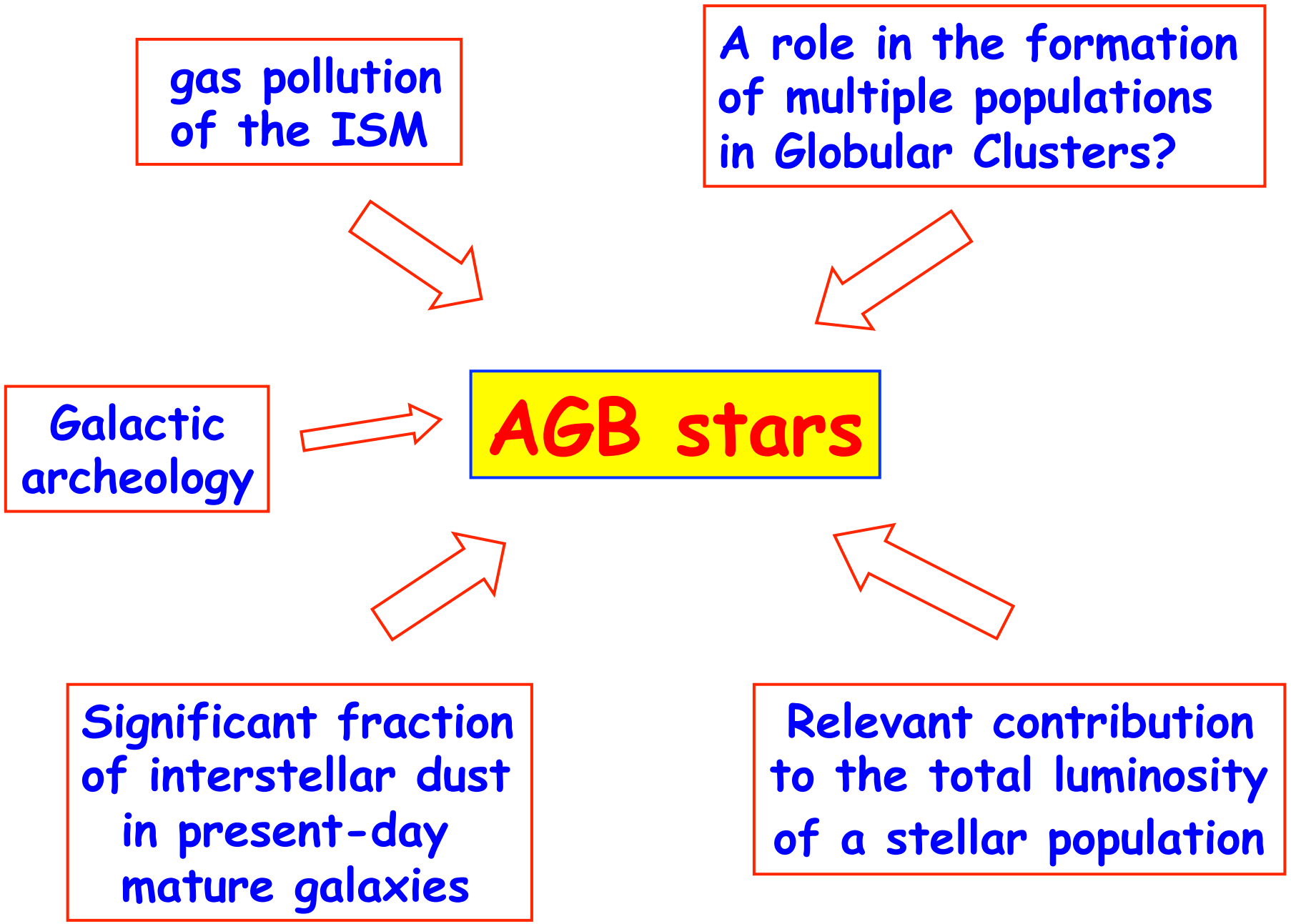

gas pollution of the ISM
A role in the formation of multiple populations in Globular Clusters?
Galactic archeology
AGB stars
Significant fraction of interstellar dust in present-day mature galaxies
Relevant contribution to the total luminosity of a stellar population

# Changes in the surface chemistry of AGBs

## (pollution of the ISM !!)

### Third Dredge-Up

* Penetration of the surface convection to regions touched by He-nucleosynthesis
* C and O increase

### Hot Bottom Burning

* Activation of proton capture nucleosynthesis at the bottom of the convective envelope
* C and O decrease
* N synthesis
* Ne-Na, Mg-Al nucleosynthesis

# AGB@Italy

* The FUNS (FUll Network Stellar) Evolutionary Code
  Straniero et al. (2006); Cristallo et al. (2007, 2009)

* The ATON code for stellar evolution
  Ventura et al. (1998, 2008)

