New, Efficient High-Resolution Red VPH Grisms in VIMOS

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VIMOS is the visible (360 to 1000 nm) wide-field imager and multi-object spectrograph mounted on the Nasmyth focus B of Melipal (UT3) (Le Fèvre et al. 2003). The instrument is comprised of four identical arms each with a field of view of 7′ × 8′ with a 0.205″ pixel size and a gap between each quadrant of ~ 2′. Each arm is equipped with six grisms providing a spectral resolution range from ~ 200–2500 and with an EEV 44-82, thinned, anti-reflection coated, 4k × 2k pixel CCD. VIMOS operates in three different modes: Imaging (IMG), Multi-Object Spectroscopy (MOS), and with Integral Field Unit (IFU). For a summary of the instrument capability and performance, see *http://www.eso.org/instruments/vimos/*

Figure 1: Prisms and grating optical elements glued together.

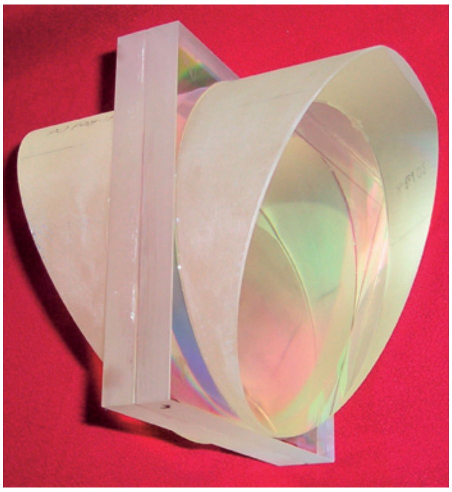
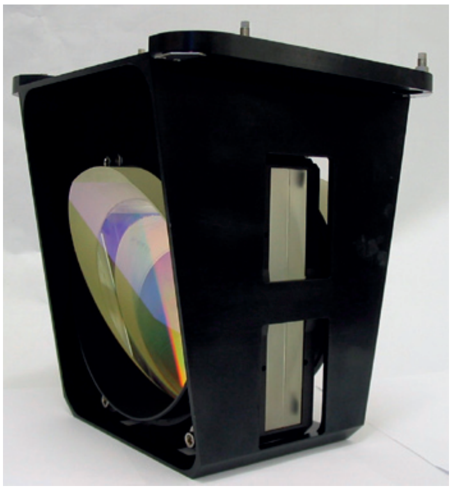


Figure 2: The VPH grism as hosted inside the new mounting.



One of the High-Resolution Red grisms (600 grooves/mm) was damaged during the instrument testing phase. From the beginning of operation in 2003, observations in this mode had to be executed using a HR_{orange} grism in one of the channels. Coupled with the relatively low efficiency intrinsic to the old grisms, this mismatch was a strong limitation to the performance of the instrument in this particular setup. In September 2005 the HR_{red} grisms were replaced by a new set of Volume Phase Holographic (VPH) grisms offering a superior efficiency while maintaining the same spectral resolution. The VPH grisms were manufactured by CSL and their operating characteristics are given in Table 1.

The definition of requirements, the VPH specifications, the procurement and the gluing of the prisms and the VPHGs were done by the Optical Instrumentation Department. The mounting design, integration and testing by the Integration Department. Commissioning and characterisation were carried out by the Operation Staff in Paranal and VIMOS-assigned staff in the Data Management Division.

Figure 3: The efficiency curve of the old grism (black line) and the new one (red line) as measured in the laboratory.

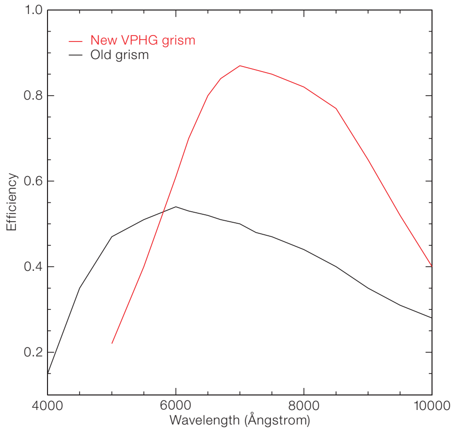


Table 1: VPHG HR_{red} grism characteristics.

Wavelength range	0.50–1.05 micron
Spectral resolution	R ~ 2500
Dispersion	~ 0.6 Ångstrom/pixel

One of the final prisms and grism optical assemblies is shown in Figure 1; the same element as hosted into the new mechanical mount is shown in Figure 2. This new mounting includes an on-board alignment system which reduces the time needed to realign the grisms in case of dismounting or earthquake events to a few minutes.

The comparison of the old versus new grism efficiency curves as measured in the ESO optical lab is shown in Figure 3; the wavelength range 0.6–0.9 micron corresponds to a slit at the centre of the field. The response of the new VPH grisms with VIMOS was measured by observing spectrophotometric standard stars on different photometric nights. The global efficiencies of the UT3+VIMOS+grism with both the old and the new VPHG HR_{red}, as provided by the ESO-VIMOS pipeline, are shown in Figure 4. A notable improvement (~ 40–70 %, depending on wavelength) has been obtained in the full spectral range covered by the grisms.

Reference

Le Fèvre O. et al. 2003, SPIE 4841, 1670

Figure 4: The comparison between the global efficiency (telescope+instrument+grism) as measured on sky by using the same spectrophotometric standard star; old grism (black line) new grism (red line).