

THE LUNA PROJECT AT GRAN SASSO : RECENT RESULTS ABOUT THE EARLY UNIVERSE AND FUTURE PERSPECTIVES

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LUNA



LUNA (Laboratory for Underground Nuclear Astrophysics)

25 YEARS OF ACTIVITY @ LNGS, 50 KV /400 KV ACCELERATORS

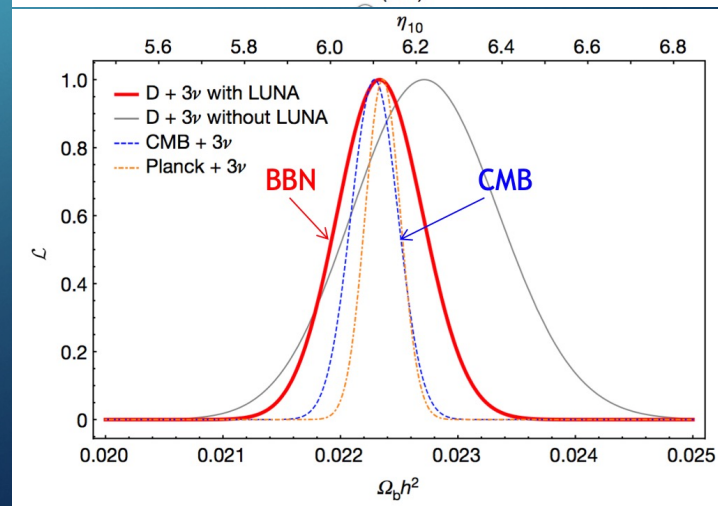
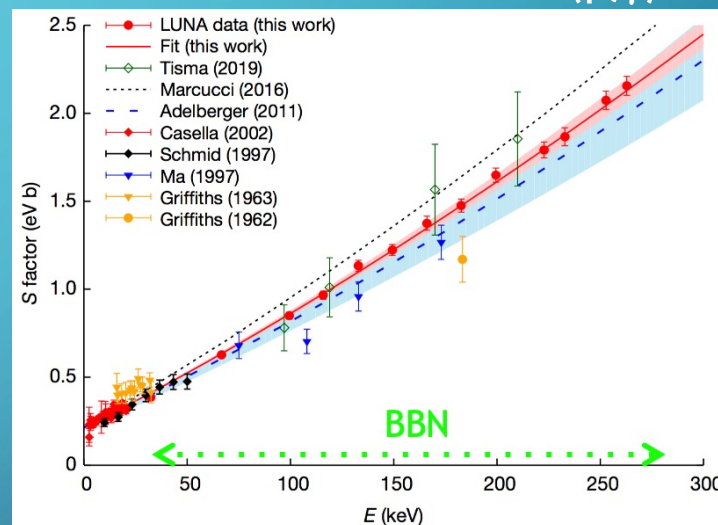
H BURNING



$E_{\text{beam}} \approx 50 - 400 \text{ keV}$
 $I_{\text{max}} \approx 500 \mu\text{A}$ protons
 $I_{\text{max}} \approx 250 \mu\text{A}$ alphas
 Energy spread $\approx 100 \text{ eV}$
 Long term stability $\approx 5\text{eV/h}$

Radiation	LNGS/surface
Muons	10^{-6}
Neutrons	10^{-3}
Gammas	$10^{-2}-10^{-5}$

Recent result about BBN $d(p,\gamma)^3\text{He}$



LUNA – 400 KV : NEXT GOALS

Bridge proposal

(reactions under study:



$^{12}\text{C}/^{13}\text{C}$ abundance ratio

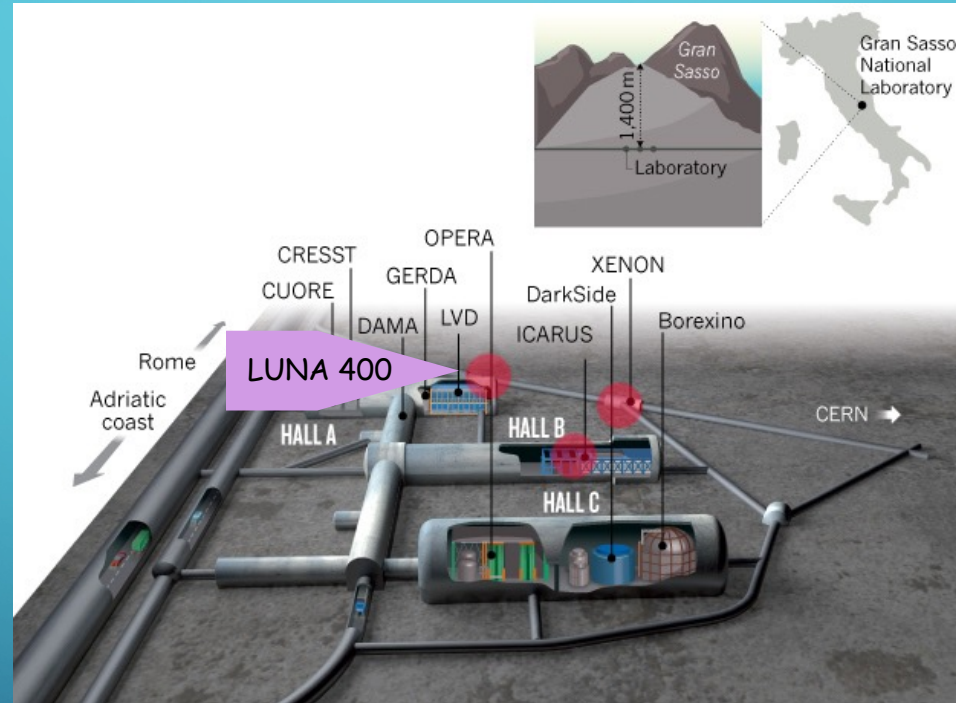


Abundance ratios of $^{18}\text{O}, ^{17}\text{O}, ^{16}\text{O}$

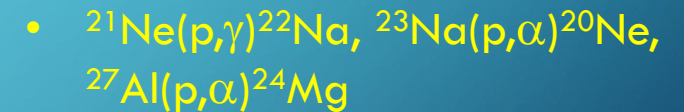


Speed of Ne-Na cycle

2021 presently under measurement..



