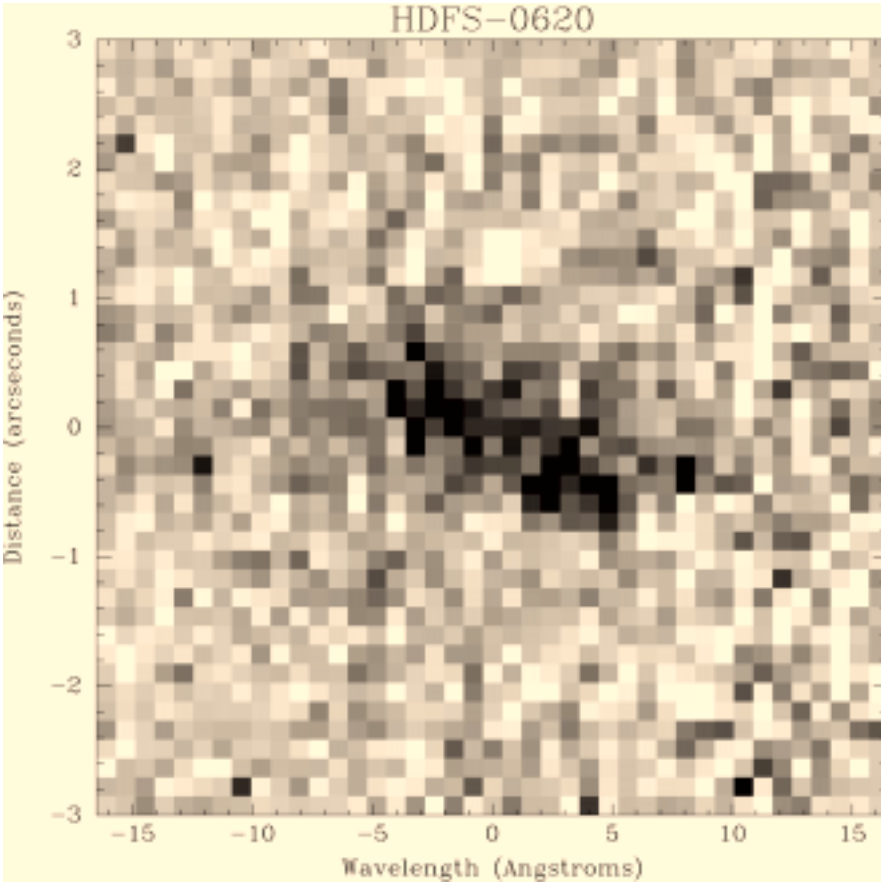
Weighing Young Galaxies – an Occasional Observer Goes to Paranal

S. WHITE, Max-Planck Institute for Astrophysics, Garching

"The VLT is Europe's great leap forward, heralded as a new window on the distant universe. Surely we can think of some joint projects that will turn the Americans green!" Trying to rally the troops at the annual meeting of our EC-funded "Galaxy Formation" network forced me to think about where the VLT pay-off might really come. A talk from Alan Moorwood provided some valuable ideas. The first efficient near-IR spectrograph on an 8-metre telescope could detect Hα past redshift 2 and [OII] 3727 to redshift 5. How about getting kinematics for distant galaxies like those in the Hubble Deep Fields or the infamous "Steidel" objects? This would have to clarify their relation to nearer, dearer, but (perhaps) more boring galaxies. Of course, I'd never taken an infrared spectrum of anything, but why not start now?

In a new field it's always important to get good help. My chance came with the news that Nicole Vogt was moving to IoA in Cambridge, one of the partners in our network. Californian graduate students now regularly present theses full of 10-metre data, and Nicole's contained Keck rotation curves for 15 galaxies out to redshift 0.8. Data for fifty more were rumoured to be in the pipeline. Some discussion showed that ISAAC could get Hα rotation curves for her most distant Keck galaxies (observed in [OII] 3727 on Hawaii) and, more interestingly, could extend the accessible redshift range by at least a factor of two. All we had to do was to find suitable candidates and to bang away for a few hours under the famous Paranal observing conditions. A proposal was duly dispatched suggesting a pilot study in the Hubble Deep Field South. We were elated when the Observing Programmes Committee gave us (most of) the time.

