1) F/11 focal expander & nominal ARIES vignetting on a H2RG detector array

Statement of purpose:
ARIES currently supports a spectroscopic "zoom mode" that is comprised of a 2-element refractive focal expander comprised of one BaF2 lens and one ZnSe lens immediately in front of the Hawaii-1 detector array (Figure 3), built into the baffle tube separating the filter wheel and the detector mount. An adjacent empty baffle tube supports the nominal f/5.6 focus using only the 3-mirror reflective camera and a 2-pixel resolving power of about R=33,000 with a 0.2" slit. The refractive camera yields an f/10.3 focus and a resolving power that varies somewhat across the array because of field distortion (Figure 4) but in the range of R=60,000 with a 2-pixel 0.1" slit.

The existing f/10.3 optics serve to illuminate the field of a 1024x1024 HgCdTe array with significant but deterministic field distortion. However, the working field of view must now be expanded to accommodate a larger 2048x2048 array.

One recommendation is to start with the current R=30,000 zemax model, the f/10.3 two-lens reimager model, and modify the optical prescription (larger lenses, re-optimization of curvatures) to illuminate as much of a 2048x2048 array as possible at R>60,000 with a 2-pixel 0.1" slit, minimizing field distortion (e.g. no worse than Figure 4) while preserving the ability to utilize the existing optics slide stage. If insufficient, the existing 2-element lens design can be replaced with an alternate design.

Flow of effort:
1. Examine and understand the existing R=30,000 echelle design. Determine the limiting source(s) of vignetting on the 2048x2048 array and recommend any modest 1-element changes that will yield a significant improvement in FoV.
2. Apply a 2-lens BaF2 and ZnSe pair per the current f/10.3 zemax model and adjust to increase the effective field of view, taking f/10 to f/11 as the desired output f#.
3. Explore trade study of solutions versus output f# and field distortion over the 2048x2048 array.
4. Determine if the existing baffle tube stage can accommodate on-the-fly switching between R=30,000 and R=60,000.
5. Transfer optical design to CAD and handoff to Manny or Ruben to make necessary mechanical alterations to baffle tubes, optics stage, mechanical feedthrus as needed.
6. Identify a vendor for the optical substrates, figuring, and 1-5 um AR coating.

Inputs available now:
1. Zemax R=30,000 f/5.6 optical model and "probably not current" f/10.3 optical model
2. Mechanical throw of existing optical stage

Requirements:
1. Illumination of 2048x2048 HgCdTe array with 18 um pixels.
2. R>60,000 with 2 pixel, 0.1" slit
3. <<10% field distortion over the whole field
4. Preserve ability to switch between R=30,000 and R=60,000 on the fly using (existing?) optics stage.

Any conflicts in requirements should be resolved by trade study, to illuminate the best path forward.

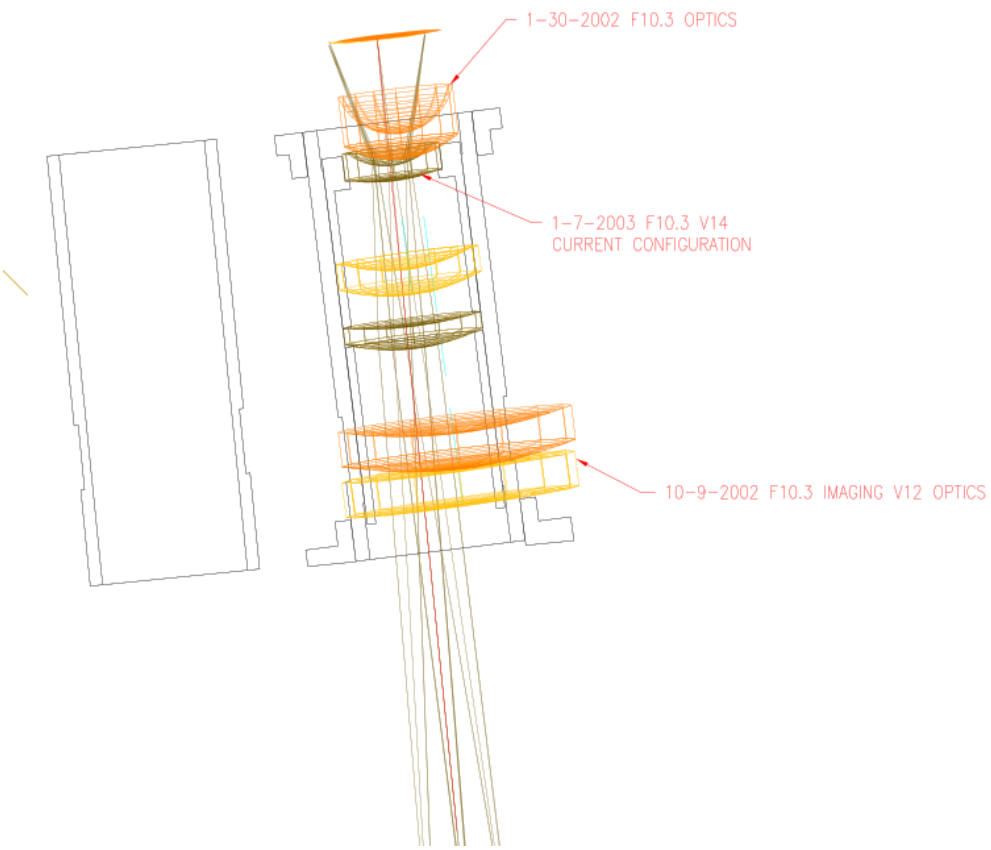

Figure 3: Overlay of zemax optical path for v14 of the refractive f/10.3 baffle tube

