THE $^{12}C(^{12}C,^{8}Be_{g.s.})^{16}O_{g.s.}$ REACTION AT SUB-COULOMB ENERGIES

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The difficult identification of ^{8}Be and ^{16}O nuclei at low energies prevented so far $^{12}C(^{12}C,^{8}Be)^{16}O$ measurements below $E_{CM}(^{12}C)=5.75$ MeV and at angles less than $\theta_{CM}(^{8}Be,^{16}O)=29^{o}$ [1].

For the present investigation, a large-area annular detector splitted into isolated halves has been used to identify $^{8}Be_{g.s.}$ particles by measuring coincidences between the α signals of both detector parts. The excitation functions between 5 and 7 MeV and at angles between 6.3^{o} and 73.3^{o} show strong intermediate structures. It has been unambiguously excluded experimentally that competing reactions (e.g. the decay into $^{16}O+\alpha+\alpha$) make considerable contributions to the cross sections.

The data were fitted using an approach similar to that applied by Häusser et al. and by Billen [2]. The multi-level fitformula contains non-resonant background amplitudes and overlapping resonance amplitudes, expressed in the standard Breit-Wigner form. The transmission through the $^{12}C+^{12}C$ potential barrier is strongly energy dependent. To simplify the fitting procedure, the cross sections were transformed to an expression similar to the S factor used in astrophysics: $S = (d\sigma/d\Omega)\ E/\Sigma(2l+1)T_l$; T_l= transmission coefficients, extracted from an optical-model analysis.

The figure shows data and best-fit curves as solid lines, respectively. The extracted parameters for the seven obtained resonances are:

J^{π}	2^+	2^+	0^+	0^+	4^+	0^+	2^+
E/MeV	5.03	5.68	5.71	5.92	5.96	6.35	6.48
$\sqrt{\Gamma_C \cdot \Gamma_{Be}}$/keV	1.8	8.9	11.7	4.7	1.4	74.2	24.5
Γ/keV	180	240	184	63	119	247	326

Four resonances (5.03 MeV,2^+; 5.68 MeV,2^+; 5.71 MeV,0^+; 5.96 MeV,4^+) are also reported in other $^{12}C+^{12}C$ reaction channels, whereas the remaining three resonances have not been found undoubtly elsewhere. In most cases the large $\sqrt{\Gamma_C \cdot \Gamma_{Be}}$ parameters denoting the product of resonance partial widths suggest strong

components of a $^{12}C+^{12}C$ or $^{8}Be+^{16}O$ configuration of the corresponding intermediate states. To fit the data, only very small background amplitudes are necessary, representing negligible statistical or direct-reaction contributions.

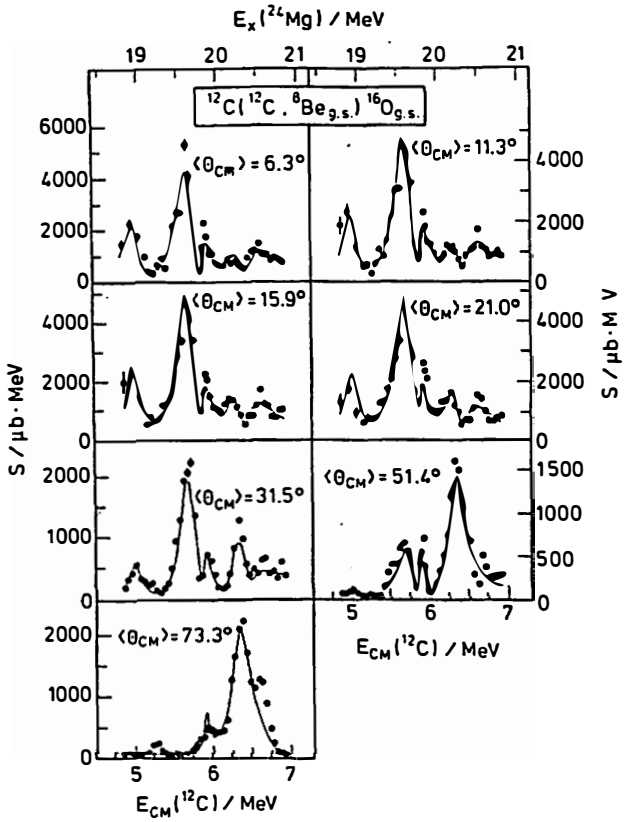

Figure: S factor excitation functions and curves of best fit

⁎ supported by the BMFT, Bonn-Bad Godesberg, Germany

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