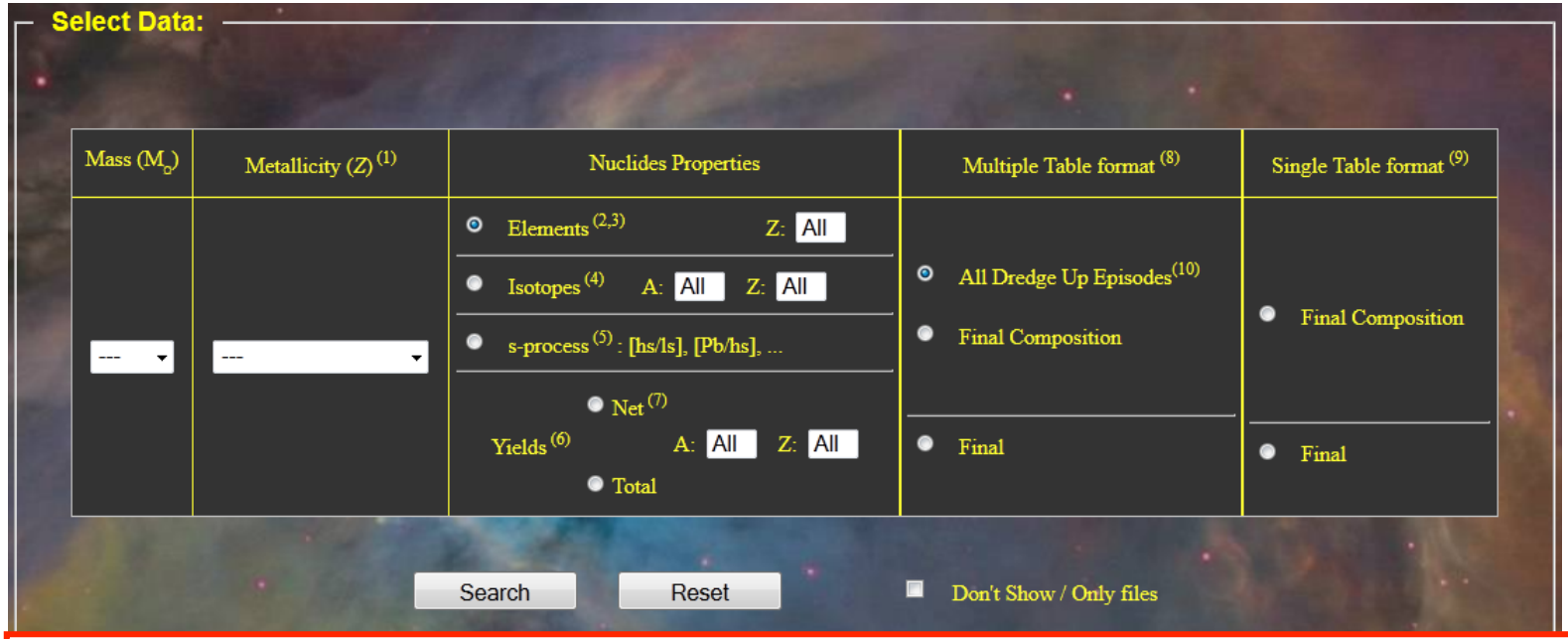
* The COLIBRI code
  Marigo et al. (2013); Rosenfield et al. (2014)

# F.R.U.I.T.Y. Database

## (FUNS Repository of Updated Isotopic Tables & Yields)

Cristallo et al. (2011, 2015)

