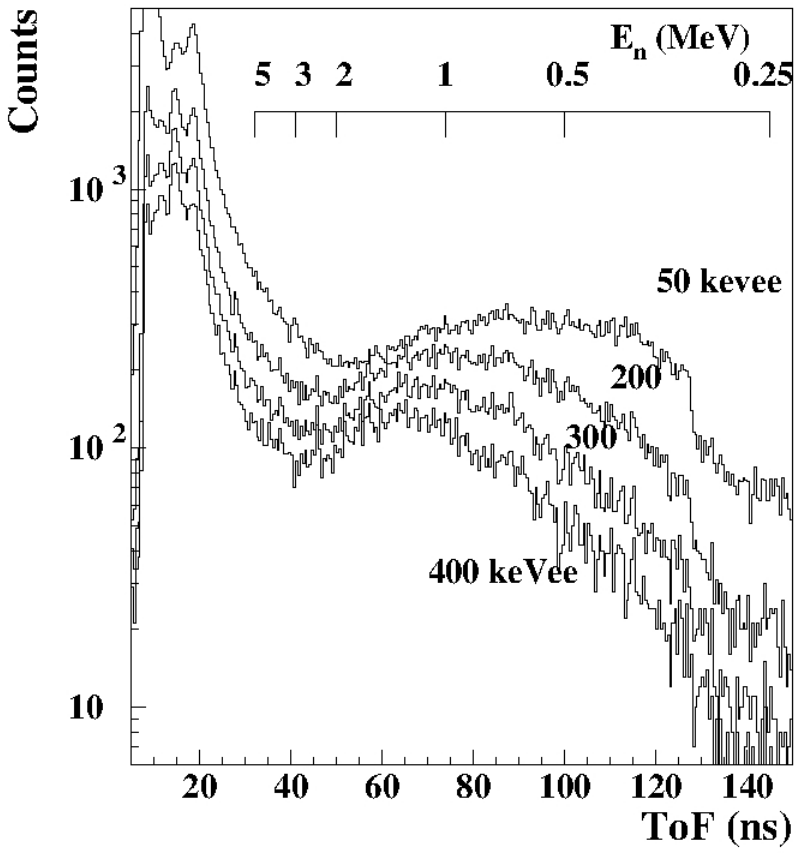


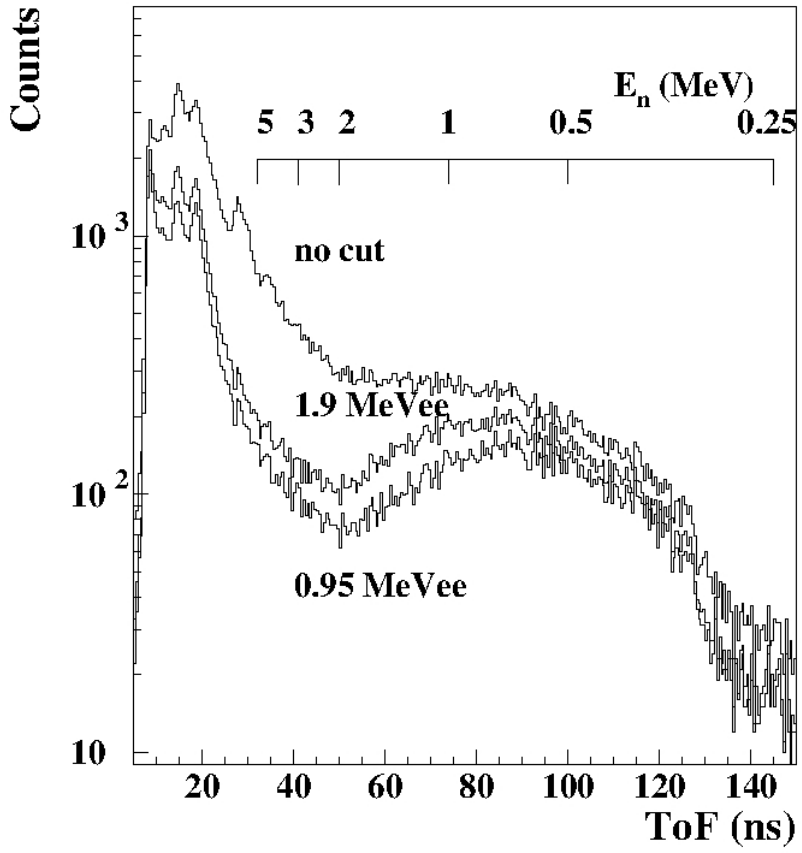
The role of the background coming from the beam line



