Rotation and slow neutron capture nucleosynthesis

J.W. den Hartogh[a,b], R. Hirschi[b,c], U. Battino[d], F. Herwig[e,f], M. Pignatari[a,f,g]

[a]*Konkoly Observatory, Konkoly Thege Miklós út 15-17, H-1121, Budapest, Hungary,* [b]*Astrophysics group, Lennard-Jones Laboratories, Keele University, ST5 5BG, Staffordshire, UK,* [c]*Kavli Institute for the Physics and Mathematics of the Universe (WPI),* [d]*School of Physics and Astronomy, University of Edinburgh, James Clerk Maxwell Building, EH9 3FD, UK,* [e]*Department of Physics & Astronomy, University of Victoria, PO Box 3055, Victoria, BC V8W 3P6, Canada,* [f]*Joint Institute for Nuclear Astrophysics, Center for the Evolution of the Elements, Michigan State University, 640 South Shaw Lane, East Lansing, MI 48824, USA,* [g]*E.A. Milne Centre for Astrophysics, University of Hull, Hull, HU6 7RX, UK*

The slow neutron capture process (s-process) is responsible for about half of all elements heavier than iron in the universe, and is therefore important for galactic chemical evolution. Its main production site is the Asymptotic Giant Branch (AGB) phase, a stellar evolution phase in stars with an initial mass between about 0.8 and 8 $M_{\odot}$. As stars rotate, it is important to calculate stellar evolution models of these stars including rotation. Currently, only one complete set of rotating AGB models exists (see [1], and http://fruity.oa-teramo.inaf.it/). There is only one, because the implementation of rotation and rotation-induced mixing in stars is uncertain and does not reproduce all observables. Specifically, recent observables obtained by asteroseismology show a process of angular momentum transport is missing in stellar evolution theory. We will show that the uncertainties in the implementation of rotation lead to unphysical features in our AGB models, that strongly influence the s-process nucleosynthesis. We will present new AGB models including rotation that also include an additional, artificial viscosity, which reduces these unphysical features. Adding this artificial viscosity is motivated by current efforts to constrain the missing process of transport of angular momentum (see [2] and more recently [3]). We will show the impact of this artificial viscosity on the AGB phase and its nucleosynthesis.

References

[1] Piersanti *et al.*, ApJ 774 (2013)

[2] Eggenberger *et al.*, A& A 544 (2012)

[3] Eggenberger *et al.*, A& A 599 (2017)