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Study of the resonance state(s) in ^{20}Mg: astrophysical implications and understanding the nuclear forces

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Study of proton unbound resonance states in ^{20}Mg is important for both nuclear structure and nuclear astrophysics. Type-I X-ray bursts in accreting neutron stars are triggered by the break out reactions from hot CNO cycles. In one of the break out sequences ^{18}Ne is a waiting point as it cannot undergo proton capture because that leads to proton unbound ^{19}Na, So it has to wait for beta decay to happen. ^{18}Ne(2p,γ)^{20}Mg has been suggested as one of the possible bypass path to rp-process nucleosynthesis. The resonant states above the proton emission threshold
in ^{20}Mg determine the ^{18}Ne(2p,γ)^{20}Mg resonant capture reaction
rate. Due to the lack of experimental data, reaction rate estimates for this reaction are currently based on the energy levels of ^{20}O taken from shell model predictions (Gorres et al.,1995). Recent calculations using nuclear forces from chiral perturbation theory predict quite a different level structure
for ^{20}Mg using the nucleon-nucleon (NN) force only and nucleon-nucleon plus three nucleon (NN+3N) forces (Holt et al.,2013). These predictions are also different from the levels predicted by shell model calculations and assuming mirror symmetry to ^{20}O. This makes the study of the excited states of
^{20}Mg important.
In this presentaion we will report the investigation of the excited states in ^{20}Mg through ^{20}Mg(d,d')^{20}Mg* inelastic scattering. The experiment was performed using the IRIS facility, stationed at TRIUMF, Canada. The ^{20}Mg beam with an average intensity of ~500 pps was post accelerated to an energy of 8.5A MeV. The speciality of IRIS is the use of a thin windowless solid deuteron target which makes this study possible with such a low beam intensities.

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