Notes on the Lowell Observatory DCT Optics
Ted Dunham 3/25/10

Introduction

The optics solicited by this RFP are for a guiding and wavefront sensing system for the Discovery Channel Telescope (DCT) and also for some test optics to be used at the prime focus of the DCT. The DCT is a new 4.25-meter telescope being built in northern Arizona as a partnership between Lowell Observatory and Discovery Communications, Inc. See www.lowell.edu for additional information.

The optics fall in three sections:

1) a simple 2-element corrector for the prime focus of the DCT (DCT-PF-1 and -2) that can be used stand-alone for obtaining early images with the telescope or in series with the 6-element reimaging optics
2) a reimager (DCT-RI-1 through -6) used in conjunction with the 2-element corrector to create an f/6.2 focus that looks like the RC focus of the telescope to allow testing of the DCT's active optical system prior to delivery of the secondary mirror and using the final guide probes that will be used at the RC focus later on
3) reimaging optics (DCT-GW-1 through -4) for the guide probes that will be used in the final guider and wavefront sensor of the DCT, which is known as GWAVES.

Overview:

The figures below indicate the location of the 12 custom lenses in the overall optical system. Figure 1 shows the 2-element prime focus corrector and the 6 element reimager that produces an f/6.2 focus to mimic the RC focus. Figure 2 shows the GWAVES guide probe optics. Only the custom lenses in the guide probe are called out. The guide probe optics also include a stock window, stock beamsplitter, two stock lenses, and stock colored glass filters that are shown but not labeled.

