24th April 2009

SCIENCE AND TECHNOLOGY FACILITIES COUNCIL

Progress report from UKIDSS

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

1. 09A observations progress

Observations in February went very much according to plan, but since that time progress has been almost negligible, with almost the whole of March and April lost to weather. The goal for this semester, for clear time to the end of April, which includes an allowance for weather, was 296h. At 21 April the clear time used was just 94h.

The usual practise has been for UKIDSS to supply allocations, in clear hours, for each survey for the whole semester, based on the total number of UKIDSS nights, and an average of 5.6h per night on target (8h on target per night, 70% clear). We also provide a broad statement of how the time for each survey should be spread over the semester, dependent on the RA distribution of target fields. In most semesters so far, weather has been worse than predicted, and then the expectation is that the final clear time achieved by each survey will match the allocations in terms of proportion. We have been concerned that in previous semesters some surveys have done better than others in terms of proportion, so for the first time we have provided target allocations for each survey for each month. The suggestion has been that JAC aim to match the allocated proportion for each month i.e. each month is treated separately, without reference to previous months. This worked very well in February.

2. Data releases, operations, pipeline, archive

DR5 for the LAS, GCS, DXS was released on April 6. UDS DR4 and GPS DR5 are well in hand. We have no significant pipeline or archive issues to raise this semester.

The fraction of observations lost in quality control was again very small, a few per cent. When trying to use as much of the observing time as possible it is inevitable that some observations will fail quality control, and we do not see an opportunity for a change in the quality control procedures that could reduce the fraction of wasted observations. There is one operational change which might make the observations more efficient. At times an MSB is started, and later rejected. In some cases, the first (say) 20 minutes are satisfactory, but the whole MSB is rejected and later repeated. Under these circumstances all the data are processed, and the best observations of any repeats are chosen for release. Ideally what would happen is that the observer marks those observations which are deemed satisfactory (e.g. the first 20 mins), and these exposures would be removed automatically from the repeat MSB.

3. Quantifying overall progress

The Board has requested an analysis of overall progress of the surveys. We have been keen to undertake such an analysis for some time but it has proven more difficult than it might seem at first glance. We present here an analysis of progress of the three shallow surveys LAS, GCS, GPS. For the deep surveys further analysis is required, and I will update the Board on results at the Board meeting. The difficulty for the deep surveys is how to assess progress, whether by integration time or by depth achieved. In particular in the UDS the gain in depth in magnitudes does not match the sky-limited expectation $\Delta m = 1.25 \log(t/t_0)$ by a substantial margin: the two estimates of progress differ by over a factor of two.

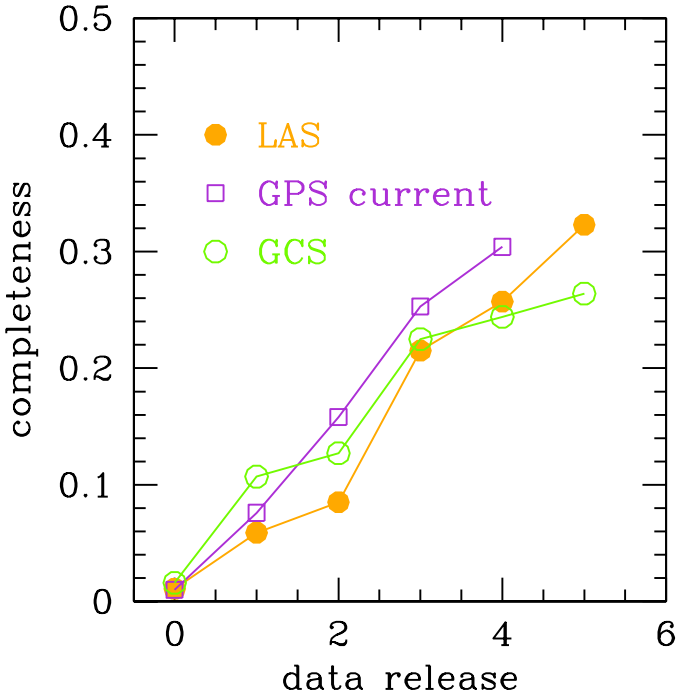

Figure 1: Completeness of the three shallow surveys, for each data release

For the shallow surveys the integration time is fixed, so that progress may be quantified simply by measuring the area covered. However the tiling of areas is not uniform, principally because some backtracking of the tiling is necessary in places in order to find a suitable guidestar. Therefore area covered is not simply proportional to the number of framesets.

