HECTOR SCIENCE MEETING

TUESDAY 8 FEBRUARY 2022, 3.00 – 4.00PM

Zoom – the meeting was recording for minute taking purposes only.

Attendees: Julia Bryant (Chair), Sree Oh, Marie Partridge, Matt Owers, Stefania Barsanti, Jesse van de Sande, Scott Croom, Mina Pak, Joon Hyeop Lee, Jiwon Chung, Hyunjin Jeong, Jong Chul Lee, Angel Lopez-Sanchez, Sam Vaughan, Amelia Fraser-McKelvie, Richard McDermid, Luca Cortese, Brent Groves, Madusha Gunawardhana, Joss Bland-Hawthorn, Charlotte Welker, Mark Krumholz, Di Wang, Sarah Sweet, Matthew Colless, Andrew Battisti, Emily Wisnioski, Gabriella Quattropani

Apologies: Lisa Kewley

Item	
1	**Action Items from the previous meeting (9 November 2021)** • Most items were addressed at the end of 2021 **WALLABY** **Action Item:** • Julia reminded the group to contact Luca with any project ideas to connect with the appropriate WALLABY team member.
2	**Update on Hector Commissioning** • The commissioning plan has many steps prior to the start of the survey but the first 2 commissioning runs have been successful. • The first steps in the 1st run were installing the instrument on the telescope and ensuring it was running. This was a complex process as it is the first instrument positioning in 3D some improvements were made to operations. • The 2nd commissioning run aimed to get light down the hexabundles which was achieved, plus centering in the hexabundles and through puts and then getting data reduction. ○ In the 1st run galaxies were not centred with the offset in the region of 100s of microns. ○ 2dfdr does a positioning check each time it goes on the telescope to correct the distortion with an algorithm, Hector is designed with a similar algorithm, but efforts are being made to find the issues leading to the distortion ○ Initially it was thought that the positioning error was the metrology matrix, however after running the robot in manual mode, this was not the case. This issue is still being investigated and the data is still being analysed to improve centering. Multiple fields will then be combined and fitted using Tony Farrell's distortion correction code. ○ Each fibre core is approximately 100 microns, the 61 core bundles (smaller cores) are ~ 1mm so 100 microns in not a big issue. A 500 micron offset means that galaxies sit close to the edge of the smaller bundles, so some galaxies may be lost from some of the smaller bundles. ○ The distortion could be in the top end of the barrel, but this could not be measured preinstallation. ○ Once centering has been addressed the next step is analysing fibre throughputs ○ Looking at the science data from the commissioning runs will highlight further questions/changes.
3	**Data Reduction** Scott, Sam and Madusha have looked at various aspects of the data reduction and summarised their findings. • Scott – the 1st steps of the pipeline work are 2dfdr based and have been completed. ○ Scott acknowledged Michael Goodwin from AAO-MQ for generating simulated data. ○ Areas to improve are sky subtraction and optical extraction. The instrument is running in simple gaussian mode at present. ○ Items which are quite urgent are the tramline maps and fibre tracing aspects. These need to be sufficiently robust, tracing some of the fibre throughputs and mark those which are dead, will help resolve this. ○ It is important to get a very accurate wavelength calibration. The sources are not that bright particularly in the blue (how this was running on 2dfdr is unlikely to be accurate enough for Hector) This can be addressed by replacing some lamps and also potentially improving the algorithm. • Madusha – shared the calibration data to show some of the data related and data reduction issues so far – see attached slides ○ Slide 1 - Dome Flat illumination Spector Blue – ccd3 there is a variation in brightness across the plot. This has not been resolved by the January commissioning run. This is due to a new dome flat illumination lamps system built for Hector by AAT staff, however work is still ongoing as it is not flat enough yet. ○ Slide 2 - AAOmega Blue – same results ○ Slide 3 - AAOmega red - less variation ○ Slide 4 - Flap Flats – ccd1 (AAOmega Blue) left plot vs ccd2 (AAOmega Red) right plot.

There is variation and red looks better than the blue. Data reduction may be struggling in the low counts in the blue. Flat flaps with a longer exposure time produced a better result for cc1 but meant that the red (ccd2) was over exposed. Two different exposure times could be used for Spector, but this would not be possible for AAOmega avoiding this would be time and cost saving.

Slide 5 – Reduced arc exposure - ccd3 (Spector blue) vs ccd2 (AAOmega red)

The arc reduction is not that good especially in the blue., Red is ok.

Discussion points

- It was noted that the problem with the blue arcs does not appear to be a signal to noise issue.
- However, the lines in the far blue only peak at a few 10s of counts therefore the support code may not be handling that or not identifying the weak lines. Because the code fits each fibre separately you get a wiggle.
- You could fit for the optical model parameters but that would require fitting for 800 fibre positions, this would be a lot of work but could lead to very accurate results.
- Fixing the lamps would be the best first approach before fixing the software.
- Adding blue LED lights has been tried to eliminate the issue.
- Data taken from 2dfdr showed the uniformity of the flats across the sky highlighted that the illumination is not uniform across the field.
- Because the spatial variation of brightness is so steep any slight errors in spatial modelling translate into flatness errors, which will be a problem.
- The issue with the flat flaps is that they may send light at the fibres at the wrong angle.
- For SAMI twilights were used for everything to counter the lack of counts in the blue.
- It was confirmed that 2dfdr dome flats will look similar with the double peak in the blue shown by Madusha.
- Scott confirmed that scattered light in Spector in the blue, although it hasn't been measured quantitively, it didn't appear to be an issue compared to AAOmega.
- The initial throughputs for Spector seem to be above spec. Spector was around a factor of 3 better in the blue than AAOmega. In the red the throughput is similar.

