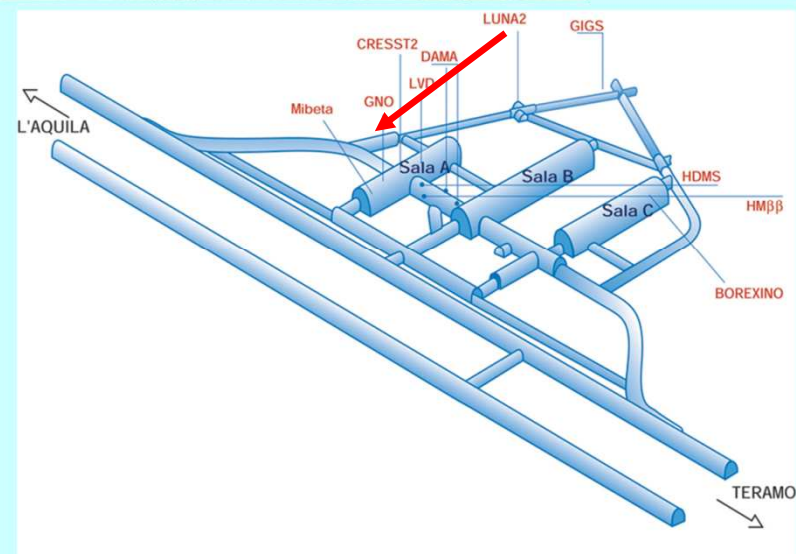
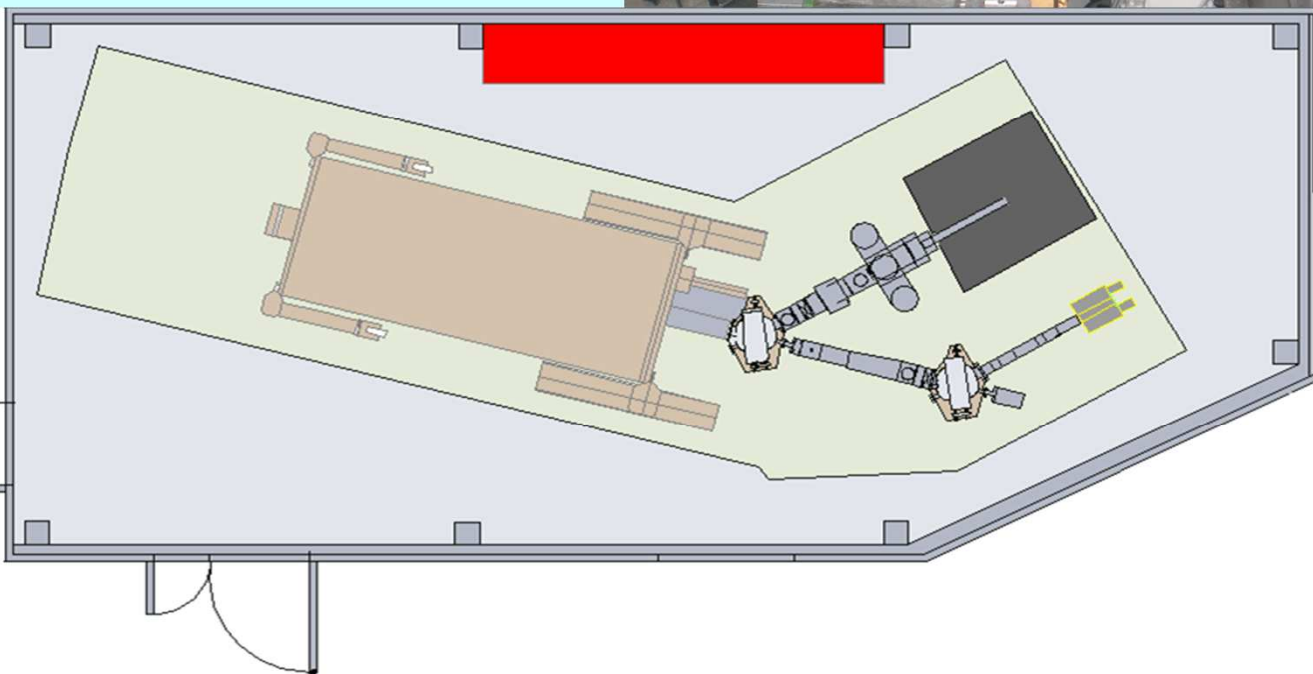
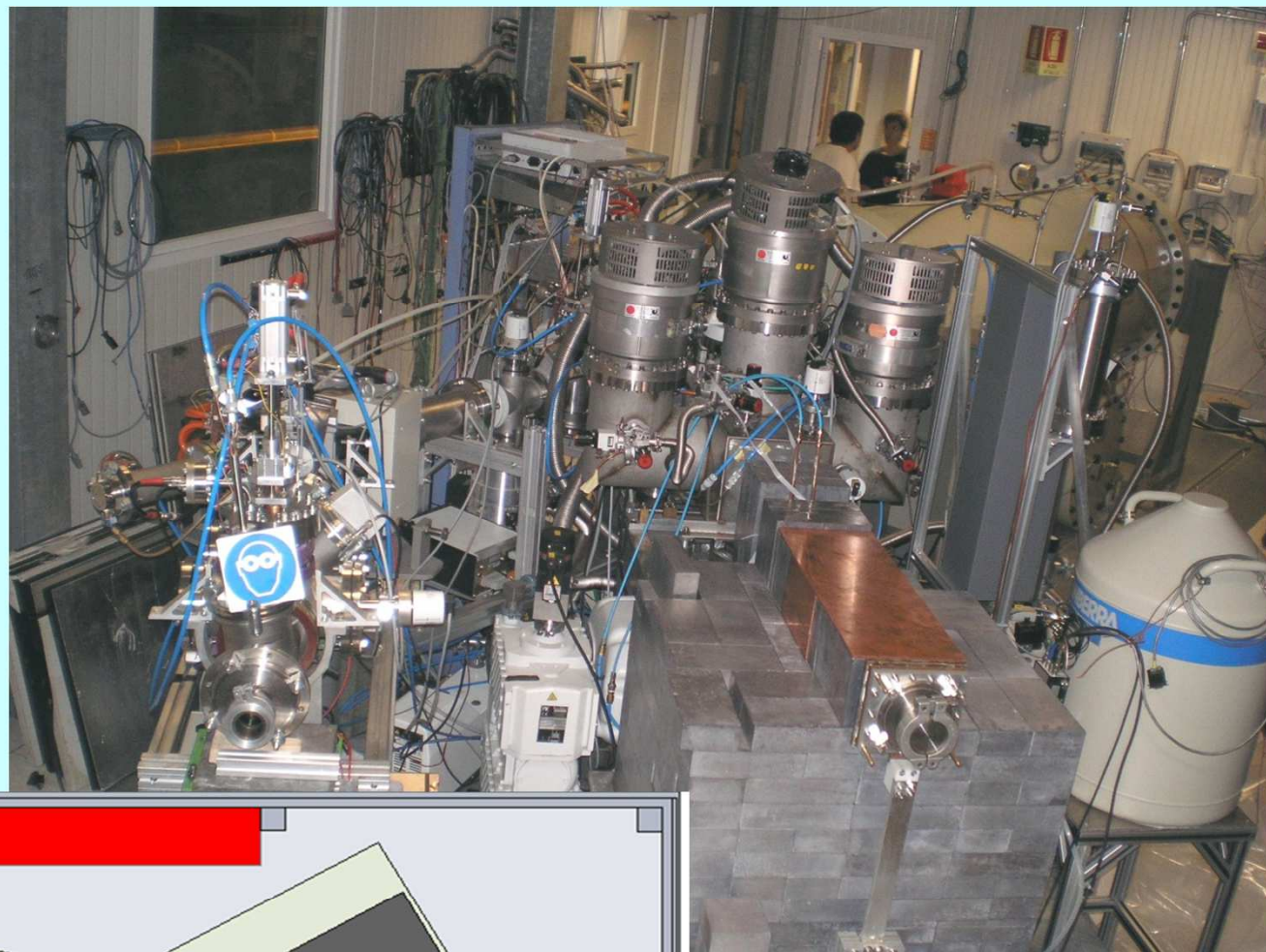


