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SCIENCE AND TECHNOLOGY FACILITIES COUNCIL

Progress report from UKIDSS

Memorandum by the UKIDSS Consortium Survey Scientist, Prof. S J Warren

1. 08B observations progress

The 08B observations are just complete and the time spent on each project compared to the allocation is provided in the Table. The first colummn lists the allocation, the second the observed time, and the third the completeness that this represents. The allocations were based on 7h on target each UKIDSS night, which would require rather good weather conditions. So the overall completeness of about 2/3 of this represents somewhat below average conditions, but not unusually so. Overall I consider this a successful short block. In particular for once the UDS did almost as well as the other surveys.

Some relevant points are that the LAS now accepts 0.1mag cirrus. Also the LAS was running well behind the other surveys until the last two weeks, when the weightings for the LAS projects were substantially increased. Fortunately conditions were good, and the LAS caught up and even surpassed the average.

It is a concern that the LAS ran well behind for much of the semester. After discussions with JAC on this issue it appears that the main factor is to get the weightings for each project suitably adjusted earlier. The GPS is again overcomplete relative to the other surveys. This is partly because there was a dearth of projects other than the GPS at the end of the night through much of November, until a new LAS project at RA=9h was created. Nevertheless I believe also that the fact that the GPS usually overfills its allocation of MSBs is also a factor.

Survey	Goal h	Complete h	Proportion completed
DXS	37	20.0	0.54
GCS	22	15.0	0.68
GPS	39	36.9	0.95
LAS	109	79.1	0.73
UDS	152	85.2	0.56

Table 1: Survey progress in 08B

2. Data releases, pipeline, archive

DR4 for the LAS, GCS, DXS was released on July 1, and for the GPS on Oct 30. The UDS DR4 is expected to take place roughly in line with the DR5 release of the LAS, GCS, and DXS, either in Dec 2008, or January 2009 (note that there is no UDS DR5, because the UDS could not be reached in 08A).

A pipeline bug was discovered by the GAMA team (see below, under LAS report for description of GAMA). The problem is that Petrosian magnitudes for deblended objects are wrong. It was decided not to rush through a fix for DR5 but to take the opportunity to review how galaxy photometry is done, and to provide a fix for DR6.

Some issues with astrometry appear in the GPS report.

4. UKIDSS workshop at RAS

The workshop ‘Science from UKIDSS II’ will take place at the RAS over 15-17 December. So far nearly 80 people are registered, and the preliminary programme lists over 45 talks. Details are at http://www.ukidss.org/rasworkshop08

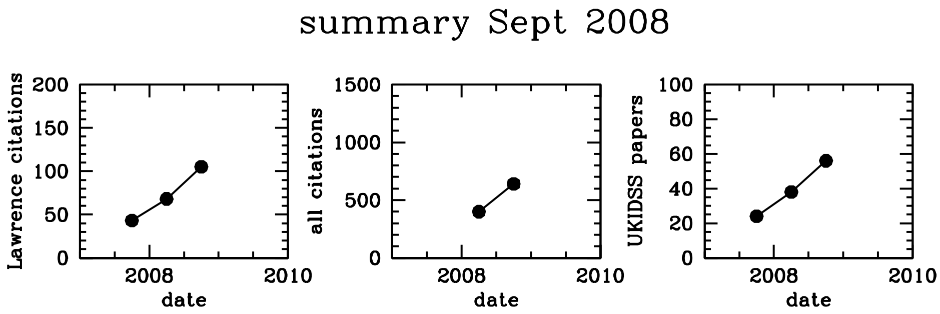

Figure 1: Trends in UKIDSS publication statistics at each Board meeting (census data end March, September).

5. Registration

There are now 91 communities registered, of which 61 are non-UK.

6. Publications

UKIDSS publications continue to be listed at http://www.ukidss.org/science/science.html. There are some plots under 'summary stats' which are reproduced in Fig. 1, and which show the trends with time, plotting results provided for three consecutive Board reports. There has been a slight acceleration this semester (note that total citations was not recorded for the Nov 2007 Board meeting).

The criteria for inclusion are either that the paper includes results that use UKIDSS data directly, or that the paper is specifically about UKIDSS (e.g. a data release paper). As previously, we refer to papers by the year and by the number recorded on the web page e.g. Chiu et al. (2007:7). The census dates for Board reports are the end of March and the end of September.

