INTRODUCTION
Nuclear physics is vital in understanding the nuclidesynthesis and energy production in stars via nuclear reactions. Nuclear astrophysical processes are important in Big Bang, in cataclysmic stellar explosions like supernovas, and in stars with very high temperature and densities. Many times we need to study exotic nuclei away from stability and their interactions to understand their importance in astrophysics and cosmology. This is possible by making exotic beams via nuclear reactions in nuclear laboratories on Earth. One such facilities is MARS at Cyclotron Institute, Texas A&M University.

NUCLEAR REACTIONS
We have used a 20Ne beam @25 MeV/u impinging on a cryogenic gas cell that contained H2, at p=3.0 atm and T=77 K to produce 20Na, then separate it with MARS, implant it and study its various decays (Fig. 5). There were 3 groups, each with 4 students. Each group performed the experiment independently. The results obtained by three different groups are shown below.

20Mg Production and Separation
Two different reactions were employed to obtain the best production of 20Mg isotope. Projectile fragmentation of 20Na @48 MeV/u on He is done in Feb. 2009 and fusion-evaporation of 20Ne(9Be,20Mg)3n @25 MeV/u done in June. The code LISE was used to obtain the predictions before conducting the actual experiment. The results are shown below.

CONCLUSIONS AND FUTURE PERSPECTIVES
The production and separation of 20Na and 20Mg was carried out using two different reaction mechanisms so as to ascertain the best method of producing 20Mg. The overall production of 20Mg was better with fusion-evaporation reaction 20Ne + He because higher beam currents were available for 20Ne. This established, the next step will be to study the 20Mg decay measurement is planned for study by the MARS group at Cyclotron Institute, TAMU in collaboration with a group from the Univ of Edinburgh, UK. The study of the states populated in the decay would help to better understand the resonances in the 20Ne reaction. It will reduce the uncertainty in the predicted rate of a reaction which is considered to be the main breakthrough from the CNO cycles into the rp-process in astrophysical phenomena such as X-ray bursts.

WHAT IS MARS AND HOW DOES IT WORK?

Production and Separation of Radioactive Beams
20Na and 20Mg with MARS
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REU 2009, Cyclotron Institute, Texas A&M University
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