Thesis defence Djamila-Sarah HARROUZ

Experimental study of the 30Si(p,g)31P reaction for understanting elemental anomalies in globular clusters

Abstract :

Globular clusters are essential objects for studying stellar evolutionary patterns and the early phases of galaxy formation. The abundance anomalies observed in the globular cluster NGC 2419, such as potassium overabundance and magnesium depletion, can be explained if an earlier generation of stars contaminates the currently observed stars. However, the nature and properties of this first generation of stars are not clearly identified. The temperature and density range of this one depends on a number of reaction rates. The 30Si(p,g)31P reaction is one of the few reactions identified as having sufficient influence to constrain the nature of the stellar site(s) that contaminated NGC 2419. The objective of this thesis is to reduce the nuclear uncertainties associated with the 30Si(p,g)31P reaction by determining the resonance strengths in the energy range of astrophysical interest. The study of this reaction was done via two distinct experiments. For low energy resonances, up to 500 keV above the threshold of proton emission, the 30Si(3He,d)31P transfer reaction was performed at the Tandem of the MLL laboratory in Munich. The light particles produced during the reaction were momentum analyzed by the very high resolution Q3D magnetic spectrometer and their angular distributions were interpreted in the DWBA (Distorded Wave Born Approximation) framework to obtain the proton spectroscopic factors. These are essential for the calculation of the proton widths used to compute the strengths of the resonances. For higher energy resonances, a direct measurement of the resonance strengths was performed using the DRAGON recoil sperctrometer installed at TRIUMF in Vancouver, Canada. The results of these experiments were used to calculate the new rate of the 30Si(p,g)31P reaction and its astrophysical impact was studied in order to better constrain the stellar conditions that can explain the abundances observed in the stars of the globular cluster NGC 2419.