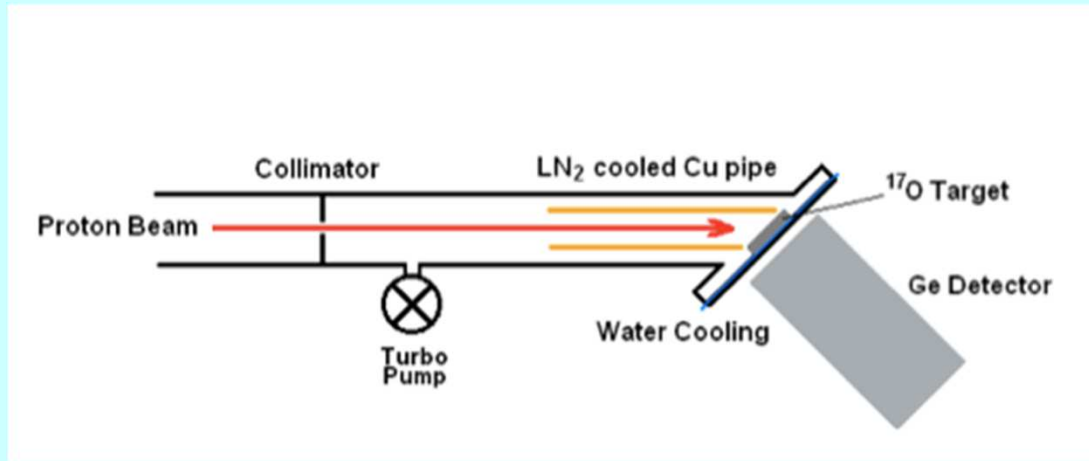
Laboratory  
Underground  
Nuclear  
Astrophysics

LUNA



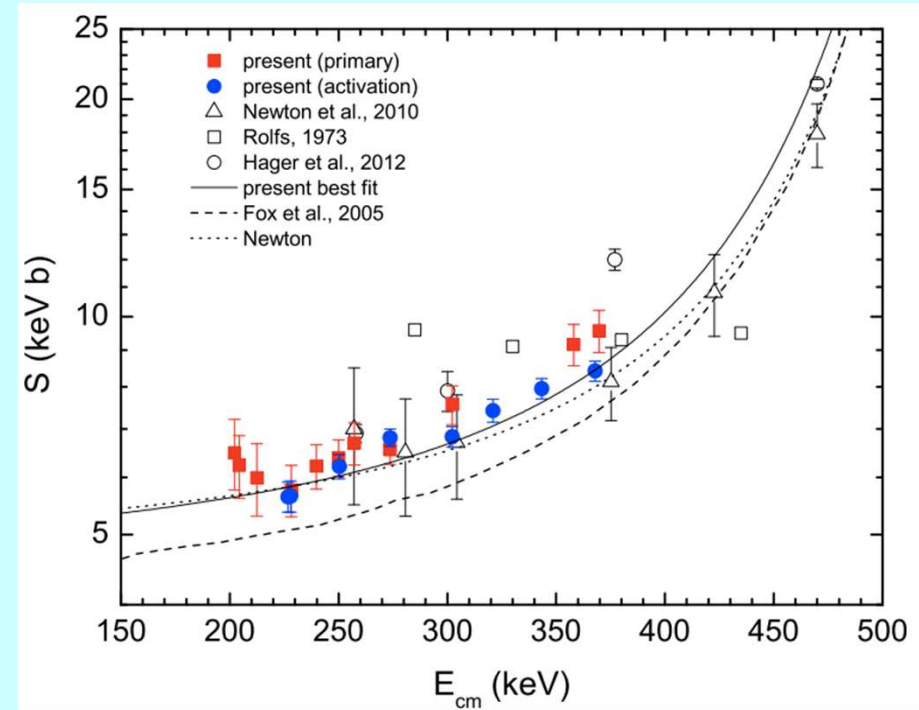
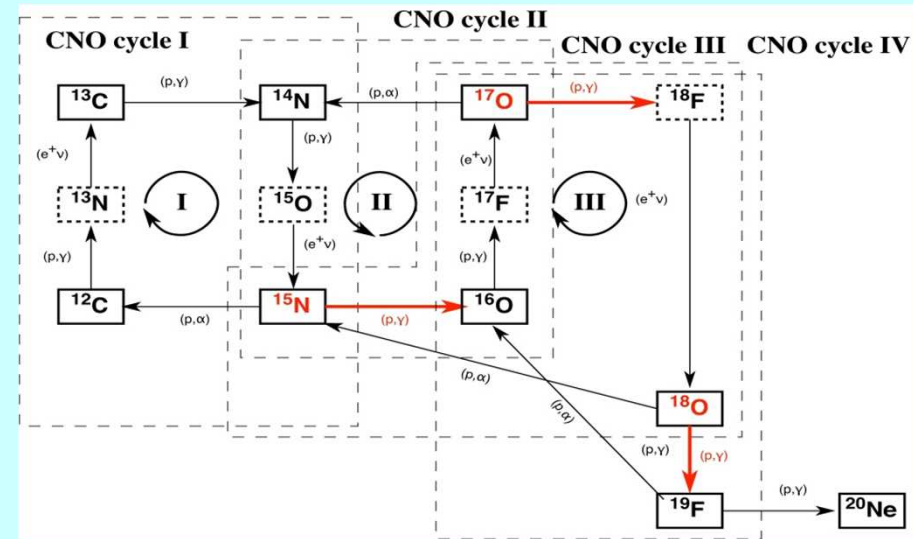


