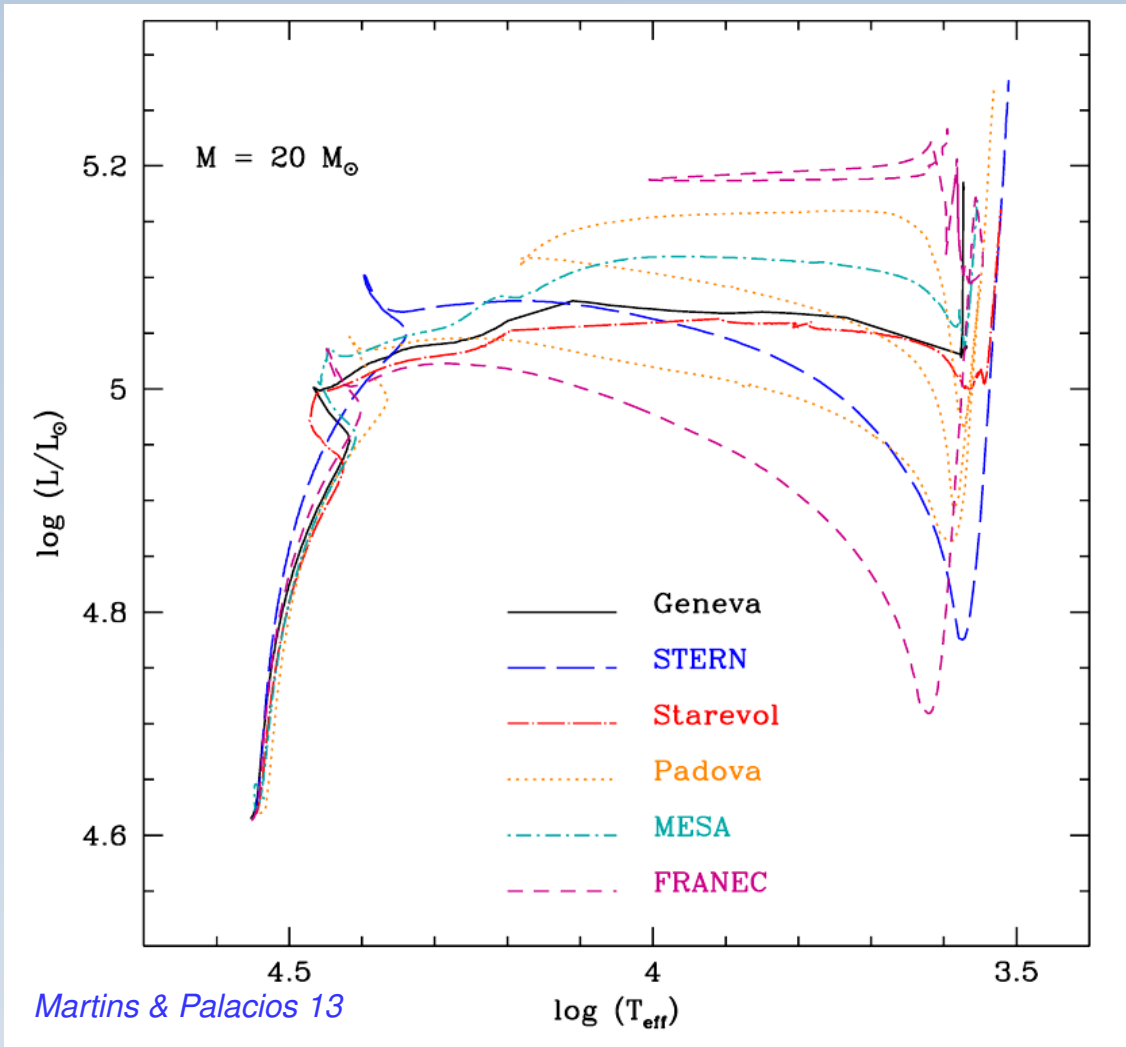
Surface abundances with HIRES: massive stars and globular clusters

