IN CONFIDENCE **UKIRTB(05)NN**

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PARTICLE PHYSICS AND ASTRONOMY RESEARCH COUNCIL

Progress report from UKIDSS

Memorandum by the UKIDSS Consortium Survey Scientist, Dr S J Warren

1. Introduction

At the time of the last UKIDSS report to the Board, in May, science verifcation observations had been completed and we had just begun full survey operations (May 13). In that report we set out a timetable for science verifcation, and this is the main item we report on here.

2. Science verifcation progress and timetable

In the last report we set out a timetable for completing the science verification (SV) process. Recall that each survey was awarded some 10hrs on sky to undertake observations necessary to finalise MSB design, and with which to do dummy science which would highlight errors or shortcomings in the pipeline and archive. SV would proceed in two steps: SV1 would be a quick release of the first approx 60% of the data to get started on, and SV2 would be all the SV data, and would follow on a timescale dependent on completion/upgrades of the pipeline and archive. There are 40 people registered for access to the SV data, and therefore nominally contributing to the SV effort. Communication amongst this group is through a TWiki page: http://wiki.astrogrid.org/bin/view/UKIDSS/SciVer

SV1 data were released on 20 July, and are incomplete in a number of respects. In particular there are no photometric errors, some parameters are missing, notably Petrosian magnitudes, galaxy photometry is not propagated to the source (i.e. band-merged) tables, and calibration is to 2MASS using a preliminary estimate of the photometric transformations. SV meetings were held at Edinburgh on Aug 18, and in Cambridge on Sep 21. The general feeling is that verification of SV1 data is largely complete, and we await release of SV2, scheduled for beginning of Nov. Broadly speaking users consider SV1 to be a considerable success in that we have a system which works, and with which several of the UKIDSS science goals can be achieved. There were no major issues revealed in SV1. Nevertheless the specified photometric accuracy of 0.02mag. is not yet achieved, and we expect considerable effort to be devoted to tweaking out subtle issues from SV2.

Some of the topics raised in SV1 include the following:

1. External astrometry is very good, and checks so far indicate that the spec of 100mas is easily met. A comment on internal astrometric accuracy follows in the next section.

2. Repeat photometry indicates photometric accuracy, when calibrated to 2MASS, is about 0.03-0.04mag, which is approaching the spec. After treating position-dependent errors, and with improved calibration there is every reason to believe the specified 0.02mag. can be reached. Comments on calibration are provided elsewhere.

3. Cross-talk (ghost) images are a significant problem, as they appear in the same place in different bands, and are sometimes classified as stars, rather than noise. CASU hope to be able to subtract the images, but failing that these regions (identifiable by reference to locations of bright stars) will have to be masked.

4. Some images are noticeably not flat amd suffer from inadequately subtracted crud from the field lens. All the SV data have been reprocessed for SV2, so this issue will be rechecked.

5. Occasionally individual channels are low/high. These are very difficult to treat satisfactorily, but are considered an ongoing issue.

6. We are a little short on sensitivity, and this can largely be attributed to the revised lower q.e. (by factor 0.8). This is a consequence of the recently discovered inter-pixel capacitance introducing covariance, meaning that the gain, and hence q.e. has been incorrectly computed up to now.

7. The problem that close pairs of stars are classified as galaxies appeared in several different analyses.

8. A high fraction of outliers in 2-colour diagrams (in fact selected as candidate brown dwarfs) appear to be mistakes rather than the 4-sigma tail. For example, in one such sample all objects were classified as galaxies in J but as stars in all other bands. Understanding the causes is deferred to SV2.

9. A number of suggestions were made to improve the WSA functionality, and all are in hand or have already been implemented.

It is perhaps worth remarking that while the UKIDSS SV process has been useful, one might have expected more results given the number of people involved. Some groups have used the data to test whether they can achieve their science goals, rather than their technical goals, and consequently have simply trusted the data rather than tested it. I will try and address this in SV2 by assigning specific tasks to individuals.

We plan a meeting 3 to 4 weeks after SV2. It is hoped to release SV2 by Nov 4 or shortly thereafter. Therefore it is anticipated that SV2 will be complete around the end of Nov. After completion of SV2, and on the basis of the experience gained, we plan to design a series of test to carry out in the archive on the May/June survey data before release. The idea is that the the majority of these checks will be automated.

3. MSB design and implementation

Following the May/June run we had a meeting of Survey Heads at Durham on July 27, where the main topic was whether any changes to MSB design were needed. Three issues influenced the discussion.

1. The basic MSB design has been 2x2x2x5=40s i.e. 2 pointings each of 2x2 microstepped 5s exposures. But 5s exposures result in large overheads.
2. We want each pixel in the final image to come from at least two different array pixels, to improve cosmetics.
3. Microstepping does not improve photometric accuracy, but could improve internal astrometric accuracy, and would allow improved measurements of galaxy morphology. Microstepped images generally look rather grotty, largely on account of the peculiar psf, due to seeing variations as the image is built up.

One would naturally expect microstepping to improve internal astrometric accuracy, but at the moment there is no definitive evidence to show this, because this only becomes an issue once the data are undersampled i.e. we need 2005B data to check this. Therefore we have retained microstepping in the bands used for astrometry. CASU plan tests on 2005B data to quantify the gains from microstepping.

