



NIC-FPS Critical Design Review

Optics

*Mark B. Vincent
(CU-CASA)*

26 July 2002

CASA-ARL

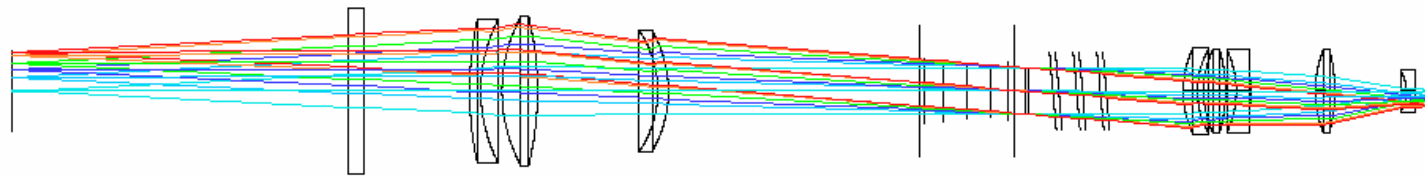
Boulder, CO





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NIC-FPS Optical Layout



Length: 1.2 m from telescope focal plane to FPA

3D LAYOUT

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MON JUL 22 2002
SCALE: 0.2000

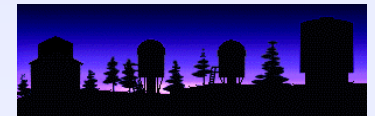
100.00 MILLIMETERS

C:\ZEMAX\NIC_FPS\NICFPS_CDR.ZMX
CONFIGURATION 2 OF 3



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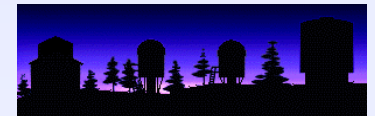


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ARC Telescope Parameters

Entrance Aperture Diameter 3404.6 mm
 Entrance Stop Placement Primary Mirror
 Central Obscuration 780.0 mm diameter
 F/# F/10.35

Camera Design Parameter	Design Value
Wavelength Range	0.85 – 2.5 μm
Pixel Scale	0.27" / pixel (1016 x 1016 HgCdTe)
Pixel Pitch	18.0 μm
System Effective Focal Length	13592 mm
System F/#	3.99
System Field-of-View	4.58' edge-to-edge 6.42' corner-to-corner
NIC-FPS Internal Pupil Diameter	Driven by Etalon (40 mm)
Collimator Magnification Factor	85.115X
Pupil Relief Distance from Collimator Lens 3	301 mm
Transmission including window and Lyot stop (not including filter or etalon)	75 %





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NIC-FPS Image Quality

Optical Design Parameter	Design Value
Geometric Distortion	0.75% at edge 1.6% at corner
RMS Spot Diameter Performance	Less than 1 pixel at all wavelengths and fields
Refocusing Between Filters	None Required

80 % Diffraction Encircled Energy Diameters

Wavelength (μm)	Best (μm)	Worst (μm)	Diffraction limit (μm)
0.90	11.9	17.4	11.3
1.30	16.7	20.0	16.5
2.00	27.4	37.0	25.2
2.40	32.4	39.7	30.3

Note that the best and worst cases are not necessarily the center and corner fields.

Diameters are for the as designed system.

18 μm pixel size.



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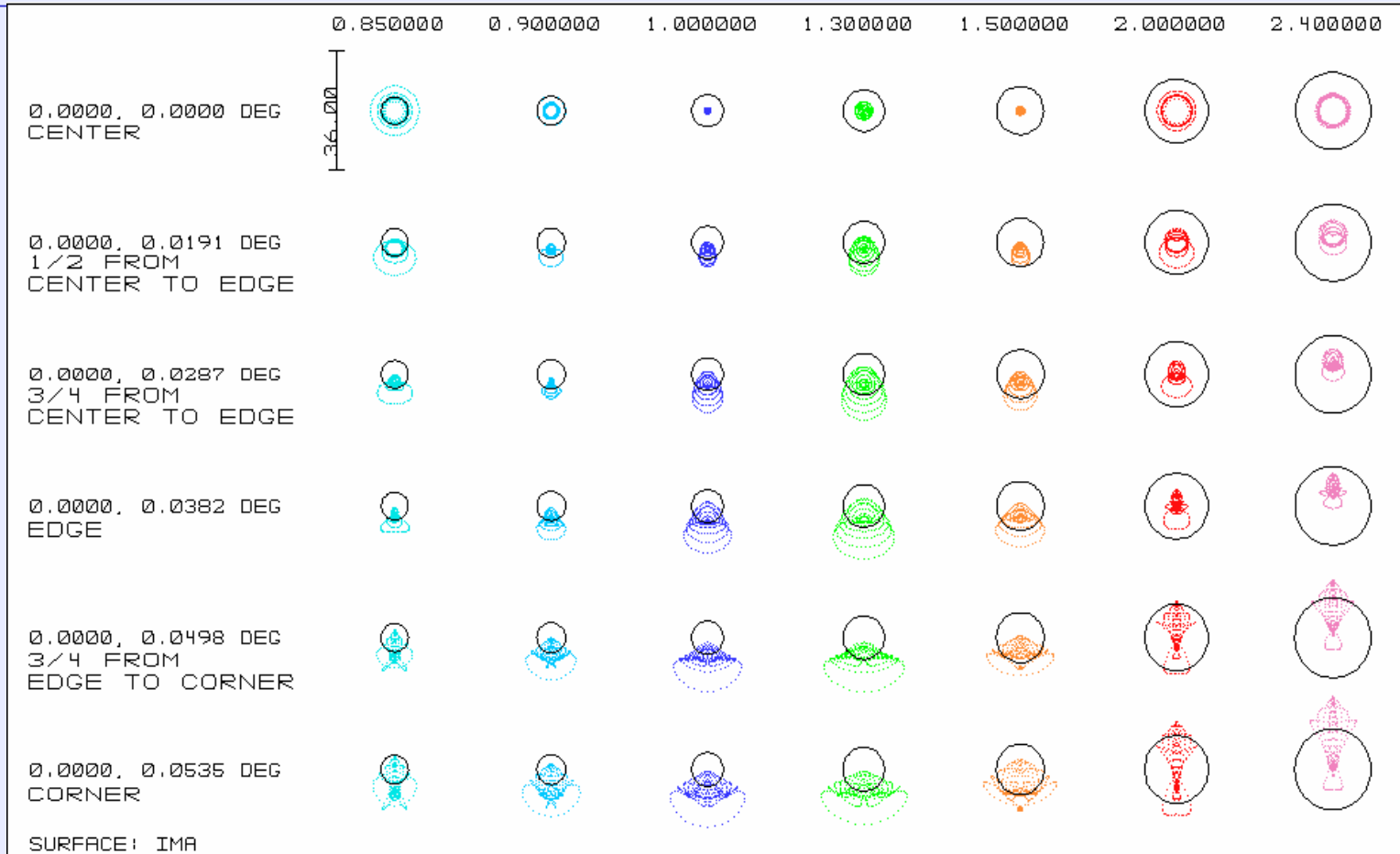
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Spot Diagrams



SURFACE: IMA

MATRIX SPOT DIAGRAM

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MON JUL 22 2002 UNITS ARE MICRONS.

