

IMaging Prime Focus Articulating SpectrographS  
IMPALAS  
Provisional Specifications: Summary  
30 May, 2001

General:

Field size: 8 arcmin diameter  
Pixel scale: 1 pixel = 0.135 arcsec; median seeing = 0.9 arcsec = 6.7 pixels  
Slit-mask capability: arbitrary slitmask features down to 0.45 arcsec; eg 100 5 arcsec slitlets

Visible Beam VPH Grating Spectroscopy

Spectral range: 3200 -9000Å (useful throughput at 3100Å; fringing beyond ~7500Å)  
Field of View (fig 1,2): direction of dispersion:  $\max(8, 13.7 - .015 \lambda(\text{cov})/\Delta\lambda)$  arcmin  
Max Res  $R=\lambda/\Delta\lambda$ (fig 3): 0.9 arcsec slit: 6500; 0.45 arcsec slit: 12000  
Resolution elements: 0.9 arcsec slit: 914 spectral resolution elements  
Grating complement (fig 3) (under study): 4? VPH gratings  
High-speed mode (fig 1): ½ of field; > 1 Hz  
Efficiency (fig 4,5,6) 31% peak on sky\*

Visible Beam Imaging/ Fabry-Perot Spectroscopy

Filter Imaging Intermediate band (eg uvbyHβ)  
Field of view bullseye (fig 1) Diameter = 1.4 arcmin  $(10,000/R)^{1/2}$   
FP etalon complement (under study):  
    Tunable filter  $R(H\alpha) = 500 - 1200$   
    Medium Res  $R(H\alpha) = 2500$ , blocked by  $R = 500$   
    High res  $R(H\alpha) = 13000$ , blocked by  $R = 1200$   
Spectral Range (under study): 4500 - 9000  
Interference Filters Full set at  $R = 25$  (blocks  $R = 500-1200$ ).  
Maximum interference filter resolution  $R = 100$   
Efficiency (on sky)\* 28% (tunable filter); 20% (double etalon)

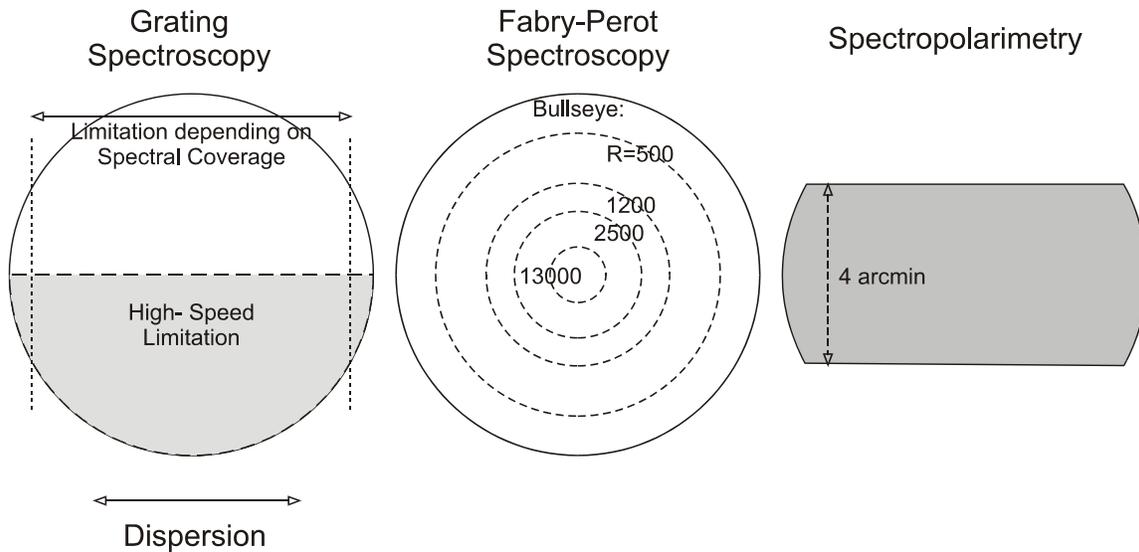
Visible Beam Polarimetry

Spectropolarimetric modes: VPH grating (except high-speed)  
    FP imaging  
    Prism resolution slitless spectropolarimetry  
Stokes modes Linear (halfwave plate); Circular (quarter wave plate)  
Spectral Range: Full range allowed by spectroscopy  
Field of View (fig 1) Central 4×8 arcmin  
Efficiency 80% of spectroscopic/ imaging modes

