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Broad resonances in light nuclei studied with β- and γ-spectroscopy

H.O.U.Fynbo[1]

[1] *Department of Physics and Astronomy, Aarhus University, Ny Munkegade 120, 8000 Aarhus C, Denmark*

Contact email: *fynbo@phys.au.dk*

In the spectra of light nuclei exist very wide resonances with widths of an MeV or more. Classical examples are the 2^+ and 4^+ resonances in ^{8}Be, and the lowest natural parity resonances in ^{12}C. For several reasons these resonances are difficult to study experimentally. First, overlapping levels in the same nuclei, which may be populated much stronger, can hide the broad resonances. Second, their appearance in spectra will be modified by phase space effects depending on the method of population, which must be corrected for in order to get to the genuine resonance properties. Third, it may be difficult to distinguish between resonant and non-resonant population of the continuum, and the non-resonant contribution will depend on the experimental method used to populate the continuum.

We have recently used the beta-decays of ^{8}B, and ^{12}N and ^{12}B, as a method to selectively populate resonances of interest in ^{8}Be and ^{12}C respectively [1-3]. Naturally, this method will only allow to study the resonances chosen by the selection rules of β-decay in each case. Therefore, in order to be able to gain further selectivity, we have developed a method to populate broad resonances by γ-decay of higher lying resonances. By appropriately choosing the initial state, a much larger range of resonances can be made available for study.

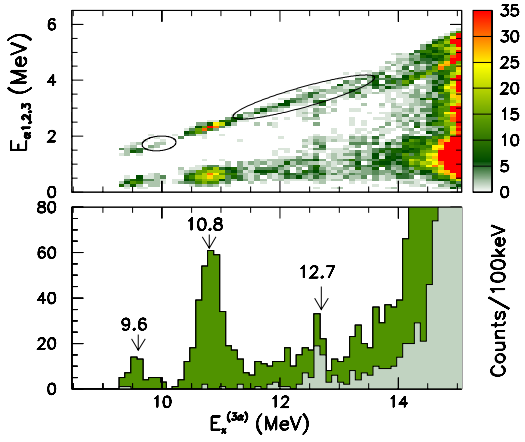

Figure 1 Spectrum of resonances in ^{12}C populated in the γ-decay of the 16.11MeV 2^+ resonance. The ovals in the scatterplot indicate previsouly unknown strength.

I will discuss results from using the reaction ^{11}B(p,γ)3α to populate 2^+, 2^-, 1^- and 3^- resonances in ^{12}C and their subsequent γ-decay to lower lying broad resonances of interest (figure 1). This provides a new take on the long-standing problem of finding the first 2^+ resonance in ^{12}C [4] as well as other broad resonances in ^{12}C. I will also discuss future plans to address similar problems in ^{8}Be and ^{16}O using the same method.

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