AIRY DIAMS : 8.282-24.51

REFERENCE : CHIEF RAY



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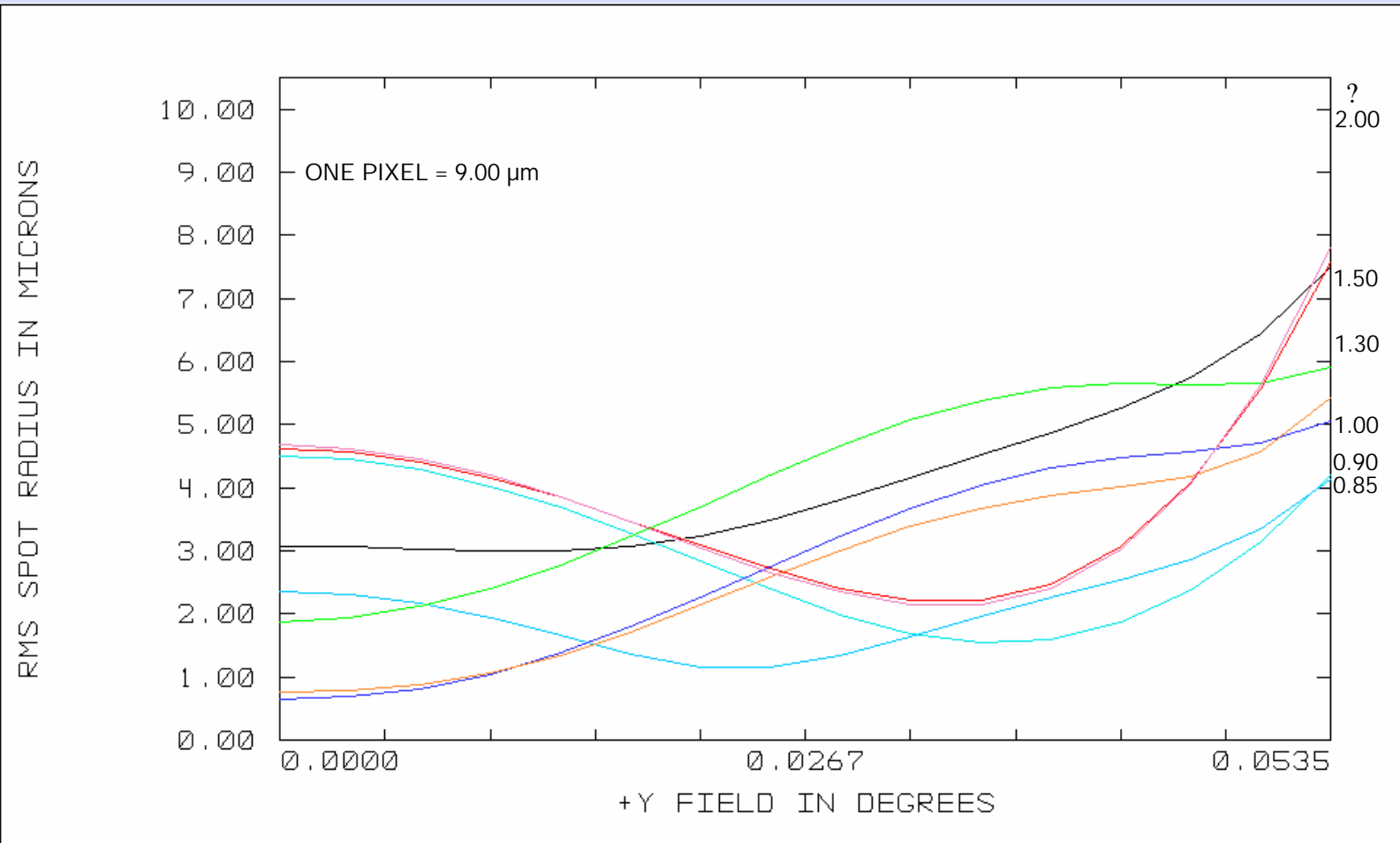
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RMS Spot Radii



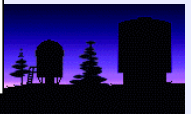
DIFFRACTION RADIUS AT ? IN MICRONS

RMS SPOT RADIUS VS FIELD

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TUE JUL 23 2002

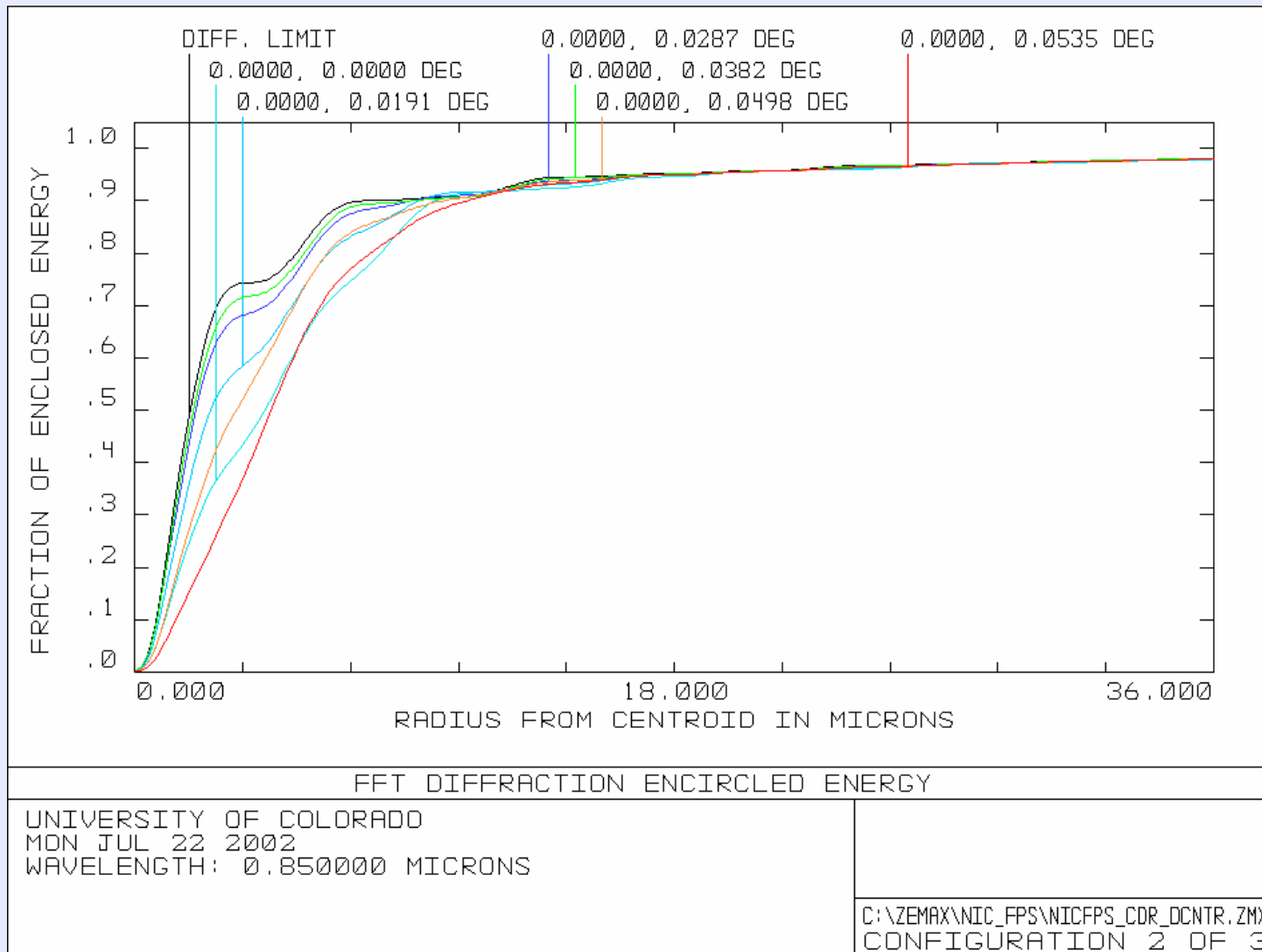
POLY	0.850	0.900	1.000	1.300	1.500	2.000	2.400
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REFERENCE: CENTROID





