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# Understand 22Na cosmic abundance by measuring lifetimes in 23Mg*

Simulations of novae explosive nucleosynthesis predict the production of the radionuclide $^{22}$Na. Its half life of 2.6 yr makes it a very interesting astronomical observable by allowing space and time correlations with the astrophysical object. This radionuclide should bring constraints on nova models. It may also help to explain abnormal $^{22}$Ne abundance observed in presolar grains and in cosmic rays. Its gamma-ray line at 1.275 MeV has not been observed yet by the gamma-ray space observatories. Hence accurate yields of $^{22}$Na are required. Within the novae thermal range, the main destruction reaction $^{22}$Na(p,$\gamma$)$^{23}$Mg has been found dominated by a resonance at $E_R$ = 0.213 MeV corresponding to the Ex = 7.786 MeV excited state in $^{23}$Mg. However the measured strengths of this resonance are in disagreement [1, 2].

An experiment was performed at GANIL facility to measure the lifetime of the key state at Ex = 7.786 MeV. The principle of the experiment is similar to the one used in [3]. With a beam energy of 4.6 MeV/u, the reaction $^{3}$He($^{24}$Mg,$\alpha$)$^{23}$Mg$^{*}$ populated the state of interest. This reaction was tagged with particle detectors (spectrometer VAMOS++, silicon detector SPIDER) and gamma tracking spectrometer AGATA. The state of interest decays either by gamma deexcitation or proton emission. The expected time resolution with AGATA high space and energy resolutions is 1~fs. Several Doppler based methods were used to analyse the lineshape of gamma peaks.

Preliminary results will be presented. Ejectiles, protons and $^{4}$He, were identified with SPIDER and VAMOS in order to reconstruct the excitation energies in $^{23}$Mg. Doppler shifted gamma-ray spectra from $^{23}$Mg states were improved by imposing coincidences with the $^{4}$He ejectile energies measured with VAMOS. It ensured to suppress feeding from higher states. Lifetimes in $^{23}$Mg were measured with a new approach. Proton emitted from unbound levels in $^{23}$Mg were also identified. With an higher precision on the lifetime of the Ex = 7.786 MeV state and the branching ratio measured in [4], a new value of $^{22}$Na(p,$\gamma$)$^{23}$Mg resonance strength $\omega\gamma$ was obtained. The impact of the new thermonuclear $^{22}$Na(p,$\gamma$)$^{23}$Mg rate on the predicted $^{22}$Na production will be discussed.

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**Auteur principal:** Mlle FOUGÈRES, Chloé (GANIL CEA/DRF - CNRS/IN2P3)

**Orateur:** Mlle FOUGÈRES, Chloé (GANIL CEA/DRF - CNRS/IN2P3)