SPICA-VIS CONCEPT DESIGN: INJECTION TABLE

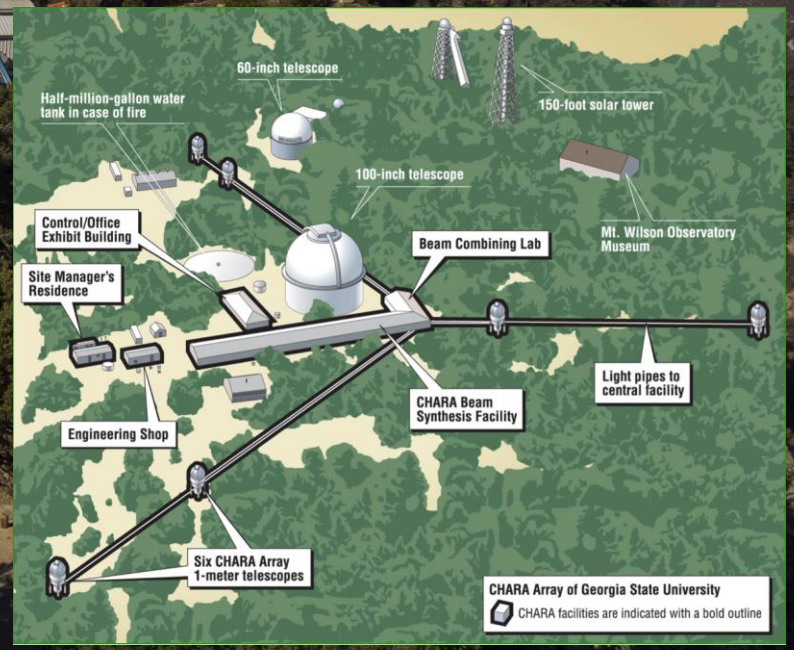
SPICA-VIS @ CHARA ARRAY

MAIN IMPUTS

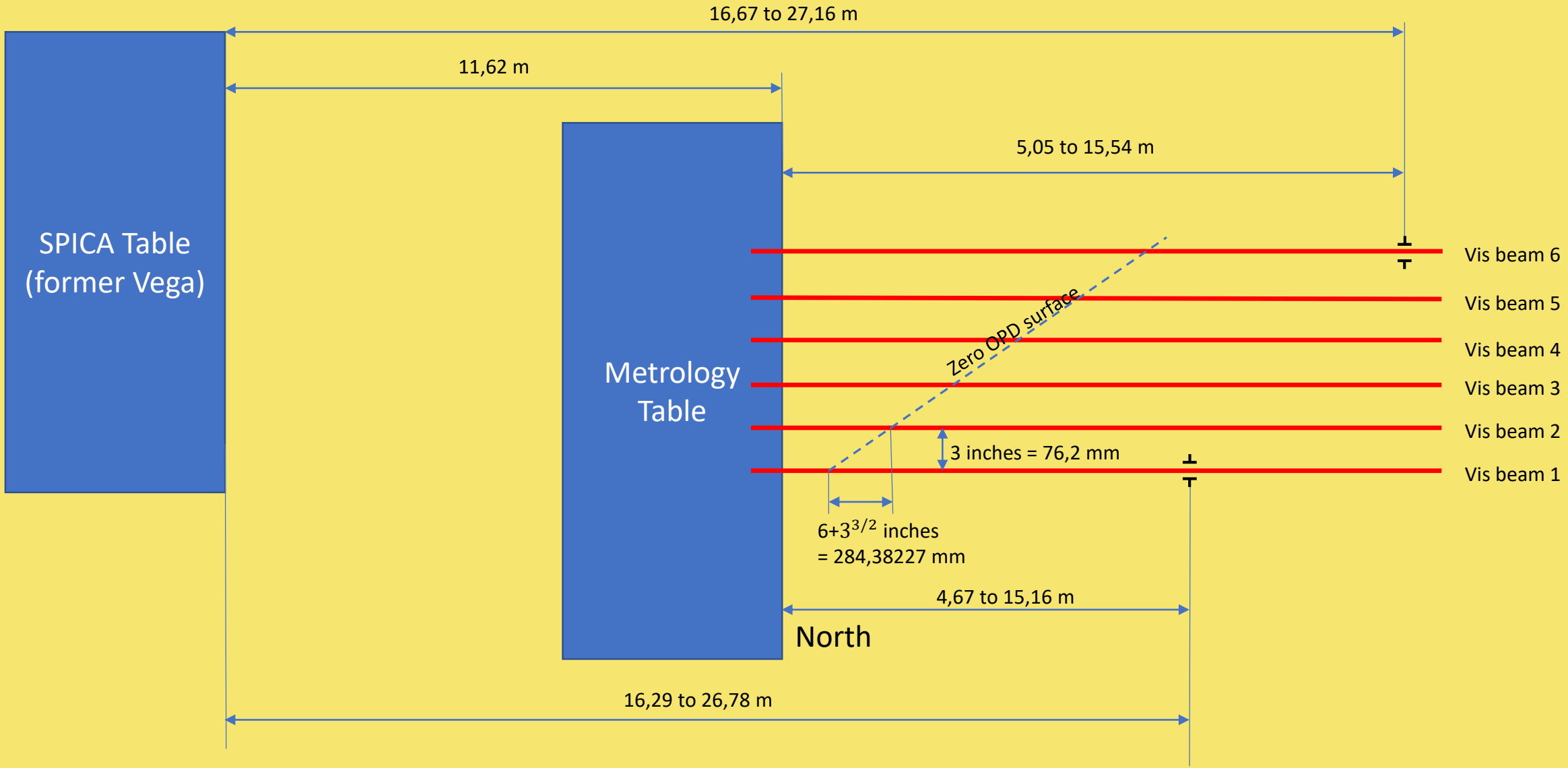
- 6 telescopes, 1016 mm diameter
- Baselines up to 330 m
- 6 beams separated by 3 inches (76,2 mm)
- Beam diameter: ¾ inches (19,05 mm)
- Magnification: 53,33
- Field of view: 0,3 to 0,6 arc-seconds
- Pupil max-min distance from North side of table: approx 27 m – 16m
- Pupil stabilization after LabAO: +/- 2% (TBC)
- Image stabilization after LabAO: +/- 0,3'' (confirmed)

