A new setup for direct reaction w/ RIBs

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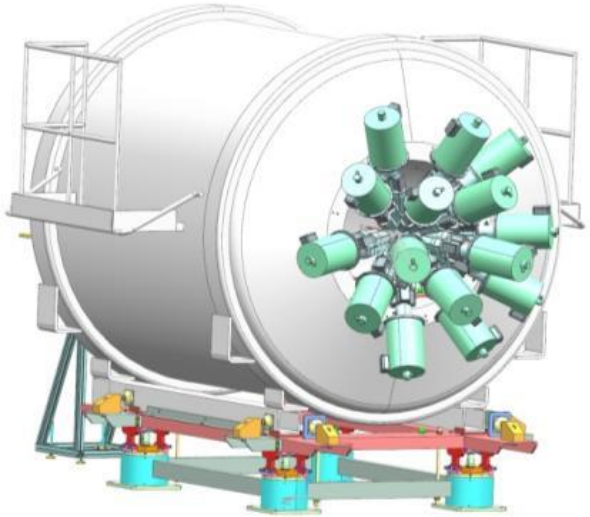
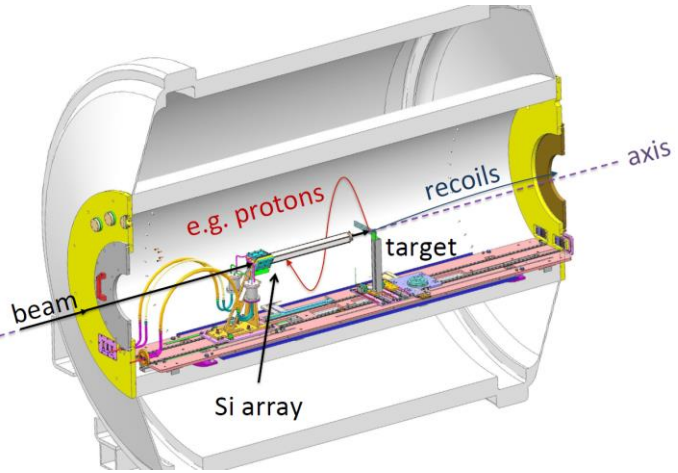
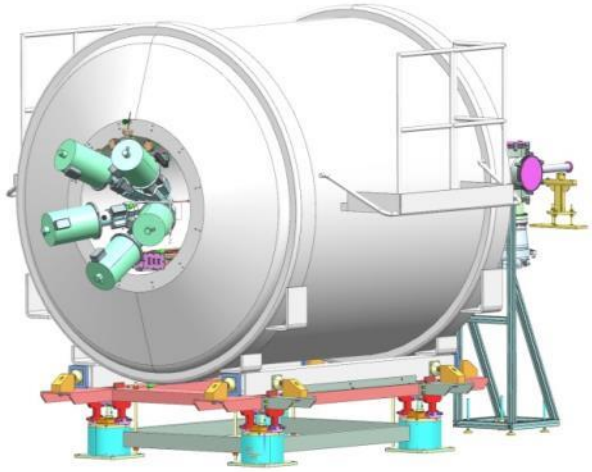
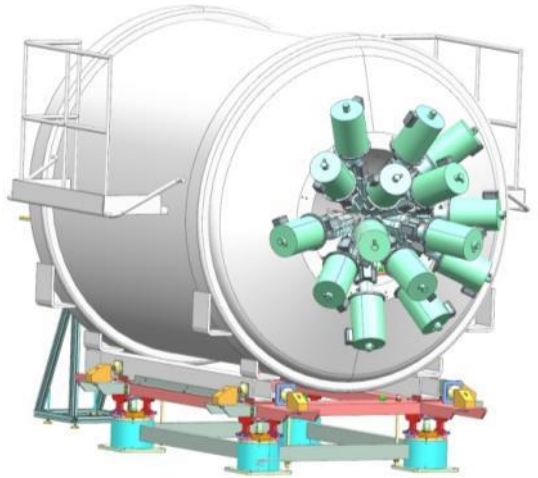


Nuclear Spectroscopy Instrumentation Network of ENSAR2, NUSPIN 2017 - GSI Darmstadt - June 26th - 29th, 2017

