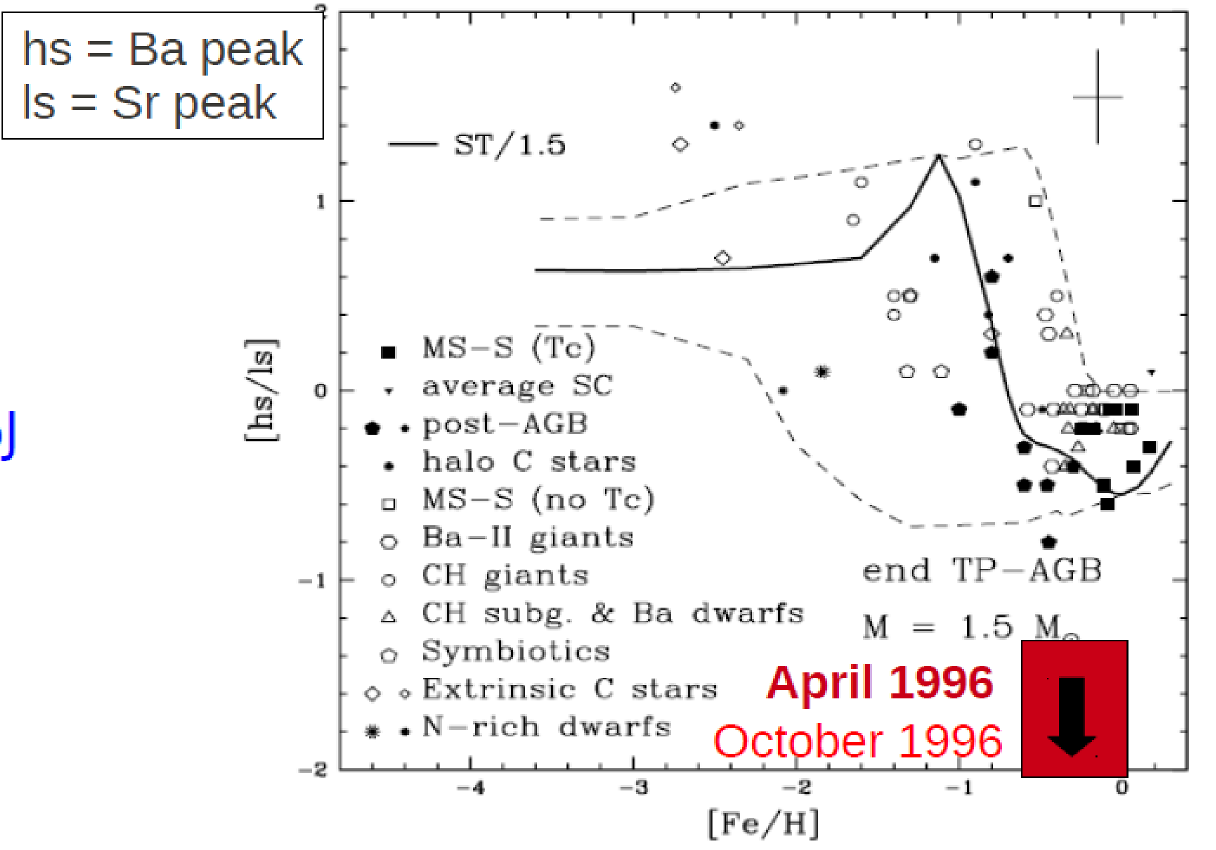
The i process

- Between the s-process and the r-process in 1977 it was defined the intermediate neutron-capture process.

In 1996 it was observed for the first time an i-process carrier.