From the end of Mar 08 to the end of Sep 08 the citation count for the survey definition paper, Lawrence et al. (2007:15), increased from 68 to 105. Over the same period the number of UKIDSS papers published increased from 38 to 56, and the total number of citations to these UKIDSS papers increased from 400 to 640.

9. Progress reports from the Surveys

9.1 LAS report (Jameson, Warren)

With effect from Oct 1 Richard Jameson stood down as survey head, following his retirement from his post at the University of Leicester. He continues to coordinate the Cool Dwarfs Stars Working Group. Warren has taken over as LAS Head for the time being.

The survey for cool T dwarfs in the LAS has had continuing success. There are now some 35 LAS discovered T dwarfs (about one third of all know Ts) of which 6 are T8+. The most interesting of these is perhaps ULAS J1335+1130 (Burningham et al., arXiv:0806.0067), which appears to be slightly cooler even than ULAS J0034-0052, as well as the cool dwarf CFBD 0059, discovered by CFHT. These 3 dwarfs are considered members of the new sub-class T9. Legget et al. (submitted) have analysed near-ir plus Spitzer spectra and photometry of the two UKIDSS T9 dwarfs, and estimate temperatures of 550-600 for ULAS J0034-0052 and 500-550 for ULAS J0034-0052, which compares to the 750K for 2MASS J0415, previously the coolest known T dwarf. Crucially a reliable parallax for ULAS J0034-0052 should be available by spring

2009. In the meantime Burningham and Pinfield have discovered a T8.5 dwarf in a binary system with an M4 dwarf, which provides the distance. This allows a calibration of purely spectroscopic methods (i.e. without distances) for estimating temperatures and suggests that the spectroscopic temperatures may be slight overestimates (by about 100K). It can be seen that UKIDSS has made quite a significant step towards completing the cool brown dwarf temperature sequence.

Burleigh and Steele have now found 5 white dwarfs with IR excesses using the LAS. The most interesting so far is PHL 5038 which is a resolved white dwarf + L8 binary, with separation 50AU. Such binaries are very rare but show that high mass stars (the WD progenitor) can occassionaly have very low mass companions i.e. extreme mass ratio binaries. Casewell & Jameson have continued their search for black dwarfs (very cool He atmosphere WDs). The best candidate has a definite proper motion of 40mas/yr, being just visible on the POSS1 plate, which is very encouraging. An application to obtain a spectrum with the VLT has been submitted.

Turning to extraGalactic astronomy perhaps the most important development is that the LAS YJHK imaging of the GAMA fields was completed this spring, and that the GAMA consortium are preparing for their second season of their AAT redshift survey, incorporating the UKIDSS K photometry. The principal aim of GAMA is the measurement of the halo mass function, and it involves a deeper spectroscopic survey than 2dF, combined with multiwavelength photometry from the UV (GALEX) to far-infrared (Herschel). GAMA have been awarded 66 nights on the AAT.

The paper on the $z = 6.13$ quasar ULAS J1319+0950 (Mortlock et al., arXiv:0810:4180) has been accepted.

9.2 GPS report (Lucas)

Survey progress

The GPS component of the UKIDSS 4th Data Release was released on 30th October 2008, 3 months and 19 days after occurred for the LAS, DXS and GCS. This was in part due to the very large number of sources in the GPS which always caused problems for WFAU. The delay was exacerbated by (i) a 3 week delay caused by a Microsoft software bug at WFAU, which prevented the data from being copied to the public server and (ii) a 1 week delay caused by a request from the GPS group to fix a bug in the astrometry which had affected all previous releases (see Pipeline section).

At the DR4 release the GPS was approximately 30% complete and covered 95% of the Spitzer GLIMPSE-north and GLIMPSE II survey regions at Galactic longitudes $l = -2$ to 65 in all 3 near infrared passbands. DR4 contains 550 million sources with detections in all three of the JHK passbands. The remainder of the GLIMPSE-north region was completed in 08A and will be released in DR5.