Fabrice Martins

Laboratoire Univers et Particules de Montpellier

The evolution of massive stars



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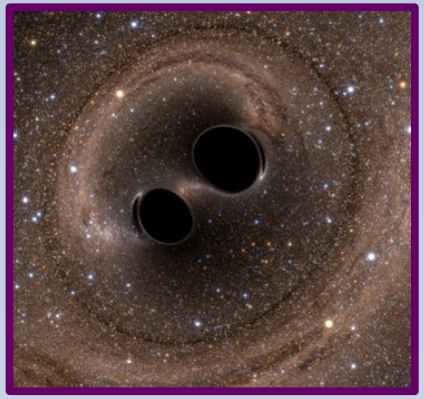
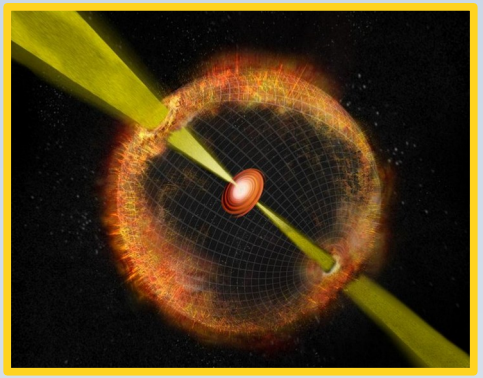
Black holes and gravitational waves



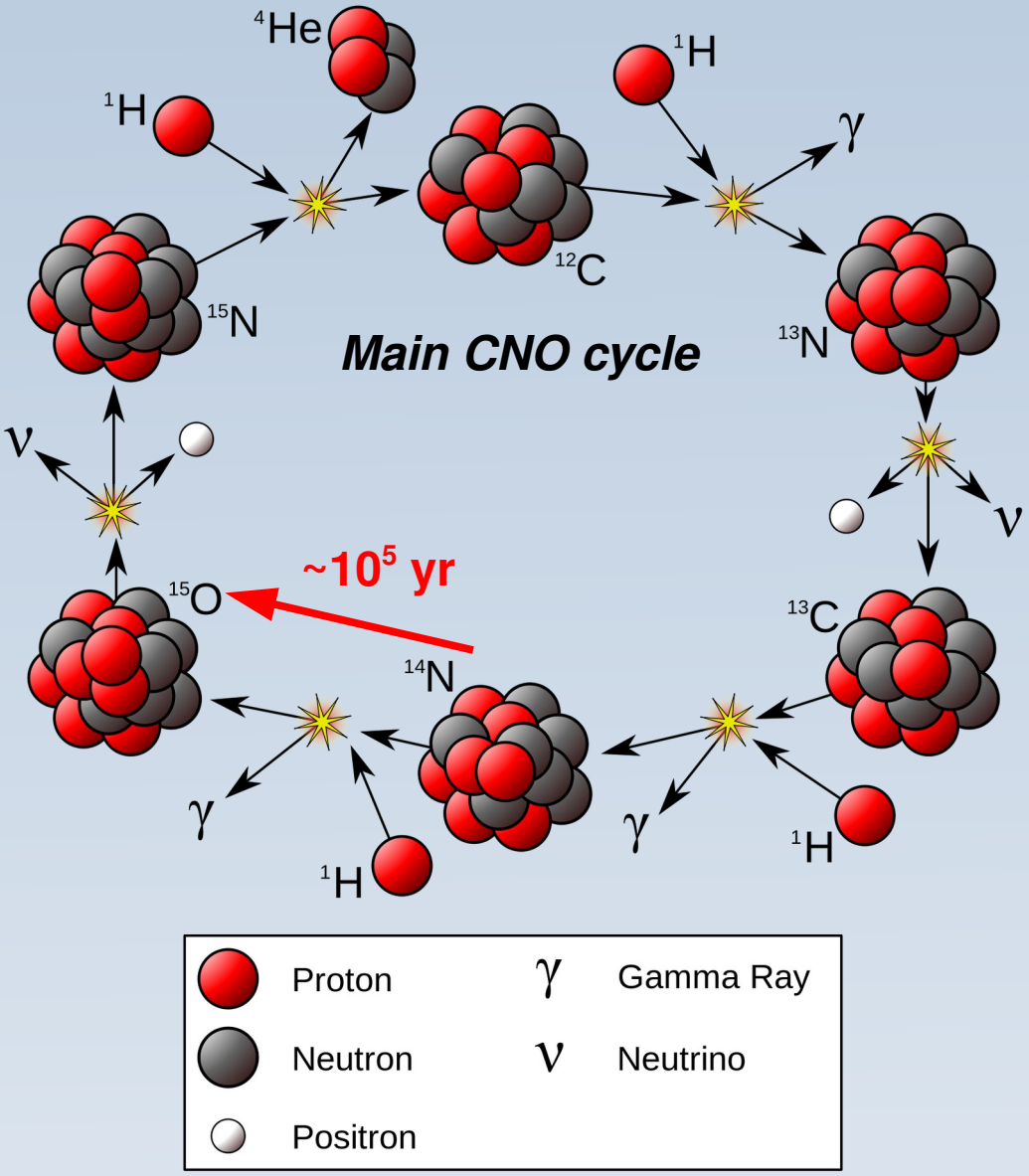


Core collapse supernovae
Long-soft GRBs

Evolution ruled by

- stellar rotation
- stellar winds
- binarity
- magnetism

Surface abundances



H burning through CNO cycle

Timescale for nuclear burning longer than mixing timescale (e.g. in rotating stars)