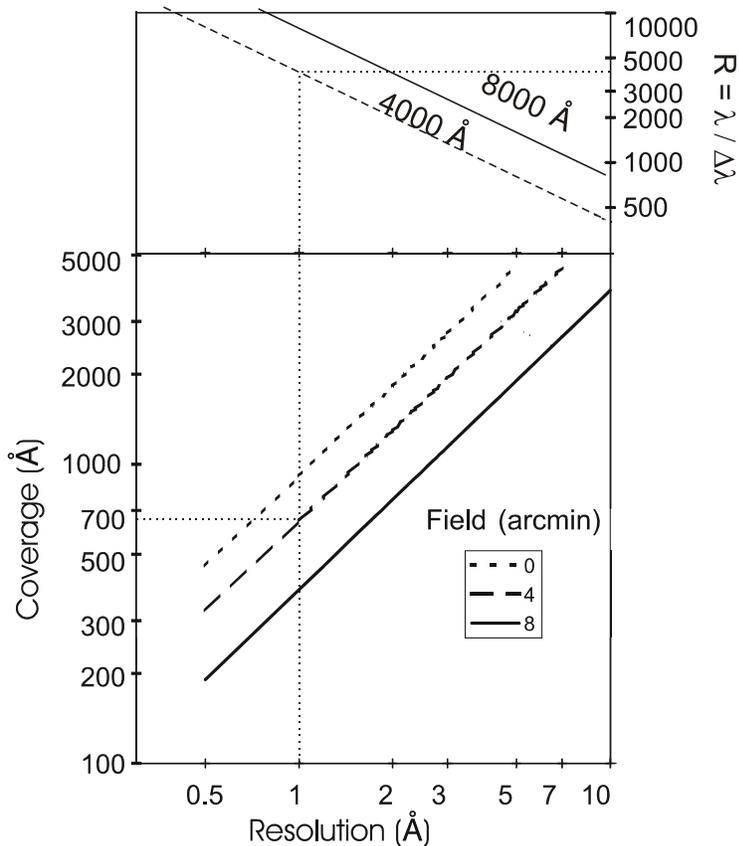
Future NIR Beam

Common slitmask/ collimator  
Simultaneous with visible beam  
Modes: same as visible beam  
Spectral Range 0.85 - 1.7μ

