Editorial

25 YEARS ON:
A NEW BEGINNING

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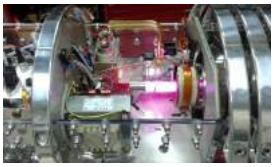

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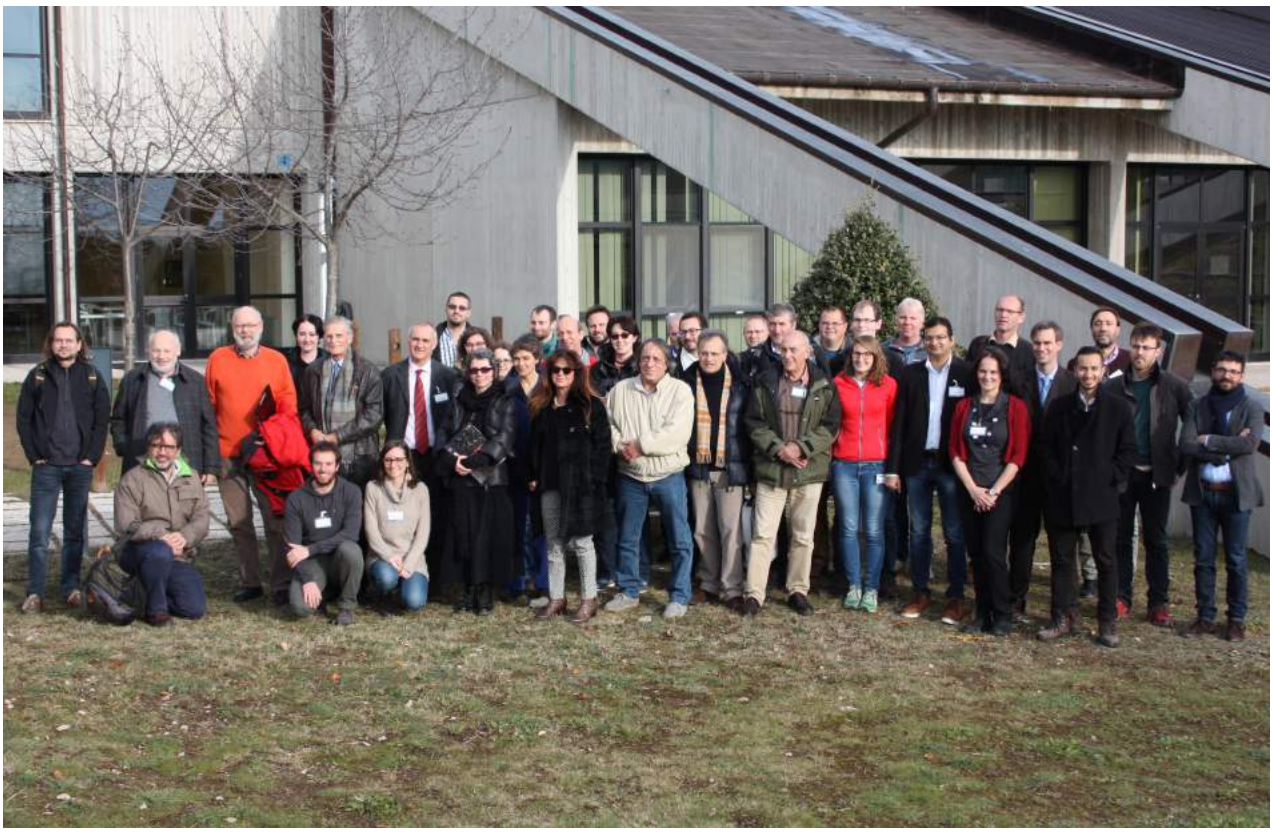
LUNA NEWSLETTER

LABORATORY FOR UNDERGROUND NUCLEAR ASTROPHYSICS



LUNA Silver Moon Workshop

Celebrating 25 years of activity at LUNA

BY PAOLO PRATI

Underground nuclear astrophysics was born 25 years ago in the heart of the Gran Sasso mountain in Italy, from a visionary idea of Enrico Bellotti, Gianni Fiorentini and Claus Rolfs. They realised that an underground laboratory would provide an ideal environment to detect rare events from astrophysical reactions thanks to the million-fold reduction in cosmic-ray induced background at the Laboratori Nazionali del Gran Sasso, INFN.