Travelling to Paranal from Garching makes one appreciate the virtues of remote observing. The shops at Paris CDG and in Buenos Aires were interesting but the attractions of neither place compensated for the long hours spent on planes and in airport lounges. The ESO guest house in Santiago, seemingly stuck in a genteel time warp between encroaching high-rise apartments, provided a welcome rest, but was spoiled somewhat by the need to get up long before breakfast in order to catch a taxi to catch a plane to catch a taxi to catch the once-a-day ESO bus to Paranal. The bus itself, complete with green baize curtains, reclining seats and movie videos, was a surreal but surprisingly comfortable way to end the odyssey. It dumped us under a clear blue sky in front of a small city of temporary buildings which appeared to have been built on the Moon. Not Ithaca, perhaps, but it turned out to be too deceptively luxurious to be considered Spartan.



H-band spectrum of the Hα emission line for disk galaxy HDFS–0620, observed with VLT+ISAAC in high-resolution mode. The galaxy has a redshift of z = 1.29, placing the Hα emission at λ = 1.5 μm, in a clear region of the H-band IR window of the atmosphere between night-sky emission lines. The gas can be traced across almost 2 arcseconds (15 kiloparsecs) along the major axis of the galaxy, yielding a rotation curve with a total observed amplitude of order 180 km/s.

In the two days before our run started we learned the novel joys of P2PP, creating enough OBs (Observing Blocks) for the more seasoned observers to decide that we were quite definitely crazy. Our problem was that it isn't easy to decide how bright a distant object is likely to be in the Hα line when all you have is broadband photometry.

Furthermore, we had to make do with photometric redshifts for most of our candidates, so we weren't sure where Hα would fall relative to the night sky. Finally, there just aren't any "big" spirals beyond redshift 1 in the Hubble Deep Field South; our best candidates were all dwarf or irregular systems. As a result we needed plenty of flexibility to adjust our programme in light of experience at the telescope – and so plenty of OBs. The inevitable drawbacks of a pilot project...

Our first night at the telescope we learned a number of things.

(1) ESO looks after its VLT observers extremely well. The night assistant attended to all telescope-related issues, including guide-star acquisition. We never had to think about such things. The support scientist knew the instrument and its performance inside out and had written all the available quick-look software. As a result he could help us assess our data as soon as they were taken. Finally, the shift manager always showed up whenever things got complicated.

(2) The telescope points and tracks like a dream. Our reference stars always arrived within a few seconds of the centre of the field, our offsets all worked to a small fraction of an arcsecond, even over several arcminutes, and the telescope drifted by only a couple of tenths of an arcsecond even after tracking for two hours.

(3) The instrument and the conditions really can be "as advertised". The see-

ing on the detector rarely got worse than 0.5 arcsec and there were extended periods when it was 0.3 arcsec. Furthermore the long-slit spectra taken by ISAAC sky-subtracted well and had a cosmetic quality quite comparable to that of good optical spectra.

(4) Even with the best equipment under the best conditions, a hard project is still hard. Our first couple of candidates showed no clear detection after a couple of hours of integration, leaving us uncertain whether their photometric redshifts were in error, their emission lay under a sky line, or was just very weak. We were greatly relieved when our third target showed strong Hα at $z \sim 1.3$ with a clear detection of galactic rotation.

Our second night was equally good and brought several more detections as well as some further "blanks". We finished with a feeling of achievement; galaxy kinematics really can be studied beyond redshift one. This night also brought an unexpected (and probably illegal) glass of champagne as the UVES commissioning team, working 20 metres away on the UT2 console, obtained their first *bona fide* quasar spectrum. It was certainly impressive; the Lyα forest could be seen booming through right down to the atmospheric cut-off. As we boarded the bus the following afternoon at the start of the long trek home, we felt sure we would be returning soon despite the distance.

(swhite@mpa-garching.mpg.de)

Sunset on Paranal (Photographer: Herbert Zodet).