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A new method for the determination of very small Γ_γ partial widths

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%%% Title goes here.
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%%% Authors and affiliations are next. The presenter should be
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%%% Abstract proper starts here.
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Gamma decay partial widths Γ_γ of nuclear levels at excitation energy larger than the particle decay energy threshold are generally quite small. Due to large background it is difficult to measure them with enough accuracy. However in some cases they are rather important in order to explain the synthesis of the elements in stellar environments. For instance only after a $\gamma-$decay a ^{12}C is produced in the triple alpha reaction, passing trough the Hoyle state [1], therefore the exact knowledge of such partial width is fundamental in order to explain the ^{12}C abundance in the universe. At LNS Catania we proposed a new method to measure such partial widths by using a multiple fold coincidence technique with the CHIMERA 4π detector [2]. In the case of stable nuclei, we will excite the level of interest by inelastic scattering of alpha particles at 15-20 MeV/A, measuring, in coincidence, the scattered alpha particle, the heavy residue populated, and the $\gamma-$ray cascade from the deexcitation of the level. The high energy alpha particle beam used will give enough energy to the residue to exit from the relatively thin target used. Scattered alpha particle and residual nucleus will be measured in kinematic coincidence with nearly 100\% efficiency due to the 4π coverage of CHIMERA. They will be identified via ΔE-E and time of flight techniques. The cascade $\gamma-$rays will be also detected, in the CsI(Tl) stage of the CHIMERA telescopes, with rather large efficiency (more than 40\% for $\gamma-$rays of 4 MeV). The new GET electronics used [3] will improve energy resolution and detection thresholds of $\gamma-$rays. Also angular distributions of the emitted $\gamma-$rays can be simply measured, as recently demonstrated [4]. The full identification of the particles and $\gamma-$ rays, with the constraints of kinematic coincidences [5], and energy conservation, can decrease the uncorrelated background up to 13 orders of magnitude. The first test experiment will be performed next July at LNS. The γ partial width of the ^{12}C Hoyle state [6] will be accurately remeasured, at the same time we expect also to measure or, at least, to improve the present constraints to the $\gamma-$decay width of the 9.64 MeV 3^- level, that is also involved in the ^{12}C production in very hot astrophysical environments [7]. This technique can be extended to radioactive nuclei, produced by the LNS fragmentation beam line, using inverse kinematic reactions on proton targets. Details of the technique and preliminary results will be shown.
\bigskip
{\small

\noindent [1] see for instance F.Herwig S.M. Austin and J.C. Lattanzio Phys. Rev. C 73, 025802 (2006) and ref. therein
\noindent [2] A.Pagano et al Nucl.Phys. A 734 (2004) 504 and ref. therein
\noindent [3] E. Pollacco et al., Phys. Procedia 37, 1799 (2012).
\noindent [4] G.Cardella et al NIM A799(2015)64.
\noindent [5] L.Acosta et al NIM A 715 (2013) 56.
\noindent [6] R.G.Markham et al Nucl.Phys.A270(1976)489.
\noindent [7] M.Tsumura et al, Journal of Physics: Conference Series 569 (2014) 012051.

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