International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

The lifetime of the 6.79 MeV state in ^{15}O as a challenge for nuclear astrophysics and γ–ray spectroscopy: a new DSAM measurement with the AGATA Demonstrator array

C. Michelagnoli[1,2], R. Depalo[1,2], R. Menegazzo[2], C.A. Ur[2], D. Bazzacco[2], C. Broggini[2], A. Caciolli[2], E. Farnea[2], S. Lunardi[1,2], C. Rossi-Alvarez[2], D. Bemmerer[3], N. Keeley[4], M. Erhard[2], Zs. Fülöp[5], A. Gottardo[6], M. Marta[3], D. Mengoni[2], T. Mijatović[7], F. Recchia[2], T. Szücs[5], J.J. Valiente-Dobon[6]

[1] *Dipartimento di Fisica, Università di Padova and INFN, Sezione di Padova, I–35131, Padova, Italy*
[2] *INFN, Padova, I–35131, Legnaro, Italy*
[3] *Helmholtz–Zentrum Dresden–Rossendorf, Dresden, Germany*
[4] *The Andrzej Soltan Institute for Nuclear Studies, Warsaw, Poland*
[5] *ATOMKI, Debrecen, Hungary*
[6] *INFN, Laboratori Nazionali di Legnaro, Italy*
[7] *Ruder Bošković Institute, Zagreb, Croatia*

Contact email: *cmichela@pd.infn.it*

An accurate determination of the lifetime of the first excited $3/2^+$ state in ^{15}O is of paramount importance in the determination of the astrophysical S–factor and the derived cross section for the ^{14}N(p,γ)^{15}O reaction. This is the slowest process in the CNO cycle and the accurate determination of its S–factor at solar energies is fundamental in order to answer many astrophysical questions, as the ones regarding the *solar composition problem* and the age of the globular clusters [1,2,3].

The results of a new direct measurement of this nuclear level lifetime are discussed. The first excited states in ^{15}O (and ^{15}N) were populated via fusion–evaporation and nucleon–transfer reactions of ^{14}N on ^{2}H (implanted at the surface of a $\approx$4 mg/cm^2 Au layer) at 32 MeV beam energy, provided by the XTU Tandem at LNL. Gamma rays were detected with 4 triple clusters of the AGATA Demonstrator array, placed close to the beam line, providing a continuous angular distribution of the emitted gamma rays. The energy resolution and position sensitivity of this state–of–the–art gamma spectrometer have been exploited to investigate lifetimes of nuclear levels in the $\approx$fs range via the Doppler Shift Attenuation Method. The deconvolution of the lifetime effects on the line–shapes of the gamma peaks from the ones due to the kinematics of the emitting nuclei has been performed by means of detailed Monte Carlo simulations of the gamma emission and detection. Coupled–channel calculations for the nucleon transfer process have been used for this purpose. The comparison of experimental and simulated spectra of high–energy gamma rays, de–exciting $\approx$fs lifetime levels, will be shown for the 6.79 MeV transition in ^{15}O and for known cases in ^{15}N, together with details of the chi–square analysis. Preliminary lifetime estimates will be discussed and compared with previous data available in the literature [3].

[1] C. Broggini et al., Ann. Rev. Nucl. Science, 60, (2010), 53;
[2] A. M. Serenelli et al., Astro. J. Lett., 705, (2009), L123;
[3] E. G. Adelberg et al., Rev. Mod. Phys., 83, (2011), 195.