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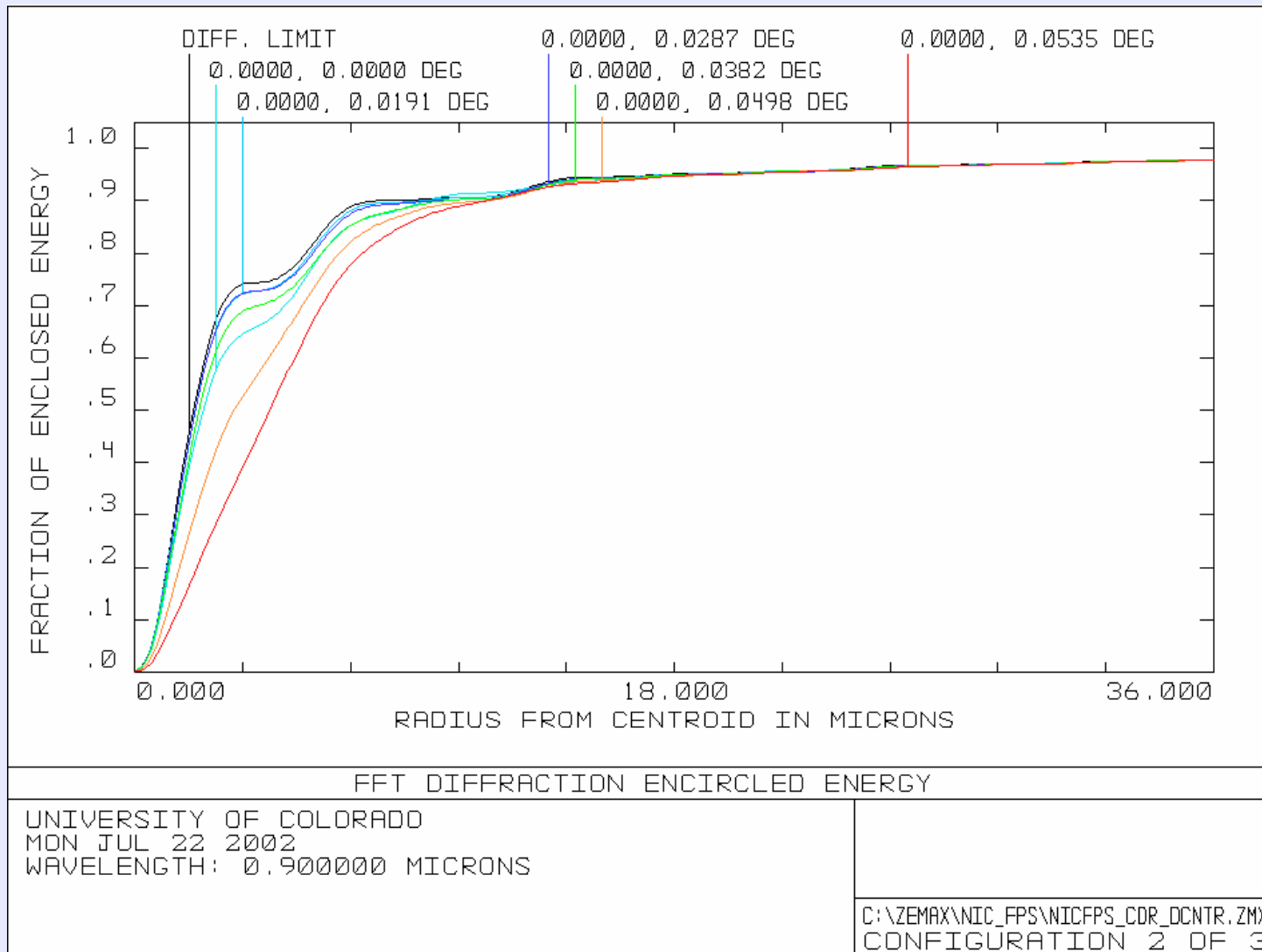
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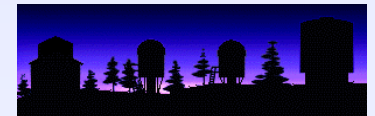


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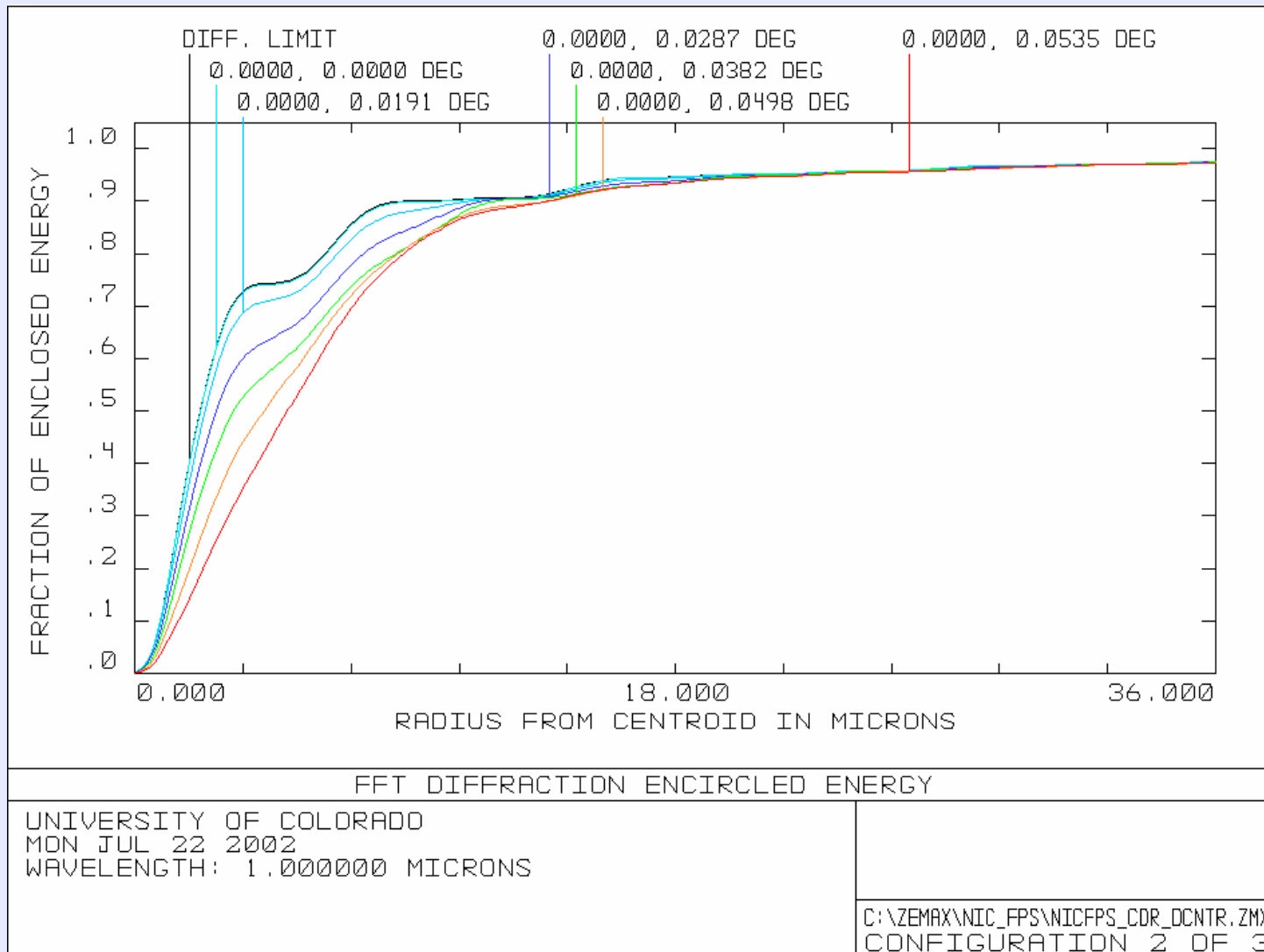
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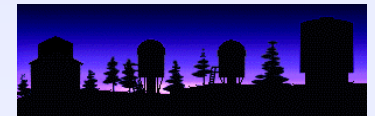


