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GOHSS: current status and technical aspects

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Abstract. We describe the current status and technical aspects of the GOHSS (Galileo OH Subtracted Spectrograph) project. In particular, we stress the most critical points and we address the innovative technical solutions implemented to fulfill the compelling requirements imposed by both the optical tolerances and the demand of a high sensitivity. The commissioning phase at the telescope is expected to begin at the end of year 2002.

Key words. telescopes – instrumentation: spectrographs – techniques: spectroscopic – infrared: galaxies

1. Introduction

GOHSS is a fiber-fed multi-echelle spectrograph which works in the spectral range 0.9 - 1.7 μm (z,J,H bands) for the TNG (Telescopio Nazionale Galileo). It will work initially in MOS (Multi-Object Spectroscopy) mode being able to record simultaneously 23 spectra at a spectral resolution of $\mathcal{R} \sim 5000$, thus allowing a software subtraction of the atmospheric OH lines. The spectral range is covered by two cross-dispersed gratings which provide each spectrum splitted into seven orders. The study of an IFU (Integral Field Spectroscopy) mode is also envisaged as a later implementation. The main scientific motivations of GOHSS are summarized in Scaramella et al. (1997), while the advantages of OH removal, and how GOHSS accomplishes this task, are discussed in Lorenzetti et al. (2000) (and references therein). We are also developing the data reduction package along with the instrument simulator: the results on the visibility function of galaxies are given by Fiorani & Scaramella (2002) (this issue). GOHSS is a collaboration between the observatories of Rome and Naples, supported by a consultancy from IoA (Institute of Astronomy - Cambridge UK). Being a national facility, funds have been granted from both the Italian community (CNAA - Consorzio Nazionale Astronomia e Astrofisica) and the Rome and Naples Observatories within a co-financing scheme.

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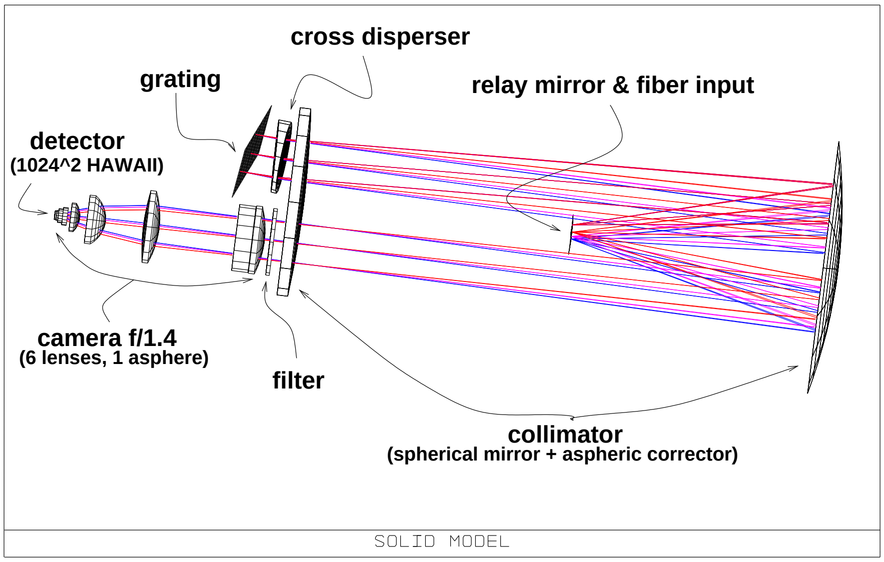

Fig. 1. Optical layout of GOHSS.

Tab. 1 - GOHSS main characteristics

Spectral resolution	4850 (z+J)	Spectr. working temp.	-45° C
(degraded)	3910 (J+H)	IR array temp.	77 K
Multiplexing	$\sim$ 25 fibers	Operational modes	MOS
Fiber diameter	1.5 arcsec	Efficiency (Total)	12 %
IR array	1024x1024	Spectral coverage	0.9 - 1.7 μm