Abbondanze isotopiche Ossigeno (eccesso  $^{17}\text{O}$  in meteoriti), sintesi  $^{18}\text{F}$  nelle Novae (osservabile), produzione  $^{19}\text{F}$  via  $^{18}\text{O}(p,\gamma)^{19}\text{F}$  e connessione ciclo Ne-Na via  $^{19}\text{F}(p,\gamma)^{20}\text{Ne}$



Attività Padova:  
studio composizione bersagli e misure attivazione

S-factor misurato sino a 200 keV, picco di Gamow delle Novae coperto completamente  
Errore ridotto di un fattore 4

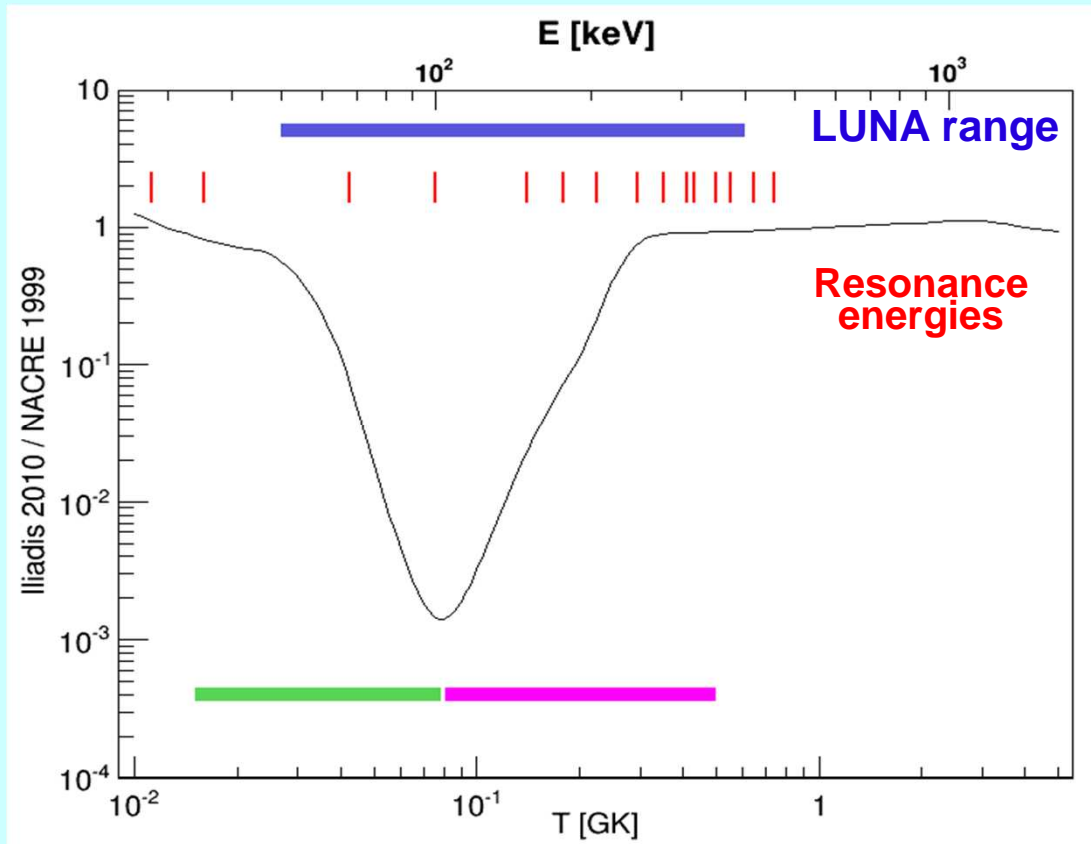


- \* A.Cacioli, D.Scott et al., EPJ A 48, 10, article 144
- \* D.Scott, A.Cacioli et al., Phys. Rev. Lett. 109.202501

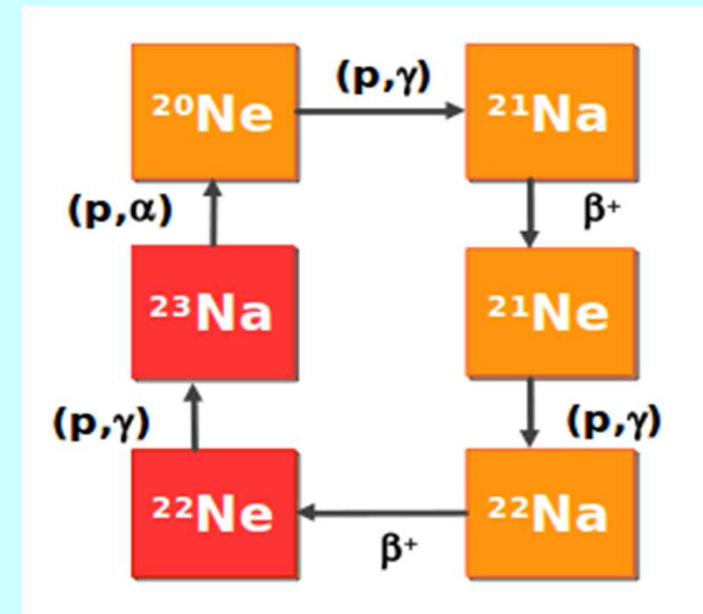
$^{22}\text{Ne}(p,\gamma)^{23}\text{Na}$   $Q=8.8\text{ MeV}$

Tesi dottorato R. Depalo+  
tesi specialistica A. Slemmer

- \* Produzione isotopi in RGB, AGB, Classical Novae
- \* Abbondanza  $^{22}\text{Ne}$ , sorgente neutroni nelle stelle