NIC-FPS Critical Design Review



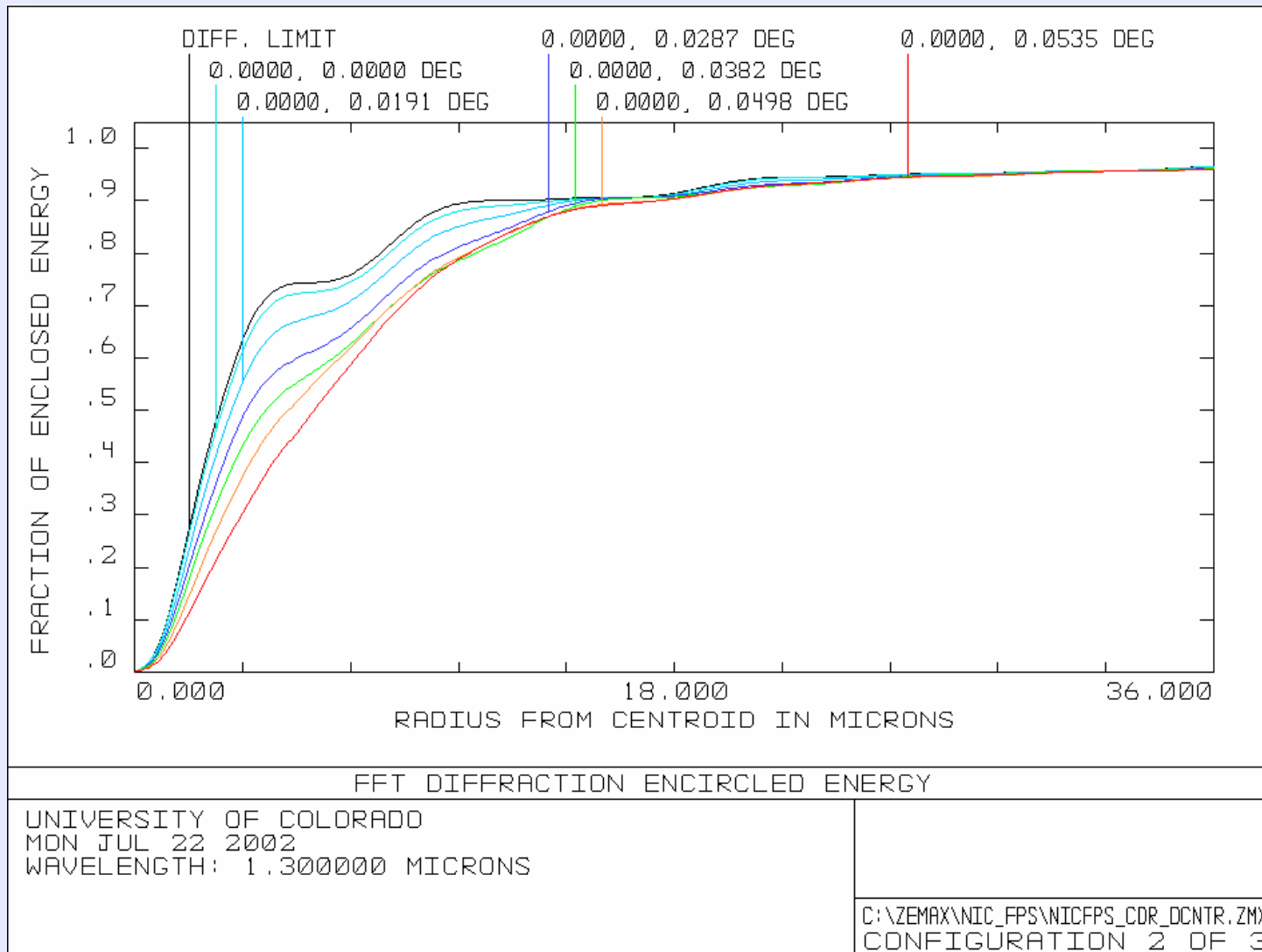
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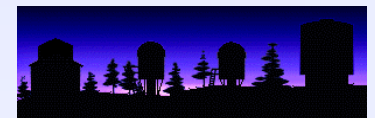