2. Overall description

GOHSS is composed by two major parts, i.e. the fiber feeding system (Vitali et al. 2000) and the spectrograph itself as depicted in Fig. 1. This latter is constitued by (*i*) a collimator system composed by a spherical mirror and an aspheric corrector plate; (*ii*) the spectroscopic unit composed by both the grating and the prism for the cross-dispersion; (*iii*) the f/1.4 camera, composed by 6 lenses, the last being the window of the dewar that houses the NIR array. Fibers from the telescope are aligned along a slit at the collimator focal plane . The f/5 primary mirror generates a 150 mm diameter beam which is then projected onto the grating. In front of this latter a prism, crossed in double pass, acts as cross-disperser to properly separate the spectral orders. The spectrum is then projected onto the relay mirror (located at the collimator focal plane) and re-collimated by the primary mirror. It then passes through a blocking filter and then the spectrum is imaged onto the 1024x1024 pixels IR HAWAII array by a f/1.4 camera lens. Details of the optical system are given in Cortecchia et al. (2001). The mechanical layout is depicted in Fig. 2. Over the optical bench are located the aluminum frames for both the primary mirror and the aspheric plate, the filter wheel, and the rotating carousel which allows to select the needed configuration of grating + cross-disperser coupled together in individual turrets. To reduce the thermal background to a level comparable with the array dark current (Lorenzetti et al. 2001), the whole experiment is put within a refrigerator cooled down to -45°C. Finally,

Fig. 2. Mechanics of GOHSS.

the main GOHSS characteristics are summarized in Tab.1.

3. Relevant technical solutions

The compelling requirements imposed by the optical tolerances (Cortecchia et al. 2001), the need of cooling down all the entire instrument and the demand for a final efficiency as high as possible, all have pushed toward some innovative technical solutions:

- **mechanics for the f/1.4 camera lens.** The main problem is due to the difficulty in aligning such optical device (6 lenses) at the low working temperature within the required tolerances. Therefore the mechanical assembly has been designed to keep the same alignment done at ambient temperature also at the working conditions. To this aim the system has been designed (Cortecchia et al. 2001) for having a highly symmetric structure and it is realized with a material having a very low thermal expansion coefficient (TEC). This is the ultra low expansion (ULE) quartz, whose TEC is $\sim 10^{-9}$ /°C namely a factor of 10^3 lower than that of materials generally used in similar applications (e.g. Invar - $TEC_{INVAR} = 2\ 10^{-6}$ /°C).
- **gratings efficiency.** A particular effort has been put in procuring quite large custom gratings (150×190 mm) with a peak efficiency larger than 80%.
- **array mount.** The positioning and the alignment tolerances of the array cannot be achieved by simply placing the array in its nominal position. This forced us to adopt a movable mount for the array as shown in Fig. 3 which ensures an adjustment for tilt and defocusing by means of actuators driven outside the dewar: in fact similar adjustments must be necessarily done at the working condition, checking the alignment on the acquired image from the array.

4. Status and schedule

All the components have been already acquired and during the first months of this

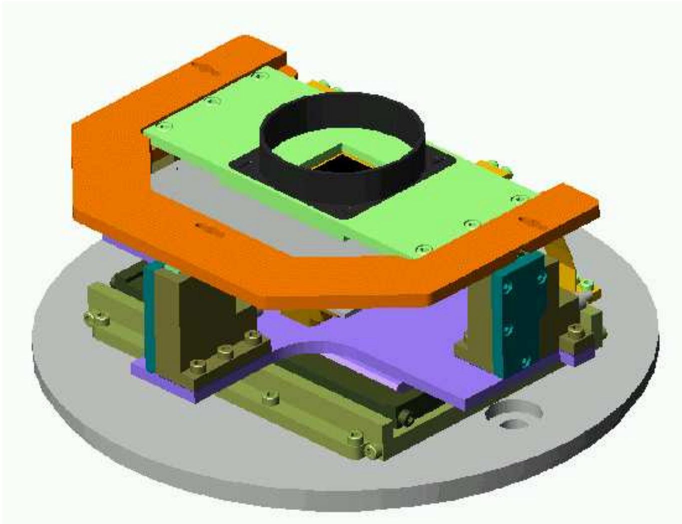

Fig. 3. Assembly of the IR array.

year (2002) the assembling of GOHSS will start in our laboratories. All the tests are scheduled within the summer along with the completion of the reduction software. Then the instrument will be dismantled for the transport to La Palma. There, it will be re-assembled again and the begin of the commissioning pahse is expected at the end of 2002.

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