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The role of ^{13}C excited states in α+^{9}Be reaction and scattering cross sections

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The study of ^{13}C structure allows to understand the effects of clusterization in light non-self-conjugated nuclei. The possible presence of rotational bands built on molecular states has been suggested in several papers [1,2]. Furthermore, in recent times, some theoretical papers [3,4] predicted the possible existence of states corresponding to the coupling of a valence neutrons to the ^{12}C Hoyle state.
To shed light on these aspects, we performed a comprehensive R-matrix fit of α+^{9}Be elastic (α_0) and inelastic (α_1 and α_2) scattering data in the energy range E$\simeq$ 3.5 –10 MeV at several angles [5]. To carefully determine the partial decay widths of states above the α decay threshold we included in the fit procedure also ^{9}Be$(\alpha, n_0)^{12}$C$_{gs}$ and ^{9}Be$(\alpha, n_1)^{12}$C$_{4.44}$ cross section data taken from [6,7]. This analysis allows to improve the (poorly known) spectroscopy of excited states in ^{13}C in the E$_x$ $\simeq$12-17 MeV region [8]. Furthermore, a better knowledge of high-energy resonance parameters (especially for broad states) can improve low-energy extrapolations of the ^{9}Be$(\alpha, n)^{12}$C reaction S-factor, that plays a key role in the description of ^{12}C nucleosynthesis during a supernova explosions [7,9]. Preliminary results of these studies will be discussed.

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