We have now developed a method to quantify coverage accurately. In short a Monte Carlo aproach has been adopted. A large number of random vectors over the sky is generated, and each vector is checked to see if it falls on any frameset. Then the proportion that hit any frameset, multiplied by 4πster. gives the survey solid angle. With a sufficiently large number of random vectors, an estimate accurate to a fraction of 1% is achieved.

Survey	EDR	DR1	DR2	DR3	DR4	DR5
LAS	0.011	0.059	0.085	0.215	0.257	0.323
GCS	0.016	0.107	0.127	0.225	0.244	0.264
GPS current	0.010	0.076	0.158	0.253	0.304	...
GPS original	0.007	0.055	0.115	0.184	0.222	...

Table 1: Completeness of the three shallow surveys, for each data release

Finally to quantify progress we form the sum over all filters of the product of area times exposure time and compare this against the original goal. The results are summarised in Table 1 and plotted in Figure 1. It is striking that the the acceleration of the LAS, post DR3, requested by the Board, has not taken place. The target was 80% completion (i.e. single epoch *YJHK* 4028 deg^2) by the end of 2009, which will be DR8. Overall progress is rather disappointing, and UKIDSS appears to have suffered from poor weather over nearly all semesters since the beginning of the surveys.

For the LAS and GCS the exposure time is uniform over all filters, so we simply need to sum the area covered, over all filters, and compare against the target area. For the LAS the target is 4028 $\deg^2$ multiplied by 5 (Y,J1,J2,H,K). For the GCS the target is 1067 $\deg^2$ multiplied by 6 (Z,Y,J,H,K1,K2). For the GPS the integration time needs to be included. The original goal was as follows: 1868 $\deg^2$ in J, H (80s) and K (3x40s), plus 300 $\deg^2$ in H2 (3x150s) plus K (40s). The GPS therefore sums to 1868*280+300*490=670040 sq degs. secs. The current GPS goals were revised by the Board at the time the surveys were reapproved in March 2007. K was reduced to 2 epochs, and H2 was reduced to 1 epoch and 200 $\deg^2$. The H2 integration time was in fact set at 160s at the start of the surveys. This means that the current goal is 1868*240+200*200=488320 $\deg^2$. secs. The completeness compared to this figure is provided in the third row of the table (GPS current). The completeness compared against the first figure is provided in the fourth row of the table (GPS original).

It will be noted that the completion figures provided here are quite different (substantially lower) than the figures provided in the article by Luca Rizzi in UKIRT Newsletter 23. Luca compared time spent against the original time requested. However this takes no account of repeated MSBs (due to poor conditions), or quality control losses (originally 20%, but now only a few per cent), nor overlaps (amounting to 10 to 15%). In addition up to the end of DR3 (i.e. until the campaigns started) a substantial proportion of the LAS was undertaken in poor seeing conditions, when integration times were doubled. These factors summed together are substantial and explain the differences.

Because the observing and quality control procedures are now in a steady state, I suggest that progress since DR3, summarised in Table 1, provides a solid basis for quantifying the end-to-end survey efficiency for the shallow surveys i.e. the ratio of useful exposure time to elapsed time at the telescope, which, together with an anlysis of time lost to weather, can then be used to predict the amount of time needed to complete the surveys. I suggest that UKIDSS and JAC work together on quantifying this efficiency based on the DR4 and DR5 observations and releases.

4. UKIDSS workshop at RAS

The workshop 'Science from UKIDSS II' took place at the RAS over 15-17 December. There were over 70 participants and over 40 talks. The presentations have been archived and are linked from the UKIDSS home page. At the first workshop a significant number of operational, pipeline, and archive issues were flushed out, but this was not the case at the second workshop. This reduces the motivation for having a workshop specifically devoted to UKIDSS, rather than presenting UKIDSS results at themed conferences. At this point we are debating within the consortium whether to hold one more 'Science from UKIDSS' workshop, possible in Tenerife.

