Nitrogen and Carbon Abundances in Early-type Galaxies

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WHY DO WE STUDY CHEMICAL ABUNDANCES?

Because they are an alternative to the stellar population synthesis models to derive star formation histories from integrated spectra. Because different elements are released to the interestellar medium in different timescales, the study of chemical abundances patterns are a complementary way to study the duration and efficiency of the star formation in a galaxy.

A classical example of the usefulness of this approach is the ratio between Mg and Fe. Mg/Fe is very high in massive early-type galaxies, which have been used to infer that these galaxies formed most of their stars in a very short period of time.

Other elements as C, N and Na have been claimed to be enhanced in massive ellipticals (with respect to Fe), but separating the contribution of different elements from the broad, highly blended, lines of the elliptical galaxies integrated spectra is not a trivial task.

HOW DO WE STUDY N AND C ABUNDANCES?

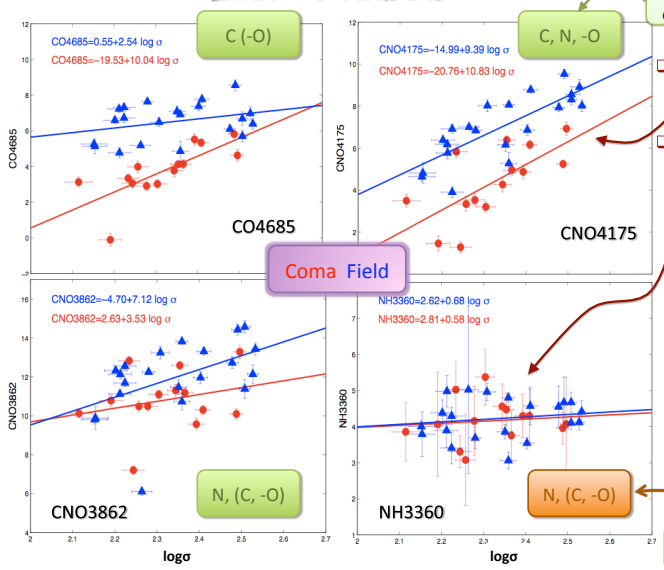
There has been several attempts to study N and C abundances in elliptical galaxies, usually using the CN indices defined by the Lick group. However these features depend on C, N and O and the three elements are difficult to disentangle.

Direct observation of the index NH3360 offers more reliable results about N, because this feature is independent of C and O.

The study of the NH feature with the new collection of indices published by Serven, Worthey & Briley (2005) – note that the sensitivity of these indices to variations of several chemical elements have been characterised using stellar atmosphere models - has made possible to understand independently the C and N trends with velocity dispersion (our proxy for mass) and environment.

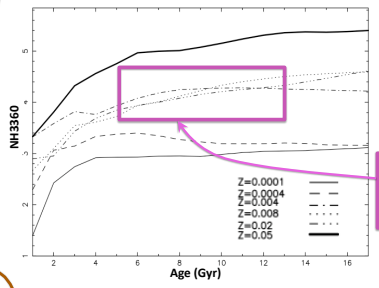
This analysis has been developed with observations of 35 ellipticals spanning a range in velocity dispersions (130 < σ < 330 km/s) and in environment: field (isolated and Virgo) and Coma.

Index - σ relations



- **C-sensitive indices (CO4685,CNO4175):**
  - Strong dependency with σ
  - Systematic offset between environments
- **N-sensitive indices (CNO3862,NH3360):**
  - flat dependency with σ
  - Independent of the environment

C & N production seems to be decoupled from one another



NH3360 does not depend either on age or metallicity

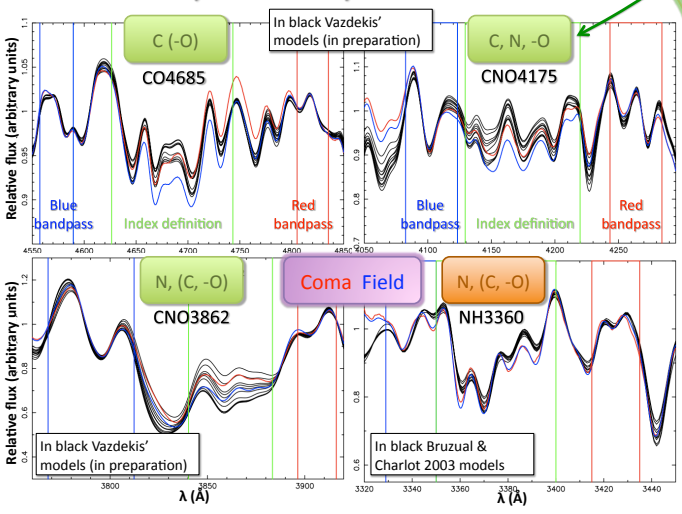
Area that covers the ages and metallicities of our ellipticals

Index defined by Davidge & Clark 1994

Indices defined by Serven, Worthey & Briley 2005

- **C-sensitive indices:**
  - Field galaxies overabundant with respect to scaled-solar models
  - Coma galaxies compatible with scaled-solar models
- **N-sensitive indices:**
  - No differences within environments
  - Overabundant with respect to scaled-solar models

Stacked spectra- Comparison with models



Discussion

N The lack of correlation between N and σ indicates that N is a primary element.

Both, massive and intermediate-mass stars, contribute to the production of N: massive galaxies (short and rapid star formation (SF)) experience the major contribution of N via massive stars, but less massive galaxies would increase their N also from intermediate-mass stars because their SF is more extended in time. This last contribution would flatten the N-σ correlation.

C C is produced in massive and intermediate-mass stars in comparable proportions.

The steep slope of C with σ would be due to the contribution of massive stars, in a similar way as the Mg-σ correlation. The offset would come from a different production in intermediate-mass stars. This latter C release would increase the C budget in field galaxies, while in the Coma cluster SF ceases before this can happen.