Sree – Hector Reduction Pipeline

- Slide 1 - The SAMI reduction pipeline is being used as the backbone for Hector data reduction. The pipeline has been modified for ccd3 and ccd4. The pipeline is working for pre-processing.
- Slide 2 - There are issues with the tramline feed. Left plot shows the tramline feed using flap flats and the right plot after updating 2dfdr. After updating 2dfdr the fibres are now well placed.
- Slide 3 – ccd3 – issues still occur for ccd3 for Spector. Madusha and Sree produced tramline plots using 2 different versions of 2dfdr. Madusha reduced the file manually and Sree reduced the data using the pipeline giving different results. They will revisit this to get the same result.
- Slide 4 – Cubing. The drizzle method is the standard method for SAMI but there were some issues, so the Gaussian process and Covariance regularized reconstruction method were also used.
- Slide 5 – Drizzle, GP and CCR Cubes. The spectrum for the 3 cubing methods estimated S/N based on the spectrum. The GP method seemed to generate the bester quality spectra in terms of S/N but it seems to overestimate the variance compared to the other methods.
- Slide 6 – Summary. Jesse and Brent are assisting to look at the effect on the different cubing methods have on stellar and gas kinematics.
- A data reduction meeting will be held in mid-March after the next observing run.

4 **Update on 2dfdr Observing (Sam)**

- Matthew and Sarah are currently observing
- 2dfdr observing are running in parallel to Hector observing to get redshifts.
- Spreadsheet - Break down by field for Semester 2021 A. The sky is split into 2 parts. The clusters redshift catalogues are incomplete and 2dfdr is being used instead of TAIPAN.
  Columns show: Field; number of records; number of targets and percentage success rate (which is quite high at over 80%); total number of targets in the field and completeness (which is everything targeted as a fraction of everything in the field). Sam made the target catalogues for the H1 & H3 fields and Matt has produced the target catalogues for the clusters.
  Number of targets likely include many things which are not galaxies. Hector field in the WAVES South region H1 is getting close to 80% of galxies which have been targeted. More work will be done on H3 in current semester to fill out the WAVES South region.
  Cluster A3716 is completed, A3667 &A015 require further work. A3395 and A3391 will also be observed currently by Matthew and Sarah.
- Plot – Spectroscopic completeness to r_mag = 19.5. Produced by Matt in Sept 2021 shows where in the clusters the redshifts are coming from. Colour shows completeness. The centres are well studied but the outskirts show things that could potentially be cut.
  H1 and H3 are out to r_mag 17.7 and all the cluster fields are down to 19.5
  The completeness on the spreadsheet is not the same as that on the plots as Matt has downgraded some of the priority for clusters that have an existing redshift in the existing input catalogues; so they don't exist in this completeness. Matt confirmed that in 2021 he observed for 10 nights to a high level of completeness to the limiting magnitude for targets for Hector.
  More data will be available at the end of this week including the galaxies at the edge of the GAMA G12 field to fill out information at the edge of G12.

	• Julia thanked all the observers and also Sree for coordinating the schedule of observers.
5	**eROSITA Opportunities (Matt)** • Matt has just stepped down as the science lead for eROSITA in Australia. Scott was involved with some AGN projects for SAMI, but there are more opportunities with Hector. • eROSITA is an all-sky X-ray survey which will complete 8 passes of the sky and is 25x deeper than the last survey which was completed in the 90s. • Via the AAL collaboration we have access to the data from the German half (not the Russian). eROSITA data that is accessible covers most of the WAVES field and 6 out of 11 clusters. • One project opportunity is to look at the x-ray properties of groups and clusters of galaxies in the WAVES field where red shift information is not yet available. There is also 2dfdr and GAMA data available in some of the fields which is a good environmental metric to use while waiting for the WAVES data. • The deadline for potential projects is Friday, however this is a rolling deadline so projects can be submitted at any time. • Matt can assist with proposal preparations; however, they do require someone from an Australian Institute and also a member of the eROSITA team to co-lead each project. It was advised to coordinate with the eROSITA working group prior to seeking approval from the AAL. **Action Item:** • Speak to Matt about any potential eROSITA proposals.
6	**Welcome to Gabby Quattropani** • Gabby is a new PhD student at MQ looking at KOALA data and improved way to determine how many components to fit when doing line fittings and potentially translate this to Hector.
	The next Hector Science meeting is scheduled for Wed 9 March 2022, 3 - 4pm AEDT **Meetings will continue alternately on the 2nd Tue and Wed of each month at 3 - 4pm AEDT (12 – 1pm AWST).**