SPINOR Grating Selection Issues

Here are some guidelines for grating selection. The image size at the Dunn Solar Telescope (DST) Horizontal SpectroGraph (HSG) grating is about 100mm x 100mm. This means that for a 63º blaze (R=2) the grating length needs to be 200mm. Since there is further spread in the dispersion direction due to slit diffraction, the grating size must be even larger in the spectral dimension. For the 63º grating the size must be 100mm x >200mm.
Slit width is guided by the desired spatial sample size of the slit. Given a new high order AO system, and expected quantum efficiency better than ASP, a likely value for SPINOR is around 0.3 arc seconds, which at 133μm/arc-second image scale for the DSP feed optics gives a 40μm slit width. ASP uses a 50μm or even 80μm slit width.
If we require camera pixels to have a spatial sample size matching that of the slit, and compute resolution as the RMS of the contribution due to slit width, pixel width (the same if spatial scales match), and grating resolving power to be about 3.0pm, the grating dispersion needs to be large. For large dispersion, a steep angle of incidence is required. About 63º blaze angle works perfectly for 630nm giving a theoretical 2.9pm resolution. Better than theoretical value is demonstrated in practice both with ASP and Solar-B.
The HSG has a collimator lens and a camera lens (or lenses). Since we expect camera pixels to be small compared to the slit width, the collimator focal length needs to be 'long' and the camera focal length 'short'. The standard and longest focal length collimator is 3040mm. For a 12μm pixel and 40μm slit width, the optimum camera lens focal length is 912mm.
What is reality? No such lens 912mm focal length exists in catalogs or on the shelf at the DST, but there are several choices at 1000mm available in lens catalogs. Let us use that focal length as a base line. Gratings are expensive, especially custom ones. Let us select gratings from the National Solar Observatory inventory and grind through the numbers for various spectral lines.

The 316 l/mm at 63.46 degrees works well for 6302 as it does currently. Maintaining spatial resolution, spatial sample size changes from 0.37 arc seconds to 0.29 arc seconds.

For 8542 (also 8498, 8638,6563,5890) the 308.57 l/mm grating at 68 degrees works great. Sorry no 6302 or 5173.

For 6302 and 15648 simultaneously, the 31.6 l/mm at 63.46 degrees works great. Narrow pre-filters will have to be purchased.
For this one 8542 doesn't work.

For large field of view at 6302, the 79 l/mm at 76 degrees is good.

1000 mm for the camera lens works OK for most configurations, but the optimum focal lengths, depending upon what is being optimized, are 460mm, 725mm, 920mm, and 1000mm.

The 308.57, 68 degree blaze grating accesses some nice Near IR wavelengths.

The 308.57, 52 degree gratings in the ESF spectro heliograph look perfect, most lines of interest are accessible. Dispersion is not as good as higher blaze angle gratings, but we might be able to live with it. If not, we can bin pixels in the spatial dimension.