The LUNA (Laboratory for Underground Nuclear Astrophysics) Collaboration started its

The Silver Moon Workshop took place at Gran Sasso (Italy) on 1-2 December 2016 to celebrate the first 25 years of activities at LUNA

25 Years On: A New Beginning

As the LUNA Collaboration celebrates the first 25 years of its scientific activities and reflects on the successes and milestones achieved so far, a new beginning looms at the horizon with the acquisition of the new accelerator, LUNA MV.

The facility will open up new and exciting opportunities to investigate key reaction of helium and carbon burning in stars at the lowest energies achievable. This, we hope, will contribute to unravel the mysteries in the creation of the elements and provide much needed experimental information on some of the most intriguing phases of stellar evolution and nucleosynthesis.

To mark this new beginning, we thought it would be appropriate to launch a LUNA Newsletter, which we plan to issue once a year in December.

The Newsletter will be our way to update the nuclear astrophysics community about what happens in our laboratory, what we are planning for the future, and who is who in the collaboration.

We hope you will enjoy it!

Prof Marialuisa Aliotta, Chair of the LUNA Editorial Board

activity with a home-made 50kV accelerator. The extremely low background allowed to access for the first time the low-energy frontiers (Gamow peak) of hydrogen burning in the Sun and made it possible to measure extremely low count rates (down to a few events per month) previously thought to be beyond technical capabilities.

With the acquisition of a 400 kV accelerator in 2002, a rich program of experimental work spanning several years was then devoted to study the nuclear reactions involved in Big Bang nucleosynthesis and in the creation of elements through the CNO, Mg-Al and Ne-Na cycles in different stars and under different burning conditions. LUNA's pioneering experiments have paved the way to major breakthroughs in our understanding of the inner working of stars, the age of the Universe, and the ways in which new elements are created from primordial hydrogen and helium.

To celebrate its achievements to date, the LUNA Collaboration hosted an international **Silver Moon Workshop** which took place at Gran Sasso on December 1-2 2016 and attracted around 50 participants from all over the world. The workshop provided an opportunity for lively discussions including updates on other underground laboratories currently being developed in Spain, the US, and China.

Today, the LUNA Collaboration embarks on another exciting adventure with the installation of a new 3.5MV accelerator that will make it possible to study key reactions of astrophysical interest (some involving carbon beams) over extended energy regions. Initially, the scientific program at LUNA MV will focus on the helium burning processes that liberate neutrons for the synthesis of heavy elements, as well as on carbon fusion reactions for a better understanding of the late evolution of massive stars. Much work is already on going to prepare the installation site at LNGS and also to develop key instrumentation for the next phase of experimental activities.

Since the first pilot experiments took off in the early 1990s LUNA has become a pillar of the LNGS research. As we embark on our next 25 years of scientific explorations, we anticipate plenty of exciting opportunities for a new generation of nuclear astrophysicists. We take this occasion to welcome our most recent members and wish them every success and fun.

Top row from the left: Iza Kochanek, Laszlo Csedreki, Klaus Stoeckel, Viviana Mossa, Francesca Pantaleo. **Bottom row from the left**: Giovanni Ciani, Federico Ferraro, Francesca Cavanna, Rosanna Depalo, Denise Piatti.

NEWS FROM THE LABORATORY

A New Rate for the $^{22}Ne(p,\gamma)^{23}Na$ Reaction in AGB stars

BY ROSANNA DEPALO AND FRANCESCA CAVANNA

The $^{22}Ne(p,\gamma)^{23}Na$ reaction takes part in the neon-sodium cycle of hydrogen burning. This cycle affects the synthesis of the elements between ^{20}Ne and ^{27}Al in asymptotic giant branch stars and novae. The $^{22}Ne(p,\gamma)^{23}Na$ reaction rate was very uncertain because of a large number of unobserved resonances lying within the Gamow window. At proton energies below 400 keV, only upper limits for the resonance strengths existed in the literature.
A new direct study of the $^{22}Ne(p,\gamma)^{23}Na$ resonances below 400 keV proton energy was performed at LUNA. The proton capture on ^{22}Ne was investigated in direct kinematics, by delivering an intense proton beam onto a ^{22}Ne gas target; gamma rays were detected with two high-purity germanium detectors. Three resonances at 156.2 keV, 189.5 keV and 259.7 keV were observed for the first time and their strengths derived with a 2-7% uncertainty [1]. New gamma decay modes and branching ratios were also extracted. For three tentative resonances at 71, 105 and 215 keV, improved upper limits have been measured [2]. Our new, updated reaction rate is a factor of 5 higher than previous evaluations at temperatures relevant to novae and asymptotic giant branch stars nucleosynthesis [1,2]. Astrophysical implications are reported in [3].