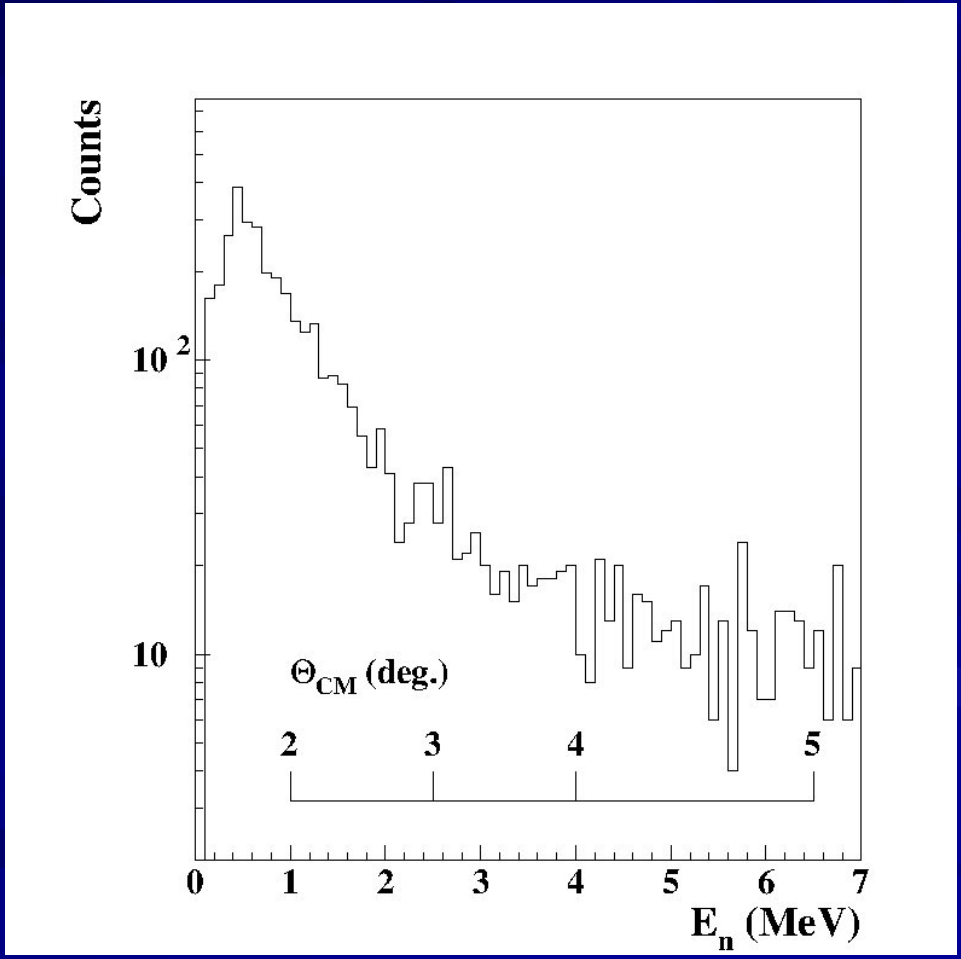


ToF spectra with different cuts

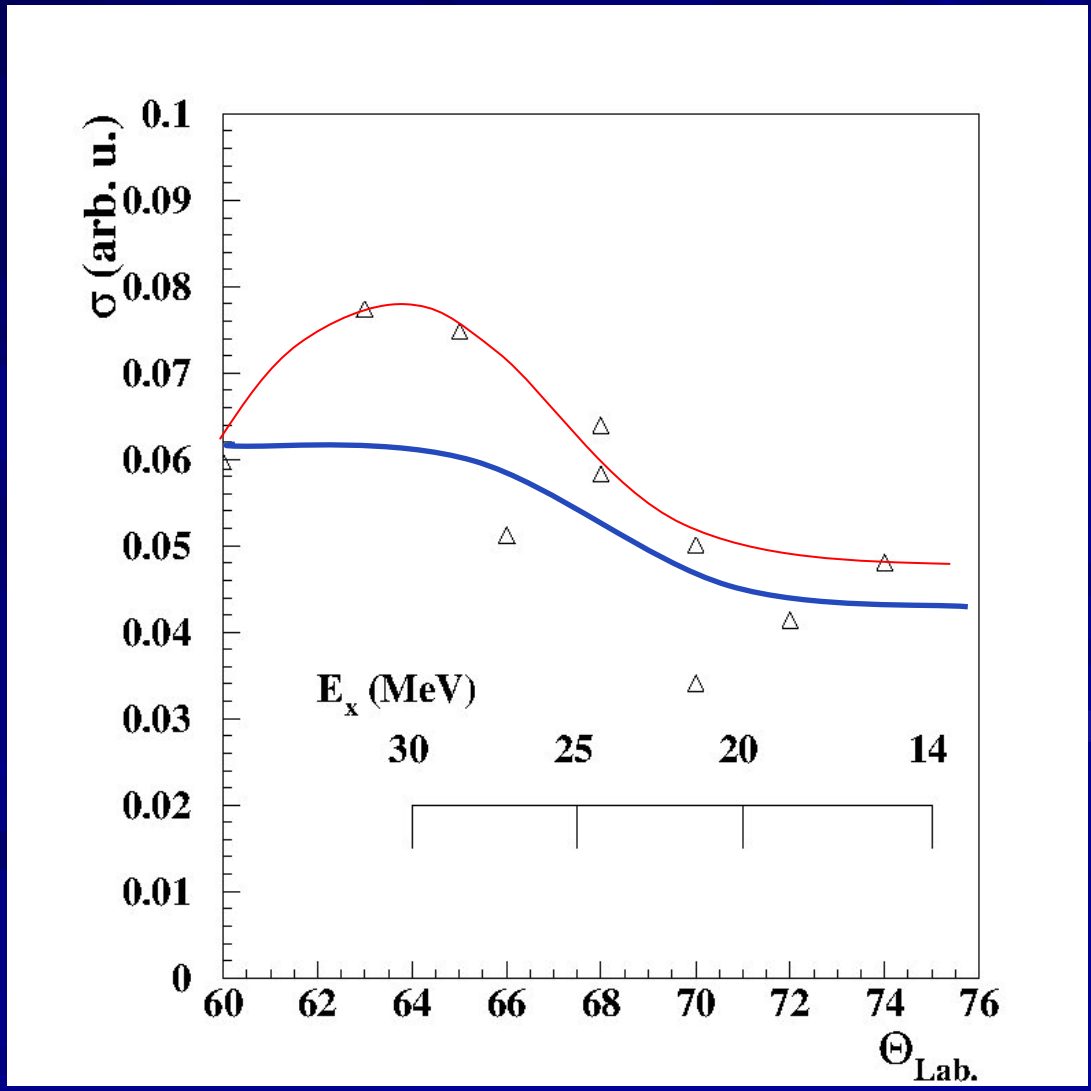




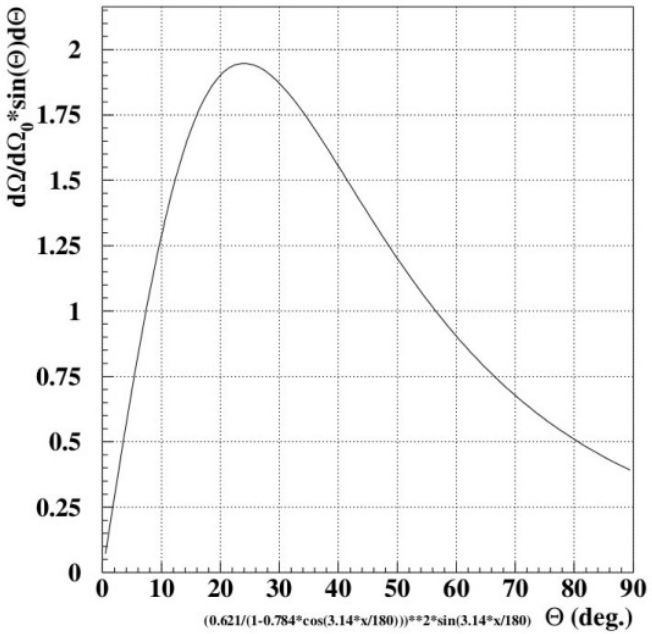