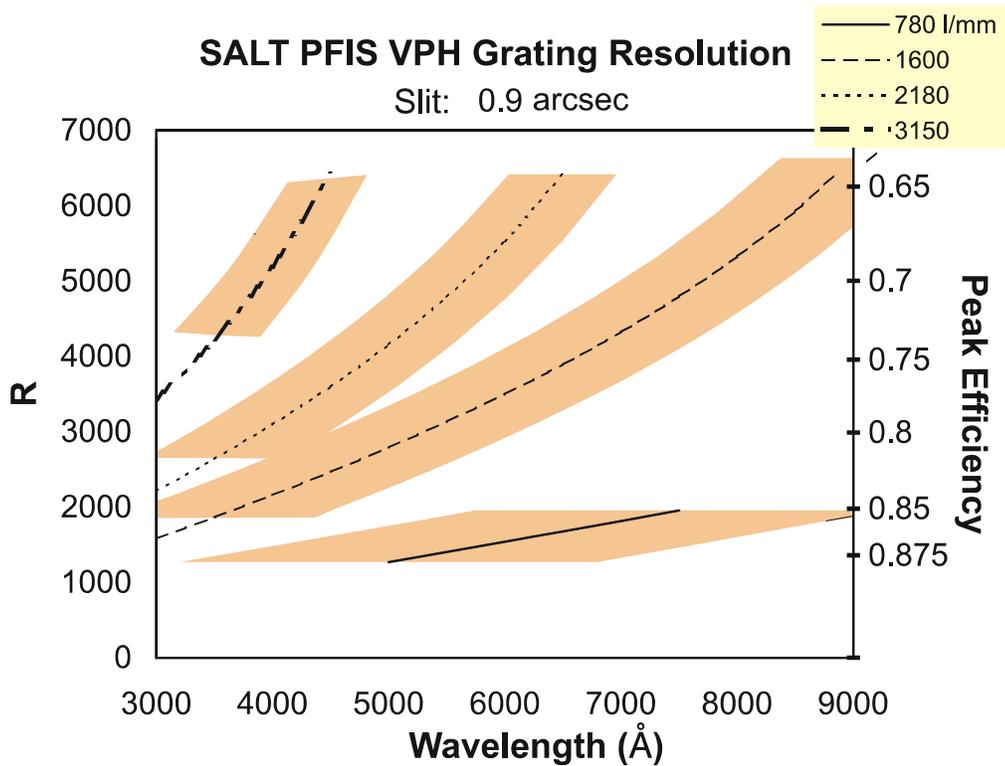
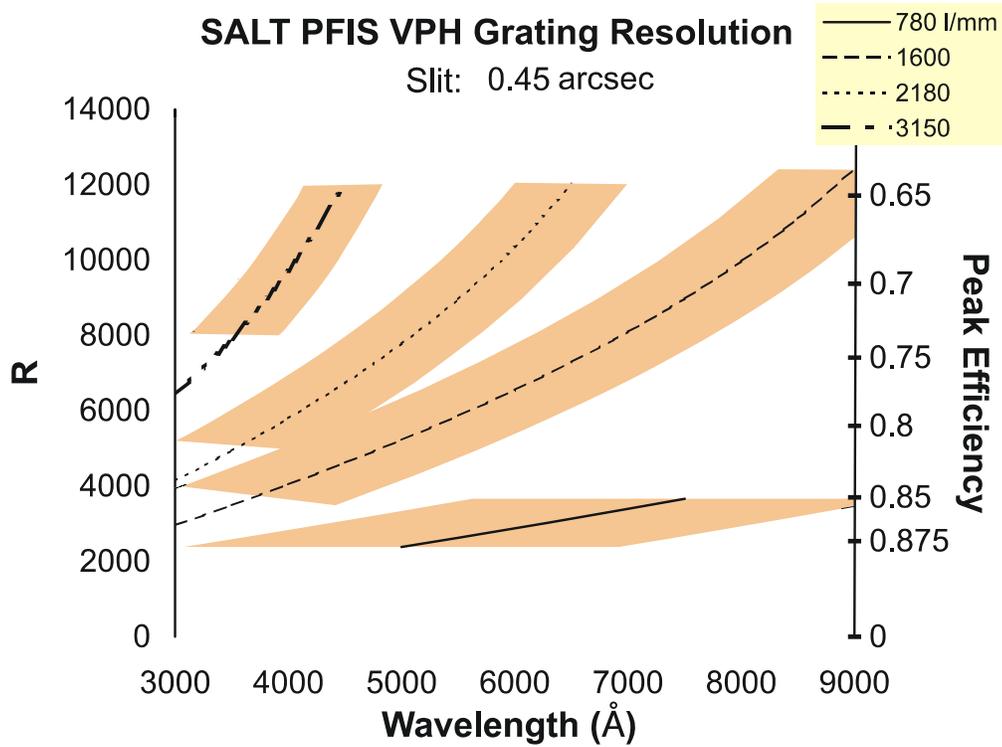
\* Includes atmosphere, telescope with 10.5m pupil over 12 deg track, spectrograph/ detector