i-process ~ 10^{15} n cm^{-3}
Cowan & Rose 1977 ApJ
Herwig, MP et al. 2011 ApJ

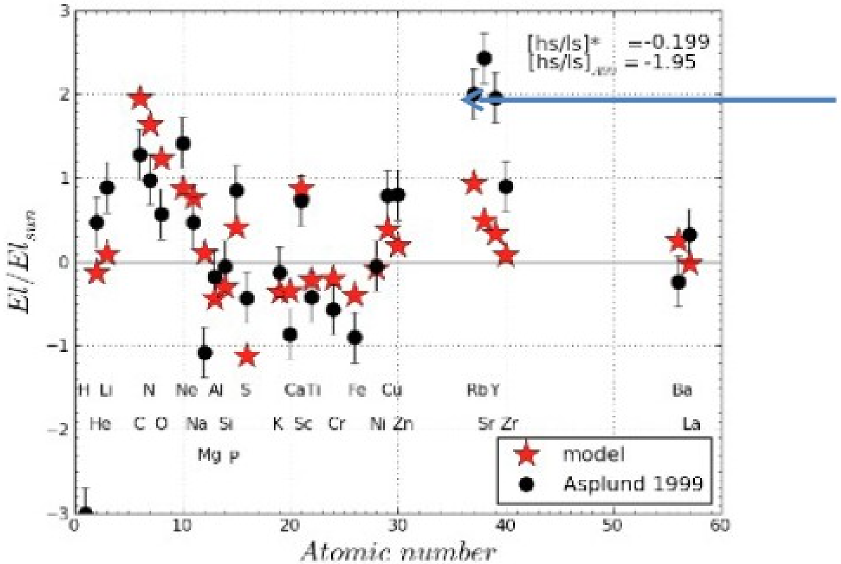
Sakurai's object



Busso et al. 2001, ApJ 557 versus
Asplund et al. 1999 A&A 343

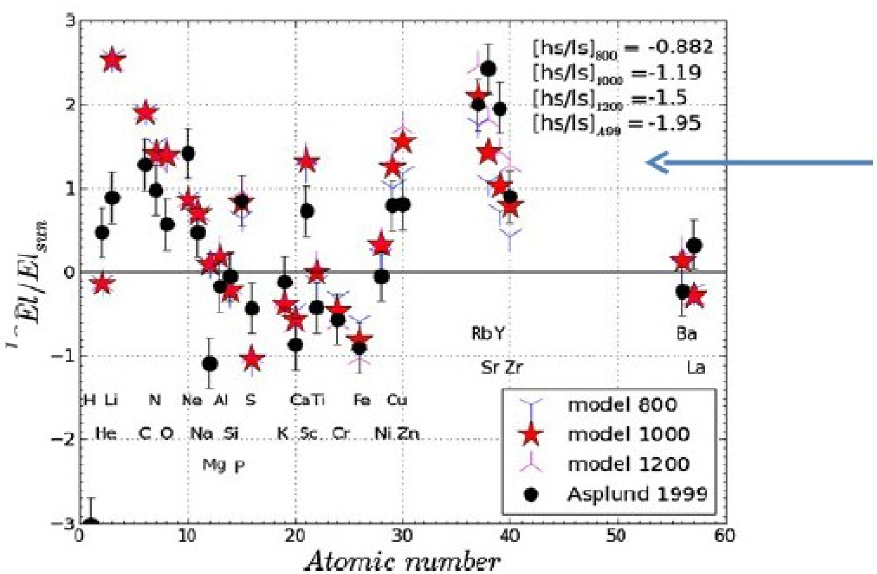
Multi-zone 1D nucleosynthesis simulations: 3D effects important

Modeling the abundance in post-AGB star Sakurai's object



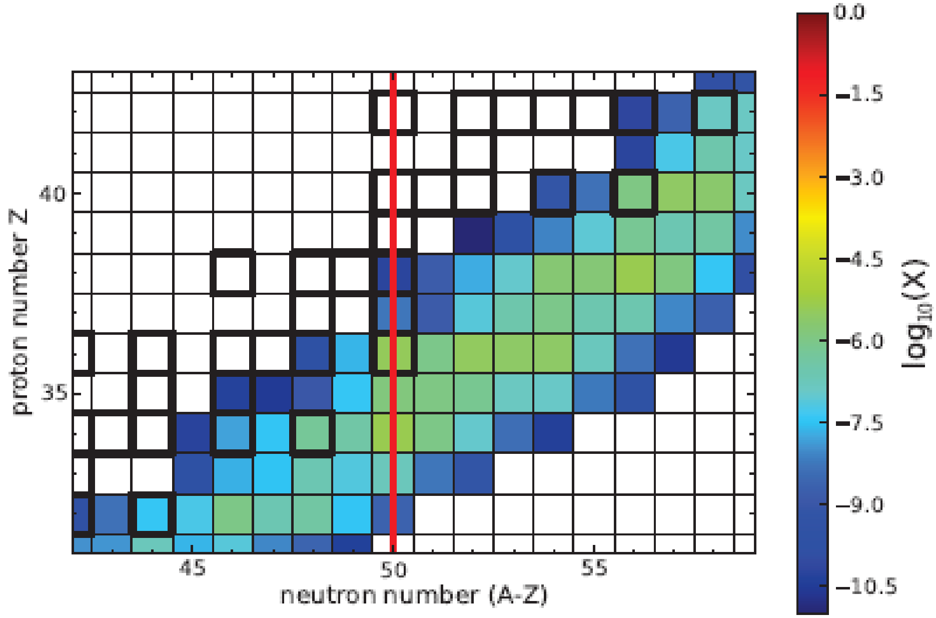
Simulations according to 1D stellar evolution: early thin burning front of 12C + p chokes off mixing