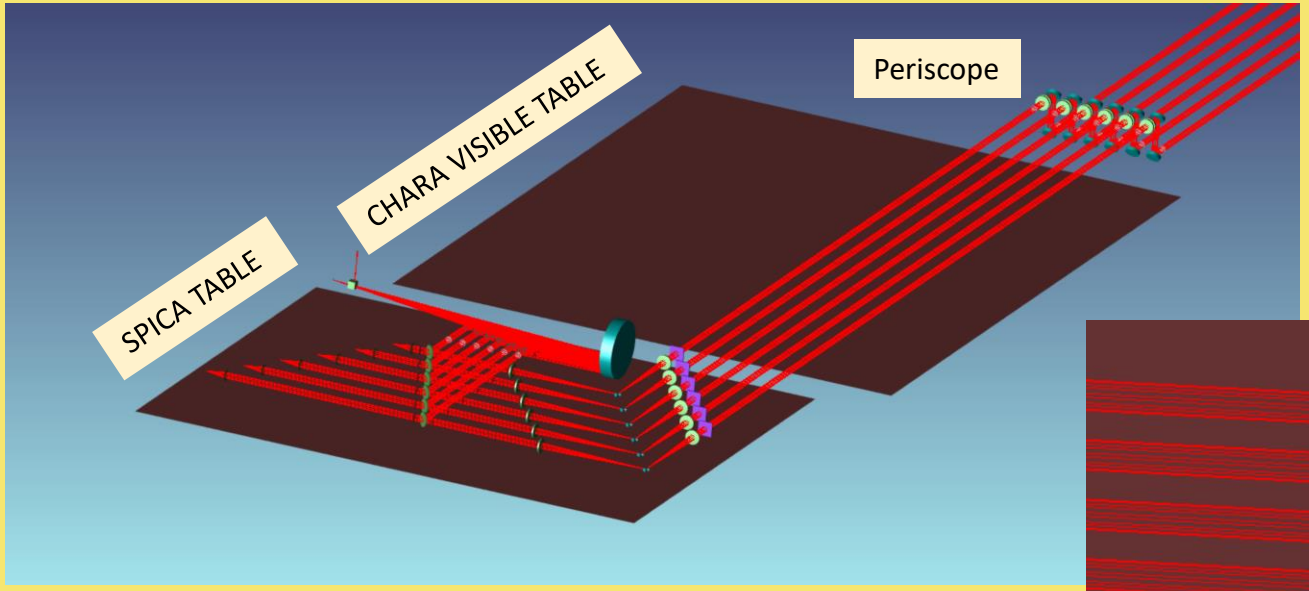
➔

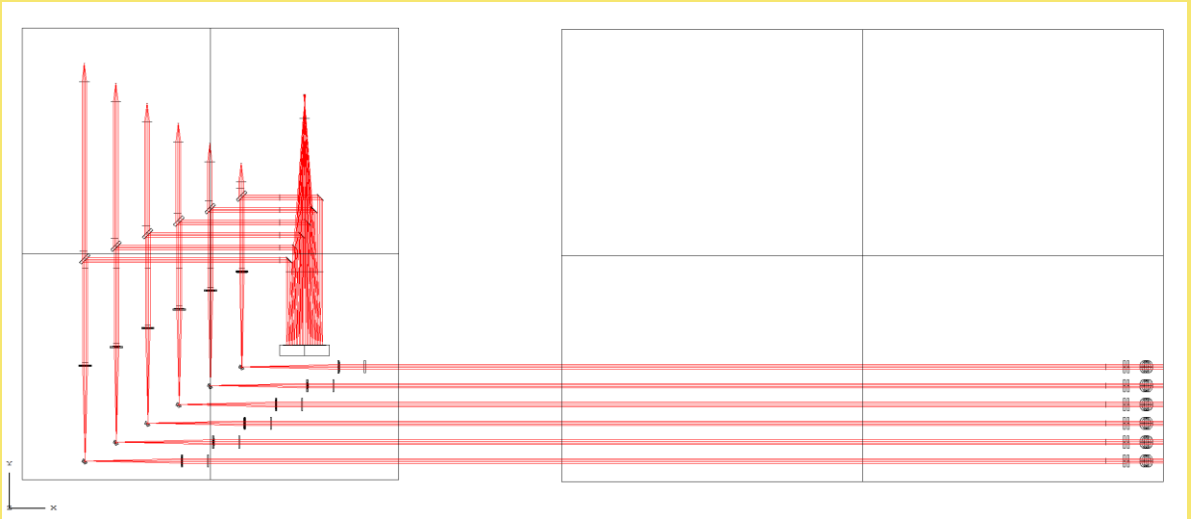
- Margin for the field: +/- 0,3'' on sky (unvigneted), +/- 2,1 mm on the entrance optics (min diameter 28 mm)
- Beam must remain centered on fast tip-tilt mirror (otherwise it generates fast piston): Fast tip-tilt placed at pupil plan
- All motorized tip-tilt mirrors must rotate around the center of the optical surface