5. Registration

There are now 94 communities registered, of which 64 are non-UK.

6. Publicity

There was a press release by Ben Burningham at JENAM, April 2009, announcing the discovery of Wolf 940B, a very cool brown dwarf in a binary system.

Steve Warren participated in the UKIRT contribution to 'Around the world in 80 telescopes' describing the telescope and the goals of UKIDSS.

7. Publications

UKIDSS publications continue to be listed at http://www.ukidss.org/science/science.html. 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

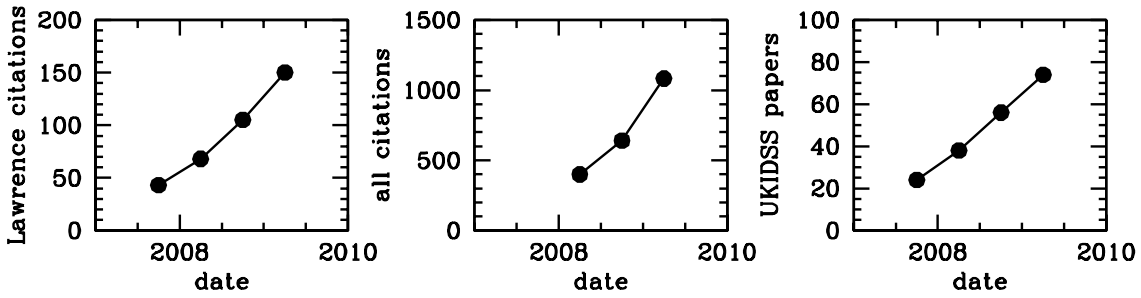

Figure 2: Trends in UKIDSS publication statistics at each Board meeting (census date end March, September).

number recorded on the web page e.g. Chiu et al. (2007:5). The census dates for Board reports are the end of March and the end of September, but the publications are updated every three months.

From the end of Sep 08 to the end of Mar 09 the citation count for the survey definition paper, Lawrence et al. (2007:15), increased from 105 to 150. Over the same period the number of UKIDSS papers published increased from 56 to 74, and the total number of citations to these UKIDSS papers increased from 640 to 1083. The citations have accelerated, while the numbers of papers published increased at the same rate as last semester. These statistics are plotted in Fig. 2.

All the papers have been entered into a personal library so that anyone interested can now access the ADSABS entries for all published UKIDSS papers at once, at the link 'Complete ADSABS list' at the URL http://www.ukidss.org/science/science.html It is then possible to sort all the papers on a desired quantity such as citations. Interestingly, although at this stage the number of UKIDSS papers is dominated by authors closely involved with UKIDSS, of the top three science papers, two are from European groups (these are Pérez-Gonzáles et al. (2008:4) and Polletta et al. (2007:10)), which is an encouraging indication of the interest in UKIDSS data.

A significant milestone has been the acceptance of the paper describing the calibration of WFCAM data by Hodgkin, Irwin, Hewett, and Warren (MNRAS, 394, 675). The original survey goal of photometric calibration accurate to *rms* of 2% is met everywhere, with the exception of Z and Y frames in regions of high extinction i.e. some of the GCS frames.

8. Progress reports from the Surveys

8.1 LAS report (Warren)

Survey progress

The LAS aims to cover 4028 deg^2 in the *YJHK* filters, with a second pass in J. The accurate areas in DR5 for the LAS, recently computed, are provided in Table 2. Roughly speaking there is 1400 deg^2 covered in Y and J contained within 1700 deg^2 covered in H and K. Deprecated frames in any filter within this area means that the area covered in all the *YJHK* filters is reduced to 1270 deg^2. In addition there is a separate (northern) area of 270 deg^2 observed only in J. These are the first epoch observations for proper motions and were completed in 2006, and we aim to cover all this area in 2009.

The *YJ* observations therefore lag the *HK* observations. This is primarily because the *YJ* observations have a more stringent sky brightness criterion, and secondarily because the seeing is slightly worse in Y and J, but the imposed seeing limit $1.1''$ is the same in all bands. We have successively relaxed the sky-brightness limit (now set at $J_{sky} = 15.5$) to reduce the lag between the filter pairs. We have also made it clearer to observers to give priority to *YJ* observations over *HK* observations.

