Extended Ionized Gas in Galaxy Clusters: the quest for low surface luminosity regions as tracers of galaxy evolution

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ABSTRACT

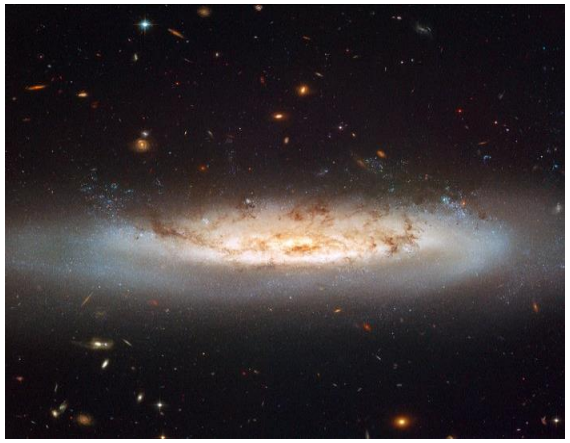
The existence of extensive ionized gas regions in galaxy clusters is the smoking gun of various mechanisms that affect the evolution of galaxies in high density environments. The detection of these emission line regions associated both to host galaxies and to stranded filaments in the core of clusters is very elusive due to their low surface brightness.

In this communication we present the methodology and results of the analysis of the cluster of galaxies Abell 2390 (z~0.23), where extended emission line regions have been successfully detected, and discuss the possible implications in galaxy evolution in clusters.

Context

The **influence of environment** on the star formation histories of galaxies is a critical question for galaxy evolution.

Different mechanisms affect the evolution of galaxies in clusters. **Extensive ionized gas regions (EIGs)** formed after galaxy-galaxy interactions and/or from ram pressure stripping **are evidencies of how and most important, where these processes take place.**



(Credit: NASA & ESA)

Deep Hα imaging has been a successful way to detect extensive ionized gas regions in galaxy clusters. However, only one non-local cluster has been found to have such regions *(Yagi, Masafumi 2015)*

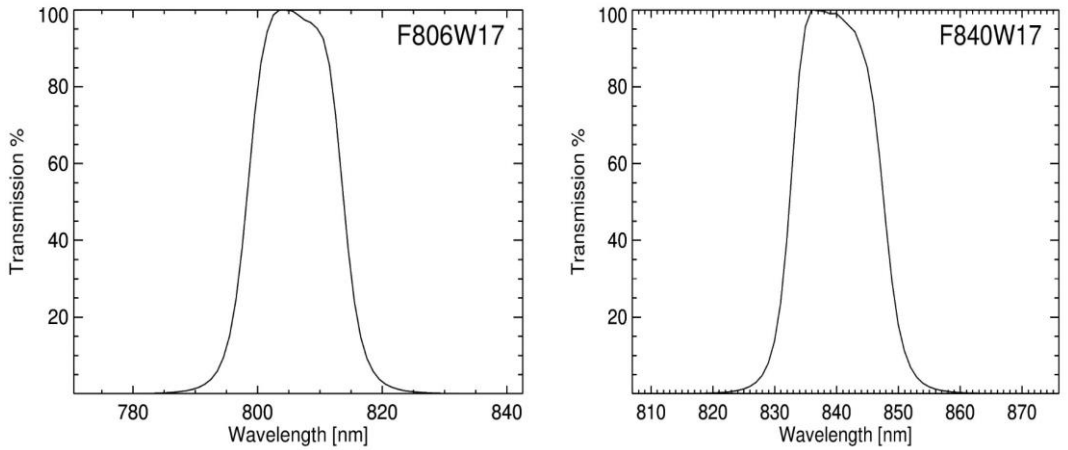
We have started a program to detect such regions in a **sample of Abell clusters at redshifts ~0.2-0.3.**

(Credit: NASA/STScI)