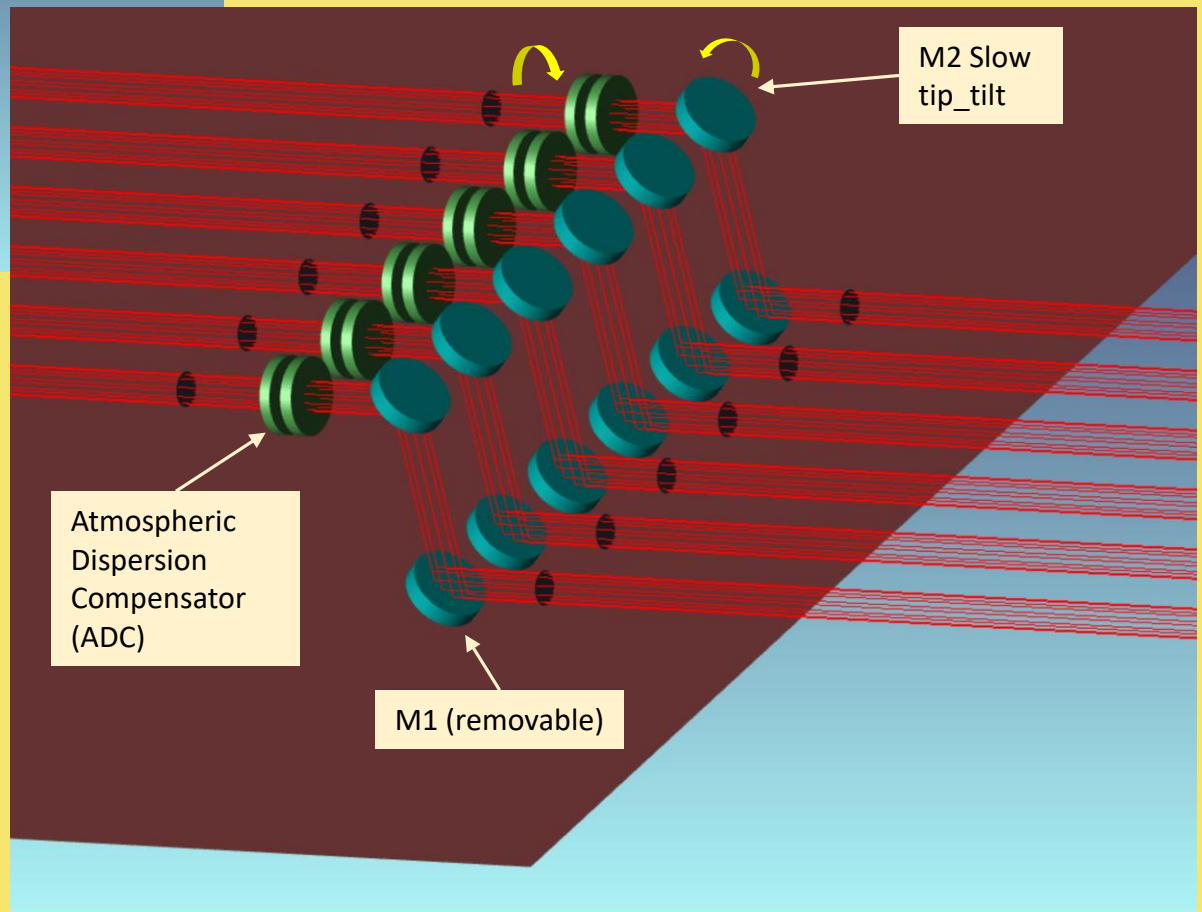


CHARA Beams & Pupil Positions




Periscope
CHARA VISIBLE TABLE
SPICA TABLE




M2 Slow tip_tilt
Atmospheric Dispersion Compensator (ADC)
M1 (removable)