Marginal activation of the C13(α,n)O16, not consistent with the observations.

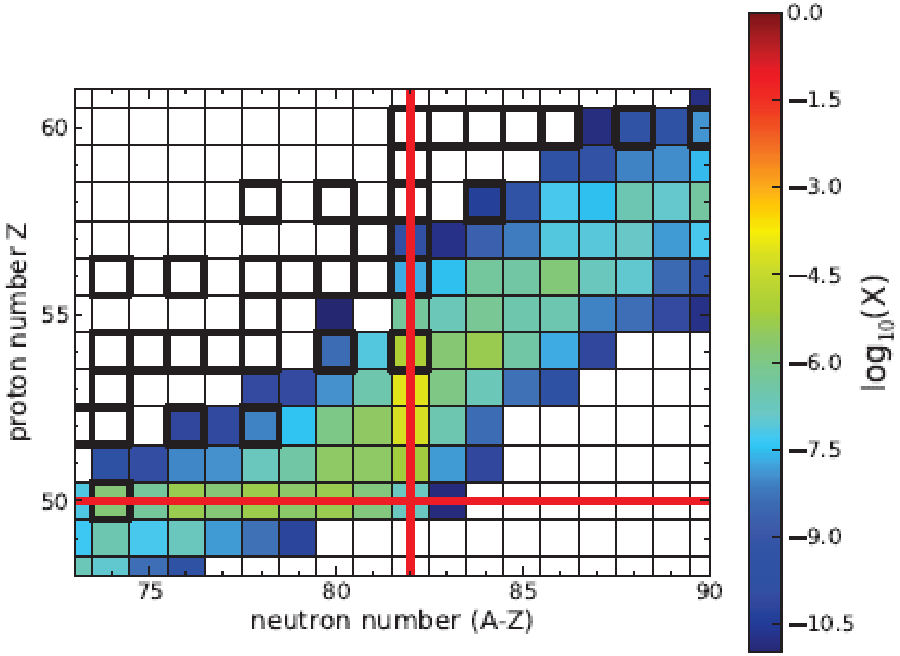


Simulations with extended mixing:
split scenario from 1D simulations does not work. H/N13/C13 reach deeper He-burning layers, activating the i process via the C13(α,n)O16 neutron production.

Herwig, MP et al. 2011, observations: Asplund etal. 1999



(a) Isotopic chart for the first neutron magic peak, $N = 50$, at $t = 1.9 \times 10^{-4}$ years.