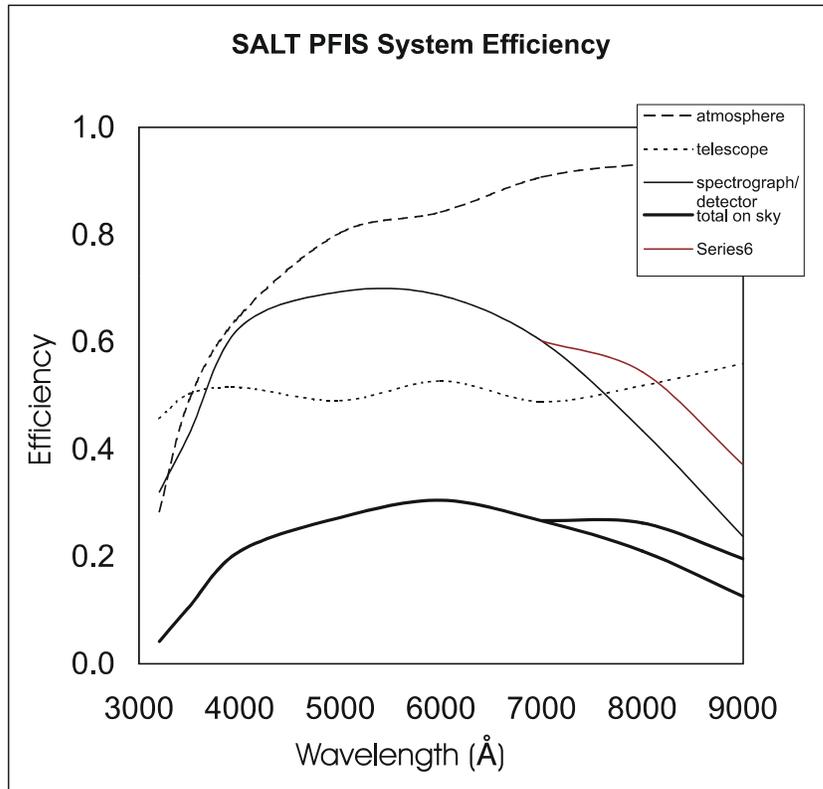
**Figure 1.** Field of View. Telescope: large (8 arcmin) circle. Left: VPH mode, showing  $\frac{1}{2}$  field limitations for high-speed spectroscopy, and spectral coverage dependent limitation in direction of dispersion (see figure 2). Middle: Fabry-Perot mode. Full 8 arcmin field of view available; dotted circles show region over which wavelength varies by no more than one spectral resolution element (the “bullseye”). Right: Spectropolarimetry. Field limitation is due to beam splitter, applicable in both VPH and FP modes.



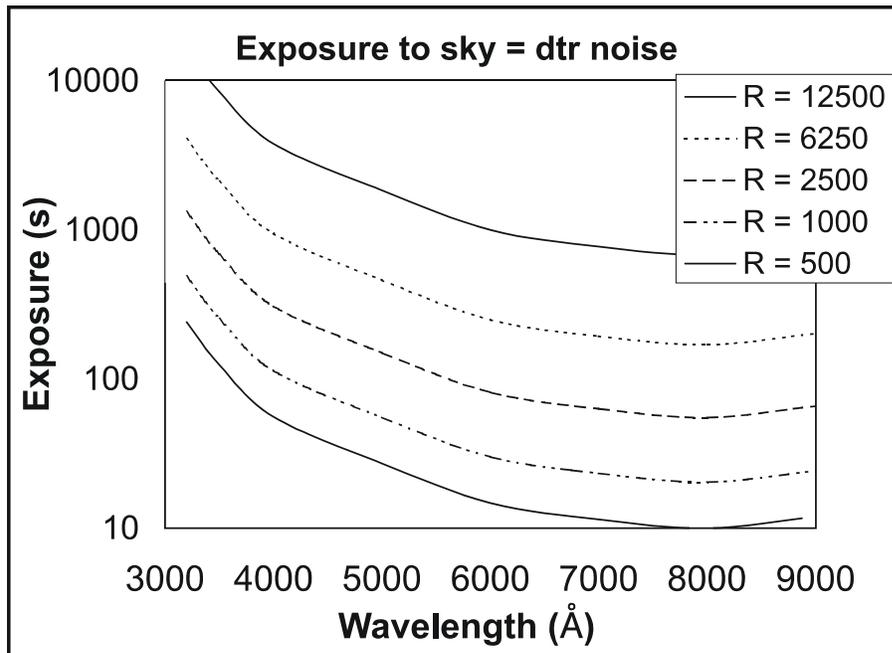
**Figure 2.** Spectral coverage, field, and resolution in grating mode. Bottom: maximum spectral coverage vs spectral resolution for a dispersion-direction field of view from 0 arcmin (on-axis only) to 8 arcmin (full field). Top:  $R = \lambda / \Delta\lambda$  vs spectral resolution for wavelengths from 4000 to 8000 Å. For instance: at  $R = \lambda / \Delta\lambda = 4000$  and 4000 Å, the spectral resolution is 1 Å; if a field of 4 arcmin in the dispersion direction is desired, the maximum spectral coverage will be about 680 Å.



