

## Indirect studies on astrophysical reactions at the low-energy RI beam separator CRIB

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CRIB (CNS Radioisotope Beam Separator) is a low-energy RI beam separator operated by CNS, University of Tokyo, located at RIBF of RIKEN Nishina Center. Various experimental projects based on interests for nuclear astrophysics have been carried out at CRIB, forming international collaborations. We present recent activities on nuclear astrophysics at CRIB.

We have studied proton/alpha resonant scatterings on many systems [1,2], using thick target method in inverse kinematics. We observed nuclear resonances which may contribute to astrophysical reaction rates. As for the  ${}^7\text{Be}+a$  resonant scattering [2], we evaluated  ${}^7\text{Be}(a,g)$  resonant reaction rate with the higher-lying resonance information obtained with the measurement. The latest resonant scattering measurement was the proton resonant scattering on an isomer-enriched  ${}^{26}\text{Al}$  RI beam.

Indirect measurements of relevant astrophysical reactions have also been performed at CRIB. The world's first application of the Trojan horse method for an RI beam was to determine the astrophysical  ${}^{18}\text{F}(p,\alpha)$  reaction rate. We measured quasi-free  ${}^{18}\text{F}(d,\alpha n)$  reaction and determined the low-temperature  ${}^{18}\text{F}(p,\alpha)$  reaction S-factor for the first time [3]. Another measurement was performed recently to determine  ${}^7\text{Be}(n,p)$  and  $(n,\alpha)$  reaction rates, which can be relevant for the cosmological  ${}^7\text{Li}$  abundance problem.

### References

- [1] J.J. He et al., Phys. Rev. C 88, (2013) 012801(R).
- [2] H. Yamaguchi et al., Phys. Rev. C 87 (2013) 034306.
- [3] S. Cherubini et al., Phys. Rev. C 92 (2015) 015805.

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