PUBLICATIONS

[1] F Cavanna et al., Physical Review Letters 115, 252501 (2015), Editor's suggestion
[2] R Depalo et al., Physical Review C 94 (2016) 055804, Editor's suggestion
[3] A Slemer et al., Monthly Notices of the Royal Astronomical Society (2016) accepted

The $^{17}O(p,\alpha)^{15}N$ Reaction during CNO Hydrogen Burning

BY CARLO BRUNO

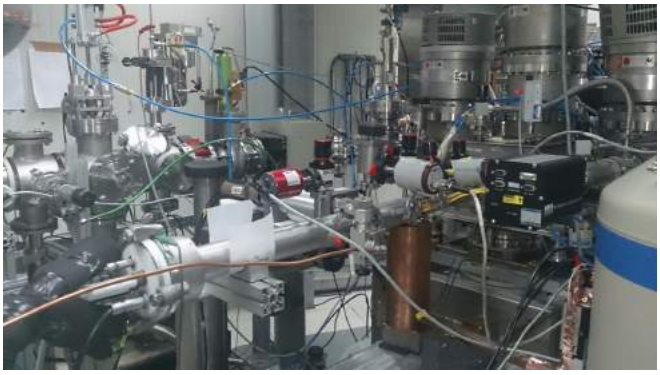
The $^{17}O(p,\alpha)^{14}N$ nuclear reaction plays a key role in a number of stellar sites where hydrogen burning occurs via the CNO cycle. At characteristic temperatures for core H-burning (all stars with $M \geq 1.5\ M_{\odot}$) and shell H-burning (red giants, asymptotic giant branch stars, and red supergiants), the $^{17}O(p,\alpha)^{14}N$ reaction rate is dominated by a resonance at E_{cm}=64.5 keV. The strength of this resonance was the focus of an in-depth study at LUNA. An intense (typically 150 μA) proton beam (E_p=70 keV) was accelerated onto a water-cooled solid Ta_2O_5 target enriched in ^{17}O. The alpha particles produced were detected at backward angles by an array of silicon detectors (shown in the Figure). Thanks to the background reduction achieved underground [1], we were able to measure the strength of this resonance with an unprecedented precision $\omega\gamma=10.0\pm1.4_{stat}\pm0.7_{syst}$ neV [2], leading to a stellar reaction rate being approximately a factor of 2 higher than previously measured at the relevant temperatures [2]. Our results imply a significant enhancement in the $^{16}O/^{17}O$ ratios expected from AGB stars and have a major impact on the interpretations of stardust grains [3] and ^{17}O stellar yields [4].

PUBLICATIONS

[1] CG Bruno *et al.*, European Physical Journal A 51 (2015) 94
[2] CG Bruno *et al.*, Physical Review Letters 117 (2016) 142502
[3] M Lugaro *et al.*, Nature Astronomy (2016) accepted
[4] O Straniero *et al.*, Astronomy and Astrophysics (2016) accepted

The Primordial Deuterium Abundance

BY DAVIDE TREZZI



Big Bang Nucleosynthesis (BBN) offers the most reliable probe of the early Universe. It is based on the well-known Standard Model of Particle Physics, the Cosmological Model and the cross sections of the nuclear processes involved. Using the more recently available experimental data, it is possible to calculate primordial abundances of light elements such as deuterium, helium and lithium. For what concerns deuterium, the uncertainty on the BBN calculated value D/H = (2.65 ± 0.07) x 10^{-5} [1] is larger than the one determined by astronomical observations D/H = (2.547±0.033) x 10^{-5} [2]. This discrepancy is essentially due to a relatively high systematic uncertainty on the $^{2}H(p,\gamma)^{3}He$ reaction cross section, presently about 6-10% in the BBN energy range. Thus, a new accurate and precise measurement of this cross section is needed.