Methodology

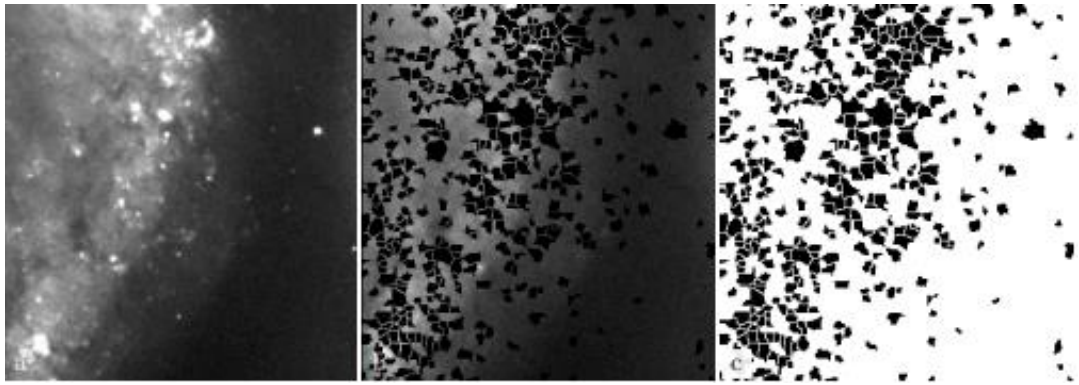
Observational strategy: Up to **12 hours taken with OSIRIS at GTC** have been used to study a sample of four clusters at redshift z~0.18-0.3, reaching flux limits of 27.5 AB magnitude at **3σ**.

Two adjacent **medium band filters (SHARDS)** have been used to detect the Hα emission by comparing in-line – off-line (continuum) fluxes.



Hα line *Continuum*

Novel techniques improving the separation of the outer boundaries of very extended and diffuse targets such as galaxies from the noise are applied during the pipeline reduction. *(Trujillo & Frilli 2016) (Akhlaghi & Ichikawa 2015)*

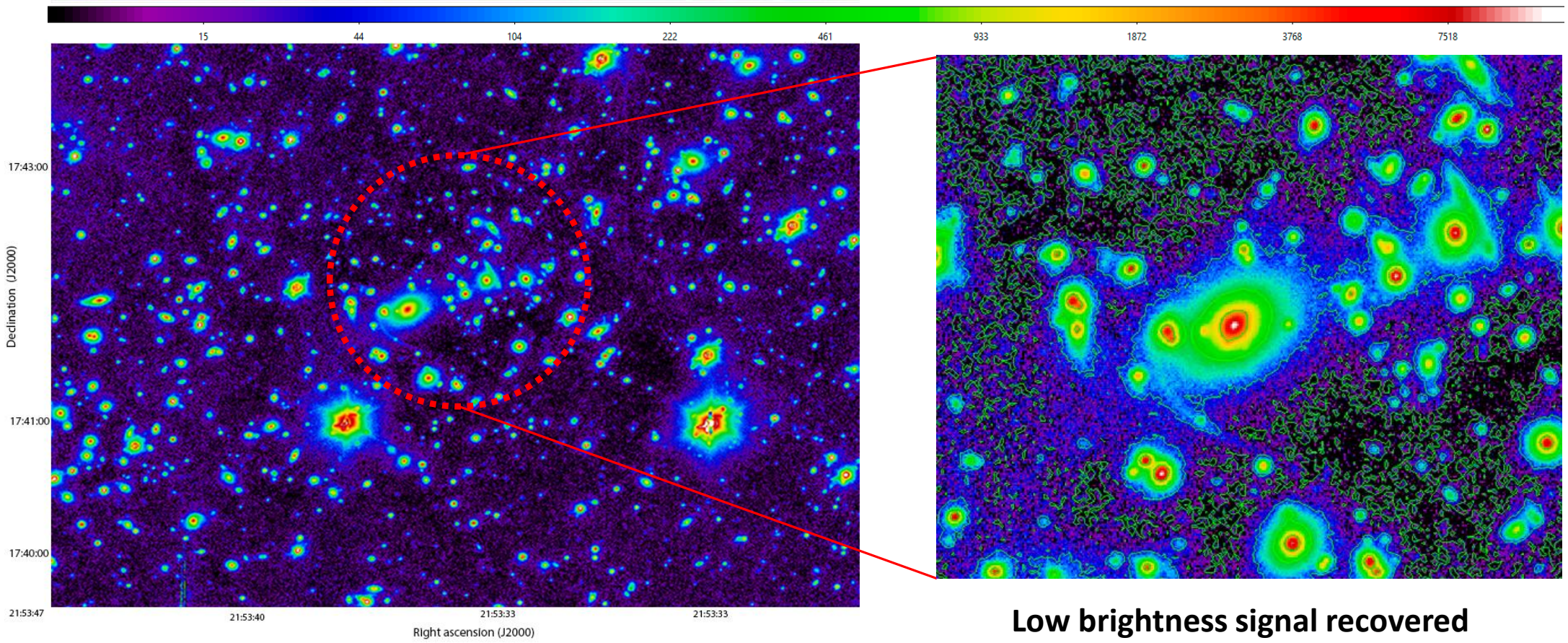


(Akhlaghi, Mohammad 2019)

This methodology successfully recovers significant information from low brightness sources.