Superconducting Solenoid + Germaniums





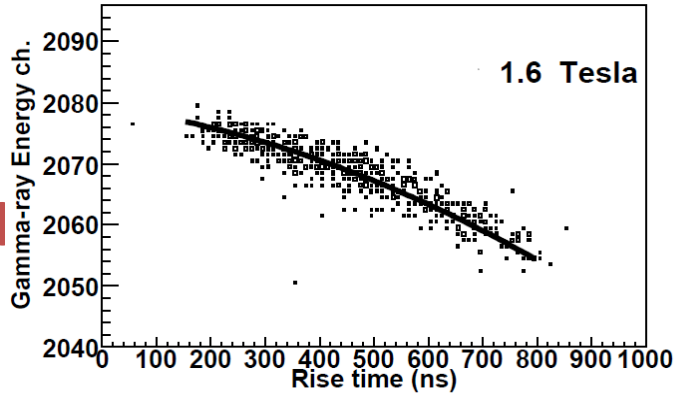


$$z \propto \cos\theta_{CM}$$
$$E_{lab} = E_{CM} - A + Bz$$

For a given state

$$\Delta E_{lab} = \Delta E_{CM}$$

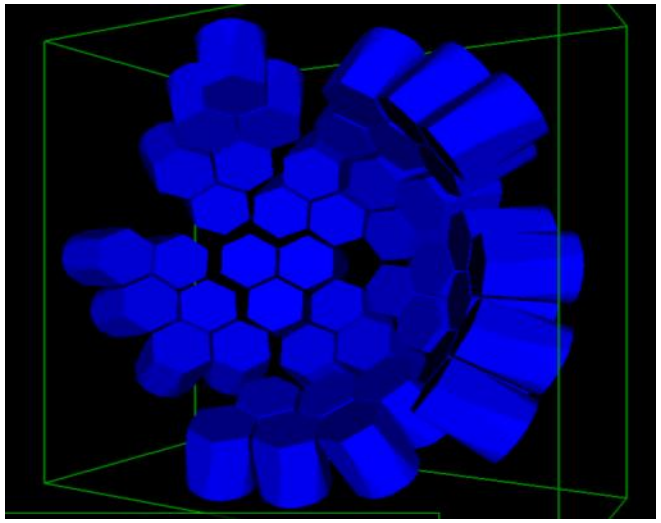
For two states at fixed z

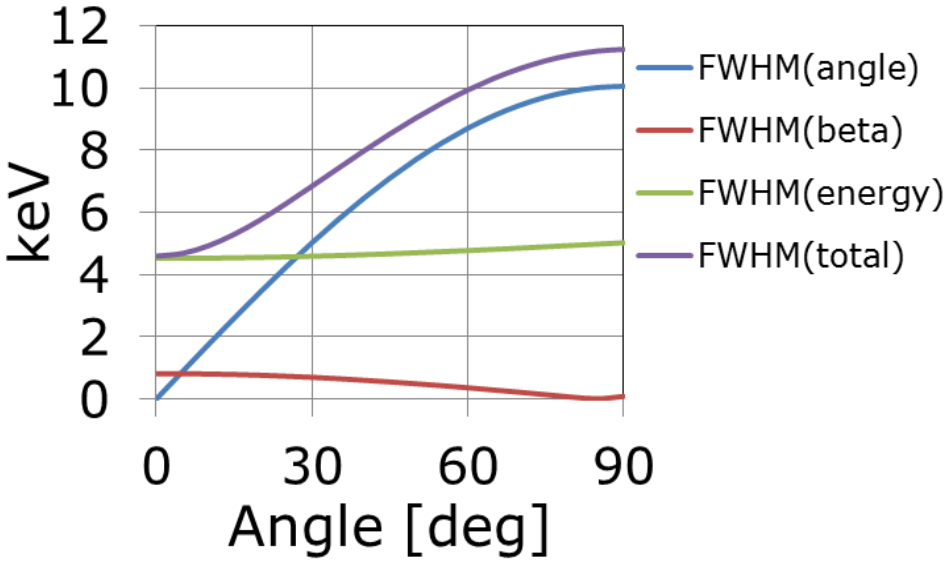


- **Helios-like superconducting solenoid**
- **Add germanium detectors**
  - **Proper signal treatment is needed**