Energy distribution of the neutrons

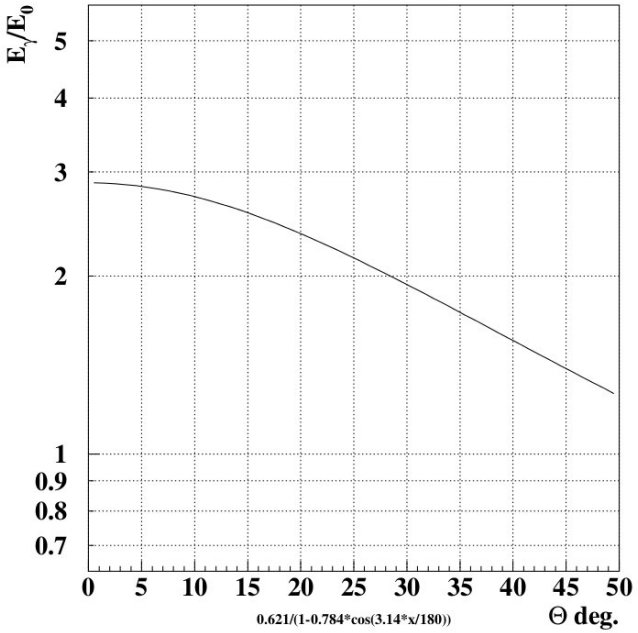


Quasi-free charge exchange process or GDR (both)?