At the renewal in March 2007 the Board allocated time to complete the first pass in *YJHK* by the end of 2009, requiring a significant acceleration of the LAS, which as noted earlier has not taken place. There are many reasons explaining this. One is poor weather, which has affected all the surveys, and we would like to work with JAC on a detailed analysis of this. A second is that many of the fields have been unobservable at times because of the moon-avoidance angle – but fortunately this has became less of a problem after installation of the new baffle. Nevertheless the seeing requirement for the LAS is quite loose. We have also tried to help speed progress by allowing thin cirrus conditions, following an analysis by Simon Hodgkin of the photometric accuracy in such conditions. We suspect that part of the problem with progress in the LAS is the RA distribution relative to the allocated nights, and that better progress would have required closer monitoring of progress week by week. For this reason we modelled the implementation of the allocation for 09A, and provided JAC with a breakdown target allocation for each month, and this was closely followed in February. Furthermore there was excellent progress on *YJ* observations. We believe this good progress is due to the close attention that Luca Rizzi has been providing since taking over the role, and may also be due to better seeing delivered since active cooling of the primary mirror was implemented. Therefore we are happy with the current arrangements, and confident that the Board's requirements can be implemented.

Filter	Y	J	H	K	all	any
	1413	1698	1691	1695	1270	2028

Table 2: Area coverage in deg^2 of the LAS, by filter, in DR5

LAS science

We describe here LAS science that is in progress or has been completed, but does not yet appeared in a journal article up to the end of March 2009. Science from the LAS continues to be dominated by stellar work, particularly cool brown dwarfs and white dwarfs. Leggett et al have published a detailed analysis of the near and mid-infrared spectra of the record-breaking cool brown dwarfs ULAS J0034−0052 and ULAS J1335+1130, providing temperature estimates of $550 - 600$K and $500 - 550$K respectively. Despite these very cool temperatures spectral changes in the near-infrared are subtle, and there is no requirement for a new spectral type yet. At the RAS workshop Smart provided a parallax measurement for ULAS J0034 consistent with the distance estimated from the spectral fitting alone. This result has been leap-frogged by the discovery by Burningham et al. of Wolf 940B, a very cool T dwarf in a binary system, in which the primary, Wolf 940A, is an M star. The accurate distance provided by the primary leads to a temperature estimate of 570K.

Other stellar studies include the search for ultra-cool dwarfs using proper motions, by Deacon and Hambly, that uses the LAS and GCS, mentioned in the GCS report, as well as a study of the debris disk around the white dwarf SDSS J1228+1040. The latter paper is one example where an object of interest happens to fall within the LAS footprint, and the UKIDSS observations are useful. The number of such papers will grow in proportion to the area covered.

It is a little surprising that there have not been more papers published on nearby galaxies, since the near-ir coverage of SDSS galaxies was one of the primary science drivers for the LAS. This is particularly true of the Virgo cluster where observations were accelerated. A notable exception is the work of La Barbera et al (2008:33), on the fundamental plane of early-type galaxies. Further work by this group was reported at the RAS workshop. Also several important publications using UKIDSS data can be expected over the next few years from the Galaxy and Mass Assembly (GAMA) project that is undertaking a large programme

of spectroscopic observations with AAOmega on the AAT. The second year's campaign, which targeted $K-$selected galaxies from UKIDSS, is just complete, and added 33,000 redshifts.

Progress on the search for the highest-redshift quasars has been satisfactory, but realistically the area needs to double to achieve the main science goals. In the 1000 deg^2 analysed in DR4, as previously reported 2 new $z \sim 6$ quasars have been discovered, and two SDSS $z \sim 6$ quasars rediscovered. These 4 quasars compare with 5 predicted, computed for the area covered using the measured survey selection function. We predict 1 to 2 quasars above the current limit of $z = 6.4$ in this area, while none have been found so far. If none are discovered by the time 2000 deg^2 have been analysed, the result will be inconsistent at the 5% confidence level.