Superconducting Solenoid + Germaniums

1. Response function

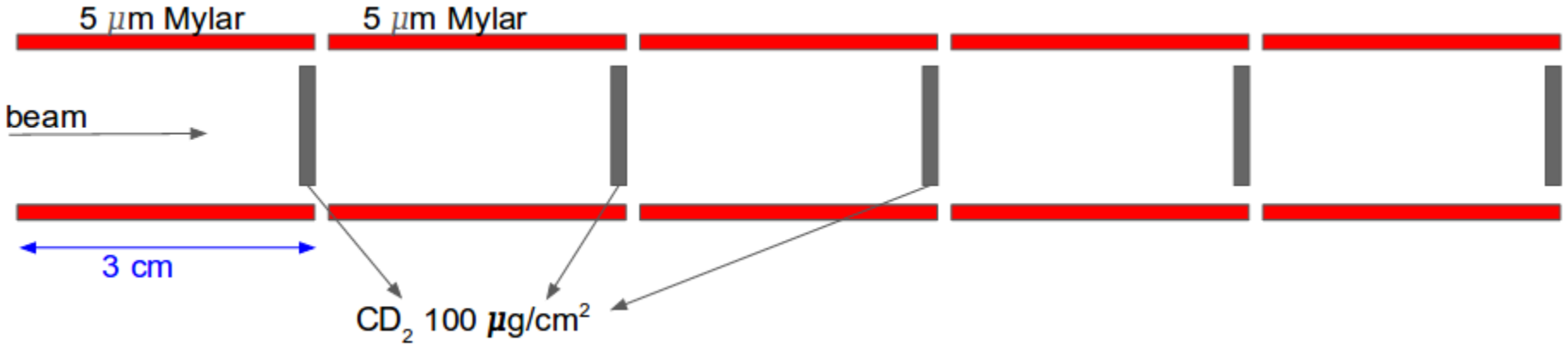




- Packing 15 triple clusters
- Expected efficiency ~ 10%

Superconducting Solenoid + Germaniums

2. Target thickness

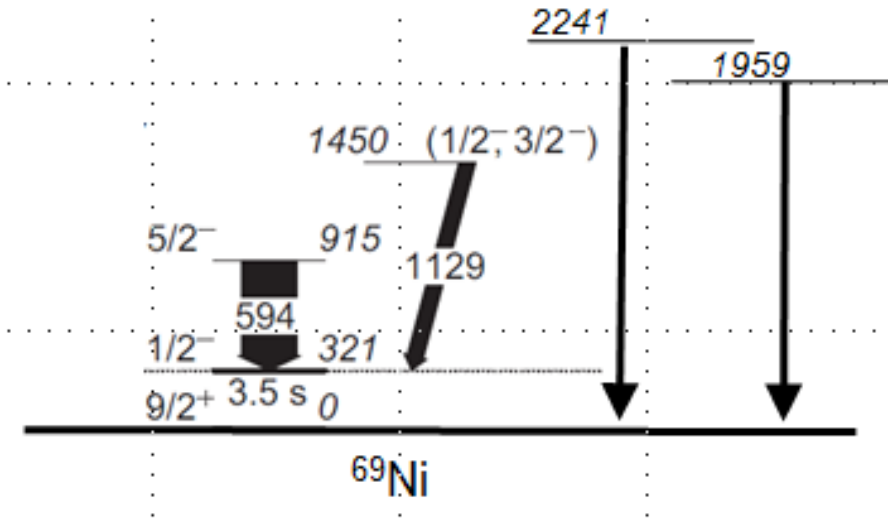


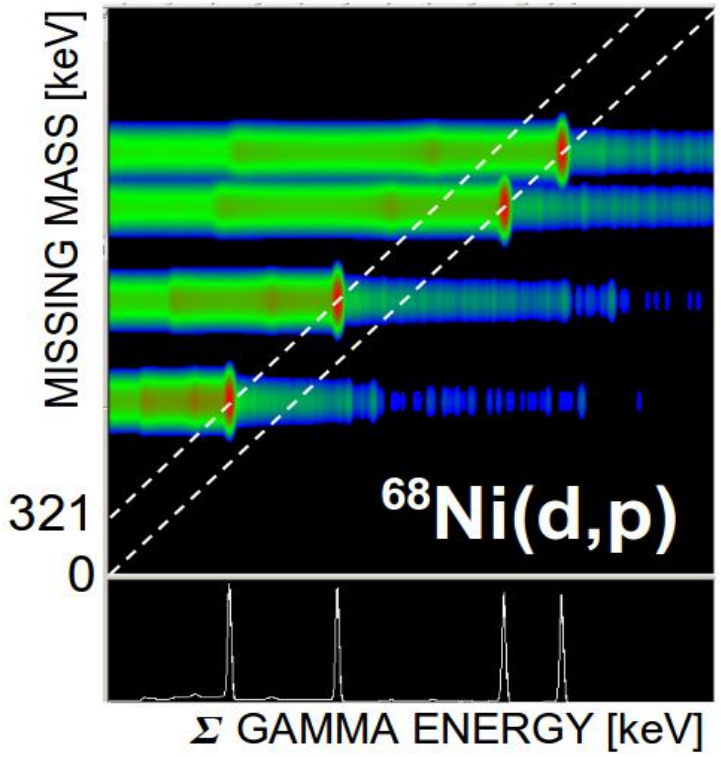
CATS:

- **windows: 1.5 um + catodes = 5 um of mylar total**
- **5 µm of mylar → 150 keV energy loss for protons**

