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HERMES – An instrument of the future

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Abstract. HERMES is a new, multi-object high resolution spectrometer for the 3.9m Anglo Australian Telescope, using the existing 2dF positioner. The primary goal of the HERMES survey is to unravel the history of the Galaxy from detailed elemental abundances for about 1.2 million individual stars. The HERMES chemical tagging survey concentrates on the 5000 to 8000 Å window at a resolving power of 30,000 in order to identify dissolved star formation aggregates and ascertain the importance of mergers throughout the history of the Galaxy.

Keywords. instrumentation: spectrographs, techniques: spectroscopic, surveys, stars: abundances, Galaxy: abundances, Galaxy: evolution, Galaxy: formation

1. Motivation

Disk formation and survival are key tests of the CDM paradigm (Freeman & Bland-Hawthorn 2002). We seek signatures or fossils from the epoch of Galaxy formation to give us insight about the processes that took place as the Galaxy formed. The aim is to reconstruct the star-forming aggregates that built up the disk, bulge and halo of the Galaxy. Some of these dispersed aggregates can be still recognized kinematically as stellar moving groups. For others, the dynamical information was lost through disk heating processes, but they are still recognizable by their chemical signatures (chemical tagging). The method uses the fact that many of the elemental abundance properties of stars are laid down at birth and these distinctive signatures are retained throughout their lives like tracer dyes. We will use our chemical tagging technique to identify directly the individual star forming events which built up the disk over the last 12 Gyr.

Disk and bulge reconstruction through chemical tagging requires a large survey and relatively high spectroscopic resolution (R$\sim$30,000). We wish to identify stars belonging to individual ancient star forming events, in order to reconstruct the formation history of the Galactic disk. We can identify some by their 3D motions, but most of these old aggregates have lost their dynamical identity through gravitational interaction with molecular clouds and spiral arms. Chemical analysis provides the way forward.

2. Science Projects

The primary science driver for HERMES is a stellar survey down to V = 14 with a total of about 1.2×10^6 stars. At V = 14 and with R = 30,000, it is expected that a SNR$\sim$100

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will be obtained in 60 minute exposures. The sample will include thin disk, thick disk and halo giants and dwarfs extending out to 1 kpc for old disk giants, 5 kpc for disk giants and 15 kpc for halo giants. This will provide stellar samples from a large number of different star formation sites in the Milky Way. Using chemical tagging techniques, complemented with distances and proper motions from GAIA, these different formation sites will become differentiable, providing the vital pieces necessary to piece together the formation and history of the Milky Way.

Additional science projects for HERMES include: chemical abundances of large samples of stars in the outer and inner disk of the Galaxy; measuring the galactic abundance gradient defined by young and old stars; chemical evolution in the galactic bulge; membership, dynamics and detailed abundance distributions of globular clusters, open star clusters and superclusters; AGB stars in the Magellanic Clouds; the ISM in the Galaxy, Magellanic Clouds and other nearby galaxies.

3. Technical Specifications

HERMES will make use of the existing 2 degree field facility (2dF) on the AAT. 2df provides 392 science fibres deployable over a 2 degree diameter field of view, with each fibre subtending 2" on the sky. HERMES will share 2dF with the existing AAOmega spectrograph via a fibre connector or multi-fibre system. The goal for the HERMES spectrograph is a 4-arm design based on high dispersion volume phase holographic (VPH) gratings (see Figure 1).

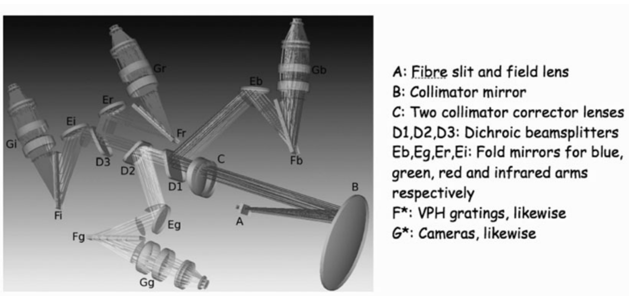

Figure 1. Optical configuration of the HERMES instrument.

The 4 arms allow simultaneous observations of 4 (non-contiguous) wavelength windows, each approximately 1000 spectral resolution elements wide. With 4 windows spread over the visible wavelength range this results in a total wavelength coverage of 100 nm. The overall operating wavelength range in which these windows may be placed is approximately 370-950m.

Each set of VPH gratings and dichroic beamsplitters provides a fixed set of wavelength windows. These components are designed to be exchangeable, allowing additional sets to provide alternative wavelength windows. A higher resolution mode using a slit mask is also envisaged.

Reference

Freeman, K. C. & Bland-Hawthorn, J. 2002, *ARAA*, 40, 487

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