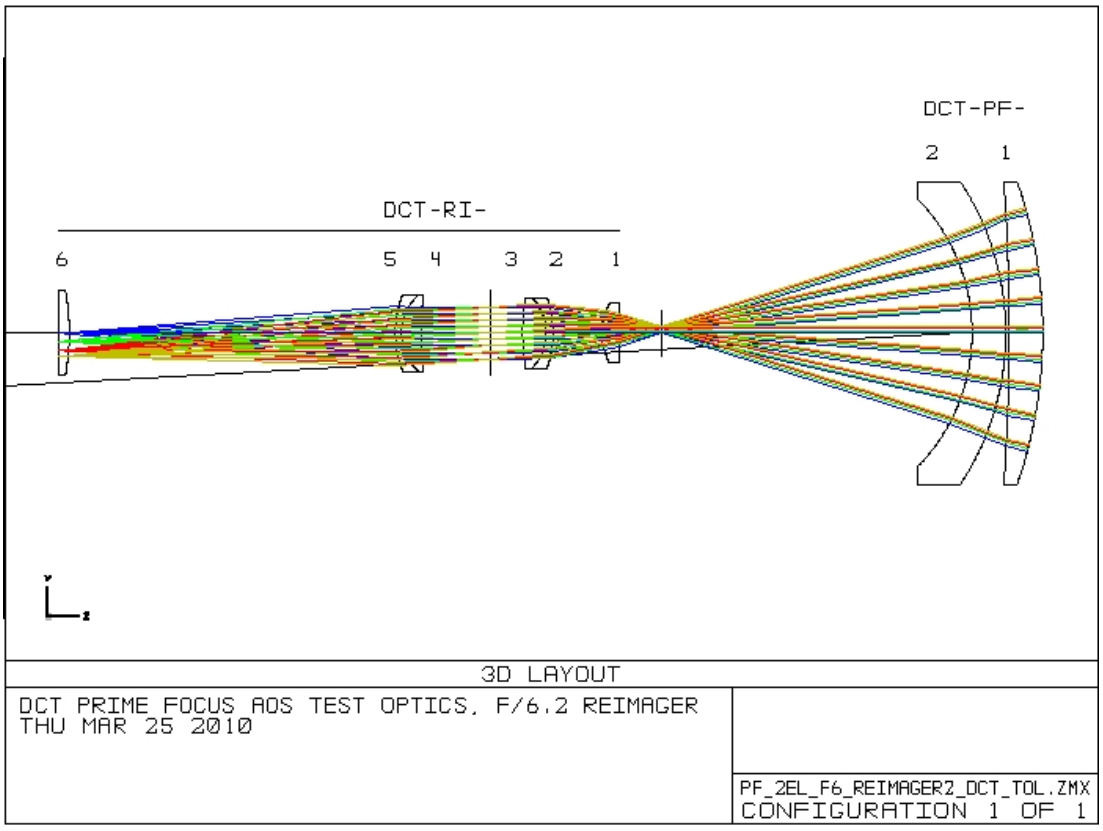


Figure 1: Two-element prime focus corrector (right) and 6-element reimager (left).