On line at www.oa-teramo.inaf.it/fruity



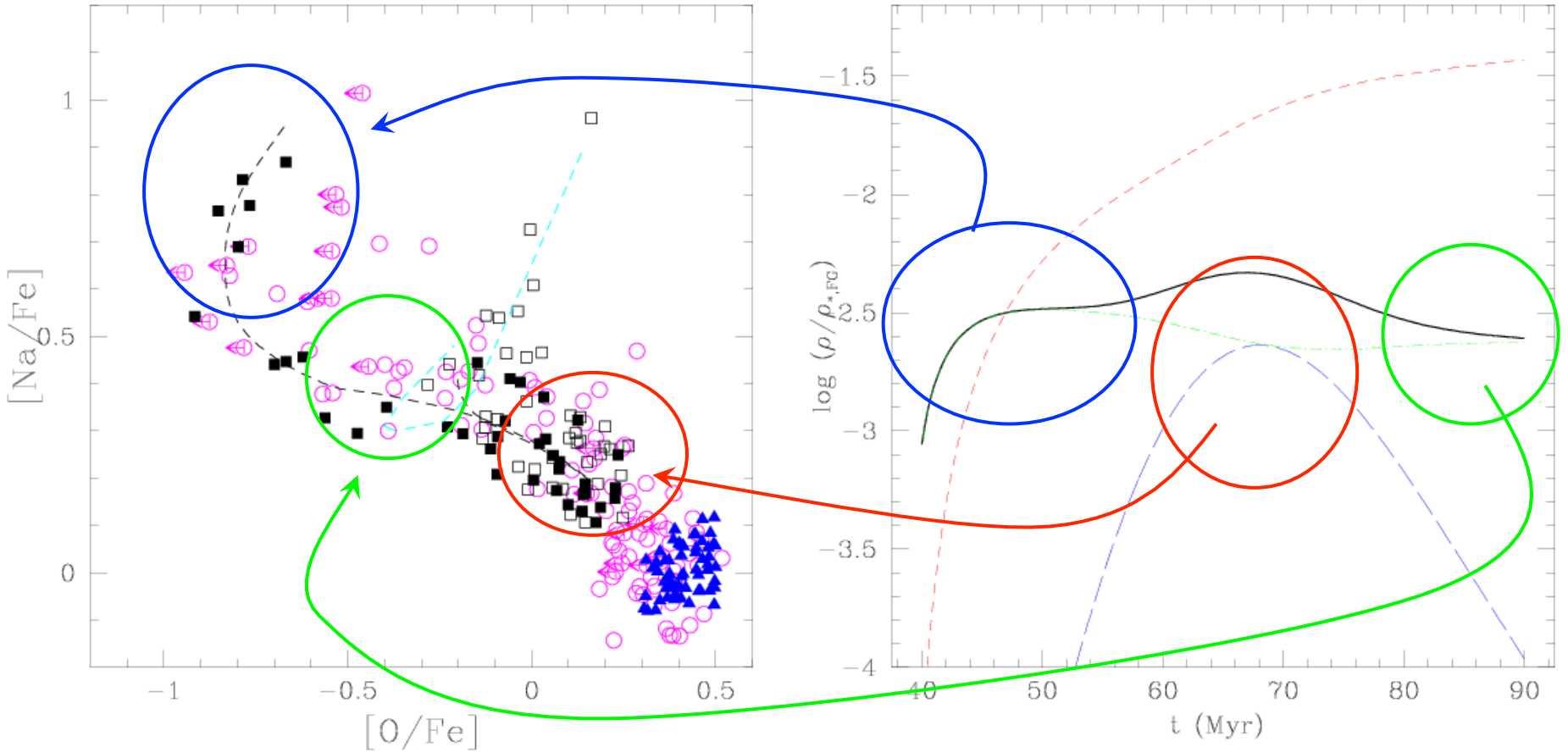

Masses[$M_{SUN}$]: 1.3 – 1.5 – 2.0 – 2.5 – 3.0 – 4.0 – 5.0 – 6.0

[Fe/H]: -2.15, -1.67 , -1.15, -0.67, -0.37, -0.24, -0.15, 0, +0.15

$V_{ROT}^{ZAMS}$ =0 – 10 – 30 – 60 km/s

# The AGB scenario for the formation of multiple populations in Globular Clusters

## Typical case: NGC 2808




Ventura+ 2001, 2002, 2006, 2008, 2013 Di Criscienzo+ 2010, 2011