8.2 GPS report (Lucas)

Data releases

There have been no new GPS data releases since the last GPS report, written just after the DR4 GPS release on 30/10/2008. The most recent GPS data that is currently in the SQL archive are for December 2007 observations. We are currently awaiting DR5, which will contain data from the 08A semester and deal with the 'nebulosity problem' using a new photometry algorithm with improved sky estimation in fields with nebulosity. We judged this to be mission critical to the GPS science aims in star formation, and therefore more important in itself than the incremental increase in sky coverage provided by the 08A data.

CASU has been provided with the full list of GPS images from EDR to DR5 that require reprocessing and are reportedly about to begin this task very soon.

Observations

36.9 hours of time were charged to GPS projects in 08B, out of 39 hours allocated, which was a good completion rate. Of the 36.9 hours, 10.2 hours were charged to the summer plane (in particular covering much of the area of the Spitzer Cygnus X Legacy project, see www.cfa.harvard.edu/cygnusX/) and 26.7 hours to the winter plane.

Progress has been much slower in the present 09A semester, owing to a combination of limited UKIDSS time in February and poor weather in March. Only 2.5 hours of GPS data have been obtained in 2009. In the short term this will exacerbate the asymmetry of the GPS progress (slow in the winter plane/outer galaxy section, fast in the summer plane/inner galaxy section). This has been caused in part by the two mid-winter Cass blocks in the past two years. The suspension of the UKIRT Cass mode should allow UKIDSS winter projects to start catching up next winter.

We are pleased to report that the H2 survey of Taurus, Auriga and Perseus that was begun under GPS auspices was completed in November, using DDT time and PATT time, as a slimmed down project focussed on the denser parts of the molecular cloud complex. The image data are available to ESO members at a web site set up by Chris Davis' at JAC (www.jach.hawaii.edu/UKIRT/TAP) and the images and source catalogues will also be available at the WFCAM Science archive as part of the GPS database.

Exploitation

1) An independent paper by the IAC group in Tenerife on the structure of the Galactic Bar is now published (Cabrera-Lavers et al., 2008:31). This is the first major fully independent paper to use GPS data.

2) The Bayesian cluster search undertaken by Samuel & Lucas at Hertfordshire is bearing fruit. 292 clusters have now been identified in initial runs with the final version of the Matlab code on the DR4 data. A large fraction of these (perhaps 40%) are new – the precise fraction is being determined by a laborious search of the literature. This large sample will be used to address one of the main star-formation goals of the GPS: the search for environmental variations in the IMF. The initial results will be presented at the European Week

of Astronomy and Space Science at Herts in April 2009 and we plan to write a paper on this in the next few months.

3) The Leeds group has obtained 6 nights of NTT time to follow up a small sample of GPS clusters to contruct HR diagrams and thereby test the validity of conclusions drawn from the photometric data provided by the GPS and the other multiwaveband imaging surveys of the Galactic plane.

Manpower

A shortage of dedicated research students and PDRAs, as opposed to experienced lecturers, has been an issue for the GPS group. This problem is now diminishing as we gain support from groups in the US and Chile, and even from STFC. Hoare now has a PDRA at Leeds (Ben Davies) who will be working mainly on UKIRT data (both the long running RMS project Cass mode data and the UKIDSS GPS data). Thomas Robitaille (formerly of St Andrews, now at CfA) is assisting Lucas with the Spitzer GLIMPSE cross match to detect Young Stellar Objects, to build on the results of his recent GLIMPSE publication (2008, AJ 136, 2413). Dr Lucas and Dr Hoare are coIs of the successful warm Spitzer Legacy projects: GLIMPSE-360. There is no doubt that the existence of the UKIDSS GPS was a major factor in allowing GLIMPSE-360 to get the 1800 hours of time that it has been allocated to survey the whole Galactic mid-plane at 3.6 and 4.5 microns, with better sensitivity than the previous GLIMPSE surveys. Both the GLIMPSE-360 and Cygnus X teams are expected to provide American manpower for joint studies with Spitzer and the UKIDSS GPS.

