Where do Stars Form in $z \sim 1.5$ Mergers?
–Emission Line Maps with 3D-HST–

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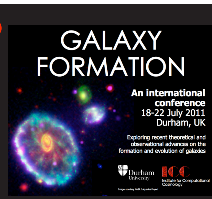
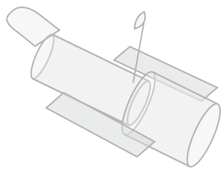


The Up-Shot

- Emission Line Mapping Is Powerful!
  - It estimates convincing redshifts; $\langle \delta z \rangle \lesssim 0.005$.
  - It enables studies of spatial extent of star formation (SF) at $z > 1$.
- Preliminary sample of mergers show large diversity in SF distribution.

3D-HST: Observing the SF 'heyday'

3D-HST is a Hubble Legacy Survey [1], which is taking rest-frame optical spectra for a complete sample of $\sim$ 9000 galaxies at $1 < z < 3.5$. Taking WFC3 NIR F140W photometry and G141 grism spectroscopy of this sample of galaxies gives an unprecedented view of the SF 'heyday', where $\sim$60% of all star formation took place. 3D-HST will provide redshifts as well as spatially-resolved maps of well-calibrated diagnostics of star formation, stellar age, metallicity, stellar mass-to-light ratio and AGN activity.



3D-HST

Where does SF happen in Mergers?

3D-HST has made it possible to trace and map the spatial extent of star formation in galaxies at $z \sim 1.5$ - the 'heyday' of star formation!

Is SF centrally concentrated, observed in all components or only seen in some parts of merging galaxies?

We can answer this question by comparing the extent of star formation traced by Hα (and/or OIII) with the stellar distribution in individual objects.

With 3D-HST the sample of mergers where such a comparison at $z > 1$ is feasible, has for the first time become large enough, that actual sample statistics is possible.

- Hence, this study!

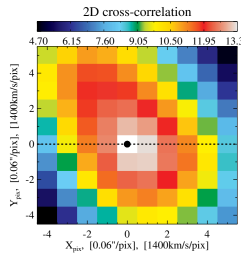
Results: Redshift estimates

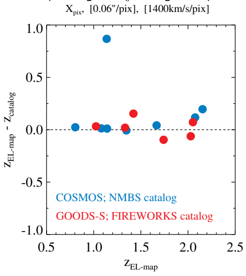
From the cross-correlation of the F140W thumbnail and the EL map the redshift can be determined.

Estimating the uncertainty on this redshift can be done by determining the offset of the EL map in the spatial direction. Hence, via a 2D cross-correlation $z + \delta z$ can be determined for all objects. For the presented sample

$$\langle \delta z \rangle \sim 0.005 \,.$$

On the right a 2D map of the cross-correlation values of Orient1 01414 (top) is shown together with a comparison of the EL map redshifts with photometric catalog redshifts (bottom).





Contact★

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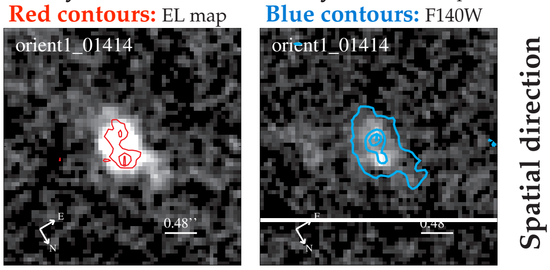
Creating Emission Line (EL) Maps

From the G141 grism spectrum an EL map is created by subtracting a continuum model. The models used here are polynomials scaled to match the spectral flux around the EL feature. Here the result of subtracting a continuum model from the 3D-HST G141 grism spectrum for the COSMOS object Orient1 01414 is shown.