D'Ercole+ 2008, 2010, 2011, 2012

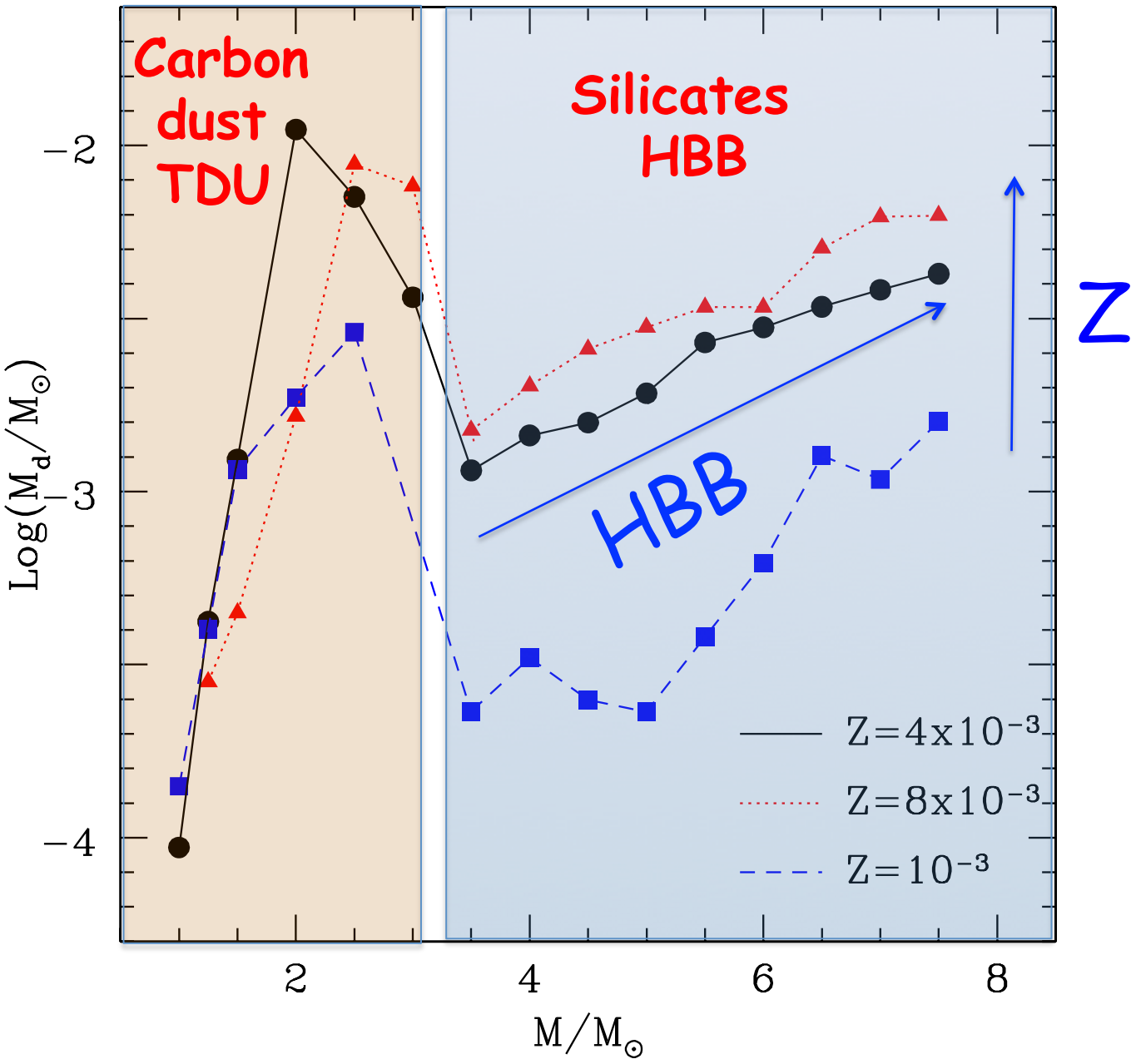
# Dust from AGBs

In more recent years dust production by AGBs has been Investigated via the description of a stationary, isotropic wind, driven by the effects of radiation pressure on the newly formed dust particles (e.g Ferrarotti & Gail 2006).