The VISTA VVV survey (PI Minniti, co-PI Lucas) is now looking unlikely to start in time to take much data in 2009, which has left the 6 Chilean PDRAs with little work to do. Two members of the Chilean team (Ivanov and Hempel) will be visiting Herts in May 2009 to explore using GPS data while we wait for VISTA to start.

8.3 GCS report (Hambly)

Observations

As part of overall UKIDSS operations, GCS observations continue to progress steadily. 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 08B (including QC losses to end of 08A) is provided in Table 3.

Target	Area deg^2	Z	Y	J	H	K1	K2
IC-4665	3	100	100	100	100	100	0
Pleiades	79	63	64	65	93	100	0
AlphaPer	50	48	45	49	97	99	0
Praesepe	28	84	89	67	100	100	0
Tau-Auriga	218	25	27	27	33	100	0
Orion	154	9	10	10	28	28	0
Upper Sco	154	25	23	22	65	66	0
Perseus OB2	13	100	100	100	100	100	0
Hyades	291	2	2	2	4	96	0
Coma Ber	79	6	6	6	7	95	0

Table 3: GCS completeness (%) in DR5

Overall completeness with respect to the original 7 year plan (for a total of just over 1000deg^2 in the filters listed above) is 26%. Given that the survey started in Semester 05A, after 4 years of observations the notional completeness should be 57%. Hence, the survey seems to be progressing at 46% of the speed originally hoped for. There are a number of reasons for this slow completion rate, e.g. quality control losses higher than originally assumed (considerably so at the start of the survey); competition for Autumn/Winter RAs; and availability of guide stars requiring a greater amount of overlap between adjacent tiles etc.

Survey release update

The current release (DR5; observations up to and including Semester 08A) contains 804deg^2 of GCS areal coverage in one or more filters - survey coverage maps are available at http://surveys.roe.ac.uk/wsa/dr5_gcs.html Individual filter areal coverage (square degrees) in ZYJHK for DR5 is 183, 185, 184, 341, 780 respectively with 146 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).

Science update

The latest results to come out of the GCS have been produced by the Tenerife group at the IAC, led by Nicolas Lodieu (Lodieu et al. 2009, A&A, submitted), who have made a detailed study of the sigma-Orionis cluster (part of the extended Orion Nebular Cluster star formation region) using GCS data.

This study has found many new low-mass brown dwarf members as well as recovering previously published members, finding a total of 287 member candidates within the central 30 arcmin in the 0.5-0.009 (solar) mass range, and equally importantly showing the level of contamination in other less sensitive surveys. Using 2MASS, evidence for variability was found over timescales of years in a handful of member candidates; but importantly such a level of variability is insufficient to affect the derivation of the cluster imitial mass function. Lodieu et al. have derived the cluster luminosity and mass functions within the central 30 arcmin from the cluster centre, down to masses corresponding to the deuterium-burning boundary (0.013 M solar) at the distance and age of sigma-Orionis, according to state-of-the-art theoretical models. They derived the mass function over the 0.5-0.013 M solar mass range, finding a slowly declining power law index alpha=0.6 when expressed as $dN/dM \propto M^{(-alpha)}$. A comparison with some of the other clusters in the GCS, IC4665 and the Pleiades, seems to show a deficit of low-mass brown dwarfs compared to the sigma-Ori cluster and the Upper Sco association. It is possible now to critically compare the underlying, single-star Initial Mass Functions for these clusters, since the accurate GCS photometry also provides the means to estimate binary fractions (e.g. Lodieu et al. 2007:17). We suspect that there may be a single, universal IMF underlying the MFs measured, but some work on modelling binarity and dynamical evolutionary effects will be required to study in detail this possibility.

Otherwise, GCS data are beginning to become useful as a general survey resource in themselves, as is illustrated for example by the use of the photometry in a recent papers concerning white dwarfs in clusters (Caswell et al. 2009, arXiv:0901.4464; Dobbie et al., 2009, arXiv:0902,4261). On a related note, the field very low-mass/ultracool dwarf works of Deacon et al. (2009, MNRAS, 394, 857) and Lodieu et al. (2009, arXiv:0812.2358) described in the previous report to the Board are now published.