Progress in 08A was quite good, with 98% of the time allocated by the Board being used. This was despite a reduction in the allocation in the revised UKIDSS 08A plan that was drawn up by Steve Warren part way through the semester to attempt to speed up some of the other UKIDSS surveys that were proceeding more slowly. The GPS considerably overfilled its revised alloaction, which is due to the fact that the GPS allocation is quite small to begin with and there are always times of the night when the Galactic plane is closer to culmination than the other survey regions. In short, it is hard to avoid giving the GPS about 10% of the time on UKIDSS nights.

The GPS is also proceeding well in the 08B block. We allocated much of the time to the region covered by the deep Cygnus-X Legacy survey with Spitzer (IRAC & MIPSGAL) at the request of both the Spitzer team and the PI of IPHAS (Janet Drew). The Cygnus-X project is detailed at http://www.cfa.harvard.edu/cygnusX/

We have previously suggested that the survey be accelerated by relaxing the definition of "photometric" time (since good photometry can be obtained through thin cirrus), but at the time of writing I am not clear exactly what the current defintion is.

Exploitation - publications

1) The GPS group paper, "The UKIDSS Galactic Plane Survey" (Lucas et al.2008 with some 20 authors) has now been published in MNRAS.

2) A paper by Chris Davis et al.,"A shallow though extensive H2 2.122-um imaging survey of Taurus-Auriga-Perseus - I. NGC 1333, L1455, L1448 and B1", on early results from the H2 component of the GPS (cancelled by the Board in Feb 2007) was published in July 2008 (MNRAS 387, 954).

3) The IPHAS Initial Data Release paper (Gonzales-Solares et al.) was published in July 2008 (MNRAS 388, 89). It includes a cross match with GPS data to better identify Hα emission line sources in Galactic fields.

4) A paper using GPS Science Verification data on Rho Ophiuchus to examine the spatial distribution of protostars as a function of evolutionary status (S.Mitchison, M.Smith et al.) has been rejected twice but has been reformulated to address the referee's concerns. The third referee's report is awaited.

5) An independent paper by the IAC group in Tenerife on the structure of the Galactic Bar (Cabrera-Lavers et al.2008, A&A, astro-ph/0809.3174) is in press. This is the first major fully independent paper to use GPS data, and I hope to see many more.

Other papers are making more minor routine use of the GPS Legacy dataset, e.g. a paper has been submitted by the IPHAS group (Wright et al.) on Nova Vul: a nova that was caught before and during outburst with IPHAS Halpha imaging and also has a pre-outburst GPS K band detection from our programme of K-only imaging in thin cirrus conditions.

Pipeline

1) Lucas has bench tested the new sky subtraction algorithm developed by CASU to provide reliable photometry in star formation regions with nebulosity. It appears to work well, so I have provided a full list of GPS images that contain nebulae which CASU will reprocess for DR5.

2) Occasional problems with the UKIDSS astrometry in the GPS have been reported by members of the implementation group in 2008. This came to a head in late May 2008 when Reba Bandyopadhyay noticed errors of a few arcsec in at least two of the multiframes near the Galactic Centre that she was trying to work with. Lucas used his gradually improving knowledge of SQL to test the quality of the astrometry in the UKIDSS DR3 release for all the shallow surveys and determined that up to 1% of the GPS fields have bad astrometry (well outside the UKIDSS spec) but that this problem did not exist in the LAS or the GCS or in less crowded fields at longitudes $l > 30$ degrees. CASU swiftly verified that the problem existed in about 0.5% of GPS data (200 multiframes) and fixed it in the Fits headers for all the GPS DR4 data. It was caused by a known reliability issue in the automated pipeline astrometry algorithm, which is supposed to be fixed manually by CASU staff on a nightly basis during the reduction. For some reason this manual tweak failed to happen on some occasions, particularly in 2007. Fixing this problem led to a 1 week delay in the DR4 release since the data had already been sent to Edinburgh.

9.3 GCS report (Hambly)

Observations

As part of continuing UKIDSS operations, GCS observations are progressing well. The status of the ten open cluster / star formation regions (listed below in priority order) in terms of the six (Z,Y,J,H,Kx2) filter coverage as at the end of Semester 08A (including QC losses to end of 07B) is provided in Table 2.

