Development of a supersonic jet target for the cross section measurement of $^{12}\mathrm{C}(\alpha,\gamma)^{16}\mathrm{O}$ with the recoil mass separator ERNA

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The reaction $^{12}C(\alpha,\gamma)^{16}O$ has a key role in the determination of the C/O abundance in the universe, which in turn influences the following stellar evolution and nucleosynthesis. The present estimate of the reaction cross section at the Gamow energy [1] relies on high precision measurements performed with the European Recoil Separator for Nuclear Astrophysics ERNA [2] in the energy range 1.9 - 4.9 MeV. Despite of this, astrophysical models demand for an improvement on the extrapolation accuracy, which could be obtained e.g. [3] by a better determination of the interference sign of the reaction E1 component. For this, measurements at lower energies down to E_{cm} = 1 MeV performed with a high precision techniques like the RMS ERNA are required.

To extend the separator lower energy limit for $^{12}C(\alpha,\gamma)^{16}O$, the ERNA collaboration installed a new 30° dipole magnet. This in turn reduced the separator longitudinal acceptance of the recoils at the lower energies to a region of few millimeter and made the previous gas target inadequate; it was replaced by a new supersonic gas jet target, which thickness (10^{18} atoms/cm^2) and length ($\sim$ 7 mm) are adequate to measure $^{12}C(\alpha,\gamma)^{16}O$ at the lower energy of E_{cm} = 1 MeV.

In this poster is presented the jet target development: it based on the use of Computational Fluid Dynamic (CFD), an innovative approach in the Nuclear Astrophysics field, aimed to evaluate the properties of a jet test version and design possible improvements, which complications relied mainly in the jet integration in ERNA. It is also presented the jet final setup that based on an innovative design solution and its characterization performed by the means of Ion Beam Analysis.

References

[1] R.J. deBoer *et al.*, Reviews of Modern Physics **89** (2017).

[2] D. Schuermann *et al.*, The European Physical Journal A **26** (2005).

[3] D. Schuermann *et al.*, Physics Letters B **711** (2012).