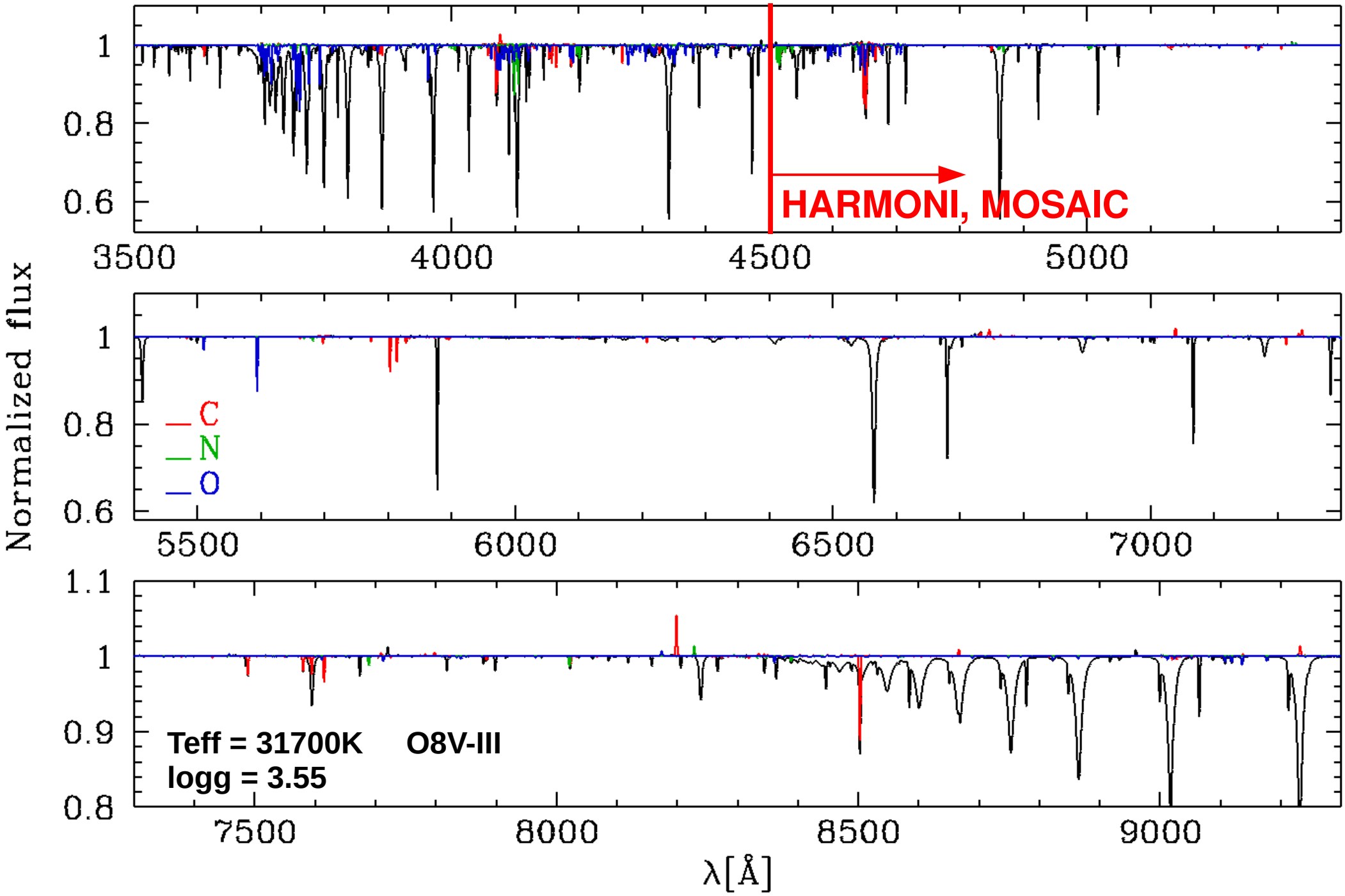
C (and O) converted to N

→ *chemical patterns should be observed at surface of stars*

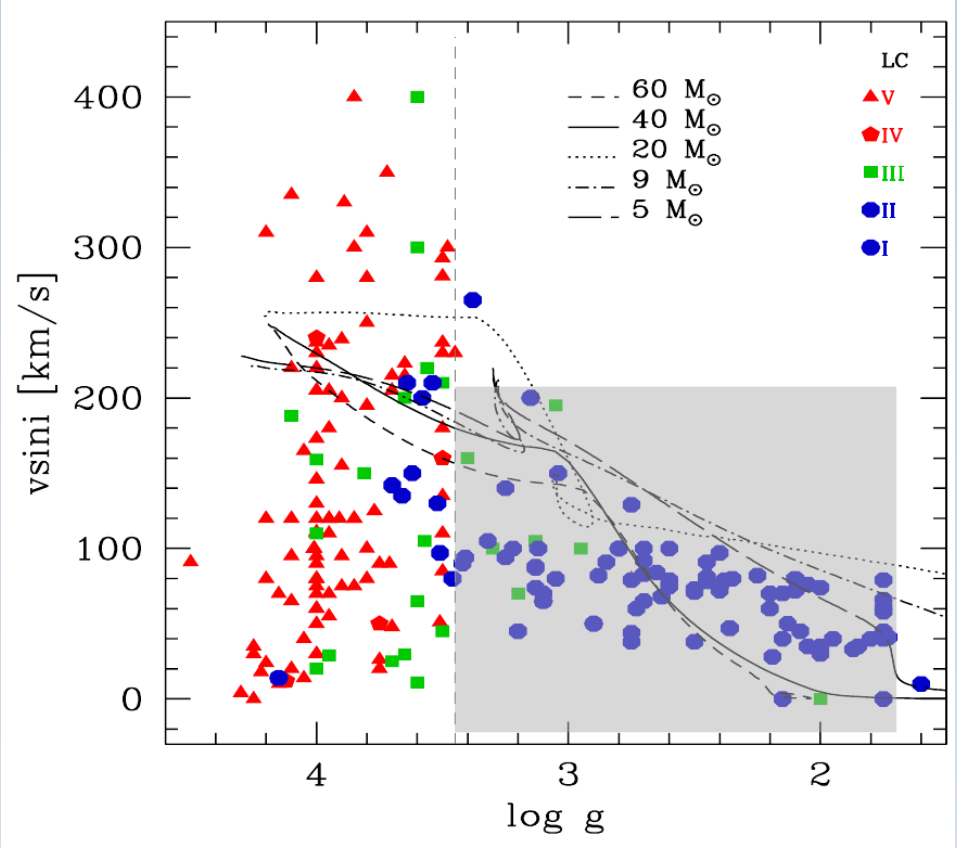