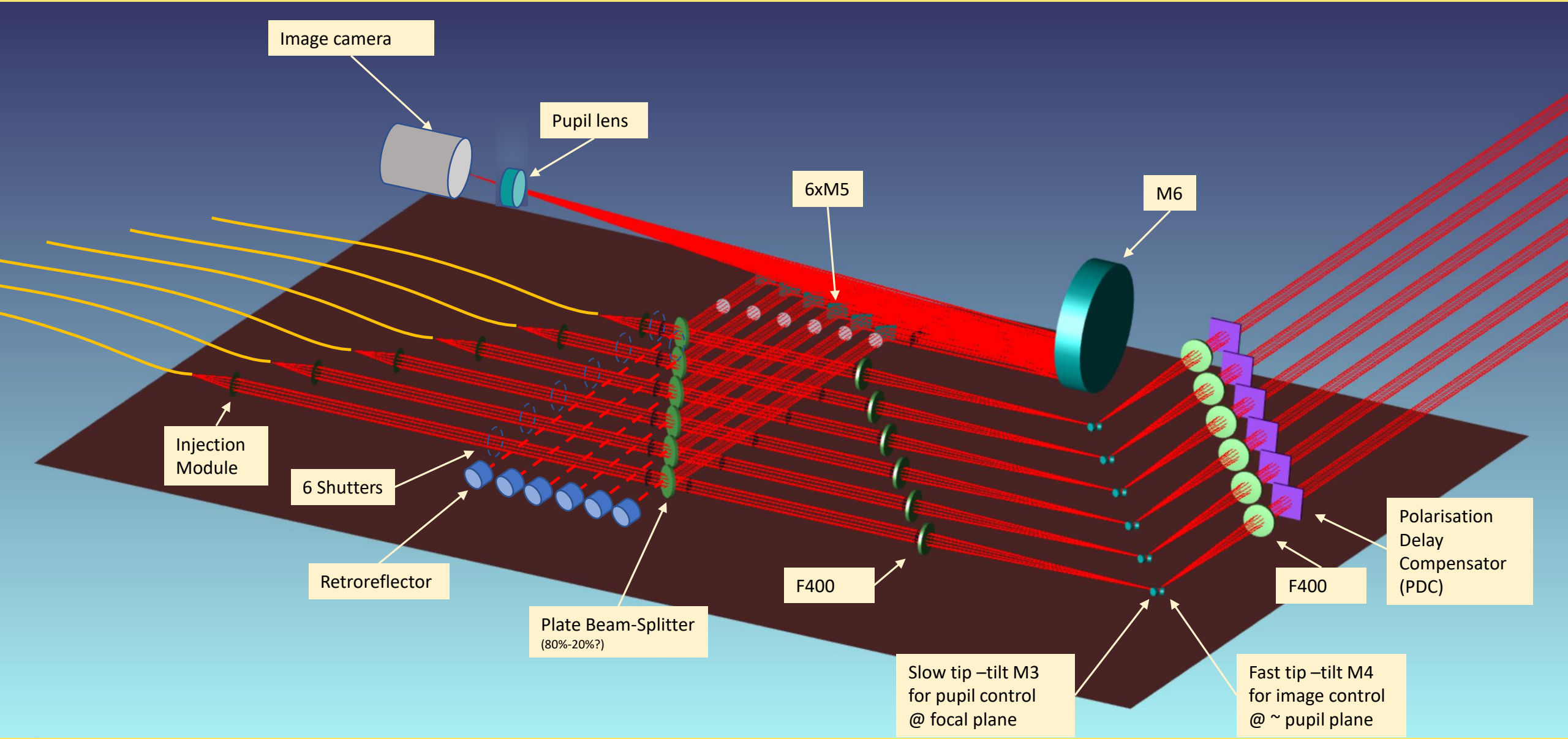
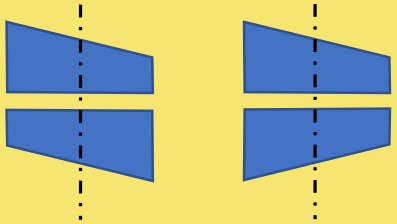


Image camera
Pupil lens
6xM5
M6
Injection Module
6 Shutters
Retroreflector
Plate Beam-Splitter
(80%-20%?)
F400
F400
Polarisation Delay Compensator (PDC)
Slow tip –tilt M3 for pupil control @ focal plane
Fast tip –tilt M4 for image control @ ~ pupil plane

Periscope + ADC: Placed on CHARA Visible Table, the periscope allows to pass over others optics. M1 is removable, while M2 is motorized in Tip-Tilt