This schematization has been used by the Rome (Ventura+ 2012a,b, 2014; Di Criscienzo+ 2013) and Padua (Nanni+ 2013, 2014) groups to calculate the quantity and the grain size distribution of the dust formed in the winds of AGB stars

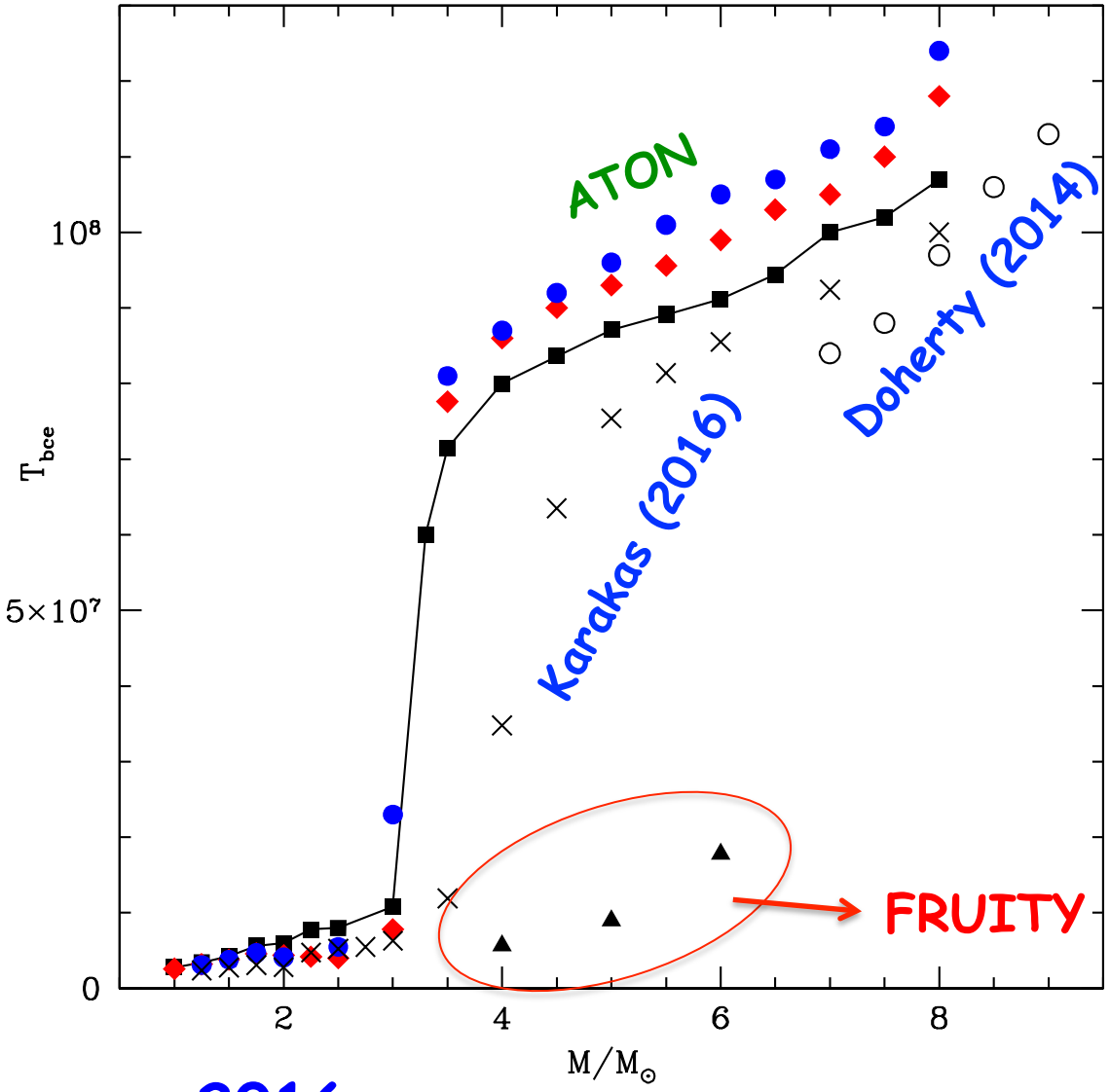
**To date, these are the only compilations of dust from AGBs available in the literature**

# Dust production by AGBs (Ventura+ 2014)



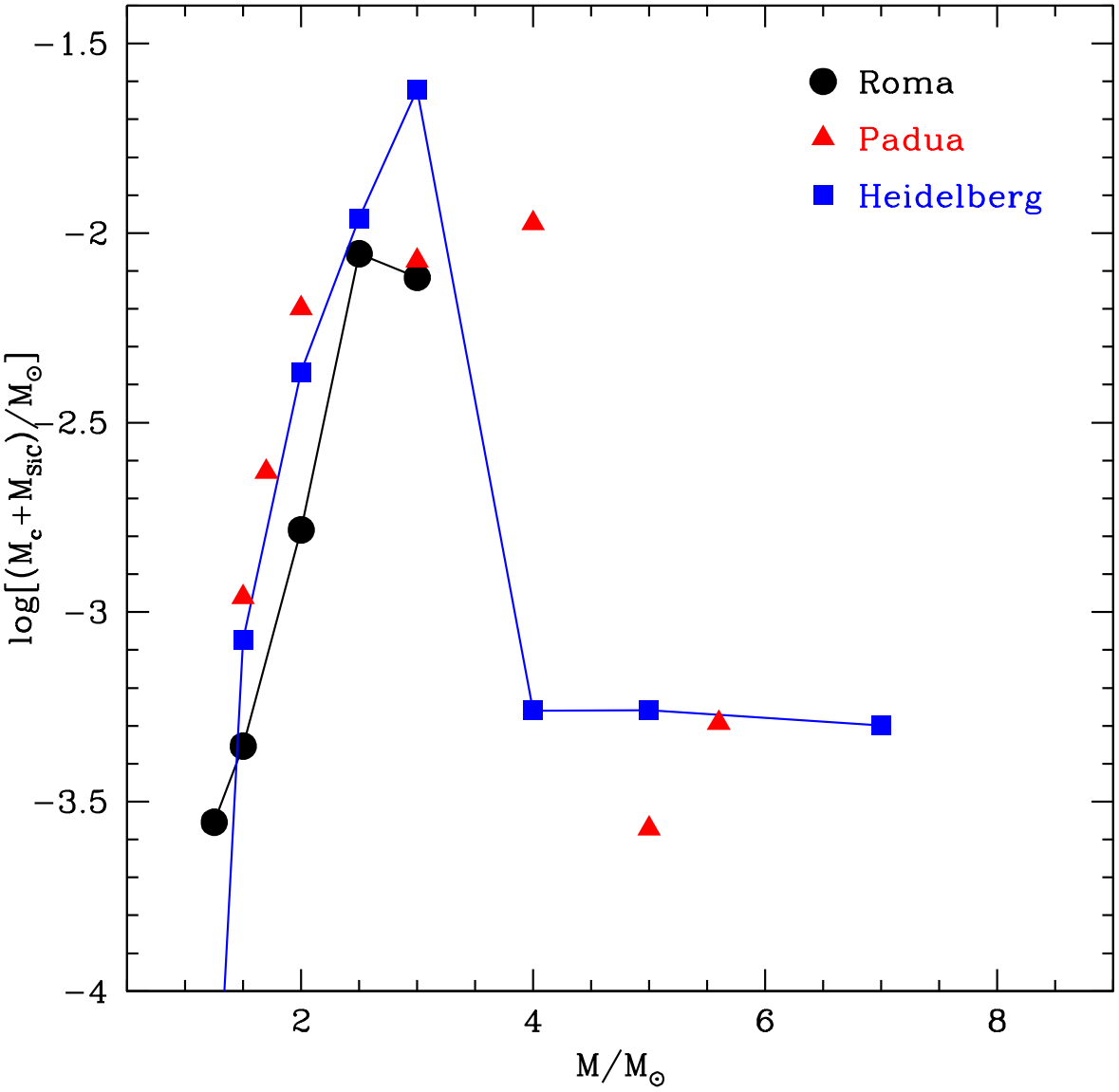
# Are the results from the various groups consistent?

