Mapping the spatial distribution of star formation in cluster galaxies at z ~0.5 with the Grism Lens-Amplified Survey from Space (GLASS)

Benedetta Vulcani
in collaboration with T. Treu, K. Schmidt, B. M. Poggianti, A. Dressler
and the GLASS team
Star formation activity
Star formation activity

Madau & Dickinson (2014)

Guglielmo et al. (2015)

Calvi et al. (2011)

BV et al. (2011)

e.g. Noeske et al. (2007)

Peng et al. (2010)
Star formation quenching

Peng et al. (2010)
Cases of gas stripping
Cases of gas stripping

Ebeling et al. (2014)
Cases of gas stripping

Ebeling et al. (2014)

Merluzzi et al. (2013)
Cases of gas stripping

Ebeling et al. (2014)

Merluzzi et al. (2013)

Fumagalli et al. (2015)
Cases of gas stripping

Ebeling et al. (2014)

Merluzzi et al. (2013)

Fumagalli et al. (2015)

Poggianti et al. (2015) + GASP (MUSE large program)
THE TEAM

- Tommaso Treu, PI (UCLA)
- Marusa Bradač (UCD)
- Gabriel Brammer (STScI)
- Mark Dijkstra (UoO)
- Alan Dressler (Carnegie Obs.)
- Adriano Fontana (INAF Rome)
- Raphael Gavazzi (IAP)
- Alaina Henry (NASA Goddard)
- Austin Hoag (UCD)
- Patrick Kelly (UCB)
- Tucker Jones (UCSB)

- Matt Malkan (UCLA)
- Charlotte Mason (UCSB)
- Laura Pentericci (INAF Rome)
- Bianca Poggianti (INAF Padova)
- Kasper Schmidt (AIP)
- Massimo Stiavelli (STScI)
- Michele Trenti (Uni Melbourne)
- Anja vd Linden (Stanford/DARK)
- Benedetta Vulcani (Kavli IPMU Tokyo)
- Xin Wang (UCSB)
The Grism Lens-Amplified Survey from Space (PI T.Treu, UCLA)

- 140 orbits HST grism spectroscopy of 10 massive clusters (Cycle 21) **COMPLETED**
- Clusters are selected from CLASH and Frontier Field (z=0.3-0.6)
- Spectra for ~20,000 objects (~10,000 down to m_{F140} ~24)

---

**Graphical Representation**

- **Parallel fields**
- **Cluster cores**

**Throughput**

- $z$(Ly$\alpha$) $\sim$ [3.5,12.7]
- $z$([OII]) $\sim$ [0.5,3.5]
- $z$([H$\beta$]/[OIII]) $\sim$ [0.1,2.3]
- $z$(H$\alpha$) $\sim$ [0.0,1.5]

**Wavelength [Å]**

- G800L
- F814W
- G102
- F105W
- G141
- F140W

---

Schmidt et al. (2014)
Treu, Schmidt, Brammer, BV et al. (2015)

glass.physics.ucsb.edu
3D grism spectroscopy

Spatial information to create maps of emission lines
e.g. Schmidt+2013, Nelson+2012,2013

Credit: K. Schmidt
3D grism spectroscopy

Spatial information to create maps of emission lines
e.g. Schmidt+2013, Nelson+2012, 2013

Credit: K. Schmidt

Schmidt et al. (2014)
Treu, Schmidt, Brammer, BV et al. (2015)
Our sample

- 2 clusters: MACS0717.5+3745 z=0.548
  MACS1423.8+2404 z=0.545
- All galaxies with reliable redshift estimation and detected Hα in emission (in G102)
- 25 galaxies with z within ± 0.03 the cluster redshift: CLUSTER MEMBER sample
- 17 galaxies with z outside ± 0.03 the cluster redshift: FIELD sample
- Stellar masses from CLASH photometry using a set of templates, computed with standard spectral synthesis models (Bruzual & Charlot 2003, Fontana et al. 2003, 2004)
- Sizes from the second order moment of the light distribution
Maps of Hα

BV et al. in press
arXiv:1511.00686
Maps of Hα

BV et al. in press
arXiv:1511.00686
Maps of Hα

BV et al. in press
arXiv:1511.00686
Maps of Ha

BV et al. in press
arXiv:1511.00686
Maps of Hα and continuum emission

- \( r(\text{H}\alpha) > r(\text{cont}) \)
  - \( r(\text{H}\alpha) = r(\text{cont}) \)
    - \( \sim 60\% \) both in clusters and field
    - \( \sim 30\% \) in clusters
    - \( \sim 20\% \) in the field

BV et al. in press
arXiv:1511.00686
OFFSET BETWEEN THE EMISSION IN THE CONTINUUM AND THE Hα EMISSION

SIZE RATIO

BV et al. in press
arXiv:1511.00686
Peak of Ha emission and position within the clusters
Maps of Hα and position within the clusters

- LOCAL GAS DENSITY (X ray emission)

MACS1423

MACS0717

$r(\text{H}\alpha) > r(\text{cont})$

$r(\text{H}\alpha) = r(\text{cont})$

$r(\text{H}\alpha) < r(\text{cont})$

Similar results obtained with the surface mass density

BV et al. in press
arXiv:1511.00686
Peak of Hα emission and position within the clusters

similar results obtained with the surface mass density

BV et al. in press
arXiv:1511.00686
SFR-Mass relation

BV et al. in press
arXiv:1511.00686
Environmental processes are expected to act on cluster galaxies, leaving a recognisable signature

- Both in clusters and field 60% of the galaxies have $r(H\alpha)$ larger than $r(\text{continuum})$ —> SF occurring in galaxy outskirts
- In clusters some examples of $r(H\alpha) >> r(\text{continuum})$ —> sign of ongoing stripping?
- Both in clusters and field there the H\alpha emission is offset with respect of the continuum emission —> bulk of SF not occurring in galaxy cores
- In clusters offset correlate with X-ray emission —> sign of ongoing stripping?
- MACS1423 is more relaxed than MACS0717 and all galaxies have H\alpha disk larger than continuum
Thanks for your attention!

Benedetta Vulcani
in collaboration with T. Treu, K. Schmidt, B. M. Poggianti, A. Dressler
and the GLASS team