8.4 DXS report (Edge)

This report is a good deal shorter than most of the previous ones due to a number of factors that mean I have very little new to inform the Board of.

The last Cass run, recent poor weather, the delay in Herschel launch, the slower start to PanSTARRS and the wait for DR5 have all contributed to less progress than we had all hoped for.

The exploitation of the DR4 data continues with Glenn Parish (Herts), Isaac Roseboom (Sussex), Caz Winkworth (Bristol) and Angela Mortier (Edinburgh) working on clustering, clusters, SWIRE and sub-mm identifications respectively.

My student, Jae-Woo Kim, has concentrated on the SA22 field and now has an excellent optical dataset that matches the four best WFCAM fields in this area. His next task is to work in improved mosaics for all the currently available DXS fields which will then be made available to all, as with the UDS.

I am aware that the DXS is beginning to be used as a comparison dataset in the NIR for galaxy counts, for instance in work on cluster studies where a background galaxy estimate is required. The availability of DXS data to the community is important in its use as a reference sample.

I appreciate that this report is again light on new results, but as I have stressed in past reports, this will change once other multi-wavelength datasets arrive.

8.5 UDS report (Almaini)

Survey progress

The UDS remains the deepest near-infrared survey ever conducted over such a large area, and continues to steadily increase in depth. The only comparable survey in preparation is the Ultra-VISTA project, which has yet to begin and is now unlikely to supersede the UDS until 2013.

Following processing at CASU, quality control, stacking and catalogue generation continues to be carried out by the Nottingham UDS team. A survey definition paper describing these techniques is currently in preparation (Almaini et al.).

The UKIDSS DR3 was the last major release for the UDS, combining the first two seasons of data. The UDS DR5 has been slightly delayed to allow the reprocessing of K-band data using an improved sky-subtraction algorithm developed by CASU. This helps to remove large-scale background gradients and correlated noise, leading to a significant improvement in depth (~ 0.3 mag) and cosmetic quality. With these gains, plus new data taken in 2007/2008, we anticipate DR5 depths of $K \simeq 22.1, H \simeq 22.3, J \simeq 23.1$ (Vega, 5σ). A release is planned for the end of May 2009. The reprocessing of all J, H data is also underway, but will be reserved for a future release to avoid further delay.

Despite this progress, we note that the UDS remains a long way behind schedule. As outlined in the UKIRT Newsletter (Issue 23), the UDS has only been observed for 198 hours to date compared to 1787 originally requested for the full survey; as such the survey is only 11% complete. This is partly due to the unfortunate scheduling of WFCAM in early semesters, partly due to poor weather and partly due to overly-strict initial constraints. Completing the UDS by 2012 as originally intended may therefore prove impossible. We nevertheless expect to push $\simeq 1$ magnitude deeper over the next 2-3 years, which will open up a wide range of new scientific projects, particularly for studying galaxies during the crucial epoch of reionization ($z > 6$). We stress that the UDS is already uniquely placed as the key infrared survey of the very distant Universe and this position will only consolidate as the survey deepens.

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 recent years. Key among these were an 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 has now been taken and reduction is in the final stages. A public release is anticipated by Autumn 2009. Combining UDS and *SpUDS* will produce by far the deepest $1 - 8\mu$m survey ever conducted.

The *UDSz* spectroscopic survey is approximately 60% complete and is anticipated to continue for another year. The data taken so far contain ~ 3000 spectra and are currently being analysed. Early indications suggest a spectroscopic redshift completeness in excess of 80%. Early scientific results include the confirmation of three galaxies with redshifts above $z = 6$ (McLure et al., in preparation).

Scientific output and publicity

High-profile scientific results continue to be made by the UDS. Excluding generic UKIDSS and WFCAM papers, there are now 22 publications based on UDS data.

Key recent highlights include the most accurate determination of the galaxy luminosity function to $z = 4$ (Cirasuolo et al. 2009), the first clear indication that passive galaxies at $z \sim 2$ reside in the most massive dark-matter halos (Hartley et al. 2008), and the discovery of very strong evolution in the space density of

the most luminous galaxies during the critical early epoch from $z = 6$ (< 1 Gyr after the Big Bang) to $z = 5$ (McLure et al. 2009).