Superconducting Solenoid + Germaniums

3. Excitation vs Deexcitation

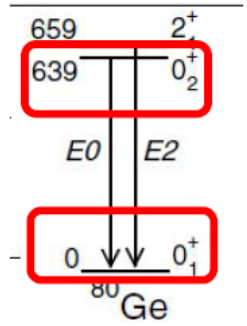


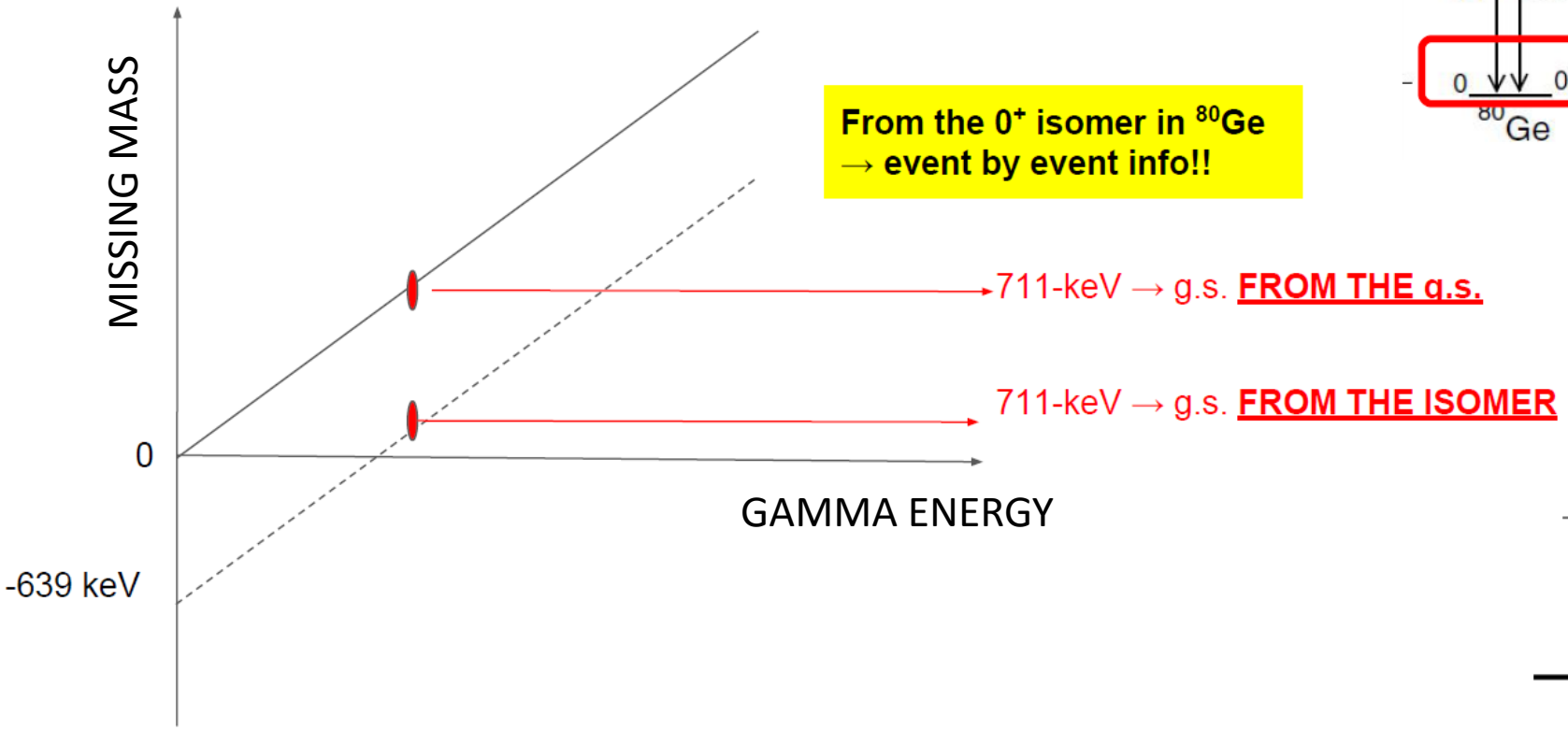


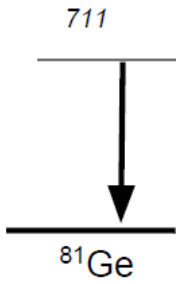