→ *surface abundances = good indicators of mixing processes*

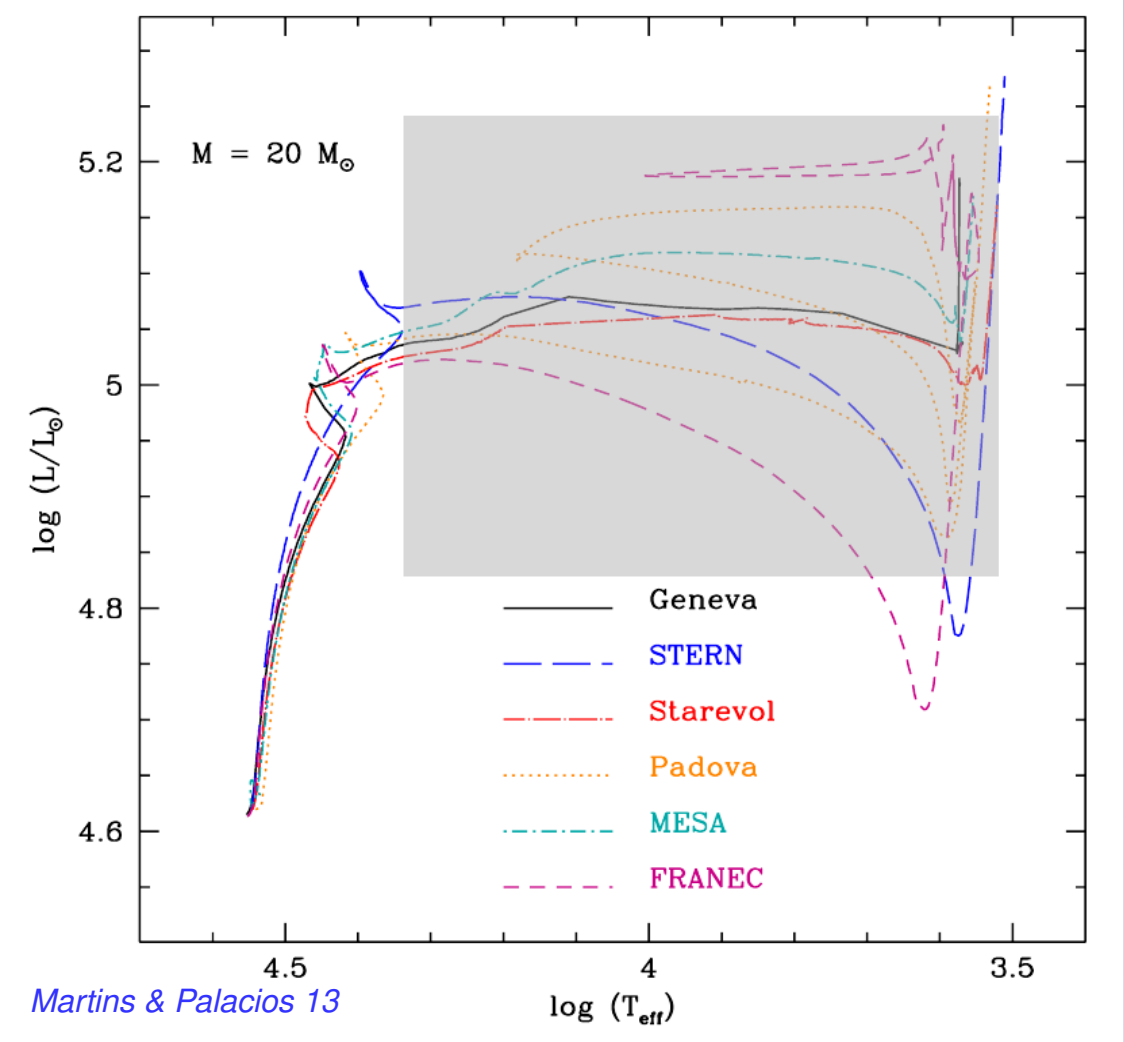
Rotation, winds and binarity impact differently surface abundances