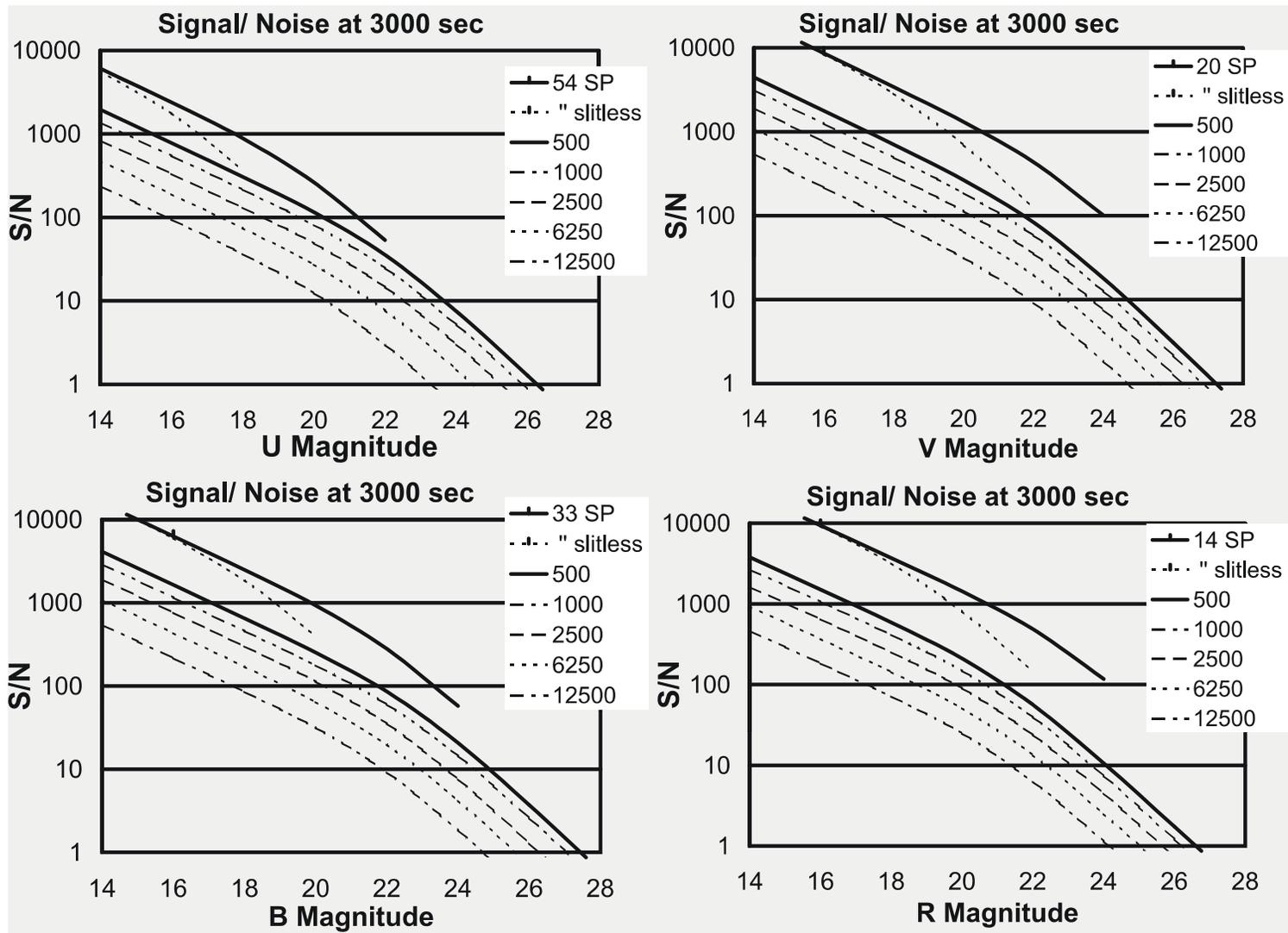
**Figure 3.** Resolution vs Central wavelength (lines) and the on axis spectral coverage shading) for sample set of four gratings in Littrow grating and camera configuration. Peak blaze efficiency shown at right. Top: 0.45 arcsec slit; Bottom: 0.90 arcsec slit (median seeing).



**Figure 4.** Predicted System Efficiency at peak blaze in grating mode. Heavy line includes atmosphere at ZD = 37°, telescope with 10.5m pupil over 12 degree track, and spectrograph/detector.



**Figure 5.** CCD exposure time at which sky photon noise = CCD readout noise. Binning 2x2 pixels except for 1x2 at R = 12500.



**Figure 6.** Photon-limited signal/noise per spectral resolution element for a 3000 second exposure on a continuum source at U, B, V, and R wavelengths. "SP" = Imaging SpectroPolarimetry, with and without slits, listed with  $R = \lambda/\Delta\lambda$ ; others for 5 resolutions in grating mode at grating peak blaze.