LUNA has started measuring the $^{2}H(p,\gamma)^{3}He$ cross section at the beginning of 2016 using a windowless gas target and a high-efficiency segmented BGO detector. Data analysis is still in progress. In order to reduce the final systematic uncertainty as well as to measure both the total and the differential cross section, a second experimental campaign is now underway at LUNA, using a high-resolution high purity germanium detector. Data taking is planned to start at the beginning of 2017. Finally, a new accurate measurement of the $^{2}H(p,\gamma)^{3}He$ reaction cross section can also play a crucial role in the validation of theoretical ab-initio calculations, as demonstrated in [3].

REFERENCES

[1] E Di Valentino *et al.*, Physical Review D 90 (2014) 023543
[2] RJ Cooke *et al.*, The Astrophysical Journal 830 (2016) 148
[3] LE Marcucci *et al.*, Physical Review Letters 116 (2016) 102501

The Big Bang and the ^{6}Li Abundance

BY ROSANNA DEPALO

At variance with ^{7}Li, Cosmic Rays are the only known source of ^{6}Li, through spallation reactions on heavier nuclei. Since ^{6}Li is easily destroyed in stars through proton capture reactions at temperatures higher than 2.5 million K, the abundance of ^{6}Li in stars provides a powerful tool to understand early stellar evolution and the structure of stellar convective envelopes. The cross section of the $^{6}Li(p,\gamma)^{7}Be$ reaction is still highly uncertain at astrophysical energies. A new resonance-like structure at E_{cm}=195 keV was suggested in a recent experiment [1]. However, its existence is still debated and a new direct measurement of the $^{6}Li(p,\gamma)^{7}Be$ cross section needed. At LUNA, an intense (~200 μA) proton beam with energies E_{p}= 50 to 400 keV will be delivered onto a ^{6}Li-enriched solid target. The combined use of a silicon detector and a HPGe detector will allow us to measure the $^{6}Li(p,\gamma)^{7}Be$ and $^{6}Li(p,\alpha)^{3}He$ channels simultaneously. The data taking is planned to start in 2017.

REFERENCES

[1] JJ He *et al.* Physics Letters B 725 (2013) 287–291

Hydrogen Burning in Giant Stars and in Novae

BY GIANLUCA IMBRIANI

The CNO cycle is the most common H-burning process. It occurs in the core of main-sequence stars more massive than the Sun, in the H-burning shell of giant stars and in Nova events. At temperatures in excess of 70×10^6 K leakage from the CNO cycle may occur with the NeNa and MgAl cycles. Here, the $^{17}O(p,\gamma)^{18}F$, $^{18}O(p,\gamma)^{19}F$ and $^{23}Na(p,\gamma)^{24}Mg$ reactions play a key role through low-energy resonances that can directly influence the rate at the relevant astrophysical energies.

Measurements of the $^{18}O(p,\gamma)^{19}F$ reaction were performed over a broad energy range using both a high-resolution HPGe detector (E_p = 140 to 400 keV) and a high efficiency BGO detector (E_p = 90 to 400 keV). A large part of the BGO measurements focused on the study of a resonance at 95 keV beam energy, whose strength has been debated in the recent literature [1,2]. Preliminary results obtained from the underground measurements appear to be able to clarify this issue. For the $^{23}Na(p,\gamma)^{24}Mg$ reaction, both BGO and HPGe detectors were also used to investigate two strong resonances at proton energies 251 keV and 309 keV. Measurements with the BGO also aimed at searching for a resonance at 138 keV, expected to be weak but potentially relevant for astrophysics. A large contribution to the uncertainty of the absolute determination of the resonance strengths is due to the stoichiometry of the sodium targets. Studies of target stoichiometry with elastic recoil detection analysis have been performed at the Helmholtz-Zentrum Dresden-Rossendorf. Data analysis is on going.