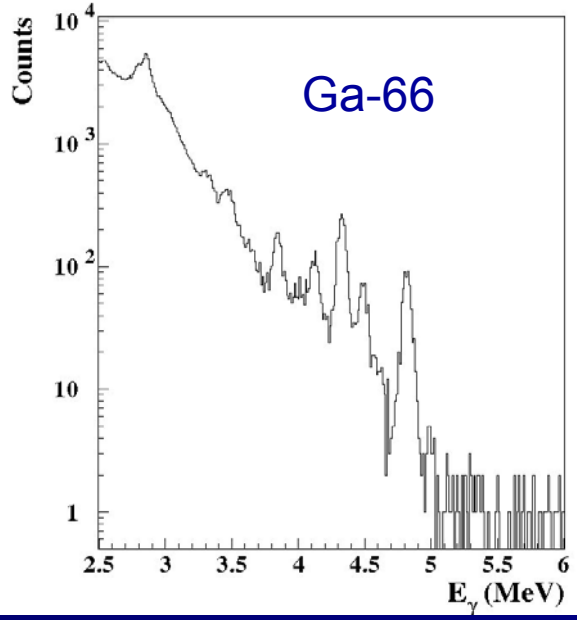
Detection of the γ-rays

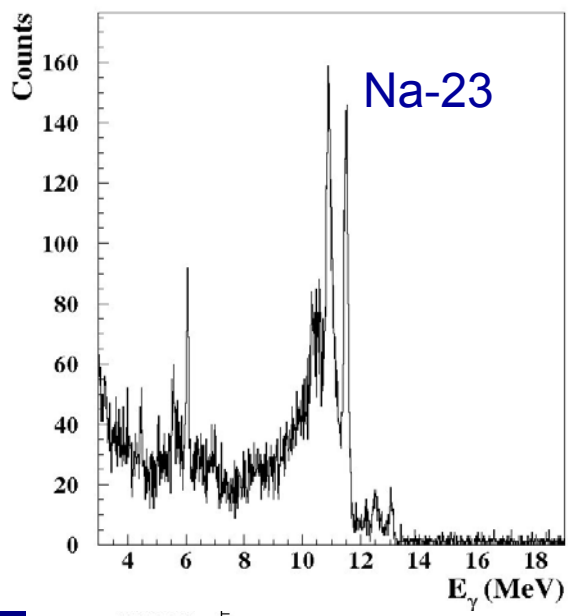


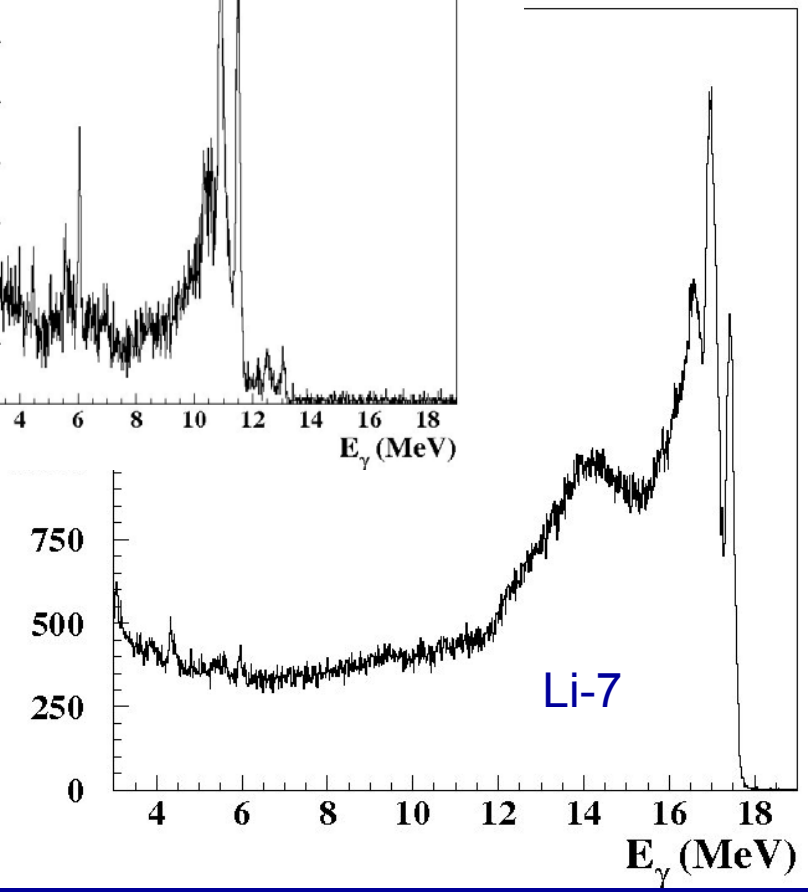


Installation of the $LaBr_3$ detectors

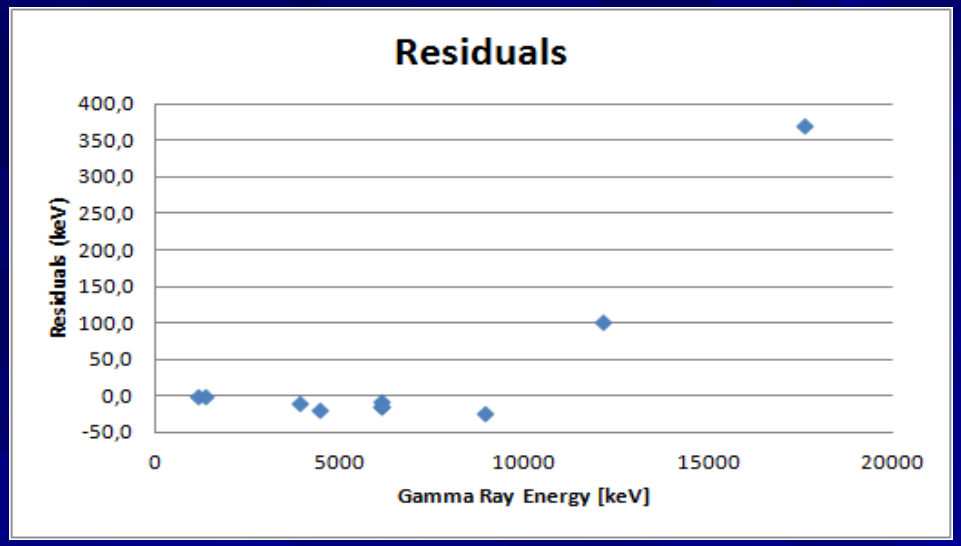
High energy spectra measured in Debrecen

