FROM NUCLEI TO DUST GRAINS: HOW THE AGB MACHINERY WORKS

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ABSTRACT: The interplay between AGB stellar interiors (dominated by mixing events like convection and dredge-up episodes and nuclear burning phases) and stellar winds (characterized by pulsations, dust formation, and wind acceleration) is often ignored.

We intend to develop a new approach involving a transition region, taking into consideration hydrodynamic processes which may drive AGB mass-loss.

Our aim is to describe the process triggering the mass-loss in AGB stars with different masses, metallicities and chemical enrichments, possibly deriving a velocity field of the outflowing matter.

Moreover, we intend to construct an homogeneous theoretical database containing detailed abundances of atomic and molecular species produced by these objects. As a long term goal, we will derive dust production rates for silicates, alumina and silicon carbides, in order to explain laboratory measurements of isotopic ratios in AGB dust grains.

STELLAR EVOLUTION MODEL:

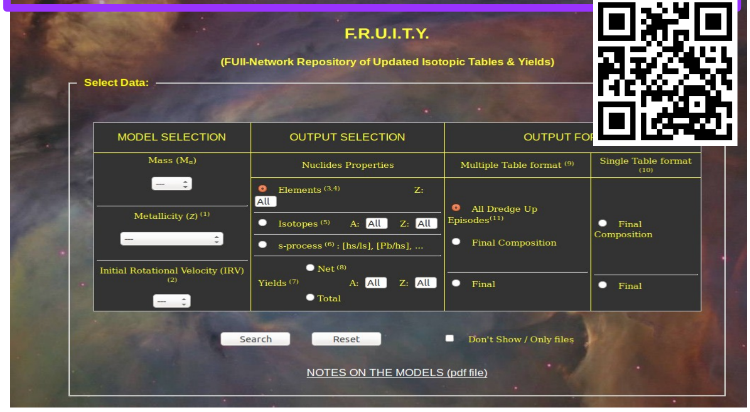
FRUITY (**F**UNS **R**epository of **U**pdated **I**sotopic **T**ables & **Y**ields)

The magnitude of the K band M_k can be derived from the luminosity L_* and the stellar temperature T_* by exploiting the T*- B.C. (Fluks 1993) relation. Once M_k is known, it is related to the pulsation period P (Whitelock+2003), which in turn correlates with the mass-loss rate M (Straniero+2006).

Isotopic abundances as function of
- stellar mass (M=1.3, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0 M_{sun}),
- metallicity ([Fe/H]=-2.15, -1.67 , -1.15, -0.85, -0.67, -0.37, -0.24, -0.15, 0, +0.15),
- rotation (V=0, 10, 30, 60, 120 km/s) and
- time (Thermal pulses experienced).

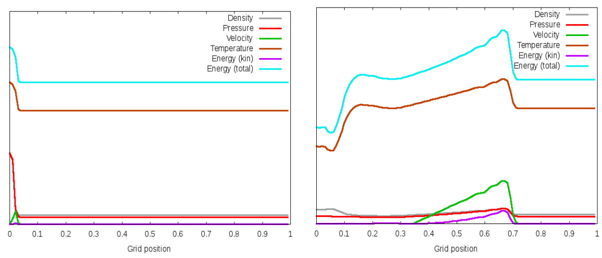
ONLINE http://fruity.oa-teramo.inaf.it/

Cristallo+07,09,11,15 Straniero+06,14 Piersanti+13,15



CIRCUMSTELLAR MODELLING

Hydrodynamic description of the inner wind (1-10 R_*) including the effects of pulsational shocks in an Eulerian reference frame

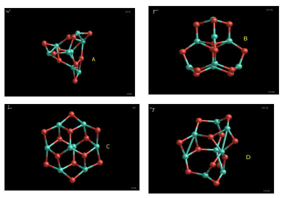


Chemical-kinetic description of the prevalent molecules and dust clusters (silicates, pure metals and their oxides) is developed and accounts for oxygen-rich, S-type, as well as carbon-rich circumstellar envelopes. The network currently contains more than 150 species and 600 reactions.

$$\frac{dn(C)}{dt} = k_{AB}\, n(A)\, n(B)$$

$$k_{AB} = \alpha \left(\frac{T}{298\ K}\right)^{\beta} \exp\left(\frac{-E_a}{RT}\right)$$

Arrhenius rate



$$\frac{dn_i}{dt} = \sum_{j,k} k_{jk} n_j n_k + \sum_{j,k} k_{jkM} n_j n_k n_M - n_i \sum_{l} k_{il} n_l - n_i \sum_{n} k_n$$

Molecular abundances and dust mass yields are compared to observations in AGB stars of various evolutionary, chemical and types and various stellar masses.