## Let's have a look at the temperature at the base of the envelope ....

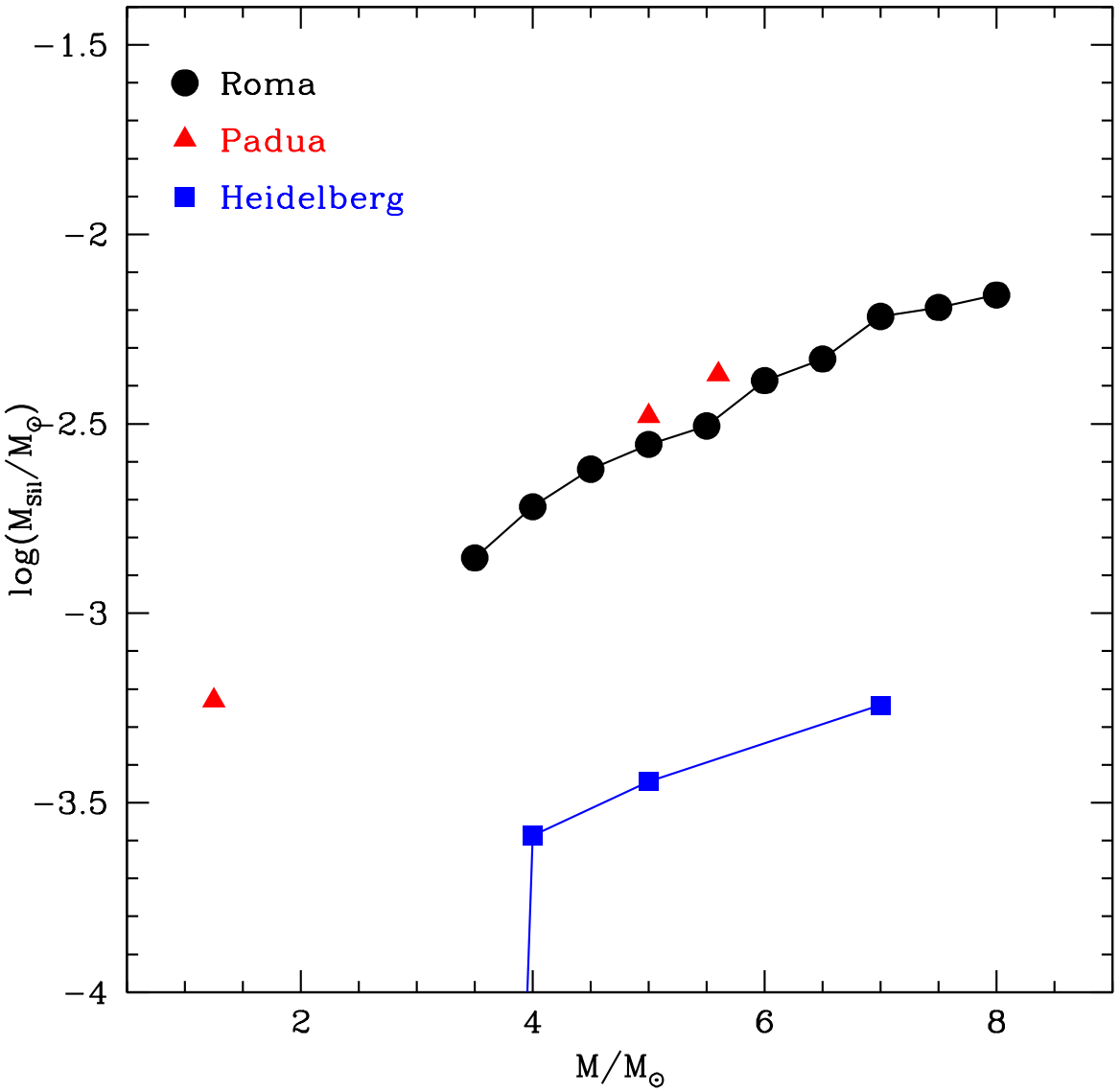



Di Criscienzo+ 2016

# Uncertainties in dust modelling I: carbonaceous dust



# Uncertainties in dust modelling II: SILICATES



**Results still highly uncertain: AGB modelling more critical than the description of dust formation in the wind**

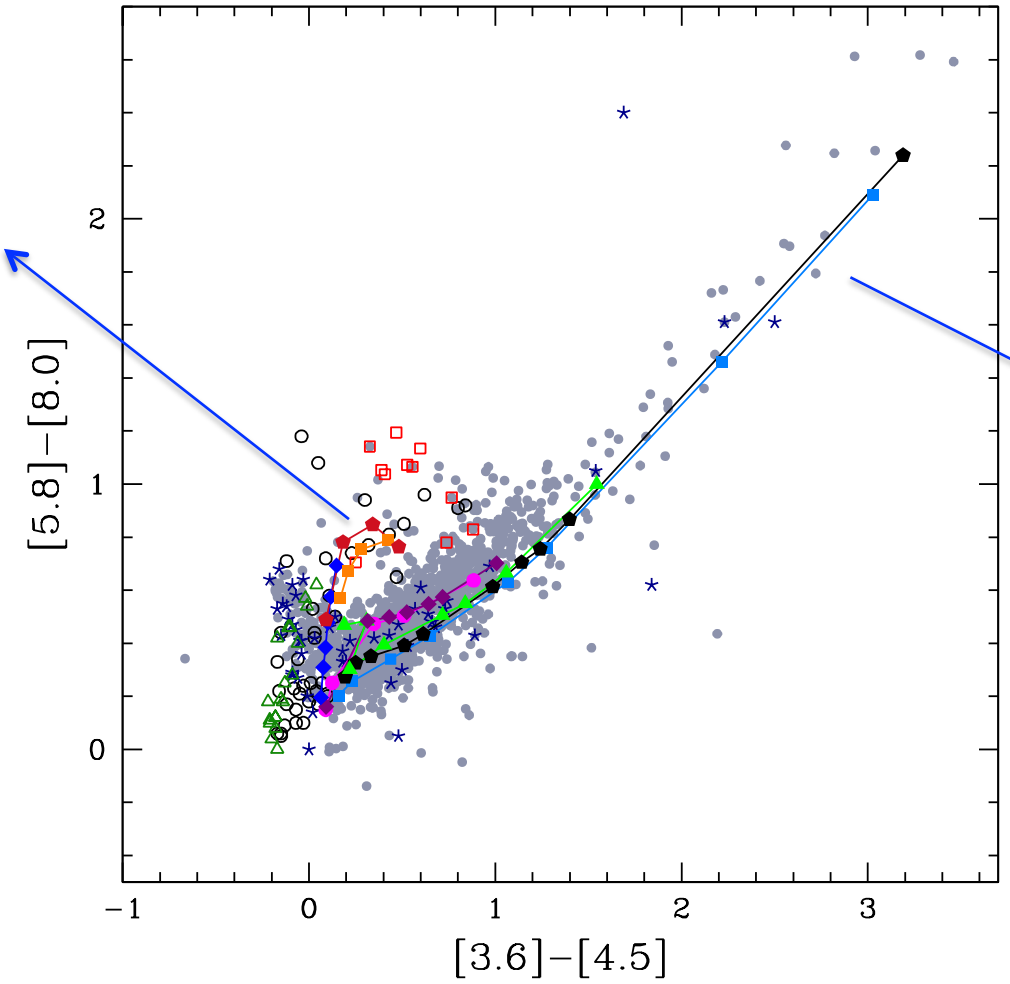
**Two possibilities to constrain the models**