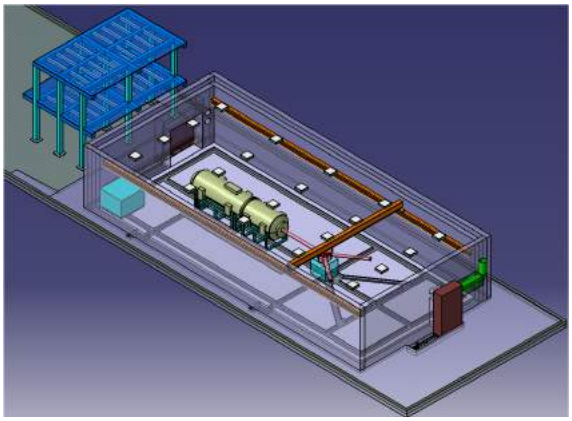
REFERENCES

[1] HT Fortune, Physics Review C88 (2013) 015801
[2] MQ Buckner *et al.*, Physical Review C86 (2012) 065804

The New LUNA MV Accelerator Will Be Installed by 2018

BY MATTHIAS JUNKER

The LUNA MV accelerator will provide intense beams of H^+, $^4He^+$, $^{12}C^+$ and $^{12}C^{++}$ in the energy range from 350 keV to 3.5 MeV. The machine is under construction at High Voltage Engineering Europe (HVEE) in The Netherlands and will be optimised for high long- and short-term energy stability, long duty cycles and long term operation without personnel on site. Before shipment to LNGS, the machine will be fully tested and commissioned at facilities of HVEE. Delivery to LNGS is scheduled for May/June 2018 and will be followed by a six-month commissioning phase. Initial physics experiments are expected to start at the beginning of 2019.



Since spring 2016, experienced engineers from LNGS are working on the design and construction of the new LUNA-MV laboratory inside Hall B of LNGS. An artist's view is shown in the figure. The accelerator and target stations will be installed in a room shielded by 80 cm thick concrete walls with two sliding doors of the same material thickness. Independent GEANT and MCNP simulations have shown that, even for the highest neutron production rate expected for experiments at LUNA-MV, this shielding will limit the neutron flux outside the accelerator room to a factor of 5 lower than the natural neutron background at LNGS. After tendering, the construction works are scheduled to start in September 2017. The fully equipped LUNA-MV laboratory (accelerator room and technical building) will be ready by March 2018.

SCIENTIFIC OUTPUT

Publications

DECEMBER 2015 - DECEMBER 2016

- **M Lugaro** *et al*. *Origin of meteoritic stardust unveiled by a new proton-capture rate of oxygen-17* **Nature Astronomy (2016) accepted**
- **A Slemer** *et al. Neon and Sodium ejecta from intermediate mass stars: The impact of the new LUNA rate for the* $^{22}Ne(p,\gamma)^{23}Na$ **Monthly Notices of the Royal Astronomical Society (2016) accepted**
- **O Straniero** *et al. The impact of the revised* $^{17}O(p,\alpha)^{14}N$ *reaction rate on the* ^{17}O *stellar abundances and yields* **Astronomy and Astrophysics (2016) accepted**
- **R Depalo** *et al*. *Direct measurement of the low-energy* $^{22}Ne(p,\gamma)^{23}Na$ *resonances* **Physical Review C 94 (2016) 055804**
- **CG Bruno** *et al*. *Improved Direct Measurement of the 64.5 keV Resonance in the* $^{17}O(p,\alpha)^{14}N$ *Reaction at LUNA* **Physical Review Letters 117 (2016) 142502**
- **G Gervino** *et al*. *Ultra-sensitive gamma-ray spectroscopy set-up for investigating primordial lithium problem* **Nuclear Instruments and Methods in Physics Research Section A, 824 (2016) 617**
- **A Best** *et al*. *Underground nuclear astrophysics: Why and how* **European Physical Journal - Topical Issue 52 (2016) 72**
- **A Formicola** *et al. The nuclear physics of the hydrogen burning in the Sun* **European Physical Journal - Topical Issue 52 (2016) 73**
- **C Gustavino** *et al. Primordial nucleosynthesis* **European Physical Journal - Topical Issue 52 (2016) 74**
- **A Boeltzig** *et al. Shell and explosive hydrogen burning - Nuclear reaction rates for hydrogen burning in RGB, AGB and Novae* **European Physical Journal - Topical Issue 52 (2016) 75**
- **M Aliotta** *et al*. *Helium burning and neutron sources in the stars* **European Physical Journal - Topical Issue 52 (2016) 76**
- **G Bellini, C Broggini** and **A Guglielmetti** *Topical issue on underground nuclear astrophysics and solar neutrinos: Impact on astrophysics, solar and neutrino physics* **European Physical Journal -Topical Issue 52 (2016) 88**
- **F Cavanna** *et al*. *Three New Low-Energy Resonances in the* $^{22}Ne(p,\gamma)^{23}Na$ *Reaction* **Physical Review Letters 115, 252501 (2015), Editor's suggestion**