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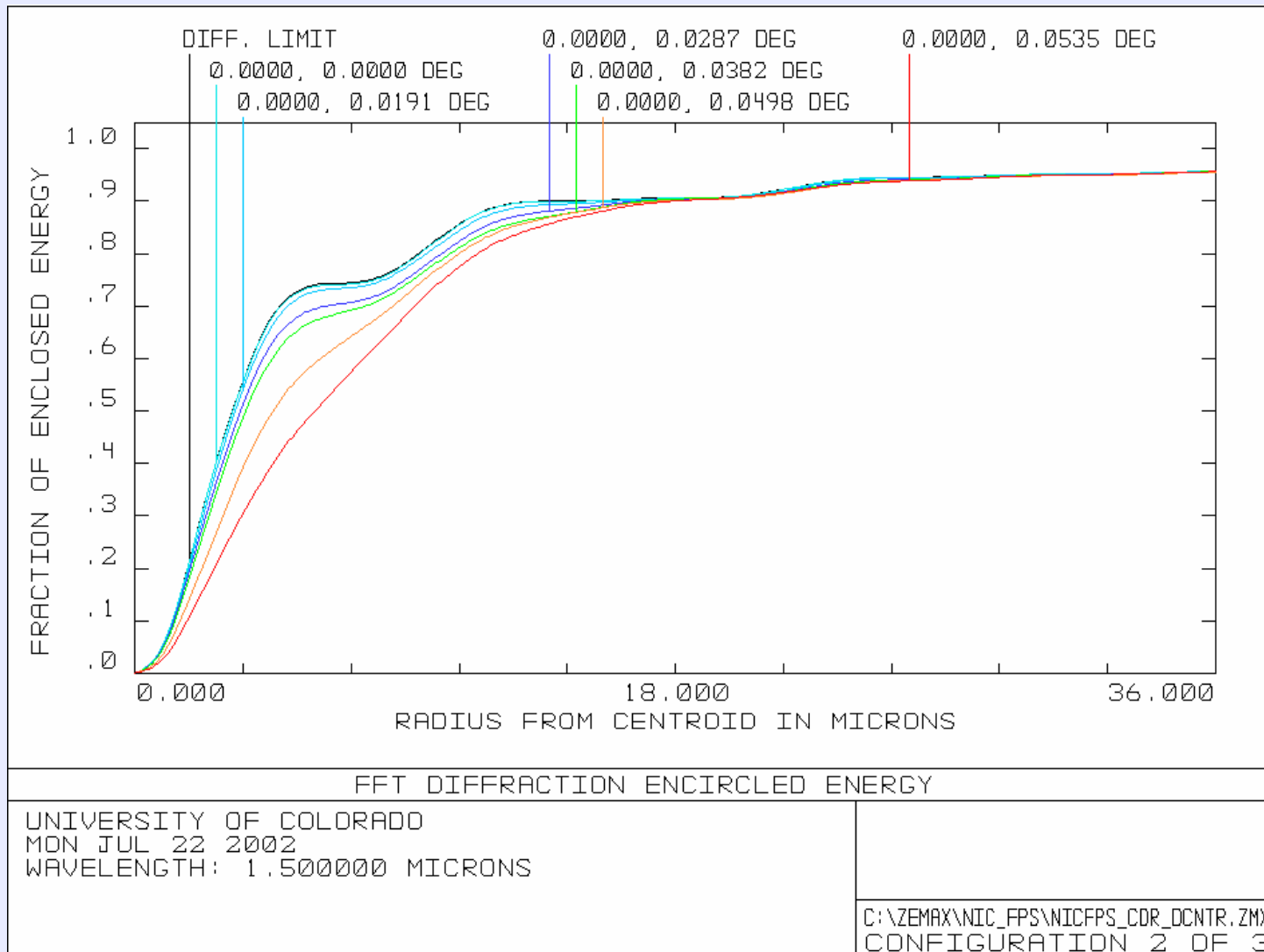
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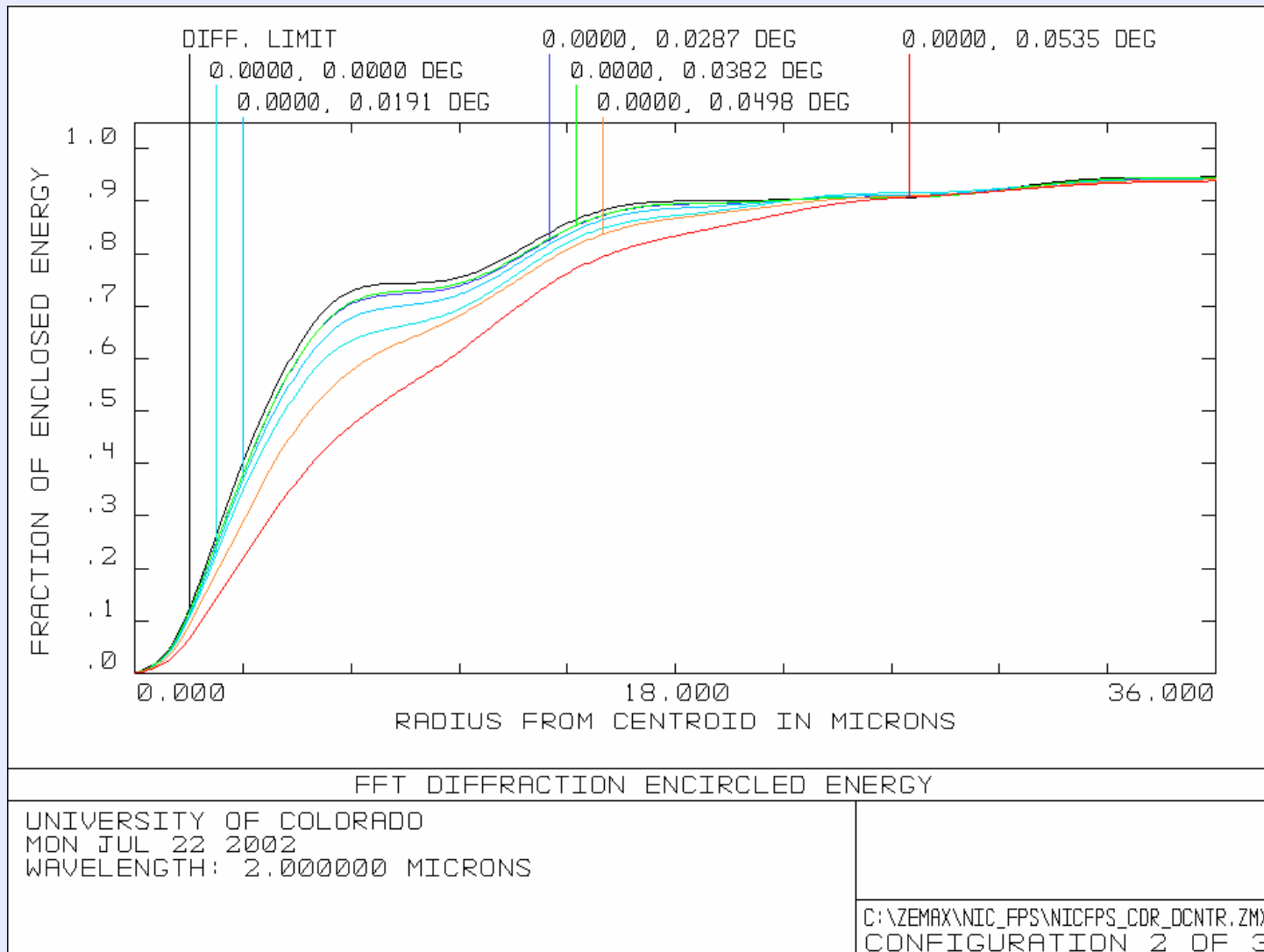
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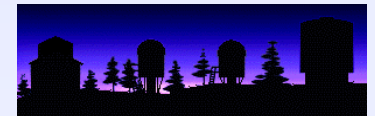


