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Southern African Large Telescope
Prime Focus Imaging Spectrograph
Anti-Reflection Coatings Specification
SALT-3120AS0016

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Modification Record

Version	Date	Comments
1.0	05-Mar-2003	
1.1	10-Mar-2003	Change UV cutoff from 300 to 320 nm

1. Introduction

The optical system of the Prime Focus Imaging Spectrograph (PFIS) comprises a refracting collimator with internal reflecting fold mirror, refractive dispersers (in the form of five volume phase holographic gratings, one standard transmission grating, and two Fabry-Perot etalons), and a refracting camera.

Each air-glass interface, if left uncoated, would reflect approximately four percent of the incident light. With 20 air-glass interfaces in the optical system (with a grating in), these reflections would result in only a 44 percent throughput.

PFIS will use three types of anti-reflection coatings.

- **Magnesium fluoride (MgF₂)** - This will be used on all collimator surfaces that might be exposed to ambient conditions. It can achieve >97% transmission across the entire PFIS bandpass (320--1700 nm).
- **Sol-gel over MgF₂** - This coating provides very high transmission across the entire PFIS bandpass (320--1700 nm). Sol-gel coatings are fragile and will thus be used only on "interior" surface, i.e. those that are internal to an optics barrel.
- **Multi-layer** - These coatings can provide >99.5% transmission across the visible portion of the PFIS bandpass (320--900 nm).

2. Collimator Optics

The following table provides information about each optic in the collimator and what type of coating is needed for each surface.

Group	Element	Material	Diameter	Center Thickness	Edge Thickness	Clear Aperture	Radius of Curvature	Wavelength range (nm)	Coating type
D1	O-L1	F_quartz	130	10	29.9	120	94.1409	320-1700	MgF ₂
							64.7932		None
	O-L2	CaF ₂	124	51	11.8	113	64.7932		None
							269.1785	320-1700	MgF ₂
S1	O-L3	F_quartz	132	10	46.8	115	-66.7515	320-1700	MgF ₂
							198.8691	320-1700	Solgel/MgF ₂
S2	O-L4	F_quartz	154	30	10.9	142	-686.2812	320-1700	Solgel/MgF ₂
							-139.4617	320-1700	Solgel/MgF ₂
T	O-L5	CaF ₂	184	55	14.0	171	930.2364	320-1700	Solgel/MgF ₂
							-134.3700		None
	O-L6	NaCl	196	15	29.3	185	-134.3700		None
							-228.0297		None
	O-L7	CaF ₂	204	37	15.1	194	-228.0297		None
-140.1829							320-1700	MgF ₂	
D2	O-L8	F_silica	202	15	43.2	187	Plano	320-900	Multi-layer
							188.1678		None
	O-L9	CaF ₂	202	53	14.2	187	188.1678		None
							-544.9774	320-900	Multi-layer

All units mm (unless otherwise specified)

3. Camera Optics

Group	Element	Material	Diameter	Center Thickness	Edge Thickness	Clear Aperture	Radius of Curvature	Wavelength range (nm)	Coating type
Q	A-L1	F_silica	238	15	31.9	221	407.5475(asph)	320-900	Multi-Layer
							225.6610		None
	A-L2	CaF ₂	238	70	14.3	223	225.6610		None
							-335.7677		None
	A-L3	F_silica	244	15	65.1	228	-355.7677		None
							268.3832		None
	A-L4	CaF ₂	244	50	16.5	230	268.3832		None
							-1777.484	320-900	Solgel/MgF ₂
S1	A-L5	CaF ₂	250	54	14.8	241	464.1057	320-900	Solgel/MgF ₂
							-365.7249	320-900	Solgel/MgF ₂
T	A-L6	F_silica	210	45	21.7	197	248.3816	320-900	Solgel/MgF ₂
							Plano		None
	A-L7	NaCl	194	15	50.2	183	Plano		None
							120.1303		None
	A-L8	F_silica	170	90	60.1	160	120.1303		None
							488.2939	320-900	Multi-Layer
S2	A-L9	F_silica	90x123	8	23.9	72x105	-173.1466	320-900	H2Oresistant ML
							539.5584	320-900	H2Oresistant ML

4. VPH gratings

We have ordered three grating substrates per grating. Two for the construction of the grating plus one spare. One side of each substrate needs to be coated.

The following table provides the dimensions, minimum and maximum angle of rotation, and wavelength coverage over which we need to minimize reflection for each VPH grating. These are specified to have multi-layer coatings.

Grating	Substrate size (mm)	Clear Aperture (mm)	Minimum Angle (deg)	Maximum Angle (deg)	Wavelength Range (nm)
G0900	200x175x10	180x155	12	20	320-900
G1300	230x175x10	210x155	20	35	390-900
G1800	250x175x10	237x155	25	50	450-900
G2300	250x175x10	237x155	25	50	350-700
G3000	250x175x10	237x155	30	50	320-550

Dimensions in mm, angles in degrees, and wavelengths in nm

5. Other optics

Other optics will also need to be coated with anti-reflection coatings. These include:

- **Waveplates** - These will get a MgF₂ coating.
- **Waveplate blanks** - These will also get a MgF₂ coating.
- **Order-blocking Filters** - These will get multi-layer coatings appropriate to the wavelength range of transmission.