**NIR and IR data of AGB samples**

**Dust and gas chemistry of PNe**

# Models with dust required to interpret IR data of AGBs in the LMC (Dell'Agli + 2015)

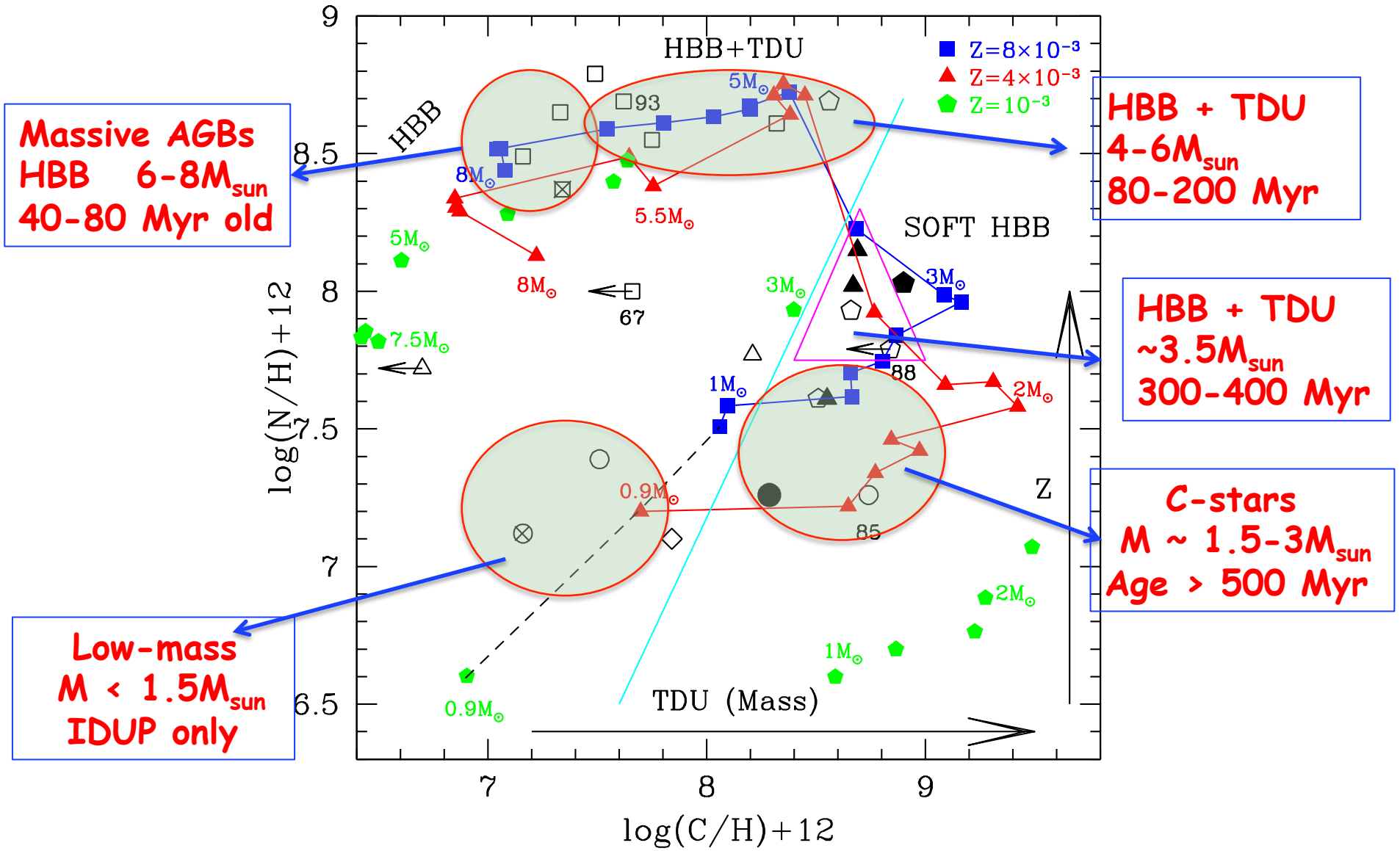
AGBs with silicates and high IR emission



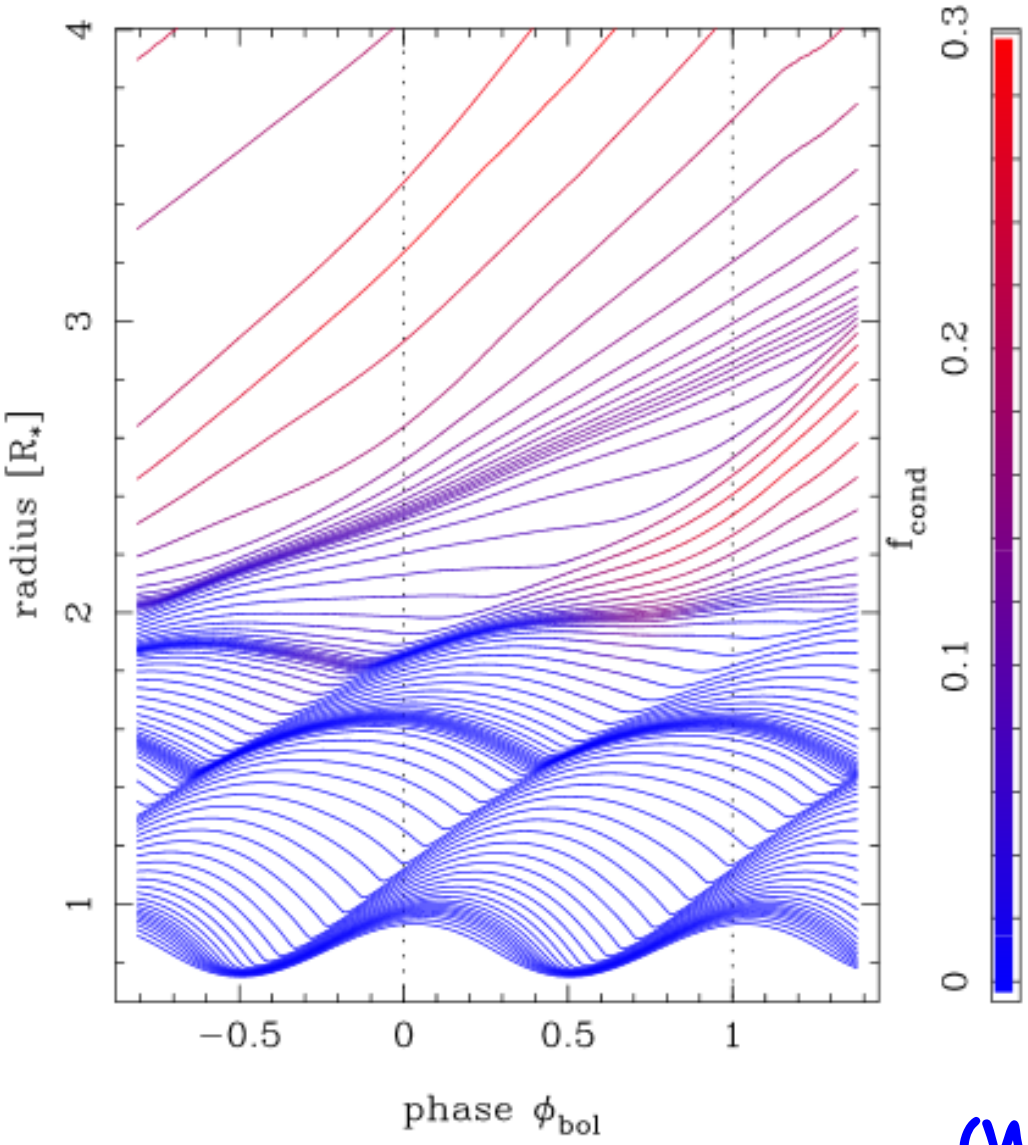

AGBs with carbon dust and high IR emission

Additional data of extragalactic AGBs coming with the new space missions!