RGB & AGB    NOVAE

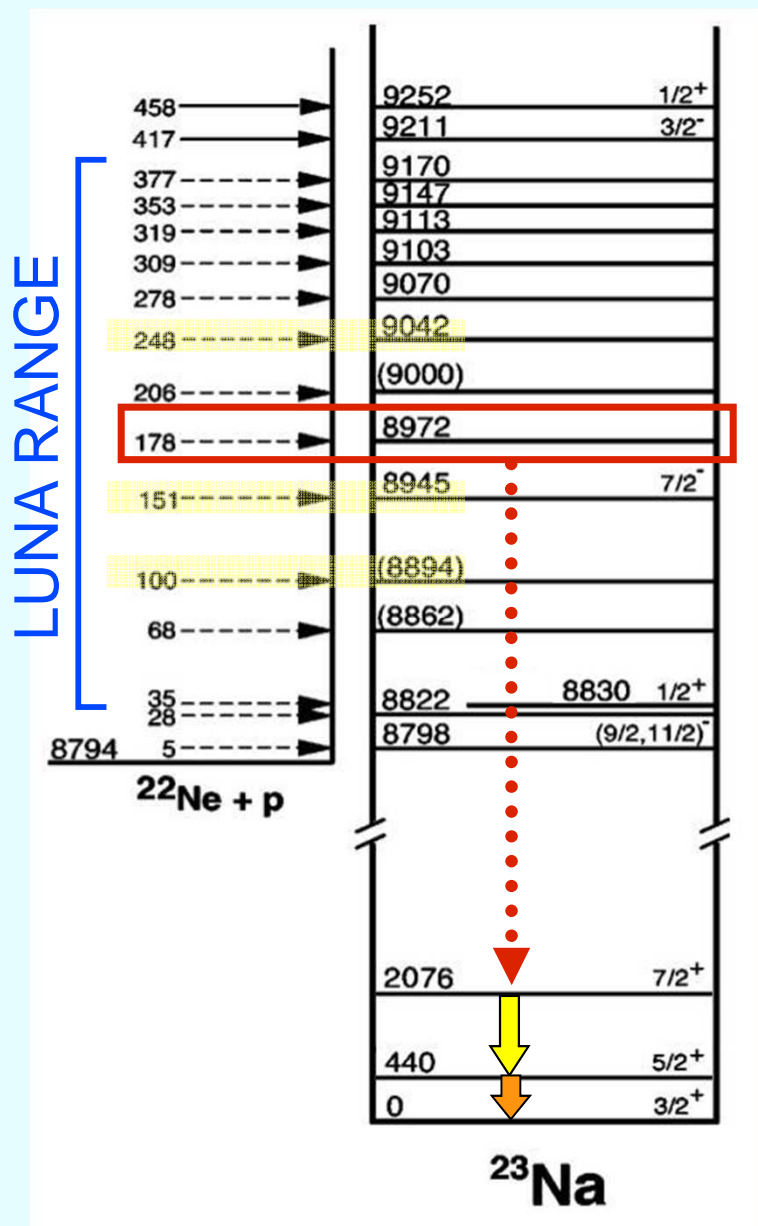


- Already performed run with natural Ne gas target
  - 90.48%  $^{20}\text{Ne}$
  - 0.27%  $^{21}\text{Ne}$
  - 9.25%  $^{22}\text{Ne}$
- Target pressures between 0.6 and 2.5 mbar
- Proton beam energies between 120 and 400 keV; beam current  $\sim 120\ \mu\text{A}$
- HpGe detector in close geometry

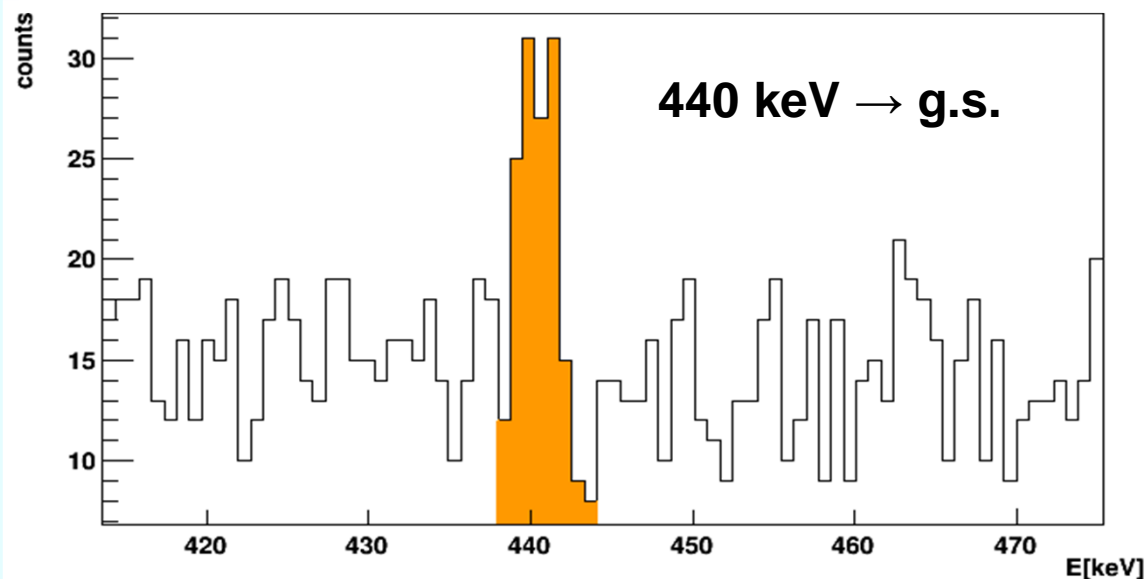
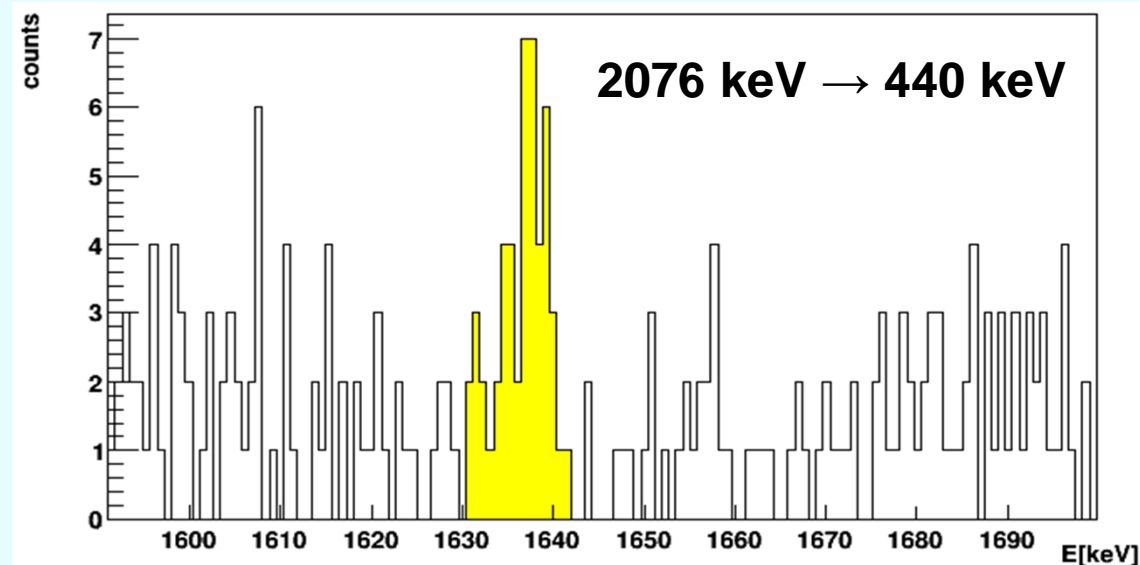
Misure ad alta energia condotte a Dresda in giugno