Completion of first epoch K coverage in all targets except Orion has been the priority for the last two semesters, and progress is as good as can be expected given the vagaries of the weather and RAs conflicting with other UKIDSS components, particularly the UDS. Only Upper Sco has $< 90\%$ coverage at K1 as we move into the second half of the UKIDSS observing programme. Our plan is to hold off on K2 observations

Target	Area	Completeness fraction (%)					
	(sq.deg)	Z	Y	J	H	K1	K2
IC-4665	3	100	100	100	100	100	0
Pleiades	79	52	52	54	93	92	0
AlphaPer	50	45	42	46	97	91	0
Praesepe	28	83	85	67	100	100	0
Tau-Auriga	218	24	25	25	32	100	0
Orion	154	9	10	10	25	25	0
Upper Sco	154	25	23	22	67	69	0
Perseus OB2	13	100	100	100	100	100	0
Hyades	291	1	2	2	3	96	0
Coma Ber	79	6	6	6	7	100	0

Table 2: GCS progress summary

as long as we dare to maximise the time baseline for proper motion measurements, although with all due regard to the continuing uncertainty over the future of UKIRT. Initial priority for K2 will be given to the more northerly targets that are inaccessible to VISTA to mitigate against the possibility of UKIRT closing before completion.

Survey release update

The last release on July 1st 2008 (DR4; observations up to and including Semester 07B) contains 737 square degrees of GCS areal coverage in one or more filters - survey coverage maps are available at http://surveys.roe.ac.uk/wsa/dr4_gcs.html Individual filter areal coverage (square degrees) in ZYJHK for DR4 is 183, 185, 184, 284, 708 respectively with 140 square degrees being in common to all (all coverage values assume a 10% overlap between adjacent frame sets, which is an average figure and is dictated by the availability of guide stars).

At the time of writing (end October 2008) preparations for the next GCS release as part of UKIDSS DR5 are well in hand, with eyeball quality control complete and results communicated to WSA QA support astronomer Mike Read.

Science update

Generally, interest in the GCS data seems healthy, with expressions of interest and intention to use the data from, for example, Tsamis at UCL (Orion), Hodgkin at Cambridge (PerOB2) and Martin at IAC Tenerife (Taurus).

The latest work from our European group, led by Nicolas Lodieu at the Instituto de Astrofisica de Canarias in Tenerife and Giovanni Carraro at ESO (Lodieu et al. 2008b) has shown that the very low mass stellar/substellar mass function of the cluster IC-4665 is identical to that of the Pleiades. This is contrary to less sensitive previous surveys (for example that from the optical CFHT cluster survey) which asserted that the MF continues to rise quite steeply into the substellar regime. We suspect that previous surveys have failed to account properly for non-member contamination at the faintest magnitudes, and have relied too much on relatively noisy optical photometry.

The Leicester group (Jameson, Casewell and Baker) continue to exploit the GCS data in their on-going studies of Galactic clusters; Baker is working on Praesepe data for his PhD thesis.

Deacon (Radboud University, Nijmegen) has extended his infrared proper motion survey techniques deeper into the infrared using GCS data in addition to LAS data to give significant extra sky coverage in his search for very low mass, nearby field stars. (Deacon et al. 2008). This complements nicely the purely photometric nearby field star work being done by Lodieu (Lodieu et al. 2008a) which similarly extends the LAS area using GCS data, and demonstrates the general legacy value of the survey as part of the whole of UKIDSS.