Most lines from C, N & O are in the blue part of the optical



Line-broadening small in the post-MS phases (blue, yellow, red supergiants)





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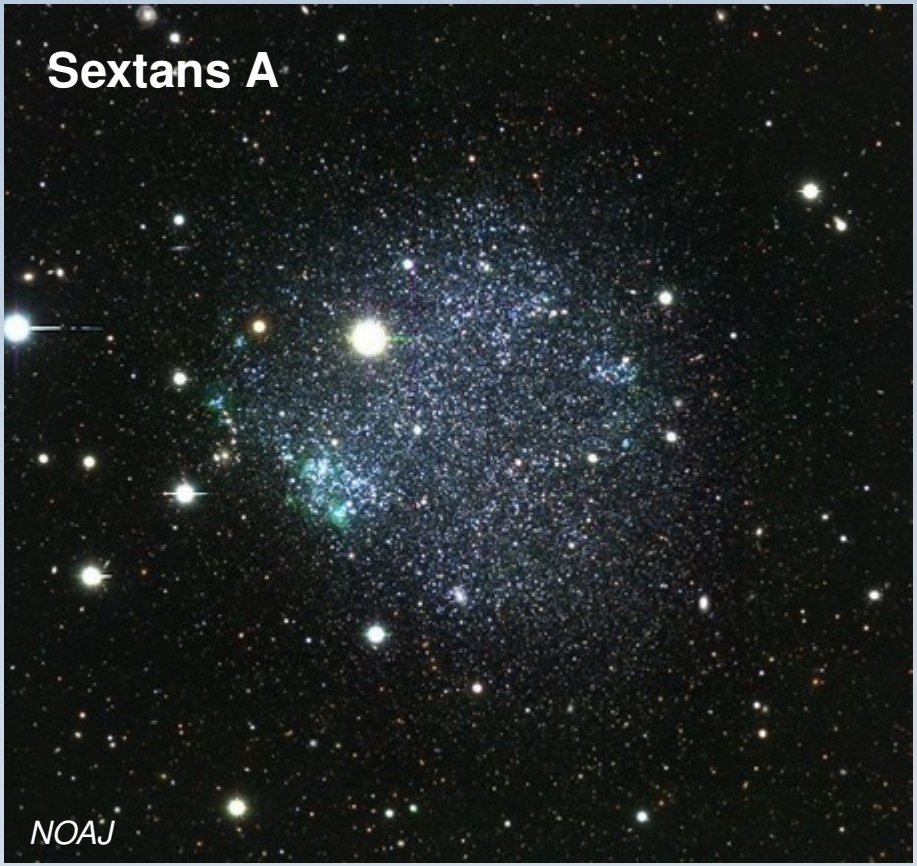
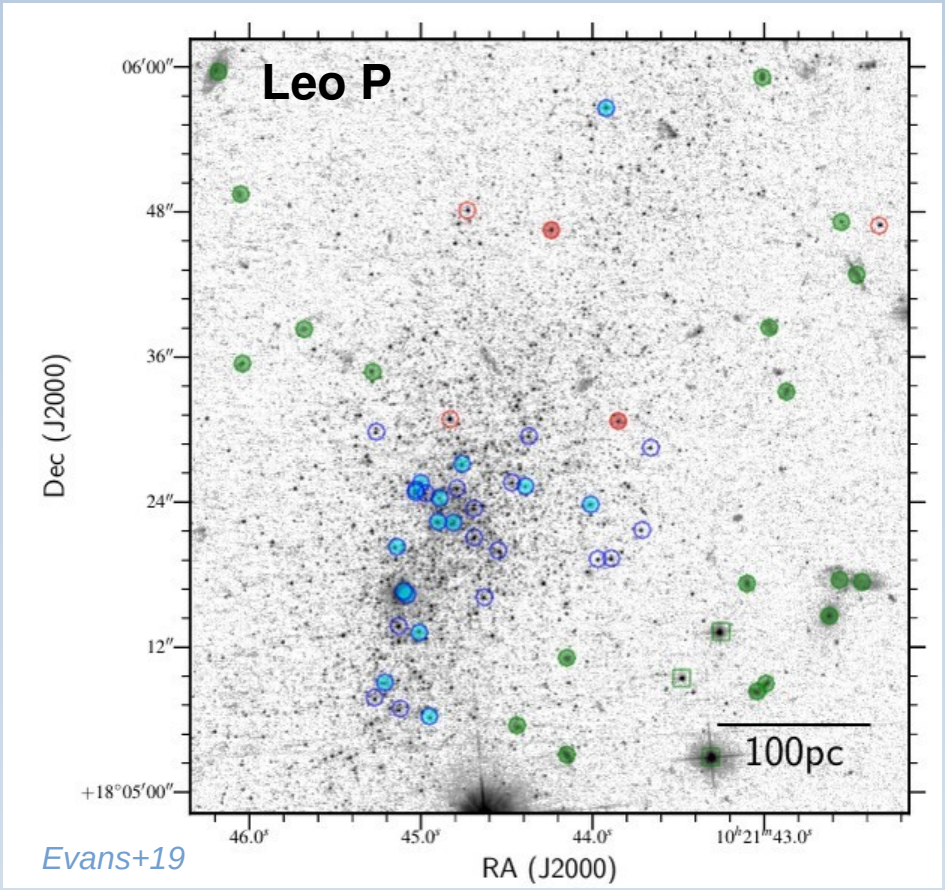
High resolution optical needed