# First test run at LUNA

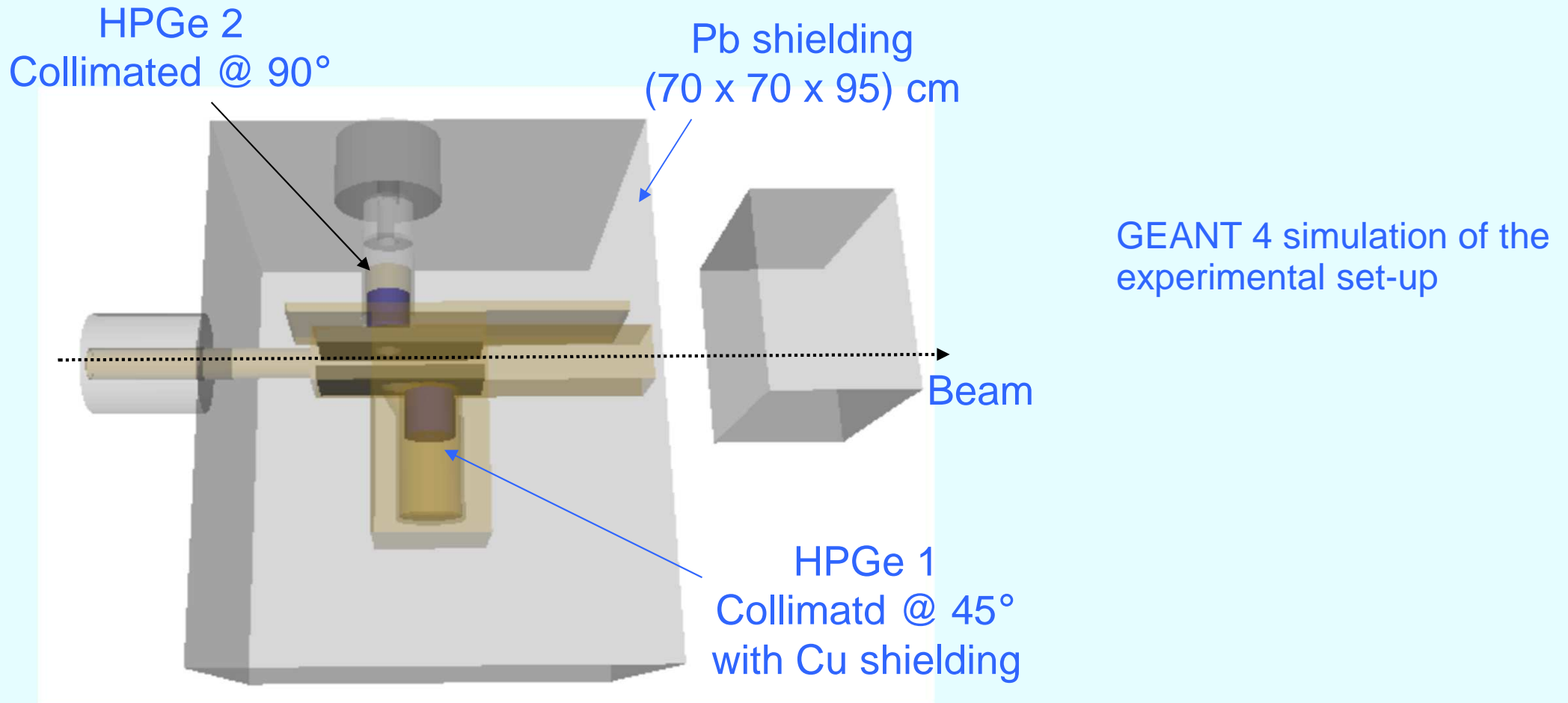


The  $^{22}\text{Ne}(p,g)^{23}\text{Na}$  resonance at  $E=178\text{keV}$  has been observed for the first time.



# Setup for $^{22}\text{Ne}(p, \gamma)^{23}\text{Na}$ resonances study

(data taking starting in late 2013)



~ 4 orders of magnitude reduction in environmental background compared to the unshielded detectors