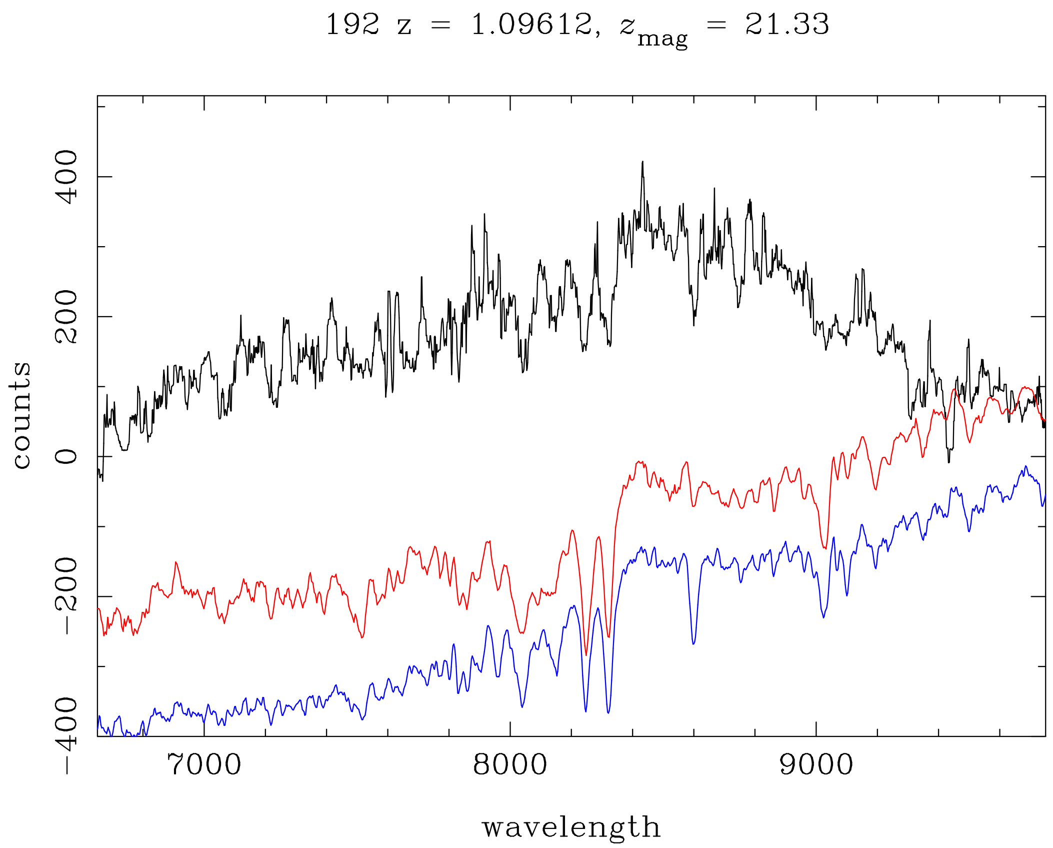

Figure 2: The preliminary reduction of a 5 night nod-and-shuffle AAOmega unfluxed spectrum of a z=1.09 LRG in the DXS SA22 area (black line) compared to template passive (red) and post-starburst (blue) galaxies. Note the clear H+K feature and strong Hdelta absorption indicating that, although red, this galaxy has formed stars recently.

Finally, the latest work from the Leicester group on the Hyades (as reported in the last submission to the Board) is now published (Hogan et al. 2008:19).

9.4 DXS report (Edge)

The DXS has continued to grow in area with a reasonable campaign on the northern Lockman Hole and Elais-N1 fields this Spring.

As I have pointed out in previous reports to the Board, much of the impact of the DXS will only be appreciated once other multi-wavelengths come along. I'm glad to report that AMI is now performing it's first Sunyaev-Zel'dovich effect surveys and that FMOS is completing it's commissioning and the DXS will be key to their early success. I sincerely hope that Herschel will be launched, PanSTARRS will begin it's deep coverage of all four DXS fields and that SCUBA-2 will get on the sky with some restricted field before I write my next report

In terms of current work on the DXS I'm happy to report the first Galactic result! Nicholas Lodieu (IAC, Tenerife) and collaborators have two brown dwarfs (one a T7) that stand out as very blue objects ($J - K < -0.1$) and the combination of depth and areal coverage of the DXS are unique. Their paper is currently being refereed and this aspect of the DXS exploitation will continue.

Work I have reported on in previous reports has been progressing gradually. Work by John Stott (LJMU) on DXS cluster identification has expanded to being a joint NIR/X-ray search which has recently revealed a z=1.2 candidate. Isaac Roseboom and Seb Oliver (Sussex) have been selecting very distant clusters from

SWIRE and the DXS. Glen Parish and Matt Jarvis (Herts) have been working on clustering of Distant Red Galaxies (DRGs) from the DXS. In Durham, the DXS forms an important component of the HiZELs project and for the selection of Luminous Red Galaxies (LRGs). Very recently, we obtained our first AAOmega nod-and-shuffle spectra of $z > 1$ LRGs (see figure) from a successful 5 night run. While $z = 1$ galaxies are not remarkable, the ones selected in the DXS ($K < 18$) are very massive and require a very large field to follow-up efficiently. David Wake (Durham) and Michael Brown (Monash) lead this work.