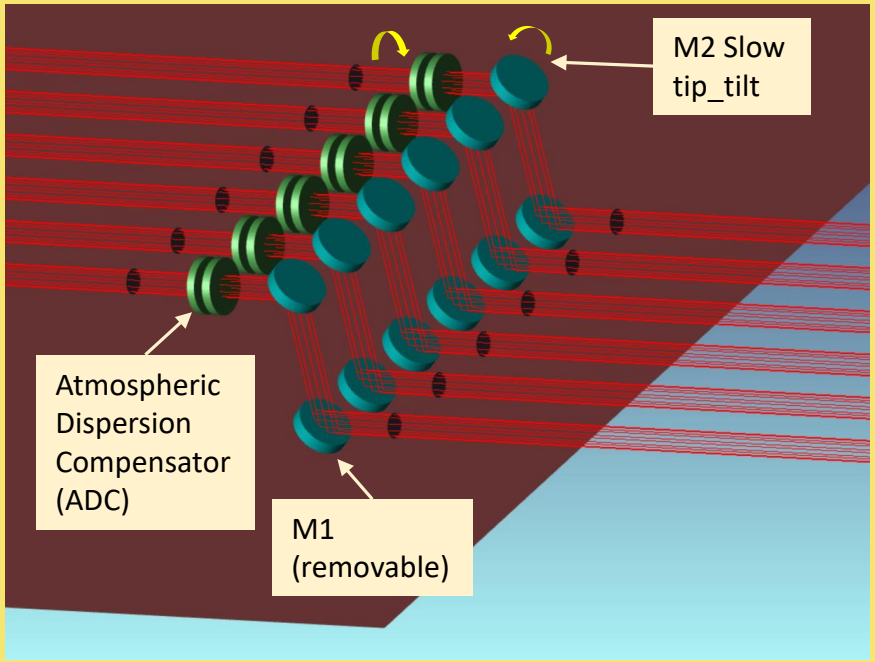
No correction

Max correction

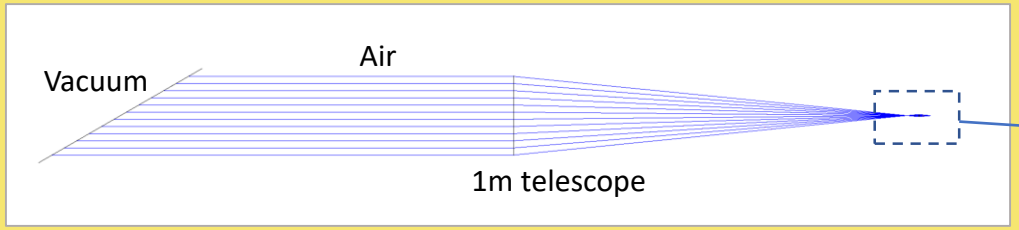
NB: Field rotation at CHARA

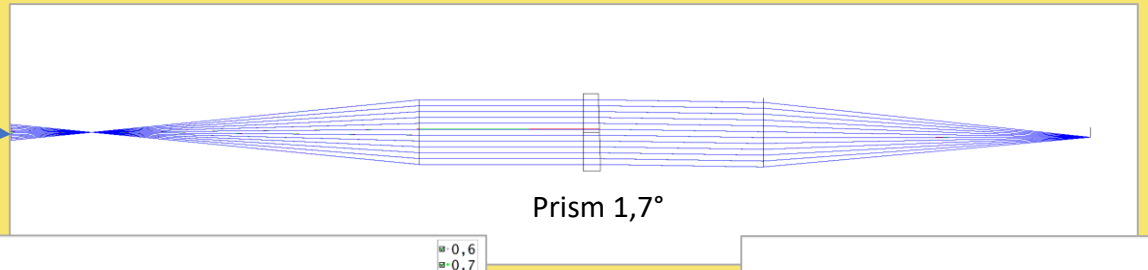
- ADC must follow field rotation, every 10 mins
- Dispersion correction every 10 mins also
- Non sensitive to beam incidence

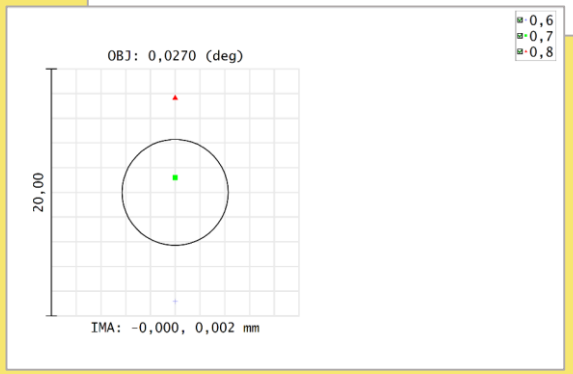
Global deviation: 53'
To be corrected with image and pupil control…
Technical solution: 2 wedged windows, with 2 motorized orientations

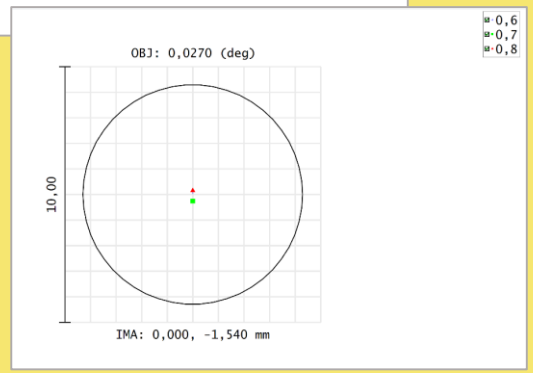


Simulation for 60° from zenith: atmospheric dispersion









Polarization Delay Compensator (PDC)

- Due to optical fibers, the vertical and horizontal polarizations have a different delay, and this delay may be different on the 6 beams.
- To correct this effect, a cristal material is inserted in each beam, and tilted to equalize the phase of V and H polarizations.
- Requires motorized stage