On the basis of these considerations the minimum integration time for the deep surveys (DXS, UDS) was increased to 10s, but microstepping was retained (since they are not limited to 40s per field). For the shallow surveys (LAS, GCS, DXS) the 2x2x2x5s sequence was retained only for the band which will be repeated (J for LAS, and K for GCS and GPS). In HK for LAS, and JH for GCS and GPS, we have adopted 4x10s, without microstepping. All observations in Y and Z use 2x20s, where the longer integration time is needed to beat read-out noise. Finally a short dark-flush sequence after each filter change has been implemented.

Finding suitably bright guide stars in LAS fields has proved to be an issue. We may have to accept that a fraction of LAS fields will suffer inferior image quality. This issue is ongoing.

Starting from Sept 2005, i.e. the second WFCAM block,it is hoped that we have reached a stable MSB design for each survey.

4. Calibration, and data release timescale

Calibration of UKIDSS is undertaken by CASU, within the pipeline, and will be improved within the archive curation activities. Simon Hodgkin (SH) has primary responsibility for calibration at CASU. UKIDSS interacts with CASU and WFAU on calibration through the calibration working group, chaired by Paul Hewett. We had a meeting of the WG, with SH on Sept 20, to assess progress, and set out a plan for future progress. At present each pawprint is calibrated to 2MASS using 2MASS detected stars, and a default extinction term. The accuracy of this is assessed by comparing the photometry of the standard stars calibrated in this way to the UKIRT FS values. This indicates typical accuracy of 0.04mag. in JHK. But there are a number of ways in which this is expected to improve. These include removing very red stars (for which the transformations show large scatter), determining average zero points as a function of time (e.g. every hour), thereby averaging over 2MASS systematics, and removing position-dependent errors over the field of view (due to a variety of causes, including the fact that the twilight flat won't be flat). It is conceivable these improvements would bring the scatter down to below 0.02mag. i.e. we could calibrate to 2MASS rather than use observations of standards. Therefore it was decided to pursue a much more detailed analysis of calibration to 2MASS using the very large database of zero points bulit up over 05A. At the time of writing some progress has been made on these issues, and a further meeting is planned with CASU next week. Nevertheless in the context of a first data release in January, the rather slow progress on these issues is undoubtedly a major concern. It also impacts on observing efficiency, since it it possible that standard star observations are not needed for calibration, merely for quality control.

A telecon of survey heads, CASU, and WFAU, was held on Oct 27, and a deadline for the release of the May-Jun data was set for the end of Jan 06, with a goal of 2 weeks earlier.

5. Survey progress

The surveys appear to be running smoothly, with satisfactory coordination between survey heads and JAC over relative priorties between surveys. It is suggested that at the end of this engineering block the 05B season be used to assess survey efficiency and progress towards completion of the 2-year plan. It seems quite likely that we will find that we are falling behind, because observing overheads are larger than originally aniticipated (although now significantly improved), and because the instrument is somewhat less sensitive than predicted. UKIDSS have decided to produce a journal paper to accompany the first data release (lead author Dye). It is likely that the frequency of papers will be matched to the WFCAM observing blocks.

6. Registration for archive access

So far 45 institutions have applied for access to UKIDSS data, of which 15 are from outside the UK.

7. Complementary optical VST data

The long-running saga of complementary VST optical data continues. After submission of proposals to observe DXS and LAS fields with VST, and preliminary approval, stage 2 was to revise and resubmit to the ESO OPC in October. The LAS proposal, deep i imaging of the equatorial block, has been subsumed by KIDS. The DXS proposal, deep multicolour imaging of the two equatorial fields, has been subsumed by VST-Census (PI Oliver). There has been a hiccup with the VST-Census proposal which remains to be resolved. At stage 1 this was classified a 'secondary' proposal, but was approved for submission to stage 2. After stage 2 submission, ESO withdrew their approval. This action has been queried, and the decision may be reversed.

8. Publicity

A PPARC press release to mark the start of UKIDSS went out on June 24, and an article appeared in The Times on June 25. Articles on UKIDSS appeared in the Autumn 2005 UKIRT Newsletter, including a summary of the first UKIDSS paper 'The UKIRT Infrared Deep Sky Survey ZYJHK Photometric System: Passbands and Synthetic Colours' by Hewett, Warren, Leggett, and Hodgkin (MNRAS submitted). Besides the Dye science verification paper referred to above, the main paper introducing and describing UKIDSS (Lawrence et al.) is at first draft stage, and we aim to submit it by end of November.

A UKIDSS talk is scheduled for the Nov. woorkshop at ROE 'Panoramic near-infrared astronomy'. An article on UKIDSS has been requested for the Mar 06 copy of ESO's The Messenger.

Besides the M51 picture that went out in the press release, 3 images of Virgo galaxies are shown on the UKIDSS web page, and Omar Almaini has taken a very nice image of NGC891. UKIRT might consider producing a homogeneous image gallery in a more systematic way. As a rule, although the UKIDSS LAS images are very much better than 2MASS, it really takes 300s per filter to produce something that looks really good. Also the optimal filter set for colour images is ZJK rather than JHK, so with the exception of the GCS, custom observations would in any case be required. UKIDSS would be pleased to interact with CASU and JAC should it be decided to set up such a project. Alternatively it could be largely handled by UKIDSS - we are considering applying to PPARC for a PUS grant to enhance the web site for public interest, and the activity could come under that.