A New Dedicated Plunger device for the GALILEO γ-ray array

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Outline

Lifetime Measurements using Plunger devices

The GALILEO spectrometer

Design and functionality of the GALILEO Plunger

Commissioning Run reproducing lifetimes in $^{180}$Pt

Discussion of the results

Summary
Lifetime measurements using Plunger devices

\[ E_{sh} = E_{us} \frac{\sqrt{1 - \beta^2}}{1 - \beta \cos(\theta)} \]

\[ \tau(x) = \frac{I_{us}(x)}{d/dt I_{sh}(x)} \frac{1}{v} \]

beam → target → distance → stopper

\[ E_{\text{Flight}} \quad E_{\text{Stop}} \]
The GALILEO spectrometer
The GALILEO spectrometer

Phase I: 3 rings with 5 single GASP detectors each @ 119°, 129° and 152°  
1 ring with 10 single GASP detectors @ 90°  
neutron wall in forward angles  
possible use of EUCLIDES for light charged particles

Later: 5 additional single GASP detectors and 10 EUROBALL triple cluster detectors

other neutron detectors e.g. NEDA  
Recoil detectors e.g. SPIDER or RFD  
Fast timing detectors e.g. LaBr₃  
Binary reactions fragment detectors e.g. MW-PPAC  
High-energy γ-ray detectors e.g. PARIS prototype
Design and functionality of the GALILEO plunger

Some constrains for the design

- Possibility to vary distances between target and stopper foil from few micrometer to tens of millimeters with sub-micrometer precision
- $\gamma$-transparency of the device to minimize absorption of $\gamma$-rays emitted from de-exciting nucleus
- Positioning and alignment of the plunger in the existing target chamber
- Mechanism to stretch both target and stopper foils
- Active feedback system to compensate for changes in the target-stopper foil distance induced by the beam
- Coupling to existing complementary detectors like EUCLIDES
Design and functionality of the GALILEO plunger

- Target Holder
- Entrance collimator 4 mm
- Stopper Holder
- Target stretcher cone
- Stopper stretcher cone
- LPS-24 Piezo Motor
Design and functionality of the GALILEO plunger
Design and functionality of the GALILEO plunger

Mechanical compatibility proven in the commissioning run with 15 E -ΔE telescopes from the EUCLIDES array in forward angles
Commissioning Run reproducing lifetimes in $^{180}$Pt

Reaction $^{154}$Sm($^{32}$S,6n)$^{180}$Pt @ 183MeV (v/c for $^{180}$Pt = 1,53(5) %)
Target 1 mg/cm$^2$ $^{154}$Sm on 2 mg/cm$^2$ Ta, Stopper 10 mg/cm$^2$ Au
25 HPGe Compton-Suppressed detectors of GALILEO (in 4 rings)
10 target to stopper distances from 5 µm to 150 µm measured (8 h each)
Spectrum of the ring @ 152° with a gate on 2$^+$ $\rightarrow$ 0$^+$ in the same ring
Commissioning Run reproducing lifetimes in $^{180}\text{Pt}$
Discussion of the results
Discussion of the results
summary

A compact plunger device was build for the GALILEO spectrometer
It is mechanically compatible to ancillary detectors like EUCLIDES
This plunger device works only with a linear motor (no piezo)
The commissioning run was successful
The lifetimes in $^{180}\text{Pt}$ are confirmed (for the $8^+ \to 6^+$ even higher precision)

Thank you for your attention!

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FIG. 1: IBM-CM total energy curves for $^{172-194}$Pt as a function of the $\beta$ deformation parameter (IBM-CM parameters as given in [36]).

FIG. 4: (Color online) IBM-CM contour plots for $^{172-194}$Pt as a function of $\beta$ and $\gamma$ (IBM-CM parameters as given in [36]). The separation between adjacent contour lines amounts to 100 keV. The deepest energy minimum is set to zero, corresponding to the red color, while green corresponds to $\approx 3$ MeV.