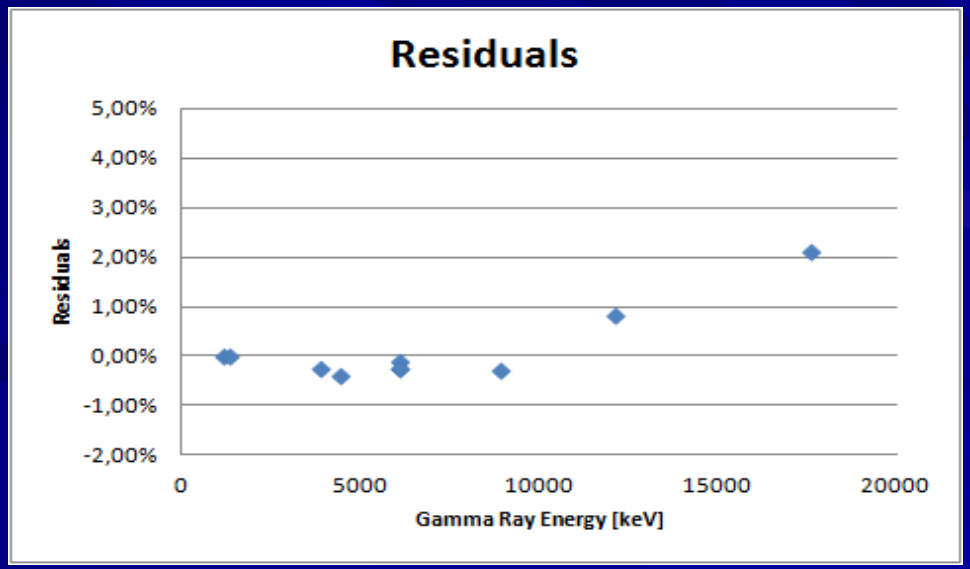




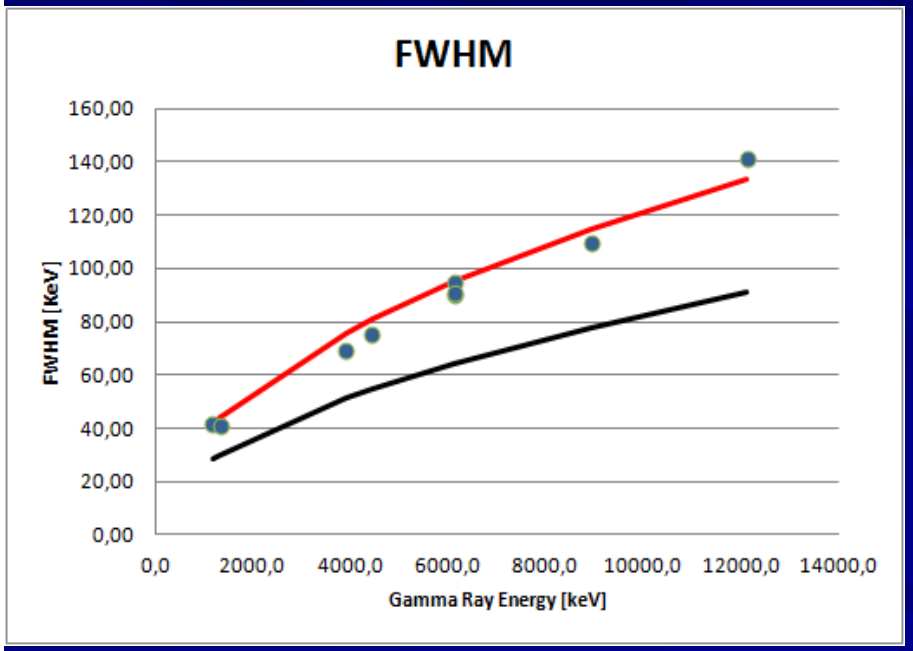


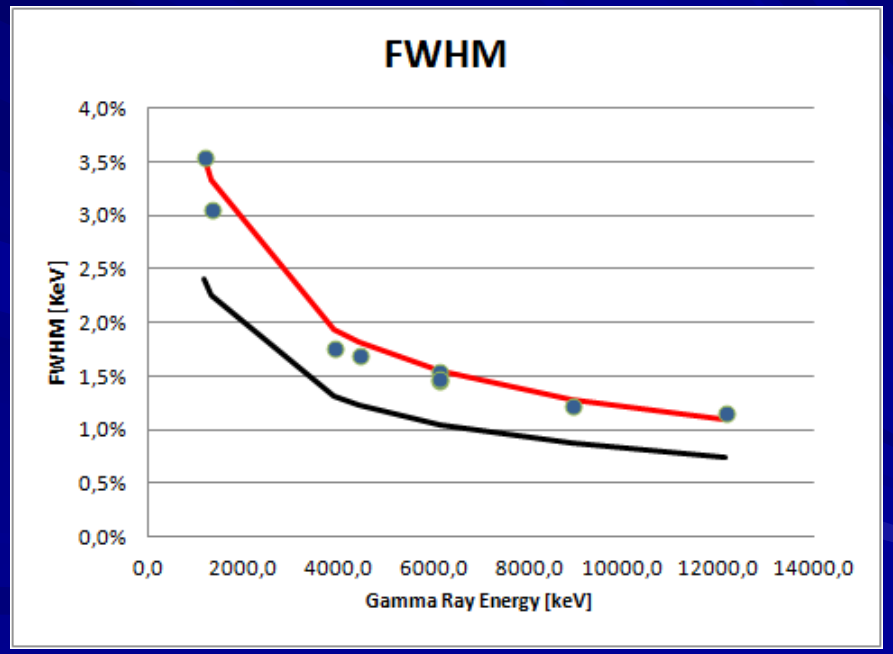
Integral nonlinearity