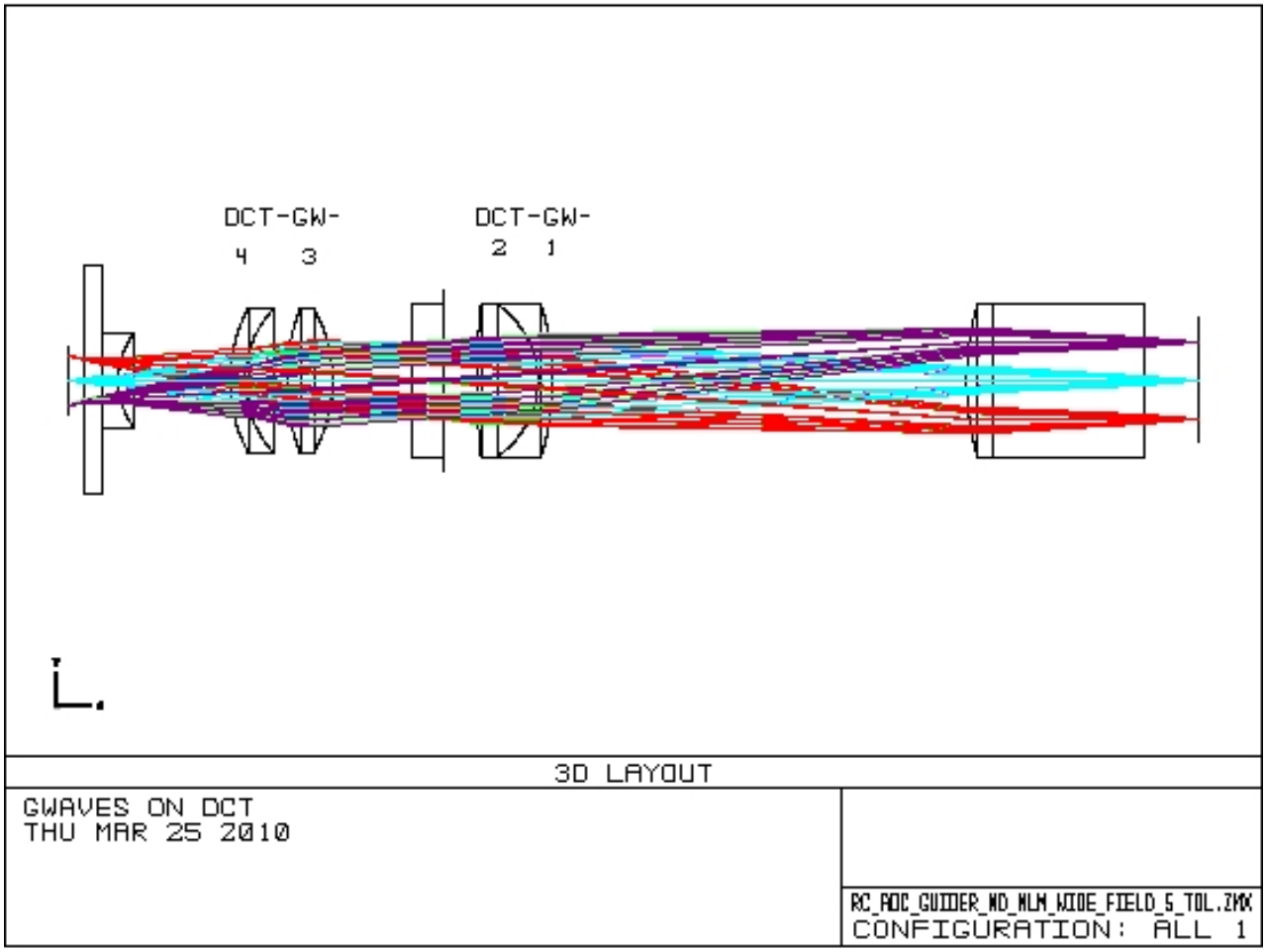


Figure 2: GWAVES guide probe optics. Only the four custom elements are labeled. The remaining optics will be bought from stock. For test purposes these optics can be used following those shown in Figure 1.

Files Provided:

This package includes:

1) This cover note (Notes on the Lowell Observatory DCT Optics.doc).
2) An Excel spreadsheet that contains the optical parameters and tolerances of the lenses. This file is DCT_PF_GWAVES_Tolerances.xls.
3) A PowerPoint file with all of the ZEMAX element drawings pasted into it as Metafiles. This file is "Lowell DCT Optics.ppt".
4) A folder with ZEMAX element files
5) A folder with ZEMAX NOT files that go with the element files
6) A folder with the ZEMAX element drawings exported as Metafiles.
7) A folder with the ZEMAX ZMX and SES files that include the optical tolerances
    - The tolerances for the 2-element corrector lenses (DCT-PF-1 and -2) are included in PF_2EL_DCT_Tol.*
    - The tolerances for the 6-element reimaging optics (DCT-RI-1 through -6) are included in PF_2EL_F6_Reimager2_DCT_Tol.*
    - The tolerances for the four custom lenses in the GWAVES probe are included in RC_ADC_Guider_no_MLM_wide_field_5_Tol.*

Discussion:
It might be possible to cement the two doublets in the 6-element reimaging optics. I solicit your advice on whether cementing is feasible with the glasses you propose to use for these lenses. They may be exposed to a temperature range from +30C to -20C. If this appears to be too risky I can grease them together. There is no hope of cementing the contact doublet in the GWAVES probe that consists of elements DCT-GW-1 and -2. I intend to grease these together.

The 2-element corrector and 6-element reimager are optics that will only be used for test work and have a limited bandpass in their optical designs. They can be coated with a single layer MgF2 coating with center wavelength as called out on the drawings. The GWAVES probes will be used in operation of the DCT for many years and have been designed to cover a broad wavelength range. Please propose an AR coating for these lenses that covers the range from at least 370 to 800 nm. Of course the mating surfaces in the three contact doublets must not be AR coated, as indicated on the element drawings.

Some of the elements have tight index/abbe number tolerances, and melt match optimization will likely be required.

I neglected to put a surface cosmetic requirement on the drawings. All should be 60/40 scratch/dig.

Quantities Required:
The table below indicates the quantities required for each element. Depending on the manufacturing process used it may be worth exploring options for additional lenses in some cases. Please contact me if you feel there may be merit in discussing this.

Table 1: Required Quantities

Drawing Number	Minimum Quantity	Description
DCT-PF-1	1	First element of prime focus corrector
DCT-PF-2	1	Second element of prime focus corrector
DCT-RC-1	1	Field flattener for the reimaging optics
DCT-RC-2	1	Collimator in reimager, contact doublet with -3
DCT-RC-3	1	Collimator in reimager, contact doublet with -2
DCT-RC-4	1	Camera in reimager, contact doublet with -5
DCT-RC-5	1	Camera in reimager, contact doublet with -4
DCT-RC-6	2	Pupil location correction lens in reimaging optics
DCT-GW-1	4	Collimator in GWAVES optics, contact doublet with -2
DCT-GW-2	4	Collimator in GWAVES optics, contact doublet with -1
DCT-GW-3	4	First element of camera in GWAVES
DCT-GW-4	4	Second element of camera in GWAVES

Delivery Requirement:
We require delivery of the optics by the middle of July, 2010.

Contact Information:
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