- **Anti-Compton gate**
- **Feeding to isomers**

Superconducting Solenoid + Germaniums

4. Isomers



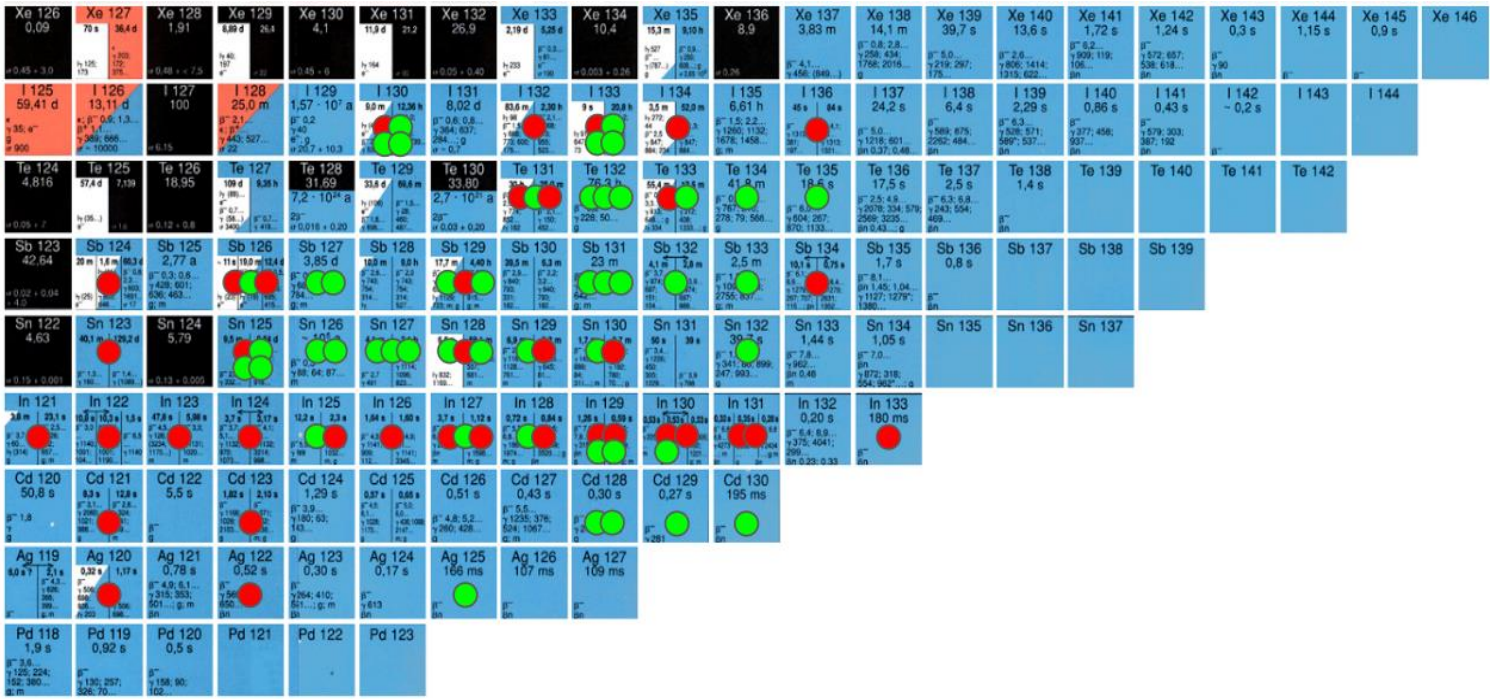




Superconducting Solenoid + Germaniums: nuclear structure

Isomers:

- > 100 ms
- < 100 ms



- Spectroscopic factors
- Lifetime measurements: feeding under control
- Neutron unbound states

Superconducting Solenoid + Germaniums: nuclear astrophysics

- ^{79}Se(d, pγ)^{80}Se used as a **surrogate** for the ^{79}Se(n,γ) reaction
- **long lived isomer** in ^{79}Se that will be present in the secondary beam
- together with the ^{79}Se sitting on the ground state.

Superconducting Solenoid + Germaniums: fundamental symmetries

^{229}Pa: Previously studied w/ ^{231}Pa(p,t) → (p,p')?

A.I. Levon et al./Nuclear Physics A 576 (1994) 267–307

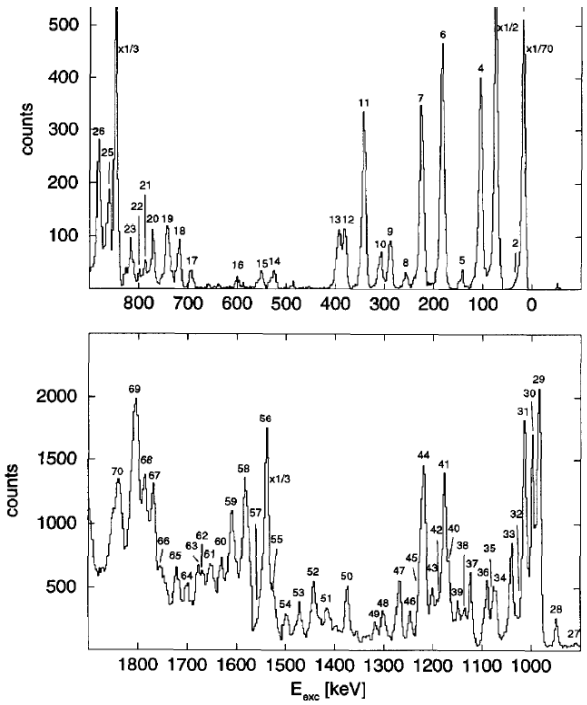
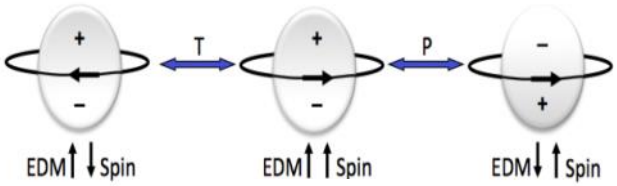


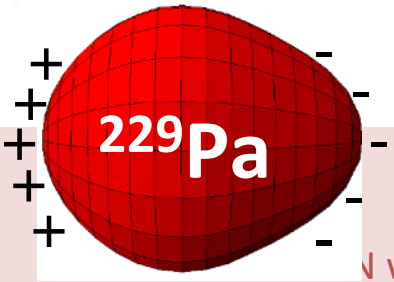
Fig. 1. Triton spectrum from the ^{231}Pa(p,t)^{229}Pa reaction at E_p = 22 MeV and θ = 45°. The peaks are numbered according to Table 1.

Permanent electric dipole moments in atoms

Beyond the Standard Model

- Dominance of matter over antimatter (CP violation)
- ^{225}Ra, ^{223}Rn, ^{229}Pa are special (several thousand times more sensitive than ^{199}Hg)





→ NUPRASEN-SPES workshop
"Probing fundamental symmetries and interactions by low energy excitations with RIB"
Pisa, December 2017- January 2018

Conclusions

- Physics at future RIBs facilities:
  - SPES
  - ISOLDE
  - …
- Physics opportunities
  - **New setups** will be the key to access new physics
  - Open to collaborations: **you are welcome**!