# Progress of nuclear astrophysics in Aisa and pacific region

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### **International Activity & Relation**



From T. Kajino

## Road map of NA in AP





## Joint efforts in NP input in AP





Method

#### Location of major accelerator facilities in Asia Pacific





A. W. Thomas et al., Nuclear Physics News, 30(2020)3

### Nuclear physics facility roadmap in Japan.





#### A. W. Thomas et al., Nuclear Physics News, 30(2020)3

#### Nuclear physics facility roadmap in China.





#### A. W. Thomas et al., Nuclear Physics News, 30(2020)3

#### JUNO layout.





#### • Z. Djurcic et al., arXiv:1508.07166 (2015).

# Nuclear chart and the major nucleosynthe processes in the universe



A. A. Aziz et al. AAPPS Bulletin 31(2021) 18; M. Wang et al., Chin. Phys. C. 41(3), 030003 (2017); T. Motobayashi et al., Theor. Exp. Phys. 2012(1), 03–001 (2012).

#### <sup>7</sup>Be spectra detected in novae explosions





A. A. Aziz et al. AAPPS Bulletin 31(2021) 18;
 A. Tajitsu et al., Astrophys. J. 818(2), 191 (2016).

#### The S E2(E) factor of the ${}^{12}C(\alpha, \gamma)$ ${}^{16}O$ reaction.





- The gray line represents the result constrained by the data of direct measurements. The red line represents the result determined with the ANC of <sup>16</sup>O ground state
- A. A. Aziz et al. AAPPS Bulletin 31(2021) 18; Y. P. Shen et al., Phys. Rev. Lett. 124(16), 162701 (2020).

#### <sup>60</sup>Fe/<sup>26</sup>Al flux ratio for the grid of exponential disk models





- <sup>60</sup>Fe/<sup>26</sup>Al flux ratio for the grid of exponential disk models (blue).
  Including the uncertainties of the fluxes from each spectral fit, the total estimated <sup>60</sup>Fe/<sup>26</sup>Al flux ratio from exponential disks is 0.184 ± 0.042
- W. Wang et al., Astrophys. J. 889(2), 169 (2020).

# NS mass-radius relation with different values of symmetry energy slope





- NS mass-radius relation with different values of symmetry energy slope L and the observational constrains from the GW170718 NSM event and other NSs. Find detailed explanations
- A. Li et al., J. High Energy Astrophys. 28, 19–46 (2020).

# A comparison between the estimated r-process abundance curves



• A comparison between the estimated r-process abundance curves with (red) and without (green) taking account of the new experimental data from RIBF [10]. Theoretical abundances are calculated in a canonical SN nucleosynthesis model assuming (n, $\gamma$ ) - ( $\gamma$ ,n) equilibrium [224]

• G. Lorusso et al., Phys. Rev. Lett. 114(19), 192501 (2015). arXiv:1906.05002

# Systematic mass along rp-process



# Planned future observatories under the ground, on the ground and in the space





Facilities in Asia and Pacific region

Planned future observatories under the ground, on the ground and in the space to detect multi-messengers from the cosmos. GWs, neutrinos, optical-to-infrared photons, and Xγ -rays are respectively the messengers of gravitational, weak, electromagnetic, and electromagnetic plus strong nuclear forces that make a variety of physical and chemical processes in the universe, galaxies, and stars; A. A. Aziz et al. AAPPS Bulletin 31(2021)18

# **CJPL and JUNA**





Beam	Intensity mA	Energy keV	
H+-	12	350	
He+	2.5	350	1
He++		800	



- Jan. 2015, JUNA got NSFC support
- May 2017, JUNA first beam in ground
- Dec. 2017, first test experiment in ground
- Dec. 2018, JUNA beam reach 10 mA
- Apr. 2019, target and detector fully commissioned
- Dec. 2020, JUNA got its first beam underground in CJPL-II A1
- May 2021, data taking for 4 experiment finished in CJPL
- Dec. 2021, news release meeting in Beijing for JUNA results
- W. P. Liu et al., Sci. China Phys. Mech. Astron. 59, 5785 (2016).

### **JUNA results**



# $^{25}Mg(p,\gamma)^{26}Al$ , J. Su et al., Sci Bull, 67(2022)125 .

<sup>19</sup>F(p,αγ)<sup>16</sup>O, L.Y. Zhang, *et al.*, Phys. Rev. Lett. 127(2021)152702.



<sup>13</sup>C( $\alpha$ ,n)<sup>16</sup>O, B.S. Gao *et al.*, submitted to PRL

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#### The 16th International Symposium on Origin of Matter and Evolution of Galaxies

CINA

25-28 October 2022

Institute of Physics, Vietnam Academy of Science and Technology

#### Overview

We are pleased to announce that the 16th International Symposium on Origin of Matter and Evolution of Galaxies (OMEG16), which will be held at the Institute of Physics. Vietnam Academy of Science and Technology. 10 Dao Tan. Ba Dinh, Ha Noi, Viet Nam. Due to the Covid-19 pandemic, OMEG16 has been rescheduled to **25 - 28 October 2022. The symposium will be organized in hybrid mode, on-site and online.** 

CMEG16 belongs to a series of biannual symposium started in 1988, bringing together researchers and students from interdisciplinary fields of nuclear physics, particle physics, astronomy, astrophysics, earth and planetary physics to address and discuss various questions on the origin of matter and evolution of universe.

Following the success of previous OMEG symposiums, of which recently he ded in Beijing, China (2015), Dasjeon, Korea (2017) and Kyoto, Japan (2019), OMEG16 will facilitate stimulus exchange through a scientific program that cover most recent experimental and theoretical advances in the following topics:

- · Big Bang Cosmology and Primordial Nucleosynthesis
- · First Generation Stars and Galactic Chemical Evolution
- · Astronomical Observations with Light, X-Ray, Gamma-Ray, and Cosmic-Ray
- Stellar Evolutions and Hydrostatic Burning Processes
- Nuclear Matter and Neutron Stars
- · Explosive Stellar Objects and Nuclear Physics
- · Meteorite Analysis and Isotopic Acundance
- · Theoretical Nuclear Physics for Astrophysics
- Experimental Nuclear Physics for Astrophysics
- Nuclear Data for Astrophysics and Related Topics
- Underground Nuclear Astrophysics
- Next generation RI Beam Facilities for Nuclear Astrophysics

AP NA meeting: OMEG

# Part of AP contribution VLBI to Sgr A\* BH







- Great progress, facility, experiment, theory
- Nice combination, collaboration, multi messenger
- Good prospective, future developments
- More collaboration, with other continents to make a global effort

AP NP facilities, A. W. Thomas et al., Nuclear Physics News, 30(2020)3 AP NA progress, A. A. Aziz et al. AAPPS Bulletin 31(2021)18