New Letter of Intent



Ne-Na-Mg-Al isotopes abundance



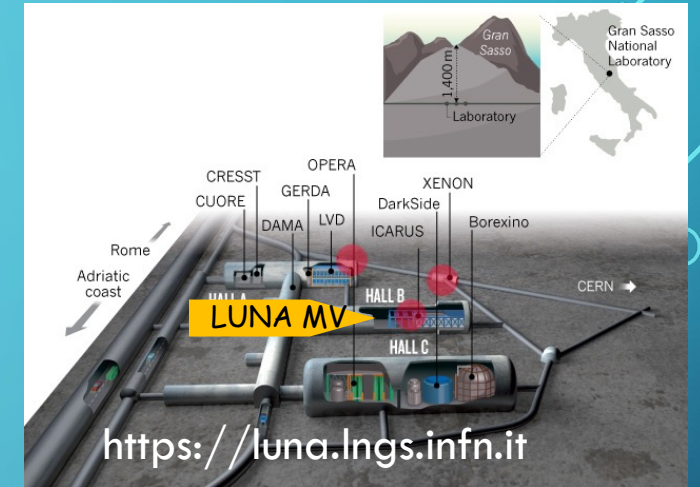
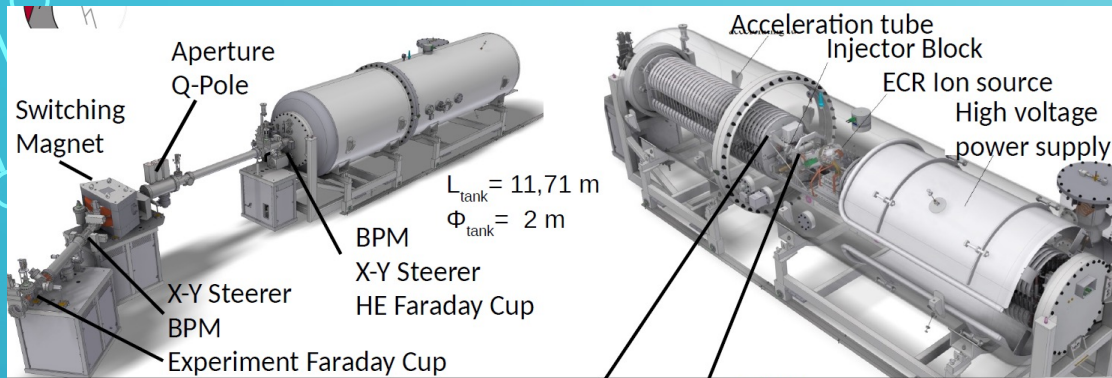
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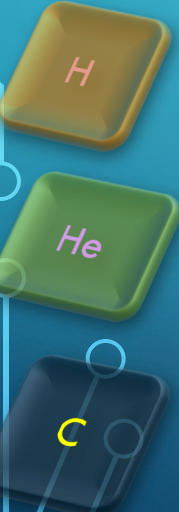
Speed of CNO cycle,
dredge up in AGB stars

2022-23

LUNA 3.5 MV : HE AND C BURNING



<https://luna.lngs.infn.it>



- $^1\text{H}^+$ (TV: 0.3 – 0.5 MV): 500 μA
- $^1\text{H}^+$ (TV: 0.5 – 3.5 MV): 1000 μA
- $^4\text{He}^+$ (TV: 0.3 – 0.5 MV): 300 μA
- $^4\text{He}^+$ (TV: 0.5 – 3.5 MV): 500 μA
- $^{12}\text{C}^+$ (TV: 0.3 – 0.5 MV): 100 μA
- $^{12}\text{C}^+$ (TV: 0.5 – 3.5 MV): 150 μA
- $^{12}\text{C}^{++}$ (TV: 0.5 – 3.5 MV): 100 μA

- Inline Cockcroft Walton accelerator
- ECR ion source
- **TERMINAL VOLTAGE: 0.2 – 3.5 MV**
- Precision of terminal voltage reading: 350 V
- Beam energy reproducibility: 0.01% TV
- Beam energy stability: 0.001% TV / h
- Beam current stability: < 5% / h

Long-lasting experimental project in front of us... !!

First 5 years proposal:

- $^{14}\text{N}(p,g)^{15}\text{O}$ test & calib
 - $^{12}\text{C}(^{12}\text{C},p)^{23}\text{Na}$
 - $^{12}\text{C}(^{12}\text{C},\alpha)^{20}\text{Ne}$
 - $^{13}\text{C}(\alpha,n)^{16}\text{O}$
 - $^{22}\text{Ne}(\alpha,n)^{25}\text{Mg}$
- } C burning
- } n for s-process in AGB stars

A.Best : ERC starting grant!!!

..and later on : $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$