ELT needed to probe sub-SMC metallicity range



Z~1/10 Zsun d=1.3Mpc



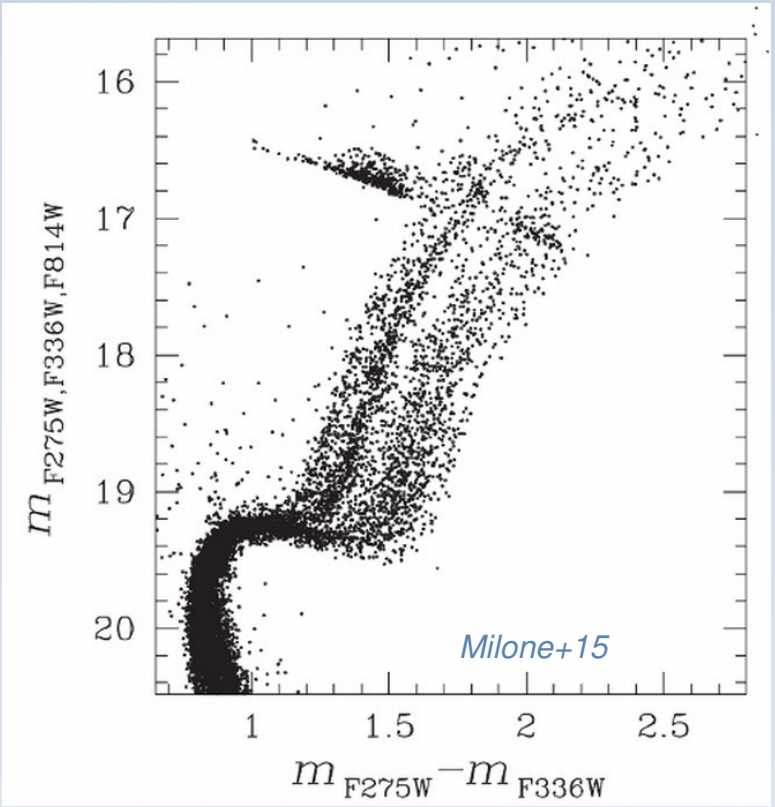
Z~1/30 Zsun d=1.6Mpc

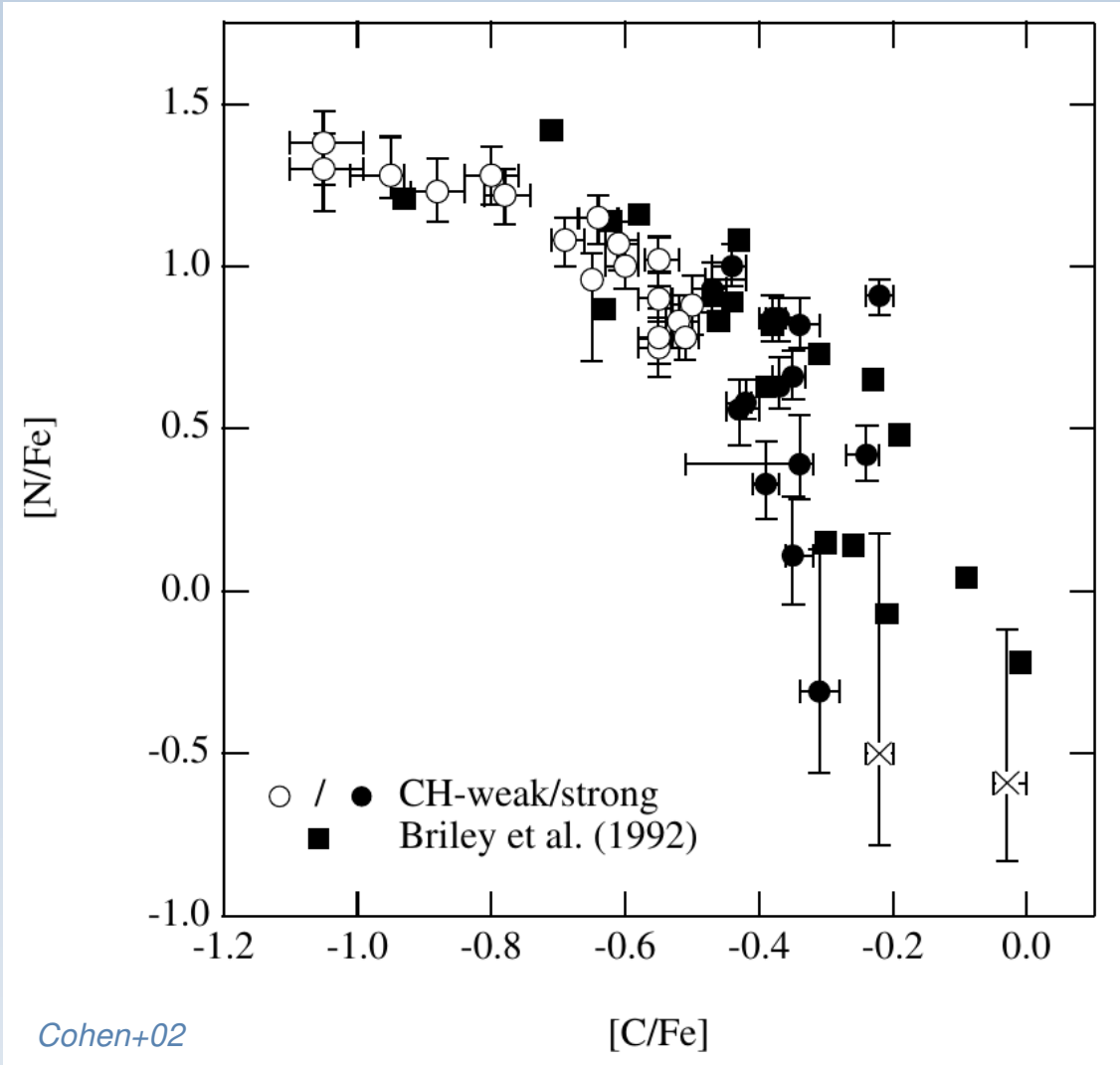
Metallicity range favoured for LGRBs
Ionizing fluxes in star-forming galaxies not currently understood by massive stars evolution

Multiple populations in globular clusters

All globular clusters host multiple populations, most likely born from gas polluted from an **early generation of massive stars.**

Different degrees of helium enrichment, through CNO cycle, are seen/ expected.