On the right: extract from **A&A 543, A31 (2012)**, B. Lazareff, J.-B. Le Bouquin, and J.-P. Berger, *A novel technique to control differential birefringence in optical Interferometers, Demonstration on the PIONIER-VLTI instrument*

To be completed…

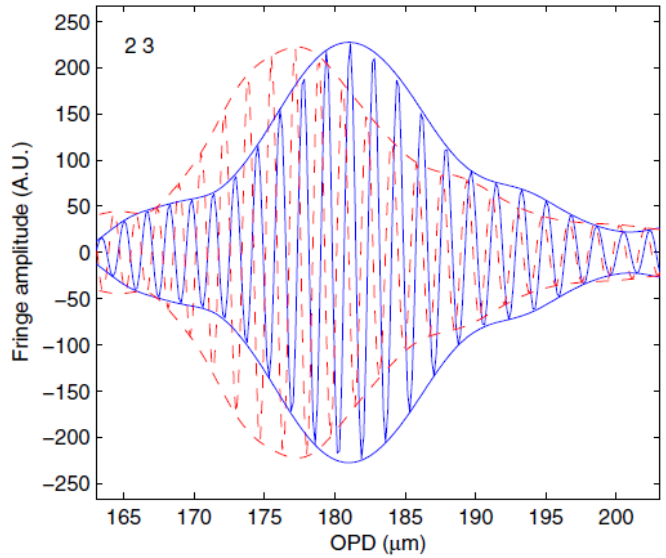


Fig. 1. Measured fringe packets in the Pionier instrument, between inputs 2 and 3, for the two linear polarizations, and with birefringence uncorrected.

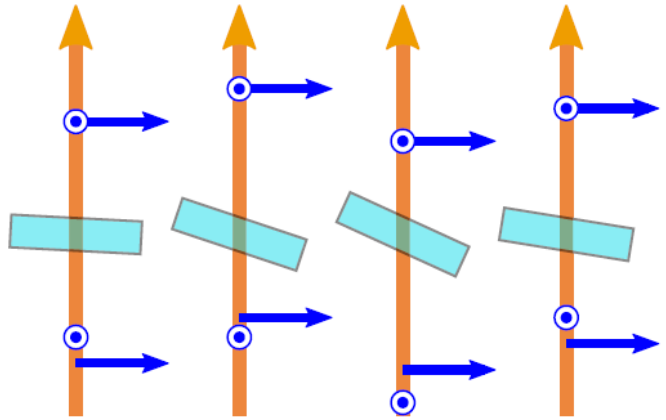


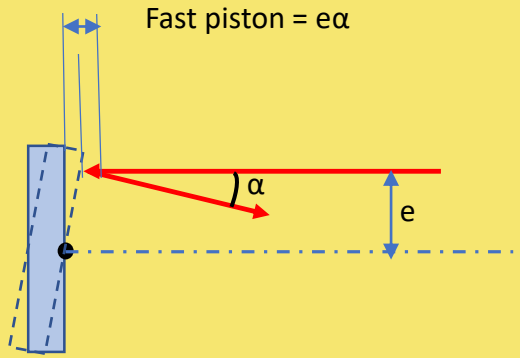
Fig. 2. Principle of the correction. Before traversing the birefringent plates, each beam is plagued by a differential delay between the horizontal and vertical polarizations. This differential delay can be canceled by suitably adjusting the inclination of each birefringent plate. The beam-to-beam delay is generally affected, but is easy to equalize once birefringence is taken care of. This figure is drawn as if the correction is performed *after* the unwanted birefringence has occurred; in the case of Pionier, the correction is in fact made upstream of the point where birefringence occurs.