Results

Abell 2390: Deep optical images of a 7x7 arcmin field have been analysed

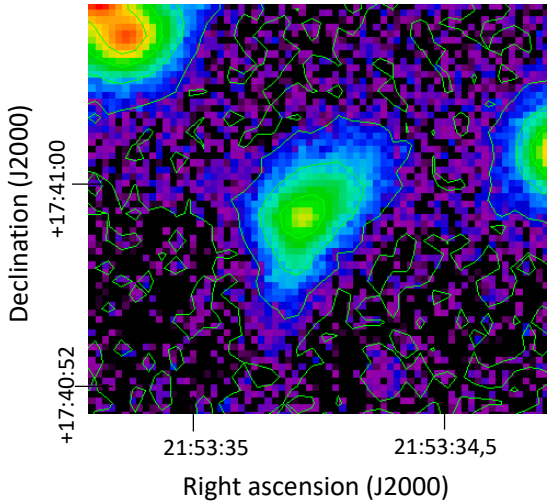


Low brightness signal recovered

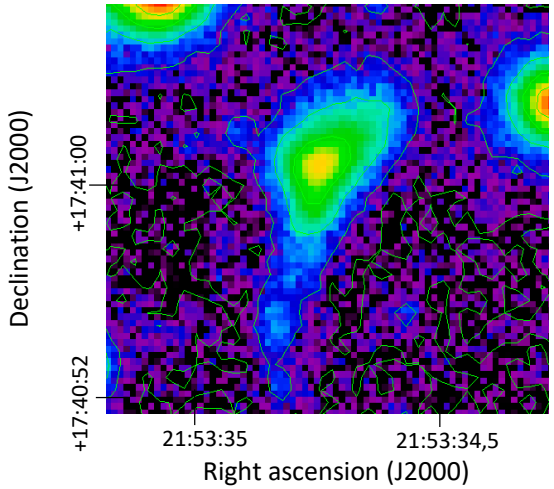
Results

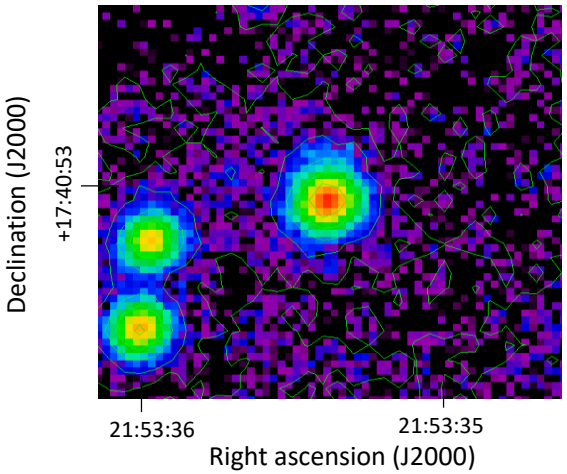
Hα emission lines regions candidates detected in Abell 2390

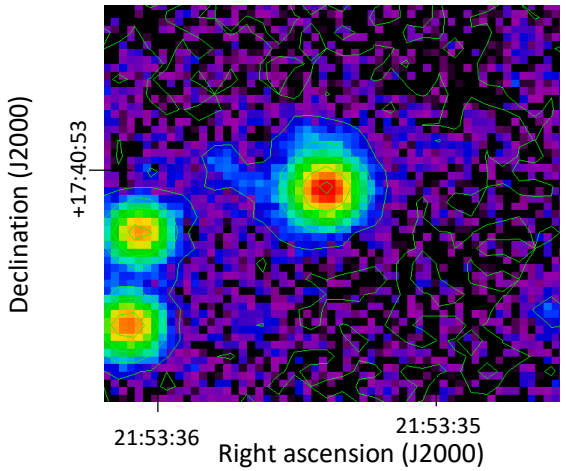
Continuum filter



Hα counterparts







- Low flux errors as a consequence of robust reduction process
- Regions detected are over **3σ** error value
- Robust artefact rejection process
  - Ghost characterization
  - Visual inspection by team
- Three bona fide EIGs. Gas stripped by galaxy-galaxy and galaxy -intracluster medium interaction

Impact and prospect for the future

Conclusions:

- Three extended ionized gas regions (EIGs) have been detected in Abell 2390
- The observational strategy and the data reduction method has shown to be successful for this kind of studies
- The size, shape and brightness of the EIGs will allow to characterise the mechanisms driving their formation

Future work

- Extend the study to the rest of the sample observed
- Apply the methodology to a larger list of Abell clusters.
- Analyse the results globally to identify the regions where the gas stripping mechanisms are dominant