3D-HST grism spectrum | **Continuum subtracted spectrum**

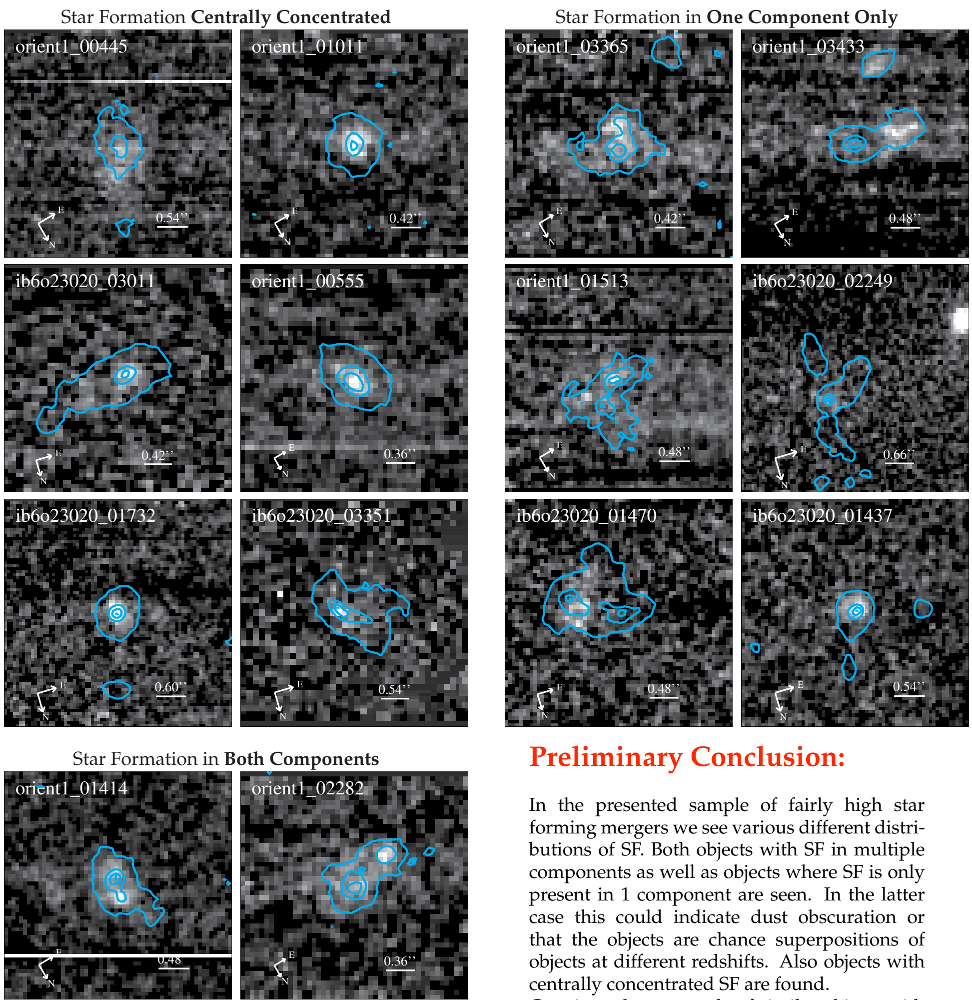
Cross-correlating the continuum subtracted grism spectrum in the dispersion direction with the F140W thumbnail of the object determines the EL map that matches the F140W thumbnail the best and hence the redshift, z.

On the right such an EL (thumbnail) map is shown for Orient1 01414 both as contours and as a gray scale image.



Results: Emission Line maps of (Potential) Mergers

Emission line maps shown in **gray scale** for 8 COSMOS (Orient1*) and 6 GOODS-S (ib6o23020*) objects. The **blue contours** show the F140W light distribution.



Preliminary Conclusion:

In the presented sample of fairly high star forming mergers we see various different distributions of SF. Both objects with SF in multiple components as well as objects where SF is only present in 1 component are seen. In the latter case this could indicate dust obscuration or that the objects are chance superpositions of objects at different redshifts. Also objects with centrally concentrated SF are found.

Creating a large sample of similar objects with a well-defined selection function will enable proper sample statistics [2].

References

[1] Van Dokkum, P., et al., 2011, in prep.
[2] Schmidt, K. B., et al., 2011, in prep.