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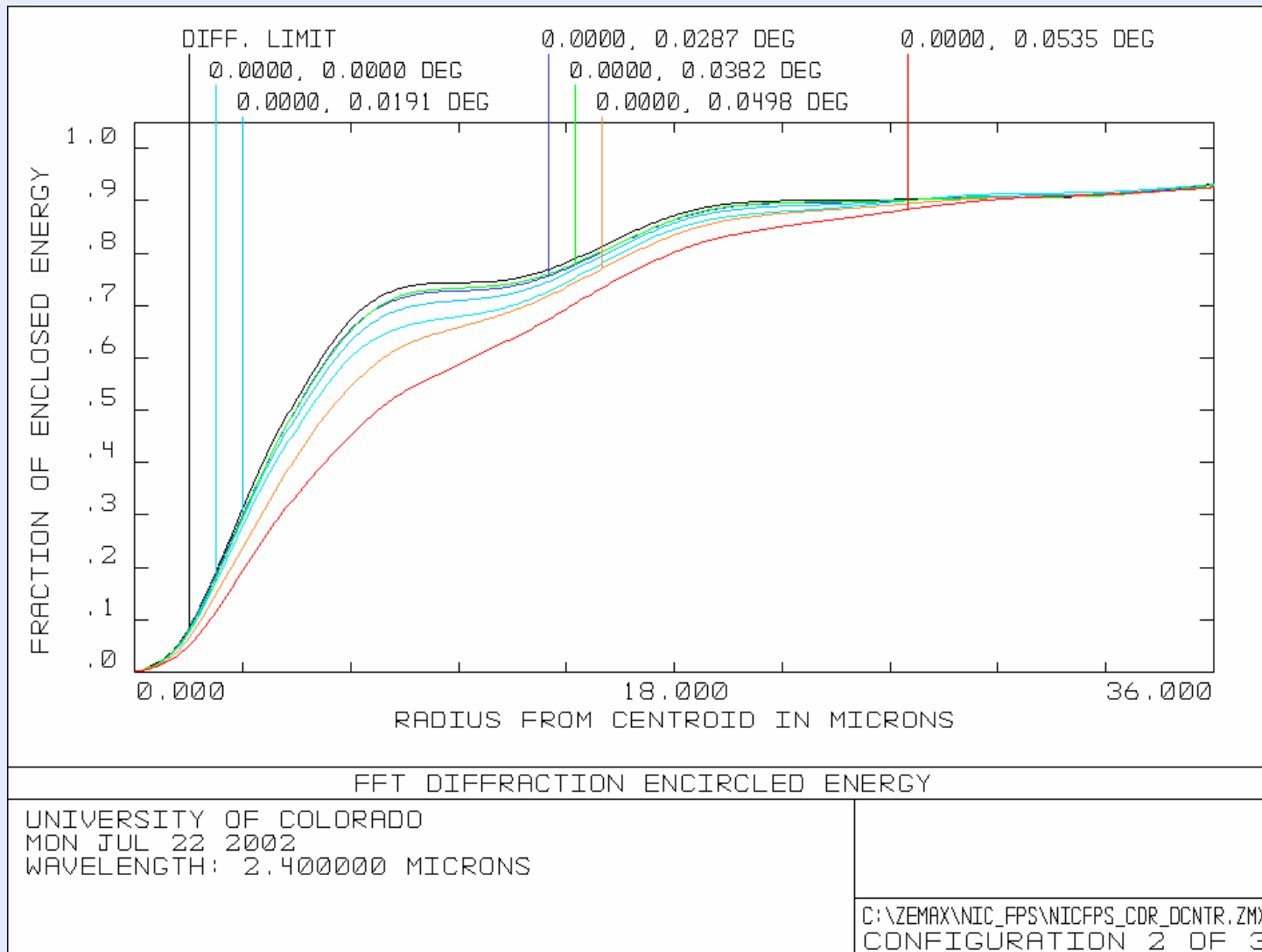
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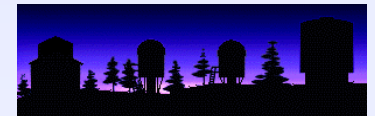


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Optical Manufacturing Tolerances

SURFACE CENTERED TOLERANCES: Radii and thicknesses in mm for room temperature optics. Irregularities in fringes at 6328 Å. Wedge in μm .

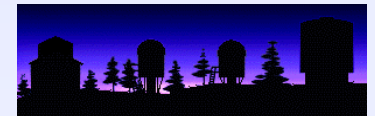
Surf	Radius	Tol Min	Tol Max	Irreg	Thickness	Tol Min	Tol Max	Wedge
Collimator lens 1 Fused Silica								
14	-288.019	-0.4	0.4	1	-9.50	-0.2	0.2	50
15	-132.797	-0.2	0.2	1				
Collimator lens 2 CaF2								
17	-132.509	-0.2	0.2	1	-29.97	-0.2	0.2	50
18	264.612	-0.3	0.3	1				
Collimator lens 3 ZnSe								
20	90.572	-0.1	0.15	1	-8.89	-0.2	0.2	20
21	101.080	-0.1	0.1	1				
Camera lens 1 ZnSe								
42	-86.479*	-0.09	0.09	0.5	-12.00	-0.2	0.2	20
43	-73.025*	-0.07	0.07	0.5				
Camera lens 2 CaF2								
45	-79.981*	-0.1	0.1	0.5	-18.66	-0.2	0.2	50
46	122.507*	-0.1	0.1	0.5				
Camera lens 3 Fused Silica								
48	80.780*	-0.08	0.08	0.5	-12.00	-0.2	0.2	30
49	449.377*	-0.4	0.4	0.5				
Camera lens 4 CaF2								
51	-93.701*	-0.1	0.1	0.5	-16.52	-0.2	0.2	50
52	136.957*	-0.15	0.15	0.5				
Camera lens 5 Fused Silica								
54	35.700*	-0.1	0.1	0.5	-8.00	-0.2	0.2	50
55	374.904*	-0.4	0.4	0.5				

*Strongly prefer that these radii be matched to test plate radii to tighten the radii tolerances to about a fringe.



