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A Set of Grisms for FORS

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1. Introduction

The University Observatories of München and Göttingen and the Landessternwarte Heidelberg are building in cooperation with ESO two almost identical **FO**cal **R**educer /low-dispersion **S**pectrographs (FORS) for the ESO Very Large Telescopes. FORS allows low-dispersion multiobject spectroscopy (19 slits) and longslit spectroscopy in the wavelength range of 330 to 1100 nm. A set of standard grisms with reciprocal dispersions of 45...230 Å/mm working in the first order are foreseen. With a slitwidth of 1 arcsec the resulting spectral resolutions range from 180 to 1800.

For further FORS details see Appenzeller and Rupprecht (1992) and Seifert et al. (1994).

2. The FORS Standard Grisms

The standard grisms are located in a grism wheel in the parallel beam between the collimator and the camera. Seven of eight positions are available for grisms. The free diameter of the grisms is 135 mm to cover the whole field of view of FORS. To avoid reflection ghosts the entrance surfaces are all tilted by 7°.5.

Table 1. FORS standard and cross-disperser grisms.

no.		mechanical parameters					spectral parameters		
cross	std.	glass	n_{glass}	gr/mm	φ	ψ	$\Delta\lambda$ [nm]	d [Å/mm]	R (1″)
I	1	FK 5	1.49	600	34°	28°.	350 ... 590	50	815
II		F 2	1.62	600	34°	34°	460 ... 710	49	1030
	2	K 5	1.524	600	46°	49°	525 ... 740	45	1230
	3	SF 5	1.68	600	46°	49°	690 ... 910	44	1530
	4	SF 11	1.79	600	46°	49°	800 ...1030	45	1760
	5	FK 5	1.49	300	21°	17°.5	330 ...(650)	110	420
	5	+GG435					(450)... 860	112	500
III	6	LF 5	1.58	300	26°.7	26°.7	600 ...1140	108	680
	7	BaK 2	1.54	150	11°.5	8°.6	330 ...(650)	225	185
	7	+OG590					(590)...1100	230	280

φ prism angle, ψ groove angle, d reciprocal dispersion,
R spectral resolution for 1″ slit width, $\Delta\lambda$ wavelength range (1. order).

Due to the space restrictions in the parallel beam the maximum length of the grisms is 115 mm corresponding to a prism angle of 46°. Table 1 contains the mechanical and spectroscopic parameters of the selected standard grisms.

The spectral dispersion curves of the grisms cover the whole spectral range of the FORS instrument with three different resolutions. The dimensions of the ruled areas required are quite large (e.g. 120×153 mm for the 46° grisms) and therefore only a few suitable standard master gratings exist. Nevertheless, all standard grisms can be realized using already existing master gratings. The material for the prisms were selected with respect to the transmission and the refractive index of the corresponding glasses.

The standard grisms are normally used in the first order. For wavelengths longer than 660 nm filters to separate the second order are needed. According to Table 1 the grisms nos. 5 and 7 can be used with and without an order separation filter in separate wavelength ranges. In both cases the surface of the CCD chip is (in one dimension) only partially utilized.

3. Grisms for an Echelle Mode

For the second copy of FORS the polarimetric observing mode will be replaced by an echelle spectroscopy mode. The cross-disperser grisms will be located in the "Wollaston wheel" in front of the pupil stop and the echelle grisms in the grism wheel. For three overlapping wavelength ranges a set of two echelle grisms (Table 2) and three cross-disperser grisms (also in Table 1) are planned. The echelle grisms are used in the orders 3 to 16. The maximum prism angle is about 51°.

Table 2. FORS echelle grisms.

no.	wavelength range [nm]	glass	n_{glass}	n_{resin}	grooves /mm	φ	ψ	orders	R (1″)
I	340...590	BaK 2	1.54	1.525	225.75	51°4	54°	3... 6	1500...1825
II	460...710	SF 57	1.84	1.665	98.76	51°2	63°5	8...16	2280...3000
III	600...1100	SF 57	1.84	1.665	98.76	51°2	63°5	6...11	2200...2470

For the wavelength ranges II and III the same echelle grism can be used.

The minimum local order separation is better than 230 pixels (5.6 mm). Hence, a "longslit" of up to two slitlets can be used in this mode.

In addition, three advanced echelle grisms with prisms of more exotic materials with higher refractive indices (sapphire, zink sulfide) are being studied. It seems to be possible to increase the spectral resolution (1″ slit) up to 2300 in the wavelength range I (340...590 nm) and up to 4000 in the other ranges. At the present time the realization of these grisms is not yet certain.

References

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