

Optics for Astronomical Instrumentation

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24 January 2008

Lecture 9: Design A Camera

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Science: The Goal

- We have a 2.4-meter f/24 telescope
- Goal is to do BVRI high-accuracy (<0.01 -mag) photometry of red giant stars in crowded fields (e.g. globular clusters)
- Typical seeing is ~ 0.7 -arcsec, but as good as ~ 0.4 -arcsec; need to take advantage of the latter as much as possible!
- Field of view should be as large as possible (of course)
- Throughput should be high
- Need broadband filters, plus narrowband filters for some work
- Problem: we can only afford a 2Kx2K CCD detector (probably with 20-micron pixels)

Feasibility Factors

- **F/# of optics:**
 - **>6 EASY; 3-6 STD; 2-3 HARD; 1.5-2.0 VERY HARD; 1.2-1.5 EXTREMELY HARD, MAJOR RISK; 0.9-1.2 EXTRA EXTRA REALLY HARD, DO NOT ATTEMPT!; <0.9 GET REAL**
- **Size of optics:**
 - **Optical: 0-100mm EASY; 100-300mm STD; 300-500mm HARD; 500-750mm VERY HARD, risk; 750-1m+ EXTREMELY HARD, MAJOR RISK FACTOR**
 - **IR**

Case Study 2: The Goal

- We have a 10.4-meter f/17 telescope
- Goal is to do BVRI high-accuracy (<0.01 -mag) photometry of red giant stars in crowded fields (e.g. globular clusters)
- Typical seeing is ~ 0.7 -arcsec, but as good as ~ 0.4 -arcsec; need to take advantage of the latter as much as possible!
- Field of view should be as large as possible (of course)
- Throughput should be high
- Need broadband filters, plus narrowband filters for some work
- Good News: we can only afford a 4Kx4K CCD detector (probably with 20-micron pixels)

Exercise

- Write what you would like to do for your project

Project Cases

- **Near-IR camera for a f/10 2-meter telescope; optimized for wide-field surveys of crowded fields with excellent seeing in the 1-2.5 μm band; money for a 4Kx4K IR mosaic detector**
- **Optical imaging spectrograph for a 10-meter f/17 telescope; optimized for moderate to wide-field imaging surveys of high-redshift galaxies with decent seeing in VRI bands; also, multi-object spectroscopic follow-up at R \sim 5000 over same bandpass; money for a 4Kx4K CCD mosaic**