Finally, I am very happy to report that I have a new PhD student, Jae-Woo Kim, who will be working on the DXS so my personal DXS research will be significantly enhanced over the next 3 years and I look forward to telling you all about it in coming reports!

9.5 UDS report (Almaini)

Survey progress

The UDS remains the deepest infrared survey every conducted over such a large area. The only comparable infrared imaging survey is the Ultra-VISTA project, which has yet to begin and is unlikely to overtake the UDS until 2012. For at least another 3-4 years, therefore, UKIRT is providing a unique probe of the distant Universe.

All quality control, stacking and catalogue generation continues to be carried out by the Nottingham UDS team. The UKIDSS DR3 was the last major release for the UDS, combining the first two seasons of data. The UDS DR4 release has been delayed, so the next UDS data release occur within UKIDSS DR5 (planned for mid-December 2008). We anticipate that this will include a reprocessing of all DR1 data using an improved sky-subtraction algorithm (kindly provided by CASU), in additional to stricter quality control and improved stacking procedures. We predict that these improvements alone will gain ~ 0.2 magnitudes in K-band depth, in particular by the removal of large-scale noise and residual background gradients. Combined with the extra data taken in 07/08, we anticipate a substantial improvement in UDS depth and data quality for the next release. A survey definition paper describing these techniques is currently in preparation (Almaini et al.).

We note that the UDS continues to remain a long way behind schedule. Of the ~ 1787 hours required for the full survey only ~ 200 have been observed to date, corresponding to 11% completion (see UKIRT Newsletter, Autumn 2008). This relatively slow progress has been caused by a combination of factors, but is mainly due to the limited visibility of the field (~ 4 months per year) and the requirement for good seeing. The unfortunate scheduling of WFCAM in 2006B (when little UDS data were taken) was also a contributing factor. To ensure rapid progress, we urge the board to ensure that the months of September-December are reserved for UKIDSS observing in future semesters whenever possible.

Progress in related large projects

As mentioned in the previous progress report, very large allocations of telescope time were awarded to the UKIDSS UDS project in 2007. Key among these were a new ESO Large Programme (*UDSz*) to conduct a spectroscopic survey of high-redshift galaxies (235 hours on VLT; PI: Almaini) and a *Spitzer* Legacy proposal (*SpUDS*) to image the field using *IRAC+MIPS* (292 hours; PI: Dunlop). Both projects are proceeding well. All Spitzer data have now been taken and are currently being reduced. A public release is anticipated before the end of 2008. The ESO VLT survey is approximately 30% complete and is anticipated to continue for another 2 years. The data taken so far contain ~ 1500 spectra and are currently being analysed. Early indications suggest a spectroscopic redshift completeness in excess of 75%. Example spectra from VIMOS and FORS2 are shown. Early discoveries include the dramatic confirmation of a Lyα emitting galaxy at $z = 6.05$.