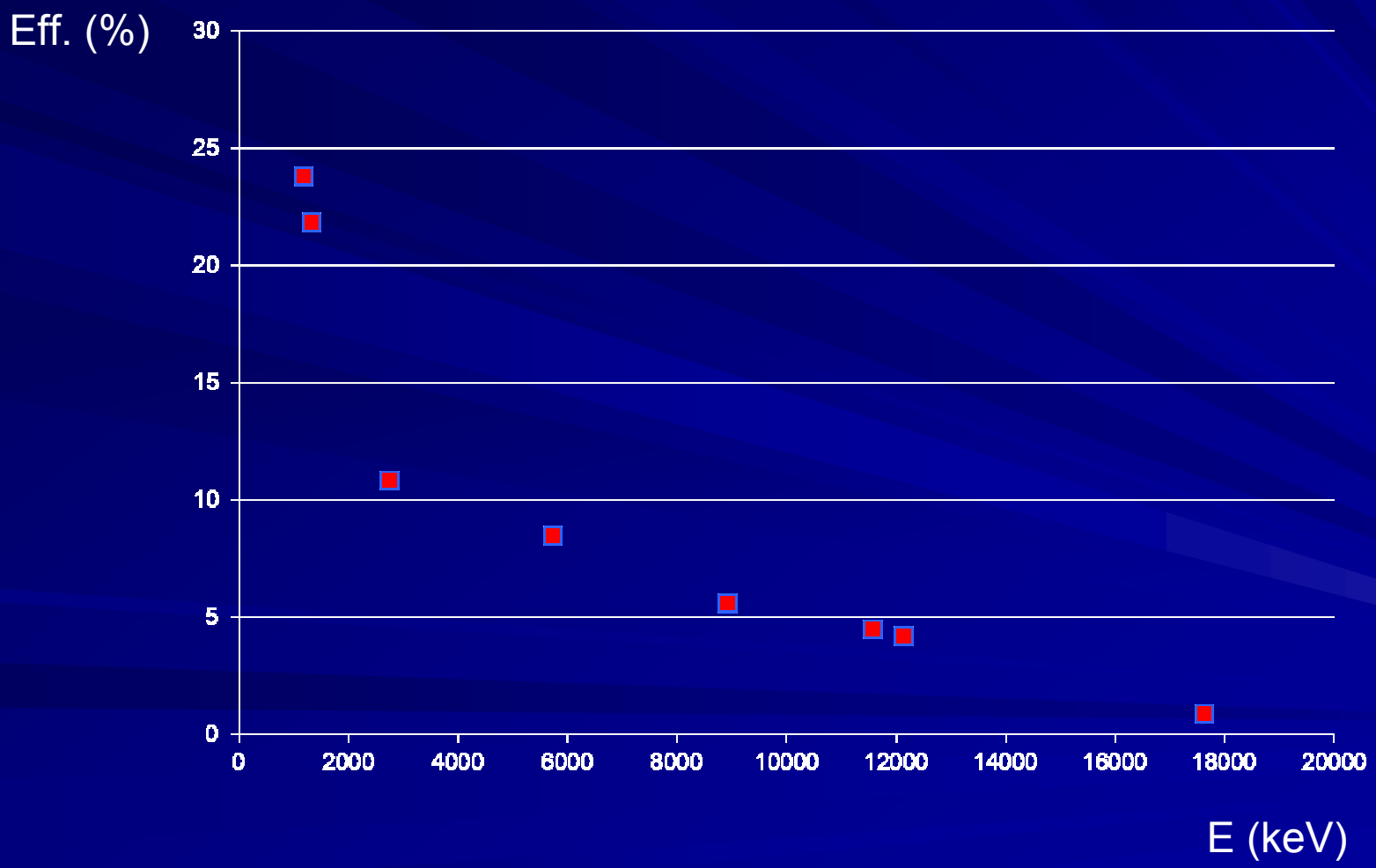


Energy resolution

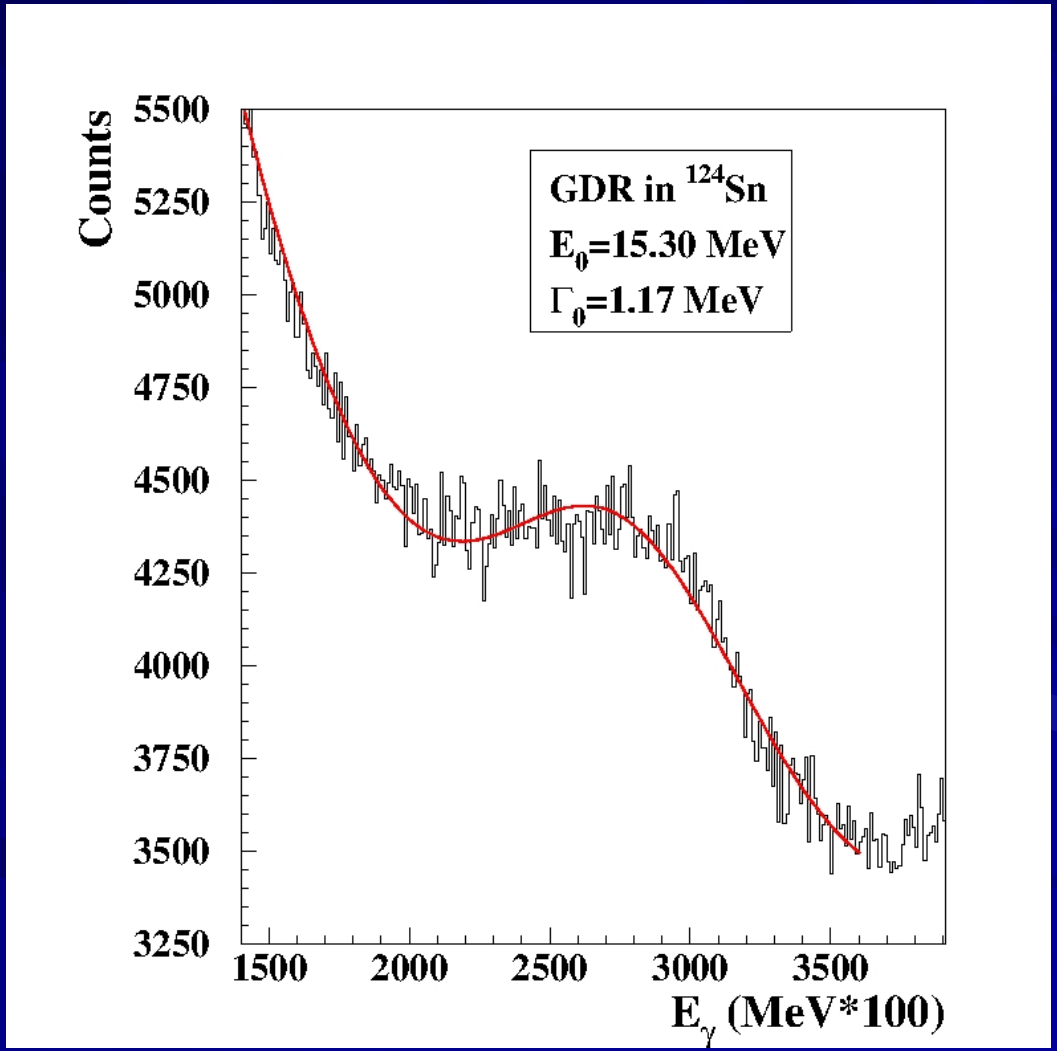




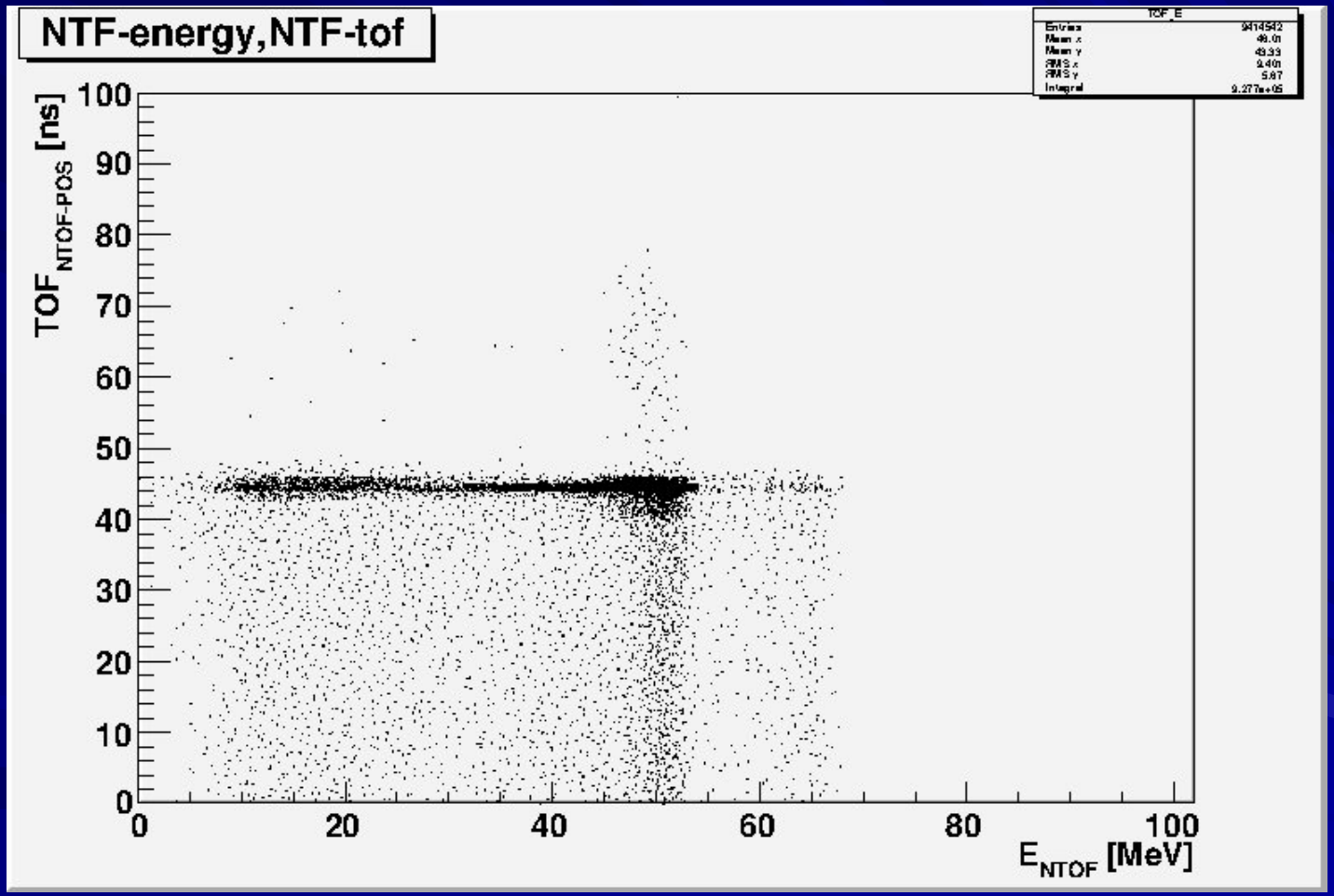