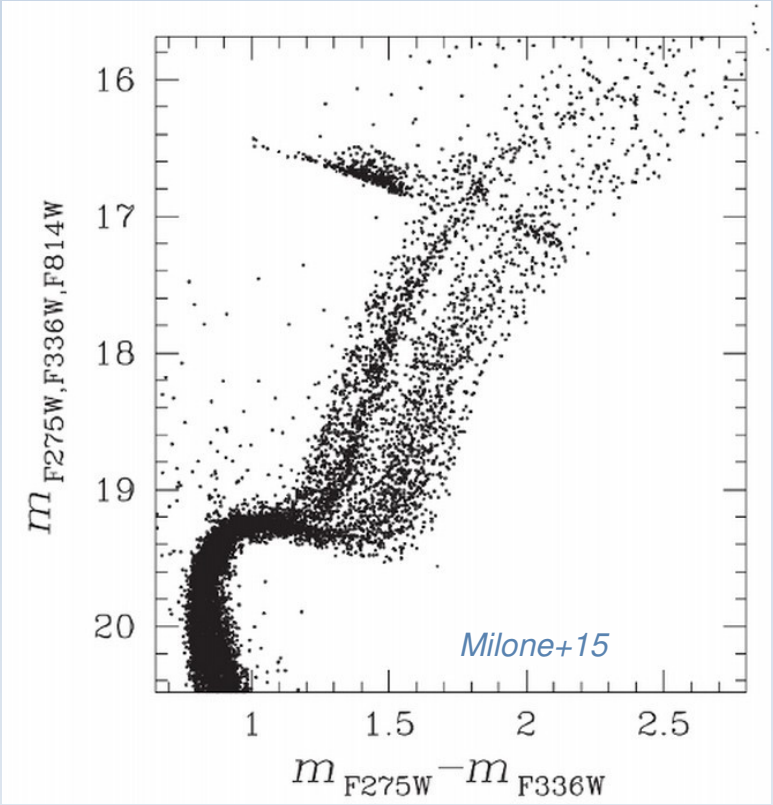
Multiple populations in globular clusters

All globular clusters host multiple populations, most likely born from gas polluted from an **early generation of massive stars.**

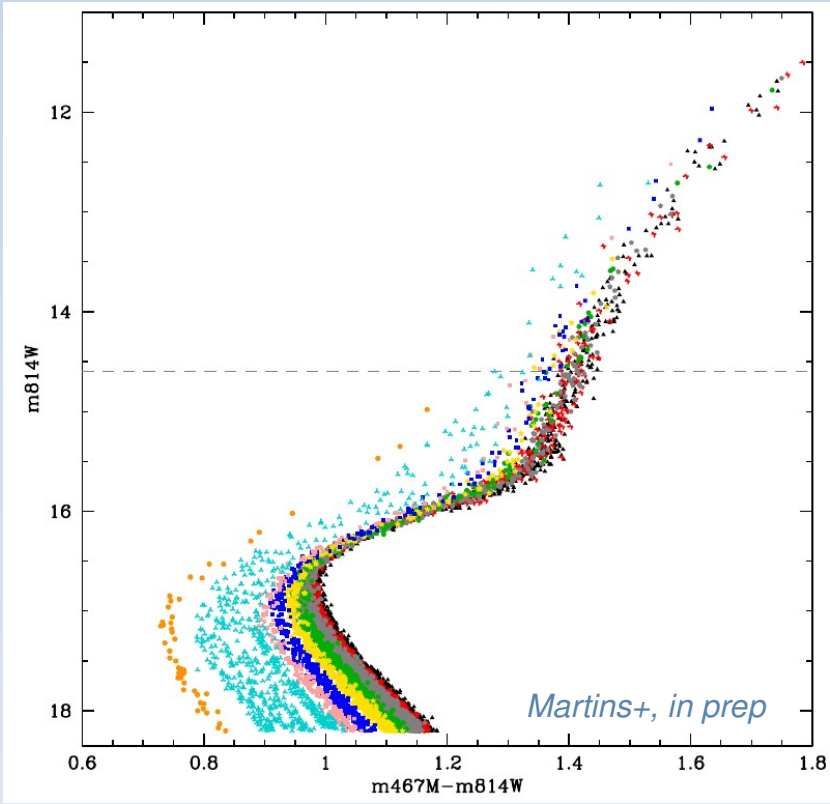
Different degrees of helium enrichment, through CNO cycle, are seen/ expected.

However, quantitative spectroscopy remains restricted to the most luminous stars (AGB, RGBs)

→ *Main sequence stars need to be probed to pinpoint the nature of the polluters responsible for the multiple populations.*



Need for high resolution optical spectrograph on ELT



Conclusion

Optical blue crucial to study massive stars at all metallicities

Local Group low Z galaxies will be prime targets to uncover the evolution of massive stars – ELT

Globular clusters need quantitative spectroscopic studies of their main sequence stars