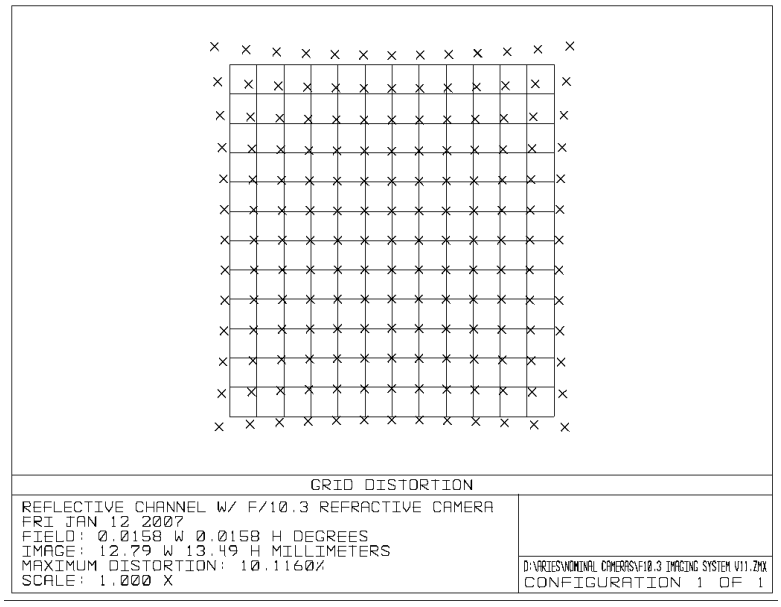

Figure 4: Field distortion of the nominal f/10.3 refractive focal expander.

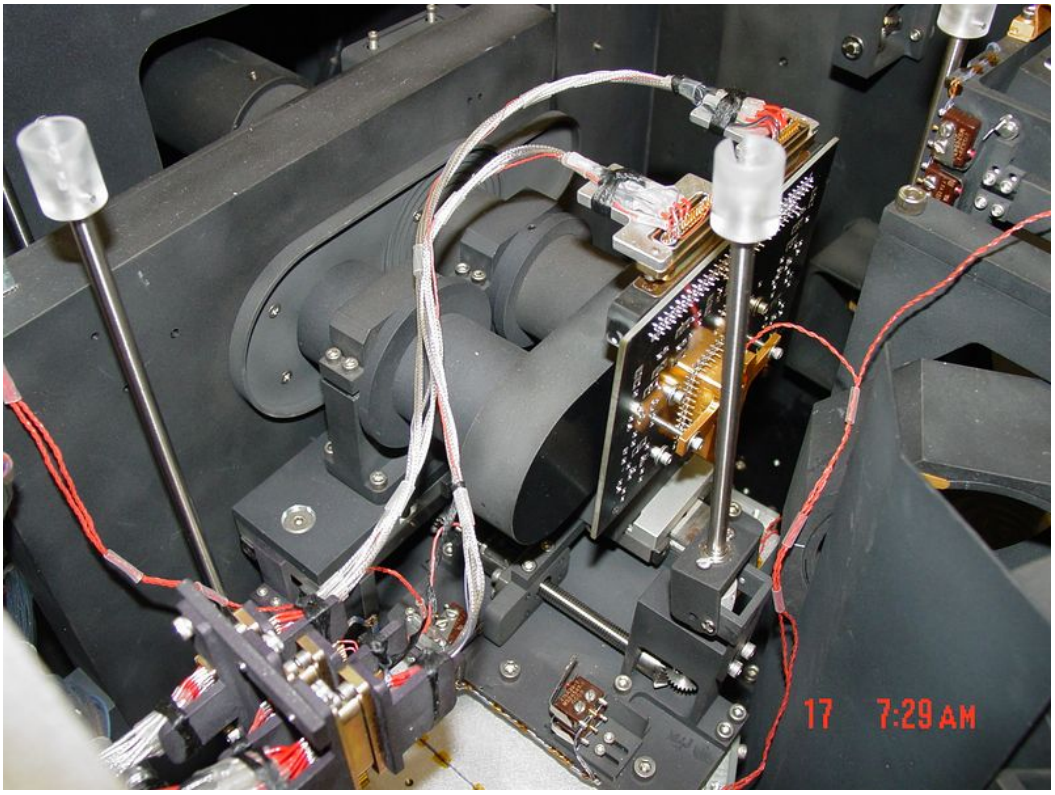

Figure 5: Photo of installed filterwheel, dual baffle tubes and optics slide stage, and detector fanout board.