# X-shooter Science Verification Proposal

## 2D study of the physical properties of a starburst at intermediate redshift


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**Abstract:**

Massive starbursts (M$\gtrsim 10^{11}$ M$_\odot$) account for more than 70% of the star formation at intermediate redshifts (i.e. $z \sim 1-2$). Up to date, most studies have been focused on their integrated properties. However, spatially resolved information about the star, gas and dust distribution as well as the ionization conditions, metallicity and kinematics of the warm ionized gas is needed to fully understand how these galaxies formed and evolved. Now, for the first time we are in a position to obtain such information at once thanks to the advent of X-Shooter. Here, we propose a pilot study to observe one of these massive starbursts with the IFU to demostrate that X-Shooter is a unique facility to asses the goals described above.


**Scientific Case:**

An important epoch in the formation and evolution of galaxies is that at redshift $1 < z < 2$ since this is the period when most of the global star formation as well as the building-up of massive galaxies was taking place. Most of our knowledge of the properties of these intermediate-z star-forming massive (M$\gtrsim 10^{11}$ M$_\odot$) galaxies comes from their detailed morphologies and integrated properties, such as stellar masses, star formation rates, average ages, and metallicities (e.g. Melbourne et al. 2008, Pérez-González et al. 2005; Rodrigues et al. 2008). However, to fully understand the processes taking place in these systems, it is essential to obtain spatially resolved spectroscopic observations to derive the dust, gas and stellar structures, as well as the excitation conditions and kinematics. So far, the studies aimed to obtain such information focused mainly on the kinematics and/or a few physical properties associated with a handful of emission lines (typically H$\alpha$+[N II]$\lambda$6584, or [O II]$\lambda\lambda$3726,3728, e.g. Puech et al. 2008, Wright et al. 2007), giving insight only into some of the issues mentioned above. The advent of an instrument like X-Shooter, a high sensitivity spectrograph able to cover from 300 nm to 2500 nm with good spectral resolution and provided with an Integral Field Unit, allows us for the first time to obtain *at once* the necessary information to 2D characterize the physical properties of the very low surface brightness galaxies at high/intermediate redshift. Here we propose to observe a galaxy at $z \sim 1.5$ with high star formation rate (20 M$_\odot$ yr$^{-1}$) which can be observed in both in SV's runs at low air mass.

**Calibration strategy:** Standard calibration.

**Targets and number of visibility measurements**

| **Target** | **RA** | **DEC** | **V** mag | **Mode** (slit/IFU) | **Remarks** |
|---|---|---|---|---|---|
| J225916.39-345408.5 | 22 59 16.51 1 | -34 54 11.5 | 22.39 | IFU | Mag. in F160W provided |

**Time Justification:**

The integrated H$\alpha$ flux for this galaxy is $\sim 3 \times 10^{-16}$ ergs s$^{-1}$ cm$^{-2}$ and its size is $\sim$1 arcsec$^2$ as measured at 1.6$\mu$m with HST/NICMOS (Shim et al. 2009). We plan to observe lines up to 10 times fainter than H$\alpha$ depending on the extinction and excitation conditions. Using the ETC, we estimate that $t_{exp} \sim 4 \times 1500$ s for the object (O) is sufficient to achieve a S/N$\sim$20 in the most important emission lines. Fixed offset sky observations (S) with the same $t_{exp}$ are also needed. We plan to observe the galaxy using 2 sequences OSSO, which would need $\sim$2 h each to be executed including overheads. In addition, telluric standards are planned to be observed at the beginning, middle and end of the observations (i.e before and after each OSSO sequence). The time needed for this is dominated by the overheads and is of about $\sim$10 min per star and thus a total of 30 min. Thus, in total, to acomplish the requested observation we would need $\sim$4 h 30 m.