Next phase: down to very low energy with BGO detector

# LUNA-MV

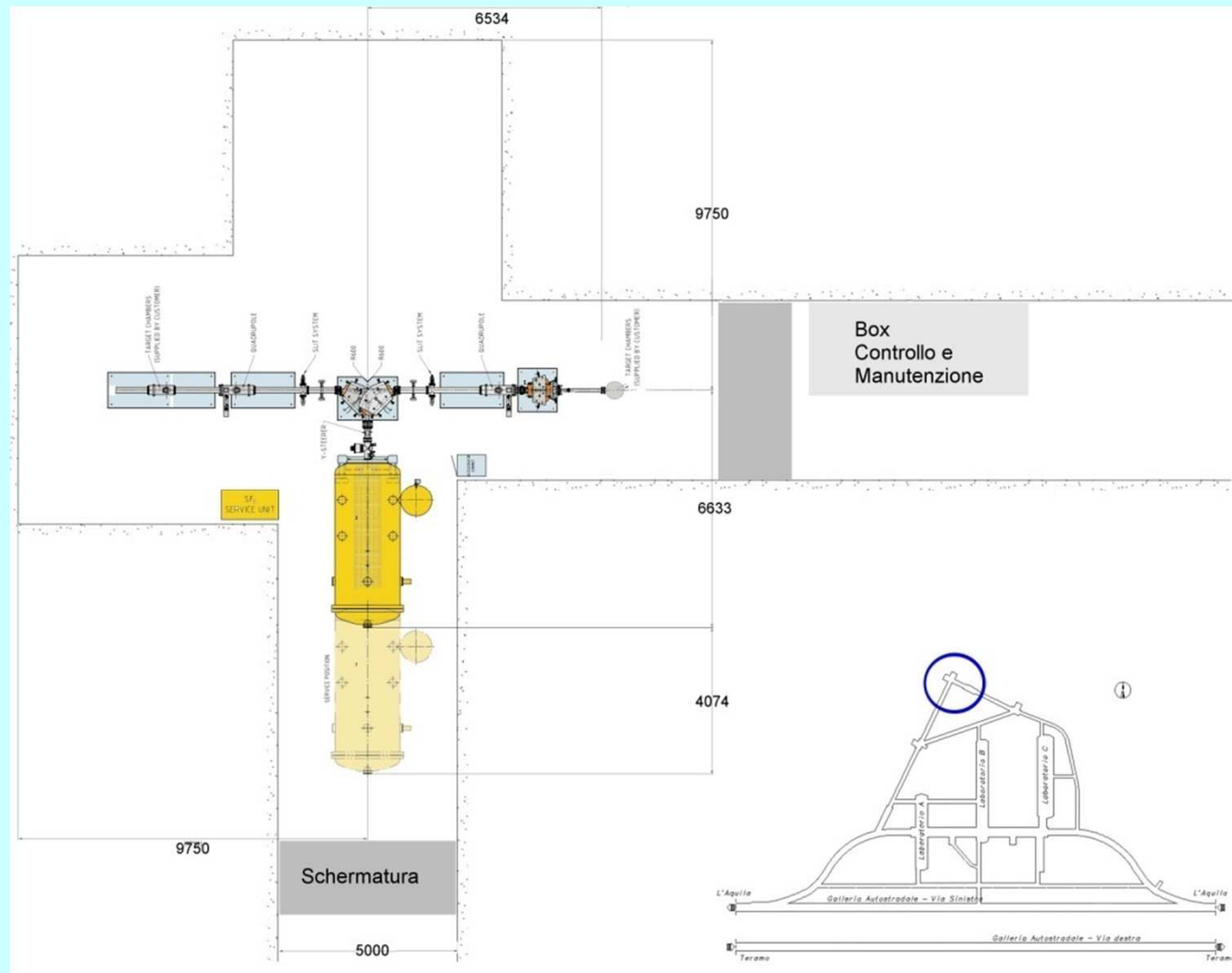
**6/2012:** premiale di 2.8 ME (totale progetto 6.4 ME in 5 anni) per acceleratore, preparazione sito, shielding, linea fascio sino magnete

**2/2013:** 'Starting up the LUNA Collaboration' @ LNGS

Nuova partecipazione padovana (esperti evoluzione stellare): P.Marigo, L.Girardi, A.Bressan

Nodo interferometrico liberato, in attesa permesso causa presenza captazione acqua

Esperimento al CN di Legnaro (CarTa): studio pulizia in C dei supporti per bersagli



# Astrofisica Nucleare @LNL

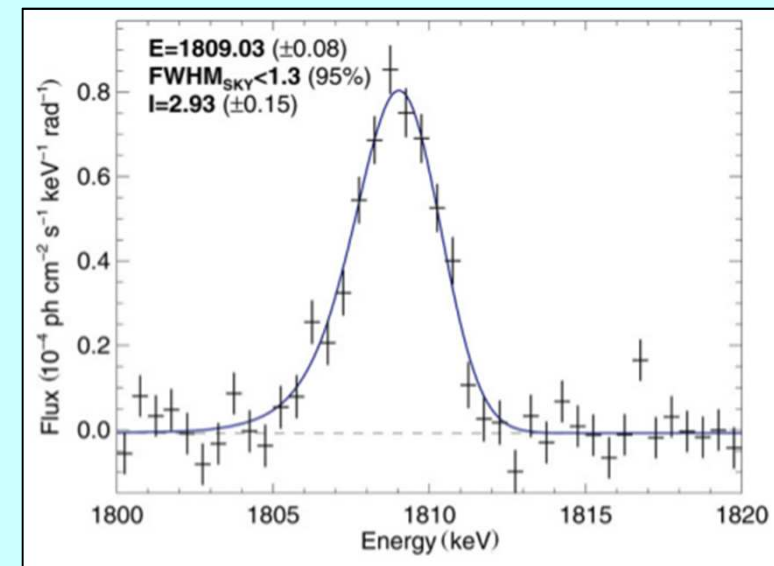
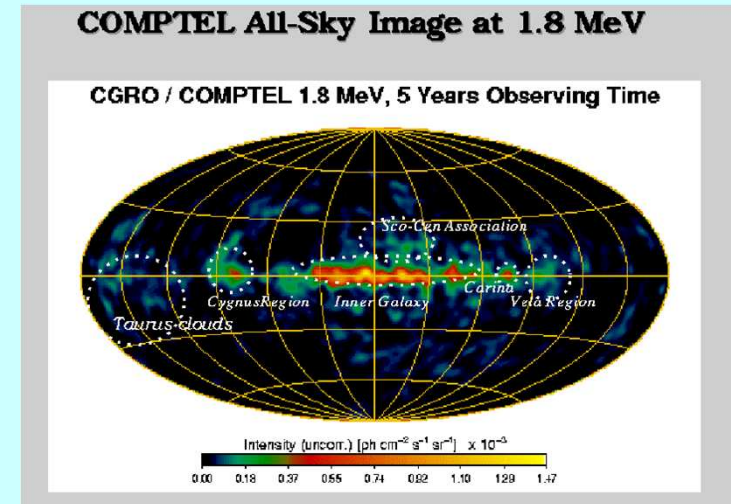
\* Vita media dello stato a 6.79 MeV di  $^{15}\text{O}$  con il Doppler Shift Attenuation Method usando il dimostratore di AGATA: fine analisi prossima

\* Astro-25Mg:  $^{25}\text{Mg}(\alpha, n)^{28}\text{Si}$  study at stellar energies with the CN accelerator, A.Cacioli e T.Marchi  
- Maggior fonte di incertezza sul calcolo dell'abbondanza di  $^{26}\text{Al}$  durante la combustione esplosiva C/Ne ( $T \sim 2.3 \text{ GK}$ ,  $E: 2.5\text{-}5 \text{ MeV}$ )  
- Due runs con apparato Ripen nel 2012

Analisi in fase avanzata (tesi magistrale di M.Leone 26/6)

Progetto FIR di A.Cacioli:  $^{25}\text{Mg}(\alpha, n)^{28}\text{Si}$  e  $^{23}\text{Na}(\alpha, n)^{26}\text{Al}$

\* Astro-10B:  $^{10}\text{B}(\alpha, n)^7\text{Be}$  proposal @AN2000  
interesse x combustibili nucleari e prima misura con gruppo Catania (Trojan Horse)