Invited Talks

DECEMBER 2015 - DECEMBER 2016

- A Best, Brazilian Meeting on Nuclear Physics, 2016, Brazil
- F Cavanna, Magellan Workshop, DESY 17-18 March 2016, Germany
- F Cavanna, Terzo Incontro di Fisica Nucleare INFN 2016 Workshop, Frascati 14-16 November 2016, Italia
- A Guglielmetti, Physics Colloquium at the Max-Planck-Institute for Physics, Munich 2 February 2016, Germany
- A Guglielmetti, LIA COLL-AGAIN Copigal Polita, LNS Catania 28 April 2016, Italy
- C Gustavino, Vulcano Workshop 2016 Frontier Objects in Astrophysics and Particle Physics, 22-28 May 2016 Vulcano, Italy
- C Gustavino, Roma Int. Conf. on Astroparticle Physics, Frascati 21-24 June 2016, Italy
- C Broggini, Roma Int. Conf. on Astroparticle Physics, Frascati 21-24 June 2016, Italy
- C Broggini, Frontier Research in Astrophysics Workshop of Palermo 22-28 May 2016, Italy
- C Broggini, International School of Nuclear Physics, Erice 16-24 September, Italy
- A Formicola, XIV Nuclei in the Cosmos Conference, 19-24 June 2016, Japan
- M Junker, Fission and Properties of Neutron-Rich Nuclei (ICFN6) 6-12 November 2016, US
- M Lugaro, Meteorical Society Meeting, Berlin 7-12 August 2016, Germany
- M Lugaro, International Nuclear Physics Conference, Adelaide 11-16 September 2016, Australia
- P Prati, 8th Japan-Italian Symposium on Nuclear Physics, Tokyo 7-10 March 2016, Japan
- D Trezzi, New Vistas in Low-Energy Precision Physics Conference, Mainz 4-7 April 2016, Germany
- T Szucs, Carpathian Summer School of Physics, Sinaia 26 June - 9 July 2016, Romania

MEMBER SPOTLIGHT

Davide Trezzi

Education: PhD at the University of Milan (Italy)

Current Position: Post-Doctoral Researcher at the University of Milan (Italy)

Why did you decide to work in Nuclear Astrophysics? Astronomy has always been my passion and fascination; nuclear physics was my area of training as an undergraduate. Thus, Nuclear Astrophysics seemed a natural choice for me and the best opportunity to fuse my interests together and transform my job into a day dream.

What do you regard as your greatest achievement so far? My life. I feel proud of all the things I have achieved, big and small. Having been able to travel extensively, to witness the beauty of the Universe, and to try to understand its best kept secrets, has been the greatest reward for years of hard work and dedication.

What do you like most about working at LUNA? I like the possibility of studying in a lab what happens in the stars. Every time I switch on the LUNA accelerator I feel as if a real star has turned on in front of me. The possibility to 'touch' the plasma and 'see' the gamma rays emitted by a nuclear reaction is simply fantastic.

Your major ambition in life? I hope to always remain in awe of all the beauty around me. I want to keep regarding my life, now with my soon-to-be wife, as a truly unique and awesome experience.

What other projects are you currently working on? I am currently building a 50kV electron-beam device in order to study the effect of cosmic radiation on aerospace devices. In my free time, I enjoy taking pictures of the night sky and developing related projects such as websites, books, conferences and public events.

NOTE BY THE EDITOR:

Davide has recently published a wonderful collection of astronomical pictures taken by himself with his amazing selection of telescopes. For a preview, please take a look at: http://www.blurb.com/b/7509530-astrobook or visit his award winning website at: http://www.astrotrezzi.it

CONGRATULATIONS TO…

Axel Boeltzig (GSSI) or submitting his PhD thesis on *Direct measurements of the $^{23}Na(p,\gamma)^{24}Mg$ cross section at stellar energies* to be defended in December 2016.