Relative efficiency of the detector



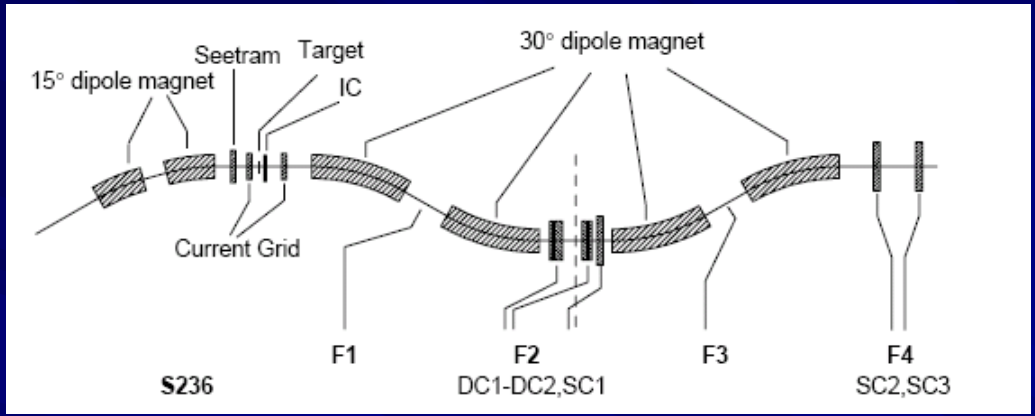
Excitation of the GDR in the ^{124}Sn beam