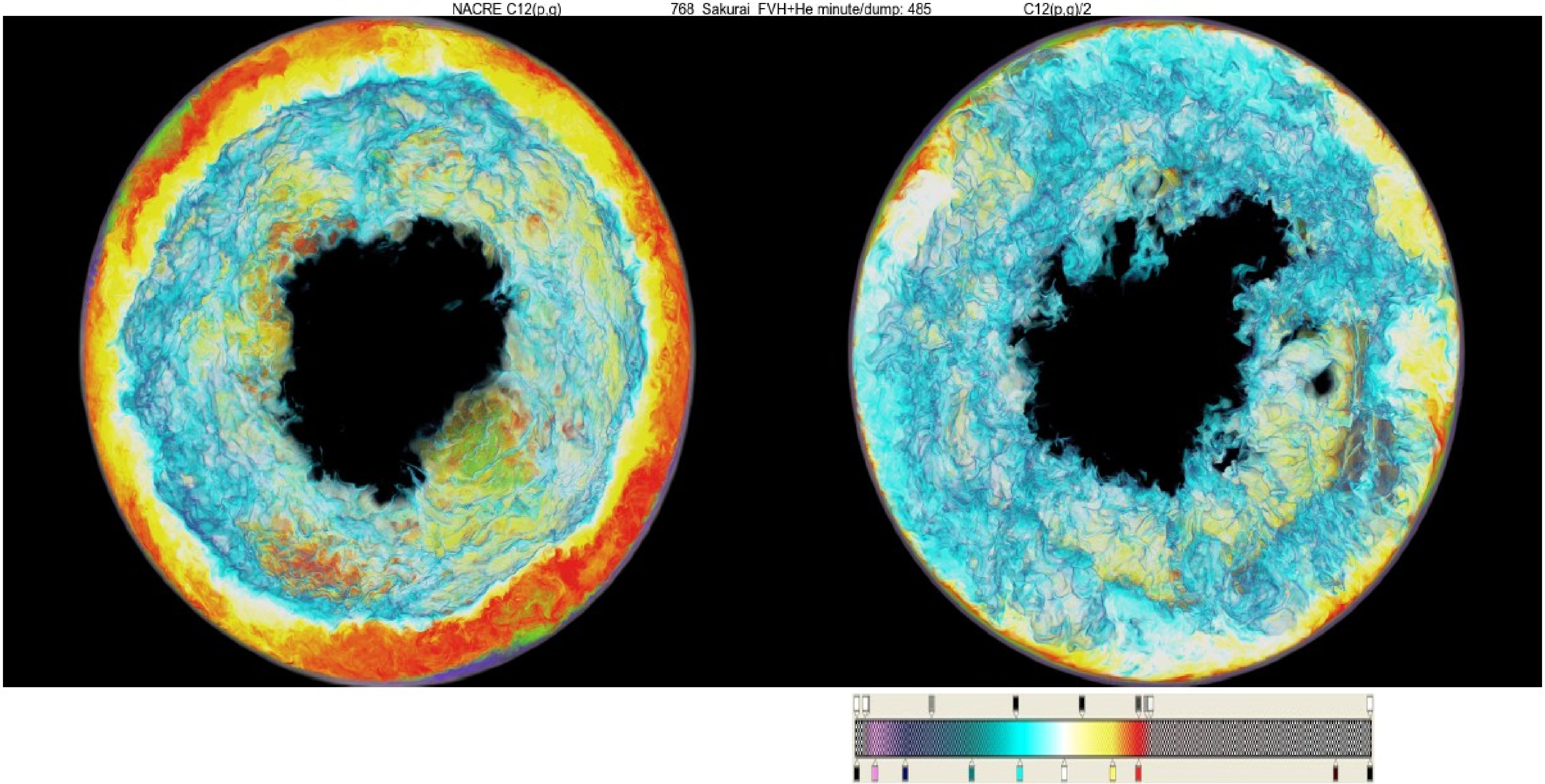
(b) Isotopic chart for the second neutron magic peak, $N = 82$, at $t = 5 \times 10^{-4}$ years.

Bertolli et al. 2013 arXiv

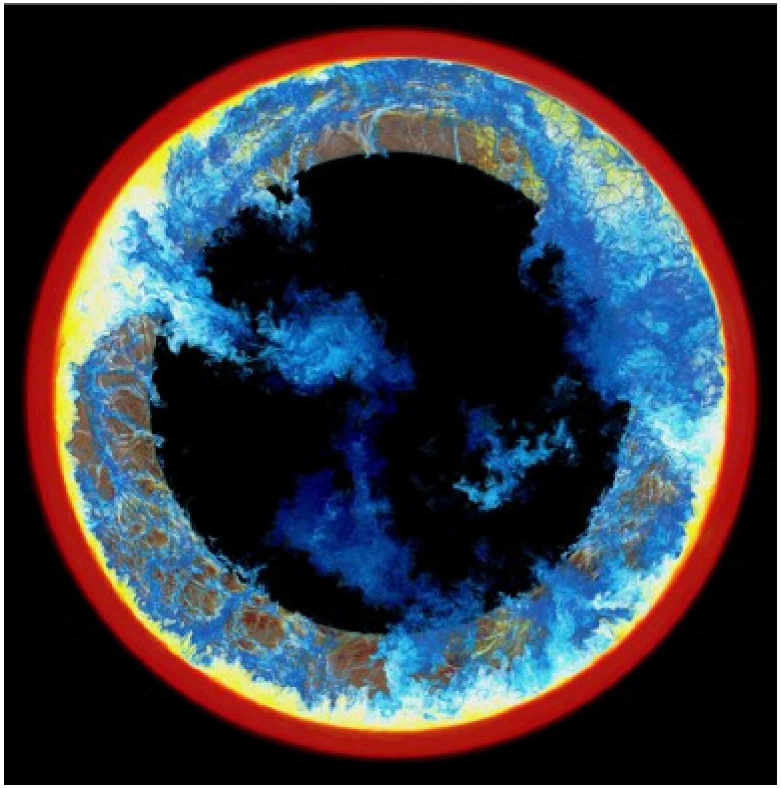
Impact of 12C(p,γ)13N reaction rate on hydrodynamic combustion feedback