R. Diehl Rep. Prog. Phys. 76, 026301 (2013)

# Experimental setup at LNL

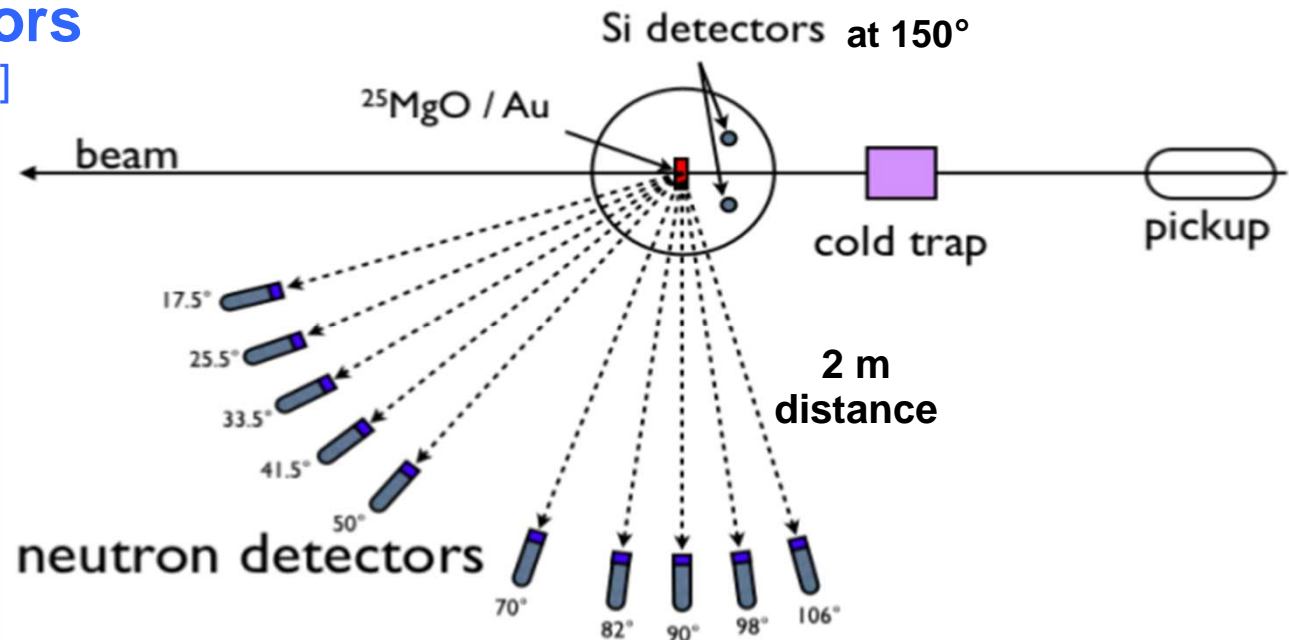
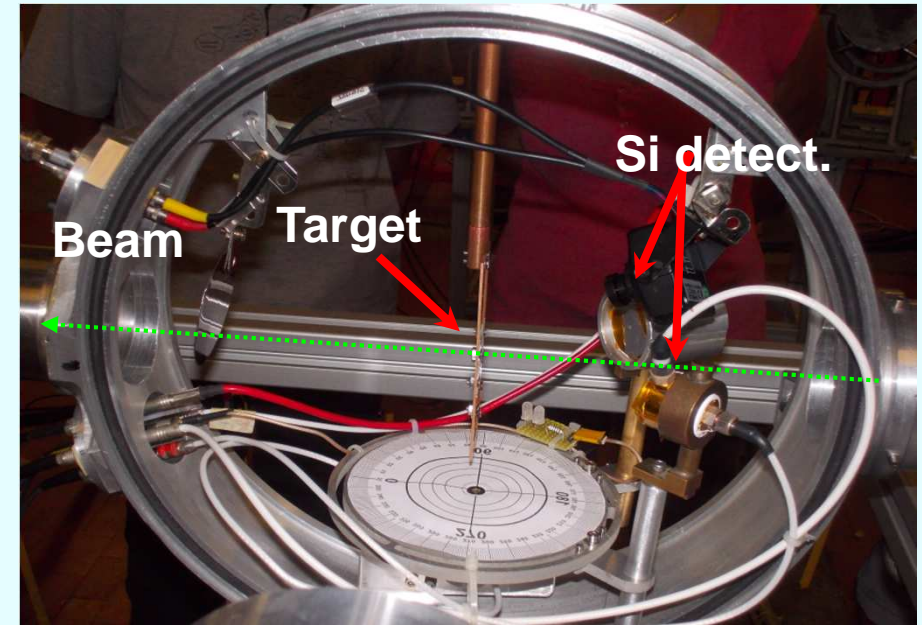
- ➔ **CN accelerator, Pulsed  $\alpha$  beam**
  - $E_{\alpha} = 3; 3.5; 4; 4.5; 5$  MeV
  - $I \sim 200$  nA
  - 2 ns bunches, repetition rate = 1/ 333ns

- ➔ **MgO target (70 mg/cm<sup>2</sup>, 95.75% <sup>25</sup>Mg) evaporated on Au (1 mg/cm<sup>2</sup>)**

- ➔ **10 RIPEN neutron detectors**  
[N. Colonna et al., NIM A 381 (1996)]

