論文の内容の要旨

論文題目: Study of the ^{21}Na(α,p)^{24}Mg Stellar Reaction by α-scattering and (α,p) Measurements in Inverse Kinematics

逆運動学における α 散乱と (α , p) 反応測定による ^{21}Na (α , p) ^{24}Mg 天体核反応の研究

氏名: ダム グエン ビン

The works of this thesis is relevant to an expected galactic γ-ray emitted following a β^+-decay of ^{22}Na and the Ne-E problem in meteorites. We studied the resonant alpha scattering on ^{21}Na and ^{21}Na(α,p)^{24}Mg reaction in inverse kinematics with a thick target method. The experiment was performed using the CNS Radio Isotope Beam separator (CRIB).

The obtained excitation function of the alpha scattering cross section shows that five distinct resonances were observed. They were analyzed by a multichannel R-matrix method including a proton channel to extract resonant parameters, such as resonance energies, partial widths, spins and parities of the resonances. These parameters are important to calculate a reaction rate of the ^{21}Na(α,p)^{24}Mg reaction. The result indicates that alpha cluster structure just above the alpha threshold strongly enhances the (α,p) reaction cross sections.

The total cross sections of the ^{21}Na(α,p)^{24}Mg reaction were directly measured in inverse kinematics. Due to limitation of the reaction kinematics and the experimental setup, the individual transitions of protons to the ground or excited states of the residual nucleus, ^{24}Mg, were not obtained, however, the total reaction cross sections were successfully deduced and used to calculate the stellar reaction rate of the ^{21}Na(α,p)^{24}Mg reaction. Although we don't know the contribution of the individual resonances to the reaction rate is more realistic, since all transitions to ground state and excited states in the residual nucleus contribute to the ^{24}Mg production.

Finally, we have calculated the rate of the ^{21}Na(α,p)^{24}Mg reaction and made a comparison with other branching reaction on ^{21}Na, ^{21}Na(p,γ)^{22}Mg, and the β^+-decay to see at which condition of temperature and density it

affects a production of ^{22}Na. In conclusion, the $^{21}Na(\alpha,p)^{24}Mg$ is dominant at a temperature above 1.3 GK; the high-temperature rp-process like in the X-ray burst and the type-II Supernovae could bypass the ^{22}Na production.