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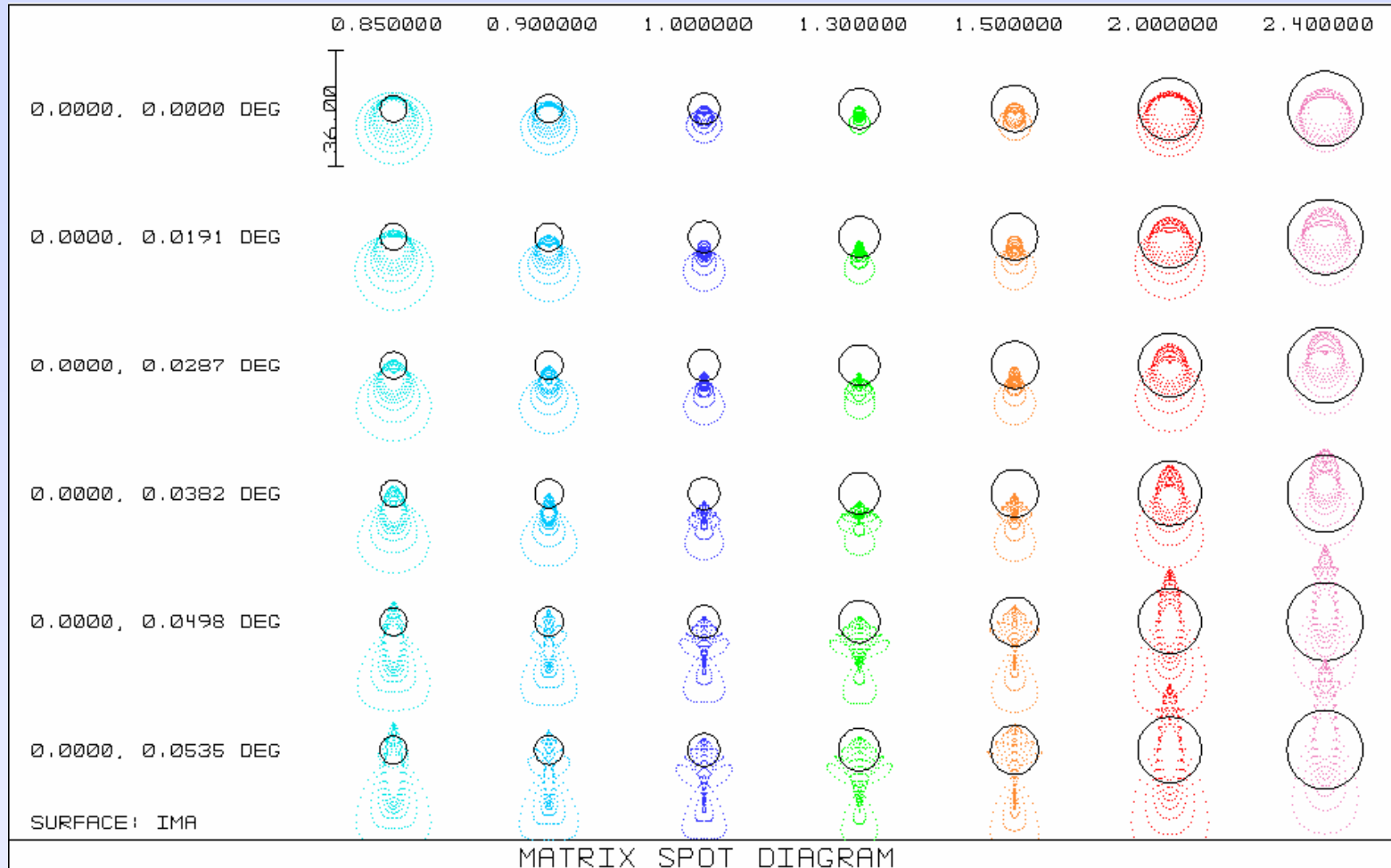




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Camera Lens #2 Decentered by 50 μm

Worst Corner



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AIRY DIAMS : 8.283-24.55

REFERENCE : CHIEF RAY

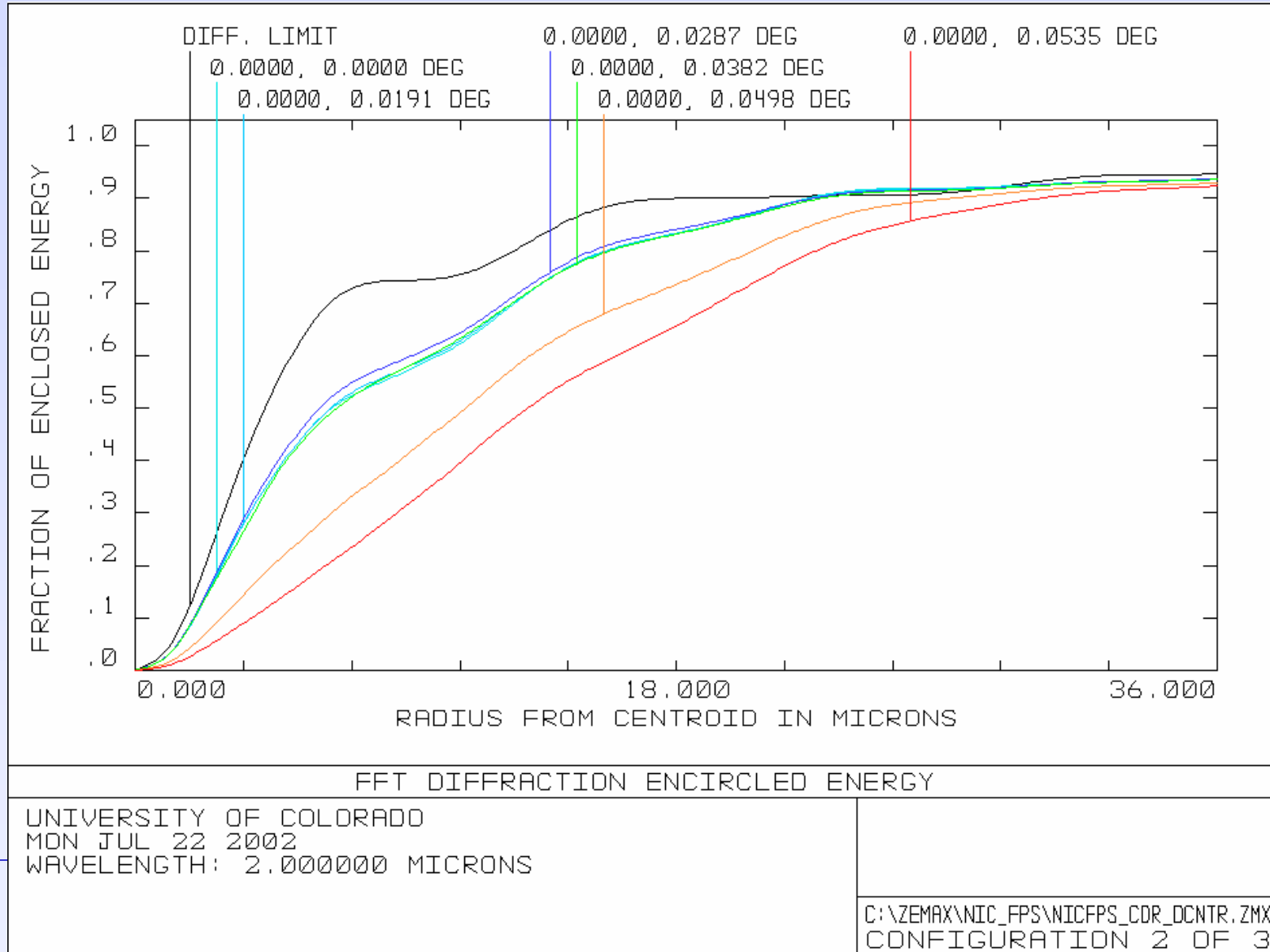




NIC-FPS Critical Design Review

Camera Lens #2 Decentered by 50 μm .

Worst Corner.