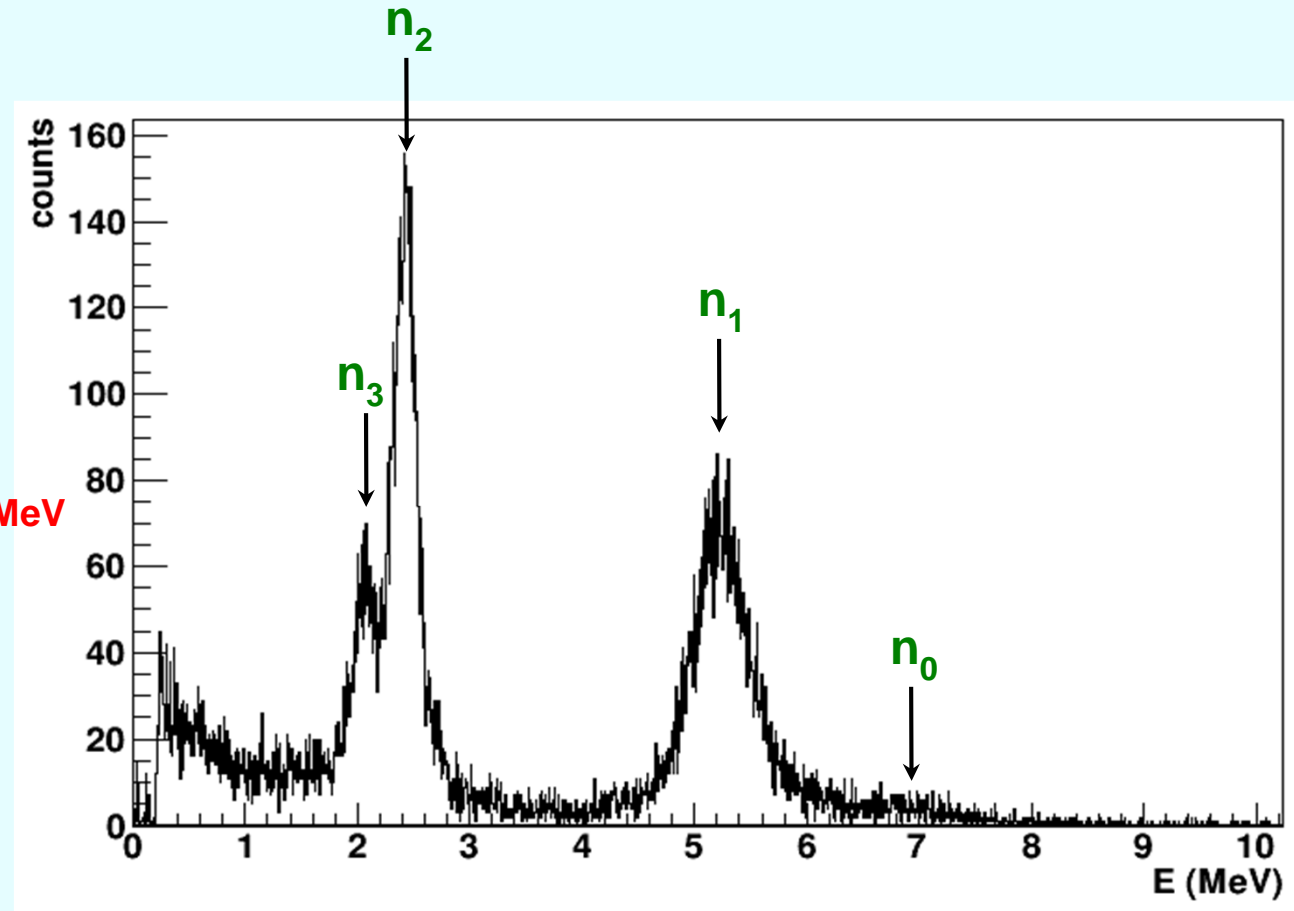
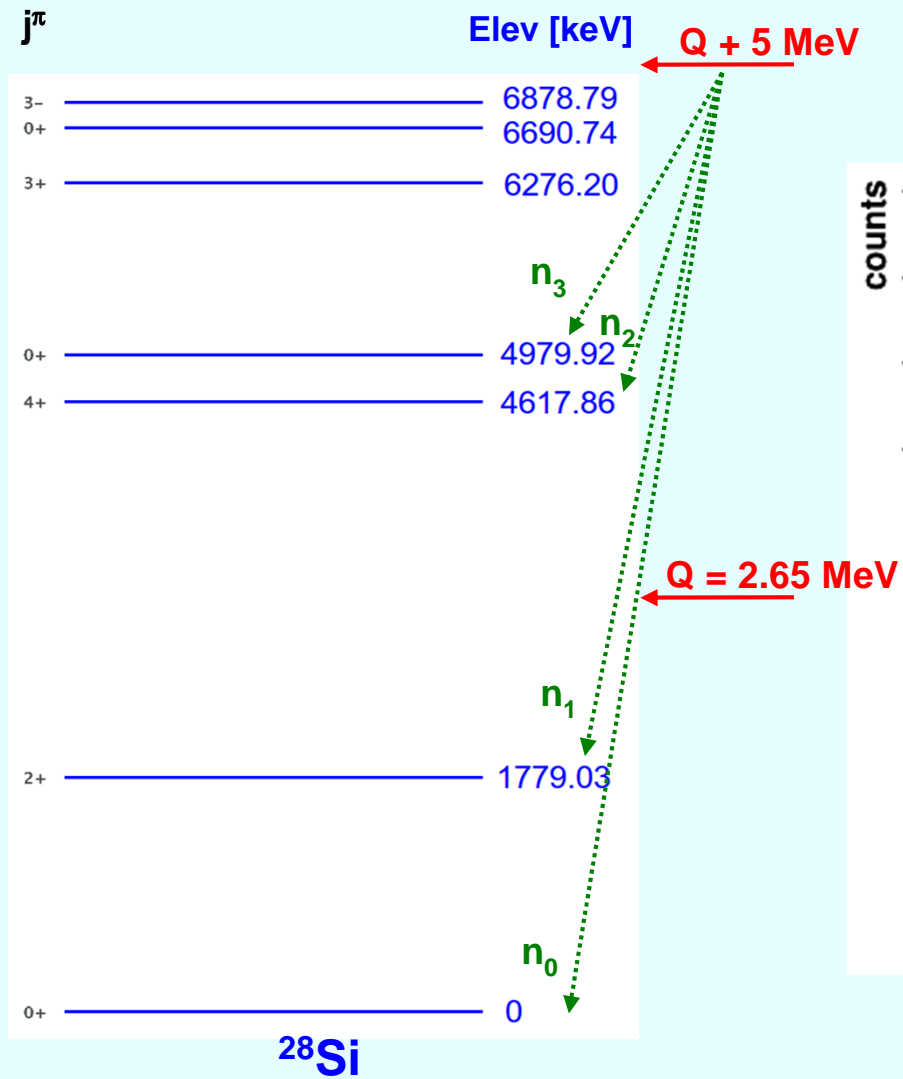
- $0 < \theta < 106^{\circ}$
- Efficiency  $\sim 25\%$
- Neutron energy from TOF

- ➔ **2 LaBr<sub>3</sub>:Ce detectors**





# Preliminary results: $E_{\alpha} = 5 \text{ MeV}$



## Articoli LUNA pubblicati nell'ultimo anno:

- \* A.Caciolli, D.Scott et al., EPJ A 48, 10, article 144
- \* D.Scott, A.Caciolli et al., Phys. Rev. Lett. 109.202501
- \* M.Anders et al., EPJ A 49, 2, article 28
- \* O.Straniero et al., APJ 763, 2, article 100

## Gruppo Padova:

C. Brogginini 80%, A. Caciolli 100%, R. Depalo 100%, R. Menegazzo 40% **3.2 FTE**

**Missioni: 30 kE** commissioning al Gran Sasso+turni misura (20 sett. 25 kE), meetings+gruppi di lavoro+LUNA-MV (4 kE), misure ancillari a Legnaro (1 kE)

**Consumo: 10 kE** 5 litri di  $^{22}\text{Ne}$  (99.9%) (6 kE), filtro per purificatore SAES-Getters (4 kE)

**Inventariabile: circa 25 kE** per sistema acquisizione BGO

**Totale: 65 kE**

Elettronica: 1 m.u., Meccanica: 1 m.u., Progettazione: 0.5 m.u.