Nuclear Structure of ^{12}C from Break-up Studies in Complete Kinematics

M. Alcorta[1] and the MAGISOL Collaboration[1,2,3,4]
[1]*Instituto de Estructura de la Materia, CSIC, Serrano 113 bis, Madrid E-28006, Spain*
[2]*Department of Physics and Astronomy, University of Aarhus, DK-8000 Aarhus C, Denmark*
[3]*Fundamental Physics, Chalmers Univ. of Technology, S-41296 Göteborg, Sweden and*
[4]*CMAM, Universidad Autónoma de Madrid, Cantoblanco, Spain*

A complete kinematics study of the ^{10}B(^{3}He,p$\alpha\alpha\alpha$) and ^{11}B(^{3}He,d$\alpha\alpha\alpha$) reactions has been performed to study the multi-particle break-up of ^{12}C resonances above the triple-alpha threshold. This gives us complete information on the direction and energy of the individual alpha particles from the decay of ^{12}C, allowing us to extract new information on the structure of ^{12}C which we shall present in this contribution.

Using Si charged particle detectors we identified γ decay of the T=1 15.11 MeV resonance in ^{12}C to states above the triple-alpha threshold. This is done by looking for missing energy between the excitation spectra of ^{12}C given by the invariant mass of the decay fragments versus the excitation energy given by the primary ejectile (Figure 1, left). We can then extract the branching ratios and compare them to the β decay branching ratios of the IAS of ^{12}B and ^{12}N measured in a previous experiment by our collaboration. These two results thus gives us a complete picture of the branching ratios of the decay from the A=12 isospin triplet leading to an improved test of the isospin symmetry.

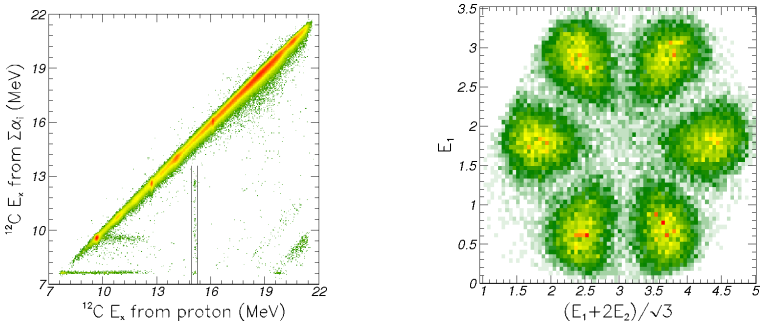

FIG. 1: (Left) Signature of γ-emission of the T=1 15.11 MeV resonance in ^{12}C. The branching ratios can be compared to the β-decay of ^{12}B and ^{12}N. (Right) Dalitz plot of the 12.71 MeV 1^+ resonance in ^{12}C. Spin and parity and decay mechanism can be extracted through the use of Dalitz plots. We compare these results to theoretical calculations.

Further, we use Dalitzs plots to study the decay of ^{12}C resonances into three alpha particles (Figure 1, right). The observed density of the Dalitz plot can be used to determine or at least impose constraints on the spin and parity of the decaying ^{12}C resonance as well as provide an understanding of the decay mechanism involved (e.g. sequential vs direct). Dalitz plots can thus allow us to determine spins and parities of resonances in ^{12}C.

In this contribution we will present our results on the γ branching intensities from the 15.11 MeV state and compare our measured Dalitz distributions to theoretical calculations. The impact of these results on the different models used to describe the structure of ^{12}C will be discussed.