NIC-FPS Critical Design Review

Camera Lens #2 Decentered by 50 μm

Best Corner



SURFACE: IMA

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AIRY DIAMS : 8.283-24.48

REFERENCE : CHIEF RAY



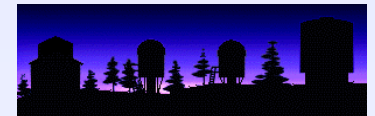
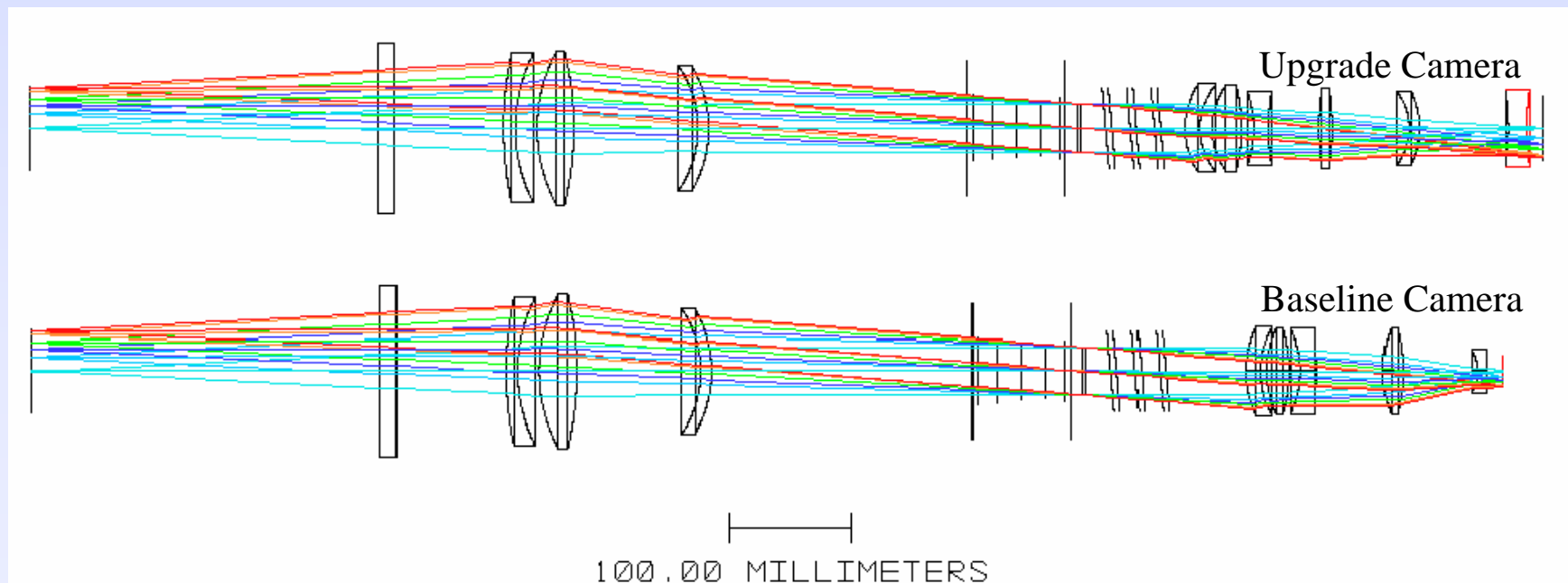


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Camera Upgrade

When the seeing at ARC improves to where 0.5" seeing is common, NIC-FPS will be ready.

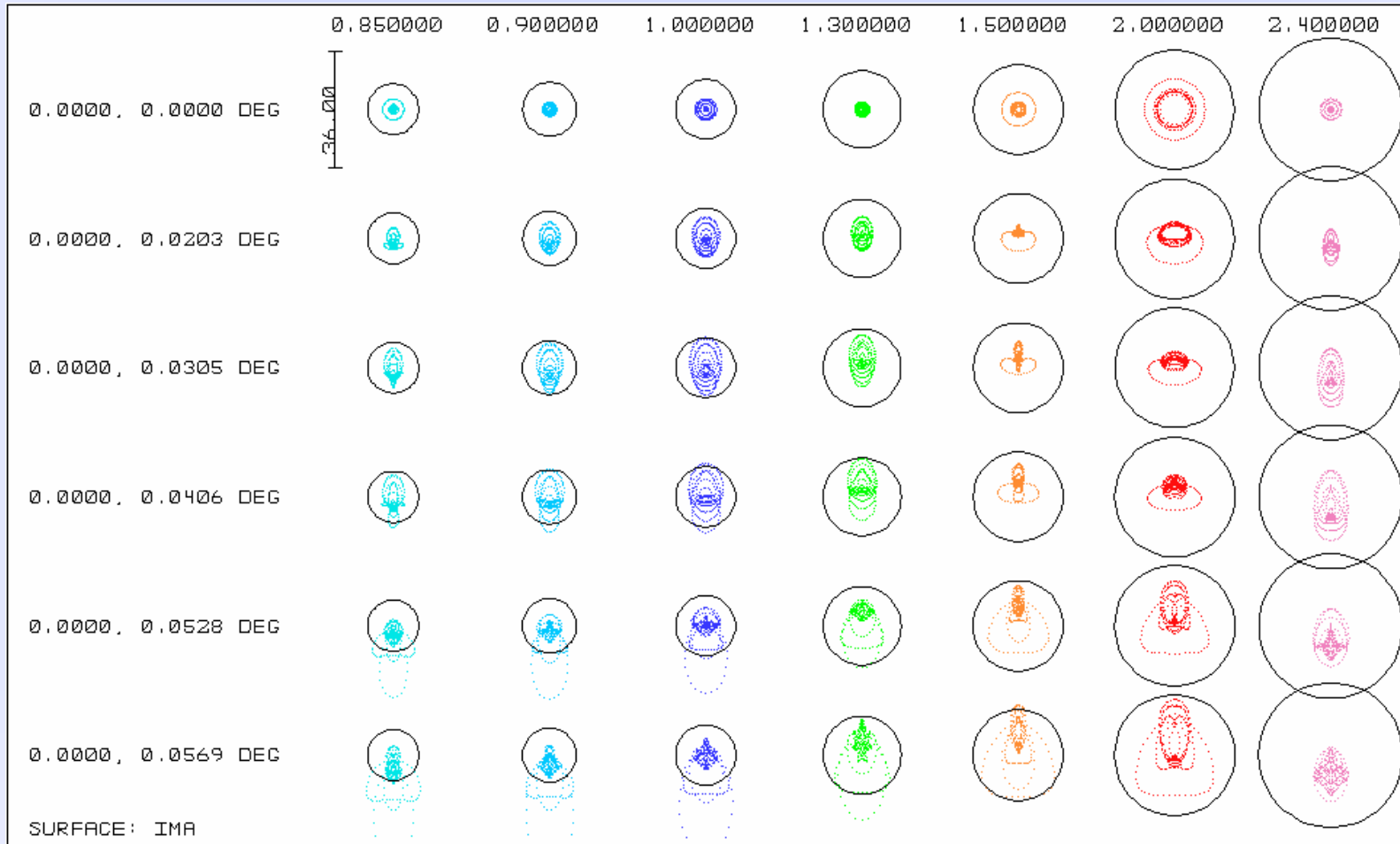
By replacing the camera and H-1RG detector with a new camera and an H-2RG, the pixel scale can drop from 0.27 to 0.144"/pixel. The field of view would then increase by ~6% with minimal vignetting. At 0.15-0.16"/pixel, the field would be even larger, at the cost of some vignetting in the corners. New camera can fit into the same space, but expanding the length by ~36 mm provides excellent image quality.





NIC-FPS Critical Design Review

Upgrade Camera's Image Quality



MATRIX SPOT DIAGRAM

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AIRY DIAMS : 15.72-44.88

REFERENCE : CHIEF RAY

