Multi-Object Spectroscopy in the Next Decade: Big Questions, Large Surveys and Wide Fields
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Integrating Mass Scale Spectroscopic Processing

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Abstract

The current decade heralds the development of several major new wide field multi-object spectroscopic (MOS) survey instruments, optimised to deliver spectroscopic observations of tens of millions of stars and galaxies. These instruments will facilitate progress over a huge range of science programmes particularly in the coming era of major facilities such as Gaia, eRosita and LOFAR.

The Cambridge Astronomy Survey Unit (CASU) has specialised in data processing of major ground-based optical and infrared imaging surveys, including for WFCAM on UKIRT and the ESO VISTA NIR and VST optical surveys. Up to a TB of data from these systems is routinely processed each night.

Building on this expertise, CASU is developing processing and data management systems for a number of these new spectroscopic survey instruments. We describe in this presentation the approach being taken to develop the processing and archive systems for WEAVE (an optical MOS which will commence operations on the William Herschel Telescope in 2017/18) and for 4MOST (an optical MOS for the ESO VISTA telescope, with an on-sky commissioning date of 2019).

As a first stage in this process CASU have developed a processing facility to handle the spectrosopic data for the 300 night Gaia-ESO FLAMES VLT survey (see http://www.gaia-eso.eu). CASU provides the processing architecture, the operational database, and the core Level-1 (L1) processing system. Higher level analysis (L2) is undertaken by partner expert groups who provide analysis for specific survey target types, for instance hot stars, cool stars, etc.. The L1 and L2 science products are integrated into the CASU Gaia-ESO archive initially for internal release but later to the community via ESO as so-called ESO Phase 3 advanced science data. Of note is the overall architecture and how this, combined with suitable interface control and a modular design, enables the analysis system to integrate successfully a range of expert-provided high-level analysis products.

We will describe the current planning for the WEAVE and 4MOST data management systems, noting the challenges in scaling up the current CASU spectroscopic pipeline system to handle the significantly larger surveys from these instruments (10^7 objects c.f. with 10^5 objects from the Gaia-ESO survey). The processing methodology pays particular attention to issues such as sky subtraction, cross-talk suppression and minimal rebinning of spectra. Level 1 products include radial velocities/redshift estimate and first pass template matching to characterise objects prior to feeding these to the more distributed Level 2 systems for further more detailed analysis such as stellar abundance determination.

We note how the design of the processing pipeline is strongly science driven. This ensures that the analysis system delivers high quality data products to the science survey teams in the shortest possible timescale, thereby allowing rapid scientific validation and exploitation of the data.