Carlo Bruno (University of Edinburgh) for winning the Gold Prize for the best poster at the Nuclei in the Cosmos, Japan (July 2016) and also the First Prize at the poster competition of the School of Physics and Astronomy of the University of Edinburgh (2015).

Francesca Cavanna (University of Genova) for successfully defending her PhD Thesis on *The neon-sodium cycle: study of the $^{22}Ne(p,\gamma)^{23}Na$ reaction at astrophysical energies* in March 2015.

László Csedreki for winning an INFN post-doctoral Fellowship in experimental physics. Laszlo joined the LUNA collaboration at LNGS in October 2016.

Rosanna Depalo (University of Padova) for successfully defending her PhD Thesis on *A direct measurement of the $^{22}Ne(p,\gamma)^{23}Na$ reaction down to the energies of astrophysical interest* in March 2015.

Federico Ferraro (University of Genova) for winning a Prize for the Highly Commended Student Poster at the VII Nuclear Physics in Astrophysics Conference in York, 2015

Maria Lugaro (Konkoly Observatory) for being awarded a prestigious 5-year Consolidator ERC Grant.

Denise Piatti (University of Padova) for receiving the James Chadwick Prize for her talk at the 54th International School of Sub-Nuclear Physics, Erice 2016

JOB OPPORTUNITIES

Interested in working with us at LUNA? Please consider the following opportunities for PhD studentships and Post-Doctoral Fellowships. These are typically highly selective international competitions and normally require strong academic records and, in the case of post-doctoral jobs, proven research experience and leadership potential. If you think you meet these requirements, please get in touch to discuss things further.

PhD Studentships

- **GRAN SASSO SCIENCE INSTITUTE (GSSI, Italy)**. Calls for applications are issued once a year, typically in **April**. Studentships are for **3 years,** which include a one-year compulsory attendance to training courses. Successful applicants will receive a gross stipend of €16,200/year. Accommodation and meals in L'Aquila are provided free of charge. For further details, please visit: http://gssi.infn.it

  If interested in applying, please contact: Dr Alba Formicola (alba.formicola@lngs.infn.it)

- **SCOTTISH UNIVERSITY PHYSICS ALLIANCE (SUPA, UK)**. Calls for applications are issued once a year, with deadline at the end of **January**. Studentships are typically for **3.5 years** with a stipend of about £12,000/year with additional funds for fieldwork. For further details, please visit: http://apply.supa.ac.uk/apply

  If interested in applying, please contact: Prof Marialuisa Aliotta (m.aliotta@ed.ac.uk)

In addition, please note that PhD scholarships are awarded once a year at most Italian universities. Calls are normally published in the summer. If you are interested in applying for a studentships to work at LUNA please refer to PhD positions available at the following universities: Bari, Genova, Milano, Napoli, Padova, Torino. Alternatively, get in touch with a member of the LUNA Collaboration based at any of those institutions (see luna.lngs.infn.it for the full list of LUNA members).

Post-Doctoral Positions and Fellowships

- **INFN POST-DOCTORAL FELLOWSHIPS FOR EXPERIMENTAL PHYSICS (ITALY).** These fellowships are for non-Italian citizens only. Eligible applicants must hold a PhD title (or equivalent) obtained by no more than 8 years prior to the call deadline (typically in **November**). Time-limit extensions apply. The fellowship is initially for one year with the possibility for a second-year extension. Annual gross salary is €40,000. For further details, please visit: http://www.ac.infn.it/personale/exp_fellowships/

  If interested in applying, please contact any of the INFN members of the LUNA Collaboration

- **ROYAL SOCIETY NEWTON INTERNATIONAL FELLOWSHIPS (UK).** The scheme provides the opportunity for the best **early stage post-doctoral researchers** from all over the world to work at UK research institutions for a period of two years. Eligible candidates should have completed their PhD by the time funding starts. They should have no more than **7 years of active full time postdoctoral experience** at the time of application. Applicants are normally agreed with the host institution (in this case, the School of Physics and Astronomy - University of Edinburgh) well in advance of the intended deadline. Newton Fellowships last for **2 years**. Funding consists of £24,000 per annum for subsistence costs, and up to £8,000 per annum research expenses, as well as a one-off payment of up to £2,000 for relocation expenses. Application rounds are typically in **March** and **September**. For further details, please visit: https://royalsociety.org/grants-schemes-awards/grants/newton-international/