Identification of the particles



Using the FRS for particle identification



Maierbeck et al., Physics Letters B 675 (2009) 22–27

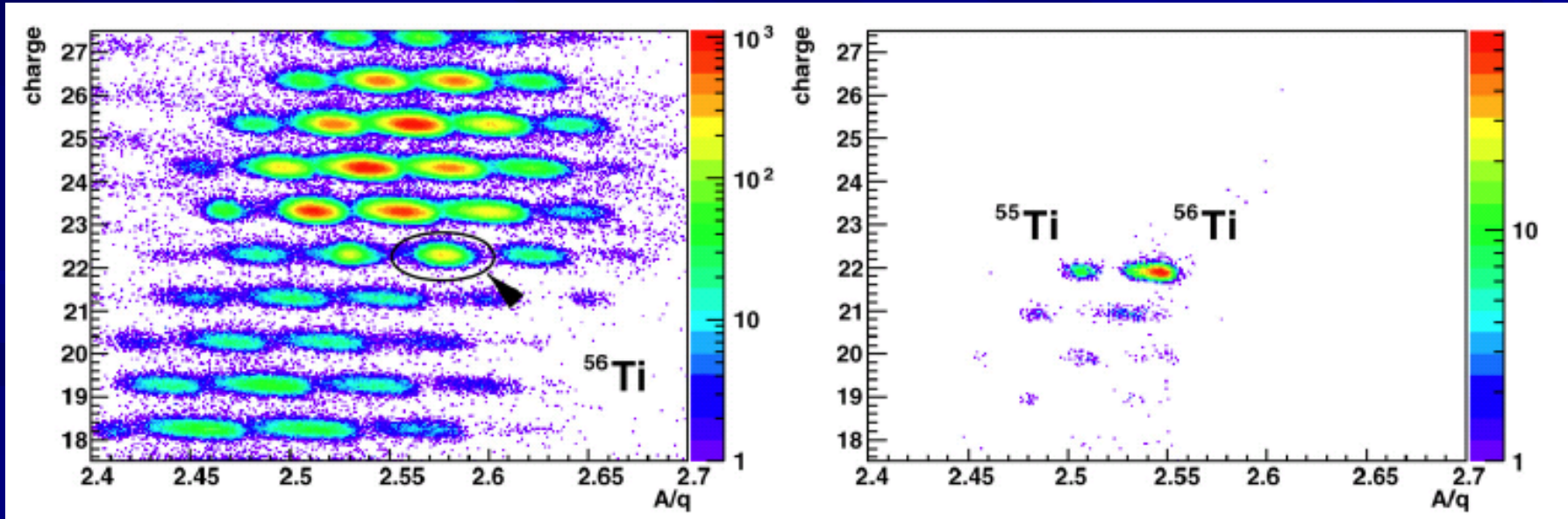


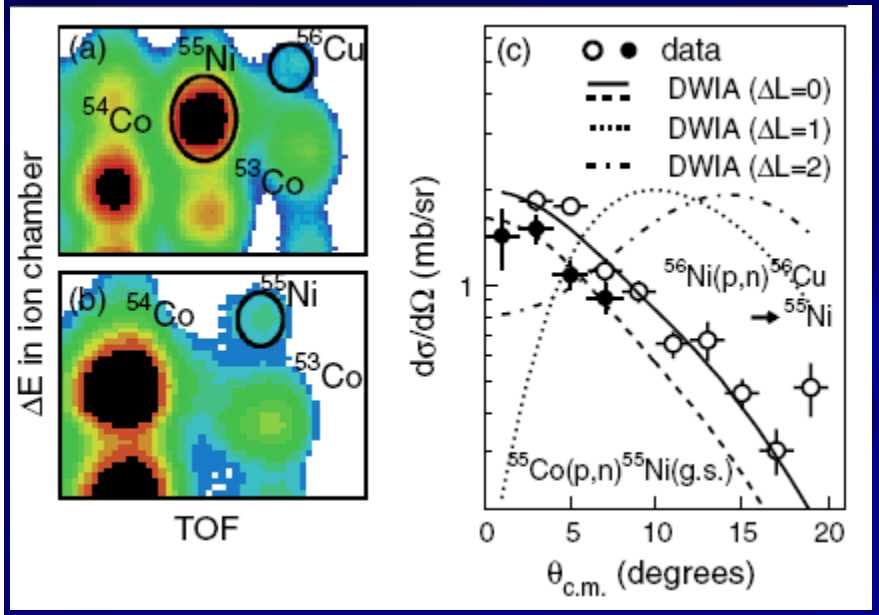
Fig. 1. (Color online.) *Left*: Charge vs. mass-to-charge ratio before the breakup target at the S2 focus of the FRS. *Right*: Charge vs. mass-to-charge ratio of fragments at the S4 focus of the FRS with ^{56}Ti identified at S2.

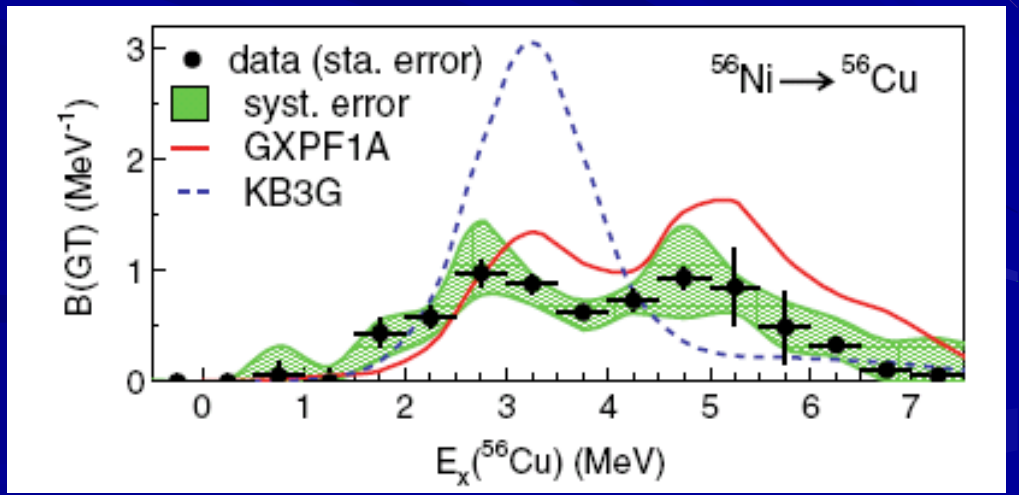
PRL 107, 202501 (2011) Selected for a Viewpoint in *Physics*
PHYSICAL REVIEW LETTERS
week ending
11 NOVEMBER 2011

Gamow-Teller Transition Strengths from ^{56}Ni

M. Sasano,[1,2] G. Perdikakis,[1,2] R. G. T. Zegers,[1,2,3] Sam M. Austin,[1,2] D. Bazin,[1] B. A. Brown,[1,2,3] C. Caesar,[4] A. L. Cole,[5] J. M. Deaven,[1,2,3] N. Ferrante,[6] C. J. Guess,[7,2] G. W. Hitt,[8] R. Meharchand,[1,2,3] F. Montes,[1,2] J. Palardy,[6] A. Prinke,[1,2,3] L. A. Riley,[6] H. Sakai,[9] M. Scott,[1,2,3] A. Stolz,[1] L. Valdez,[1,2,3] and K. Yako[10]

[1]*National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824-1321, USA*





THANK YOU