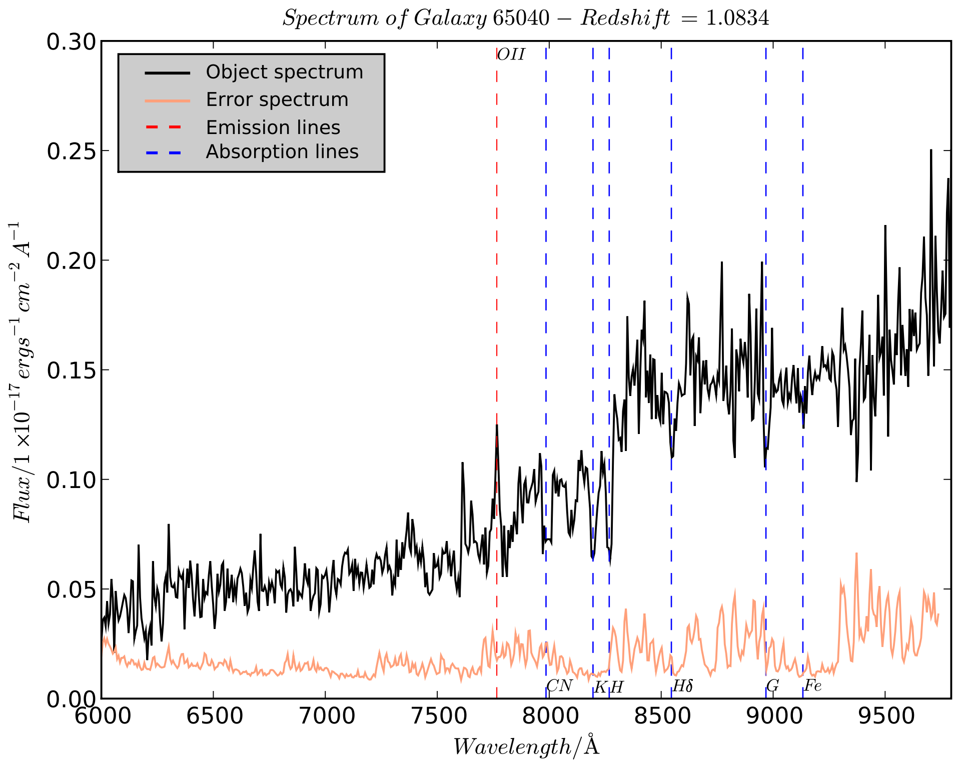

Figure 3: *Spectrum of an extremely red galaxy ($R - K > 5.5$) from the UDS, recently taken using the VLT FORS2 spectrograph. The completed project will yield spectra for ~ 4000 representative UDS galaxies at $z > 1$, providing a lasting legacy for detailed study with future generations of facilties.*

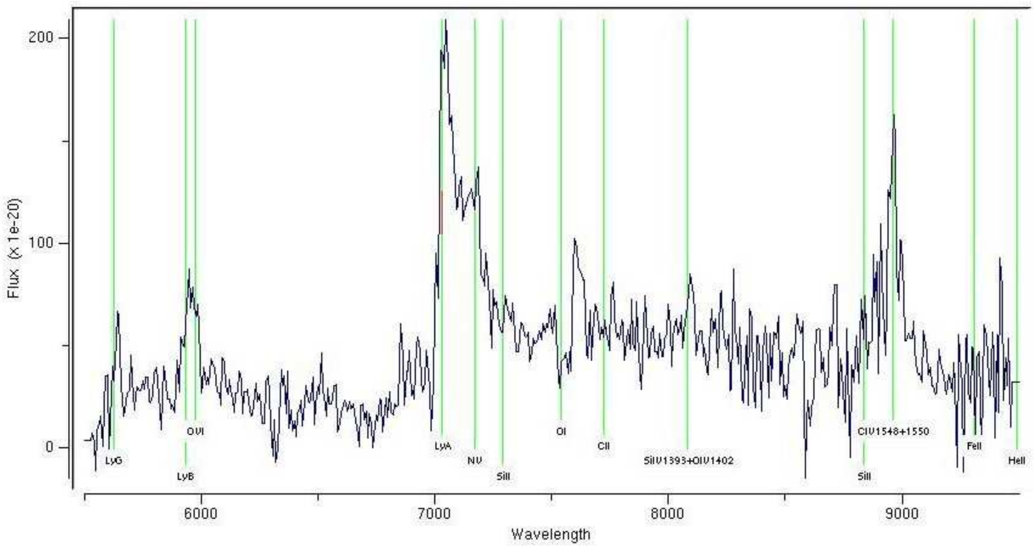

Figure 4: *Quasar at $z = 4.78$, recently identified using the VIMOS spectrograph as part of the UDSz project. Such rare targets are likely to form the basis of future targeted observations to cross-correlate intervening absorption systems with the cosmic web of luminous galaxies.*

Scientific output and publicity

High-profile scientific results continue to be made by the UDS. Excluding generic UKIDSS and WFCAM papers, there are now 16 publications based directly on UDS data. A welcome recent development has been the appearance of substantial publications based on UDS data from authors outside of the UDS working group (e.g. Quadri et al. 2008; Williams et al. 2008).

Further details are provided at the UDS team web page: http://www.nottingham.ac.uk/astronomy/UDS