  If interested in applying, please contact: Prof Marialuisa Aliotta (m.aliotta@ed.ac.uk)

- **ROYAL SOCIETY UNIVERSITY RESEARCH FELLOWS (UK).** The scheme provides the opportunity to build an independent research career. Those appointed are expected to be strong candidates for permanent posts in universities at the end of their fellowships. The Fellowships are for **5 years** with a possible 3 year extension. The basic salary, commensurate with the applicant's skills, responsibilities, expertise and experience, can be up to a maximum of £39,708.70 per annum. Eligible candidates must posses a PhD title and between **3-8 years of post-doctoral research experience** by the application deadline. Applications are normally agreed with the host institute (in this case, the School of Physics and Astronomy - University of Edinburgh). Shortlisted applicants will be invited for interview at the Royal Society in **early-mid April**. For further details, please visit: https://royalsociety.org/grants-schemes-awards/grants/university-research/

  If interested in applying, please contact: Prof Marialuisa Aliotta (m.aliotta@ed.ac.uk)

- **STFC ERNEST RUTHERFORD FELLOWSHIPS (UK).** These are highly prestigious and highly competitive fellowships that may lead to permanent academic posts. The Fellowships are for **5 years** with a typical salary of £33,000-35,000/year (depending on level of experience). Eligible candidates must have 5 years of postgraduate research experience, with normally a minimum of 2 years of post-doctoral experience. Applications MUST be agreed with the host institute (in this case, the School of Physics and Astronomy - University of Edinburgh), where a pre-selection based on CV and a draft research plan takes place by the **end of August each year.** Selected applicants will have to submit a full research proposal to STFC for further consideration. Candidates who pass the STFC pre-selection process in January will be invited for interviews in Swindon (UK) in February. Posts normally start in September. For further details, please visit: http://www.stfc.ac.uk/funding/fellowships/ernest-rutherford-fellowship/

  If interested to apply, please contact: Prof Marialuisa Aliotta (m.aliotta@ed.ac.uk)

- **POST-DOCTORAL AND PHD POSITIONS AT KONKOLY OBSERVATORY, BUDAPEST (HUNGARY)**. Applications are invited for post-doc and PhD positions at Konkoly Observatory (www.konkoly.hu) in Budapest (Hungary) to work with Maria Lugaro starting in 2017 in the following areas: Nuclear Astrophysics/Nuclear networks; Stellar nucleosynthesis; Supernova nucleosynthesis; Galactic chemical evolution.

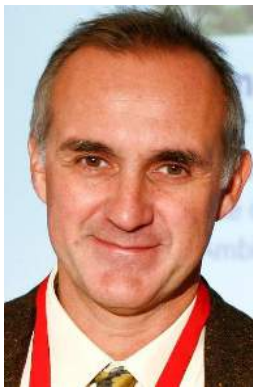
  If interested in applying, please contact: Dr Maria Lugaro (maria.lugaro@csfk.mta.hu)

Please note that additional opportunities may arise from time to time within individual groups of the Collaboration. For updates, please consult the Job Opportunities page at the Collaboration website at http://luna.lngs.infn.it

THE COLLABORATION - CONTACT US

The LUNA Collaboration comprises about 40 researchers from the following Institutions:

- INFN (Assergi LNGS, Bari, Genova, Lecce, Milano, Napoli, Padova, Roma, Torino) Italy
- GSSI, L'Aquila, Italy
- Konkoly Observatory, Budapest, Hungary
- MTA ATOMKI, Debrecen, Hungary
- HZDR, DRESDEN, Germany
- University of Edinburgh, Edinburgh, UK
- Osservatorio Astronomico di Collurania, Teramo, Italy



For any question about LUNA, or if you are interested in joining the Collaboration, please contact the LUNA Spokesperson: Prof Paolo Prati (paolo.prati@ge.infn.it)

For any question about this Newsletter, please contact the Chair of the Editorial Board: Prof Marialuisa Aliotta (m.aliotta@ed.ac.uk)