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A supersonic jet target for the cross section measurement of the 12C(alpha; gamma)16O reaction with the recoil mass separator ERNA

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Summary

12C(alpha; gamma)16O plays a key-role in the determination of the C/O ratio at the end of stellar Carbon burning. Since stellar models predict an exceptional sensitivity of the following stellar evolution and nucleosynthesis on that parameter, the reaction cross section of 12C(alpha;gamma)16O must be determined with the precision of about 10% at the relevant Gamow energy of 300keV . The ERNA (European Recoil mass separator for Nuclear Astrophysics) collaboration could measure, for the first time, the total cross section of 12C(alpha; gamma)16O by means of the direct detection of the 16O ions produced in the reaction down to a an energy Ecm = 1.8MeV. To extend the measurement at lower energy, it is necessary to limit the extension of the
He gas target. This can be achieved using a supersonic jet, where the oblique shock waves and expansion fans formed at its boundaries confine the gas, that can be efficiently collected using a catcher. A test version of such system has been realized and experimentally characterized as a bench mark for a full numerical simulations using FV (Finite Volume) method. The results
of the commissioning of the jet test version and the design of the new system that will be used in combination with ERNA are presented and discussed.

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