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New improved indirect measurement of the 19F(p,alpha)16O reaction[5mm]

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The 19Fp,alpha_0 16O is the main fluorine destruction channel at the bottom of the convective envelope in Asymptotic Giant Branch (AGB). Because of the Coulomb barrier, direct measurements cannot access to the energy region of astrophysical interest (below 500 keV). We report on the indirect measurement of the alpha_0 channel using the Trojan Horse Method (THM).
Before THM measurement, only extrapolations were available below about 500 keV, showing a non resonant behaviour, sharply contradicting the trend of the astrophysical factor at higher energies \cite{nacre}.
A previous indirect experiment using the THM has observed the presence of three resonances in the energy regions below E_cm approx 450 keV, energies corresponding to typical AGB temperatures, thus implying a significant increase in the reaction rate with respect to the NACRE extrapolation \cite{nacre}, assuming an almost constant S-factor.
Anyway, statistics turned out to be scarce to perform an accurate separation between resonances, preventing one to draw quantitative conclusions on their total widths and spin parities.
A new experiment has been performed to verify the measured TH astrophysical factor and to perform more accurate spectroscopy of the involved resonances, in the light of the new direct measurements confirming previous results and providing better identification of the involved states.
The Tandem accelerator of the Laboratori Nazionali di Legnaro provided a 55 MeV 19F beam with a spot size on target of 1 mm and intensities around 1-3 nA. Thin self-supported deuterated polyethylene target (CD_2) of about 100 mug/cm2 were used to minimize energy and angular straggling, placed at 90^\circ with respect to the beam direction.
We used the modified R-matrix approach to investigate the energy region E_{cm} < 1 MeV, so as to span both the range of astrophysical interest and the 0.6 < E_{cm}< 0.8 MeV interval needed for normalization.
The new experiment has confirmed and improved the measured TH S-factor and it has allowed to obtain more accurate resonance data at astrophysical energies.
From the modified R-matrix calculation the reaction rate has been calculated. We compare the present 19F(p,alpha_0)16O reaction rate with the one reported in.
At the astrophysically relevant temperatures T_9= 0.04-0.2, the rate from the present work agrees, within errors, with the one obtained by \cite{Laco2} and there is only a small difference (sim10%) between the two adopted values. A larger discrepancy (sim 30%) is found at temperature T$_9 sim 0.4 due to the interference of 0.113 and 0.251 MeV resonances.

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