# Understanding the observations of PNe in the LMC (Ventura+ 2015)



# Dust as wind driver in AGB stars




From Nowotny et al. (2011)

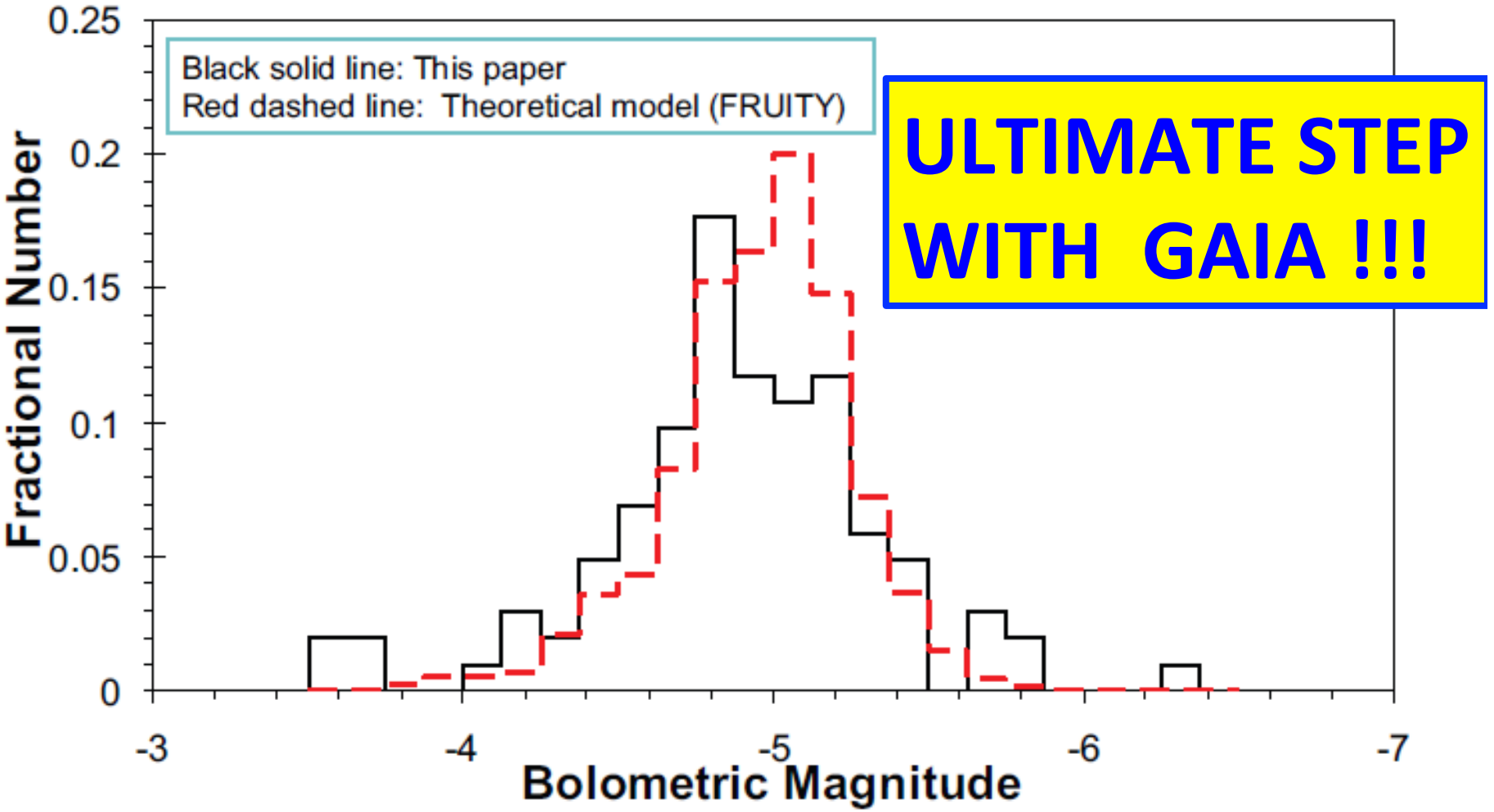
Among candidate species there are **SiC grains**

RECIPE

* Hydro code for shocks propagation
* Radiative transfer equations
* Non-equilibrium chemistry
* Dust formation path

**(Work in progress @ Teramo)**

# The Luminosity function of Galactic C-stars




**ULTIMATE STEP WITH GAIA !!!**

**THEO: Cristallo+ 2011 (ApJS, 197, 2)**
**OBS: Guandalini & Cristallo 2013 (A&A, 555, 120)**

**Distances from van Leeuwen+ 2007** **P-L from Whitelock+ 2006**

**ALMA**: characterization of the chemistry along the circumstellar envelope of AGB stars

**GAIA**: determination of the parallaxes of individual AGBs: opens the possibility of using the wide sample of Galactic AGBs to deduce information on the internal physics

**JWST**: extending the analysis at the moment limited to the MCs to all the galaxies in the local group and (maybe) bejond

**ELT**: High resolution spectroscopy of obscured AGBs with **Metis & Hires** → determination of the isotopic ratios (crucial diagnostic!)

# Crucial questions

1) Can we converge towards a homogeneous description of the AGB evolution? (important to fix the contribution from AGBs to gas pollution)
2) Do rotation and magnetic fields affect the internal structure and the evolution of AGBs?
3) Which is the evolutionary connection between AGBs and PNe?
4) Which is the dust mass budget expected from AGBs?
5) Which was the role of AGB stars in the early dust enrichment of the Universe?
6) Which is the feedback of AGB stars on the host environment?