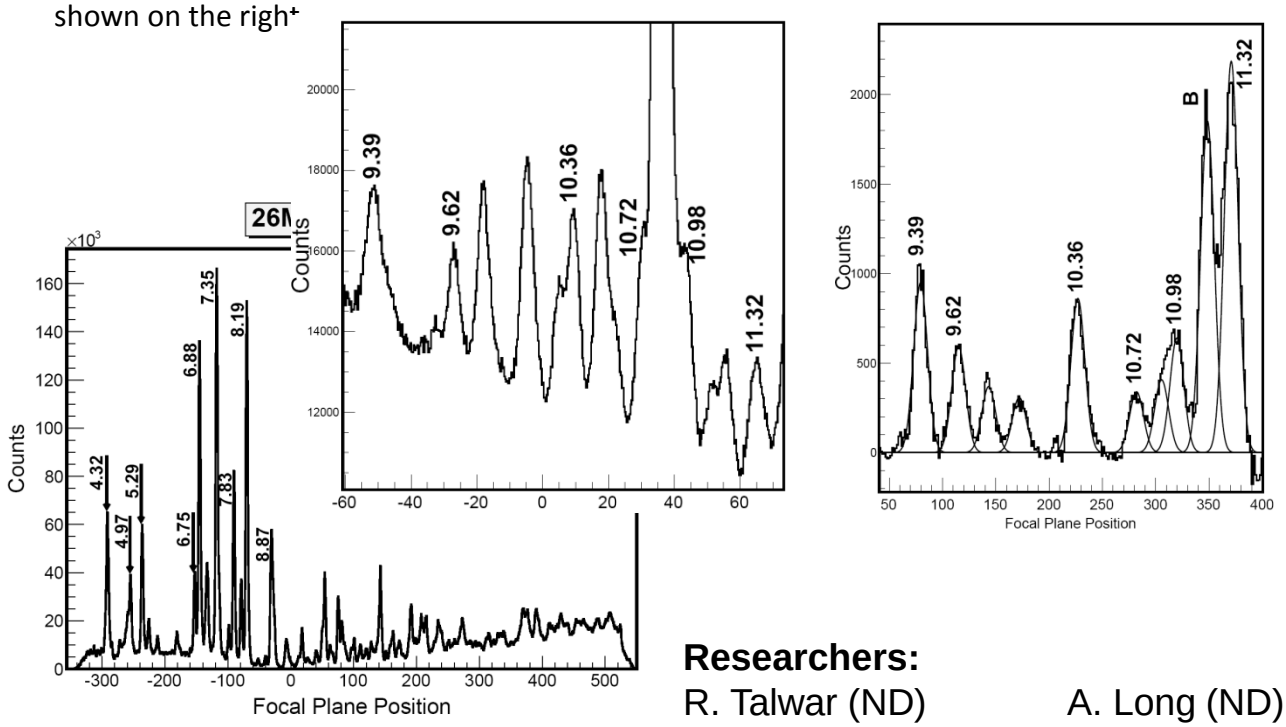
Joint Institute for Nuclear Astrophysics

$^{22}Ne(\alpha,n)^{26}Mg$, Neutron source for the weak s-process: exploring the α-threshold in ^{26}Mg

Core He- burning in massive stars is the main site for the nucleosynthesis of the light s-process nuclei, A < 100. Towards the end of this burning phase the temperature increases and effectively activates the $^{22}Ne(\alpha,n)^{26}Mg$ reaction. This reaction acts as the neutron source for the production of the s- process elements by neutron capture on the seed elements (A ~ 50-60). The cross section for this reaction has been measured down to the neutron threshold at E_α= 478 keV and the lowest energy resonance has been observed at E_α= 704 keV. However, the reaction rate still carries substantial uncertainties. Because of the large α- separation energy of ^{26}Mg (10.6 MeV), the level density is fairly large and many levels can contribute in principle to the reaction rates of the $^{22}Ne(\alpha,n)^{26}Mg$ reaction as well as to the competing $^{22}Ne(\alpha,\gamma)^{26}Mg$ reaction. For this reason we have started an experimental program at RCNP, Osaka, to study the energy levels around the α- threshold using several different reactions. First results from α- inelastic scattering and α- transfer reactions are shown in figure 1. A comparison of the spectra reveals the high selectivity of the (^{6}Li,d) reaction. This program will be continued with higher resolution and will include a study of the $^{25}Mg(d,p)^{26}Mg$ reaction using polarized beam.

Fig. 1 – The particle spectrum for the $^{26}Mg(\alpha,\alpha')^{26}Mg$ reaction is shown on the left covering the excitation range from ~ 4 MeV to ~ 20 MeV. The cut-out shows the energy range around the α-threshold in ^{26}Mg. The corresponding energy range, as observed in the $^{22}Ne(^6Li,d)^{26}Mg$ reaction, is shown on the right.



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