- Additional run (right panel) with reaction rate 12C(p,γ)13N * 0.5 performed by **Paul Woodward** and his research team at Minnesota.
- Run on newest NSF supercomputer **Blue Waters: 11.27**, running on 110,656 cores for 11.27hrs

Standard 12C(p,γ)13N | Snapshot at 485m | 12C(p,γ)13N * 0.5



Most recent results for the hydrodynamics of H ingestion:



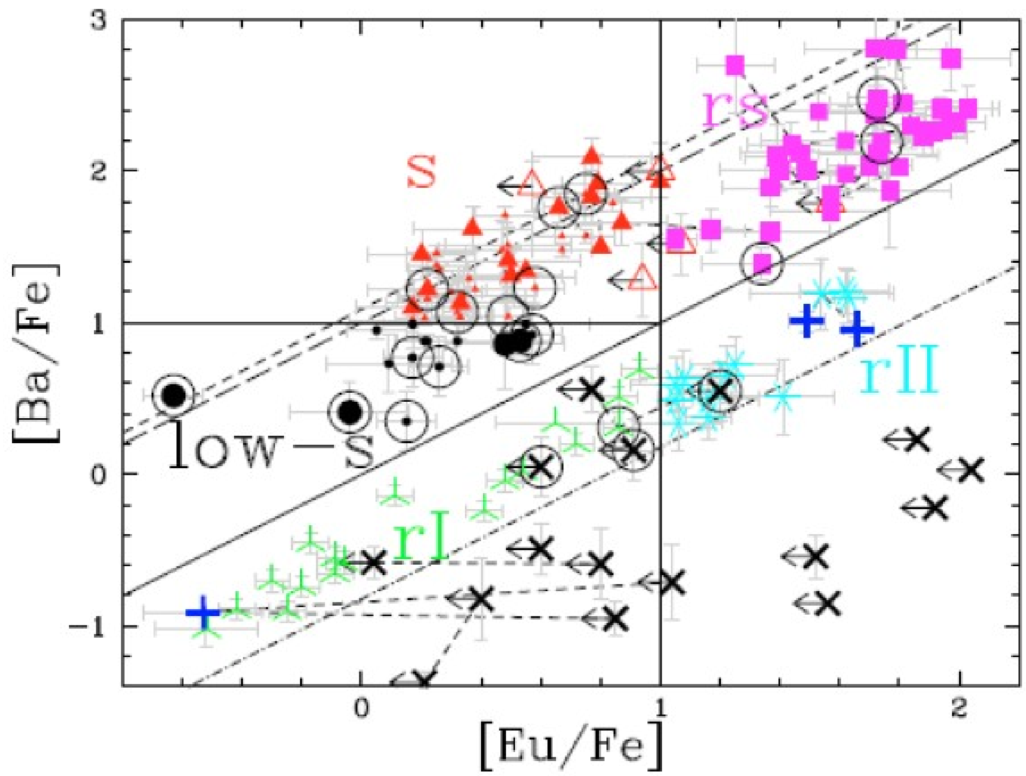
Woodward et al. 2014, arXiv1307.3821
Herwig et al. 2014, arXiv1310.4584

- Analysis of the entrainment process at the top convection boundary and on the subsequent advection of H-rich material into deeper He-rich layers.

- Defined the quantitative dependence of the entrainment rate on grid resolution.

Future step:
include limited network with virtual species and virtual neutron capture rates, to evaluate the neutron density distribution and the neutron exposure.

CEMP-rs stars → CEMP-i stars



Masseron et al. 2010

~ 20% of the low metallicity stars are carbon-rich (Lucatello et al. 2006)

Bertolli, MP et al. 2013, arXiv
Herwig, MP et al. 2014, in prep.