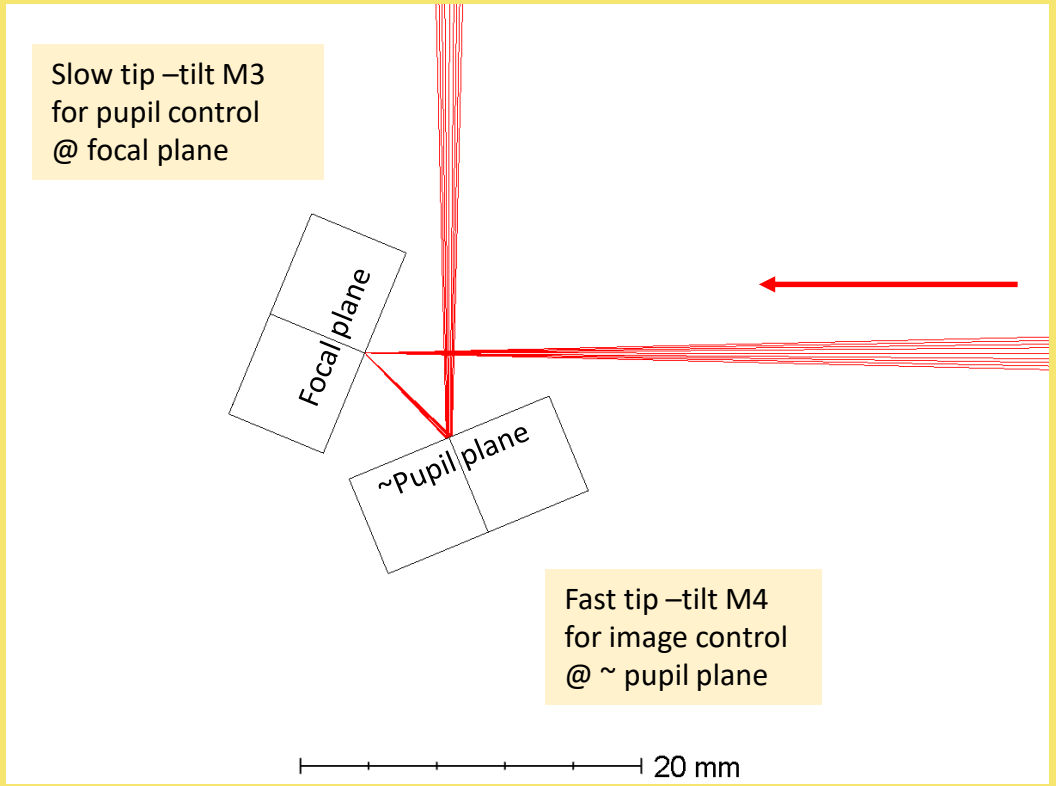
Image and Pupil Control: Placed in a focal plane, a slow tip-tilt mirror stabilizes the pupil. Near the approximate pupil plane, the fast tip-tilt mirror stabilizes the injection into fibers.
To avoid generating fast piston errors, the beam must always be precisely centered on the fast tip-tilt rotation point.

- Field: +/-0,3'' (sky), +/- 16'' (lab) ~ 0,0001 rad
- Typical fast tip-tilt movement: 0,0001 rad
- If centering error is 1 mm, generated fast piston = 100 nm = Lambda/7
- If centering error is 0,1 mm, generated fast piston = 10 nm < Lambda/70
- Pupil diameter @ fast tip-tilt: 0,37 mm

➔ centering accuracy: 0,1/0,37 = 27% easy!

Beam centering on fast tip-tilt:

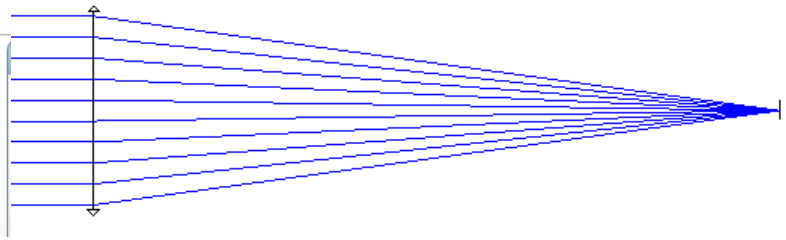




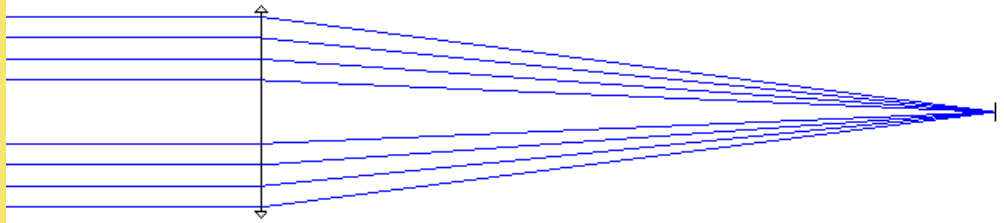
Fiber Injection:

Wavelength Data

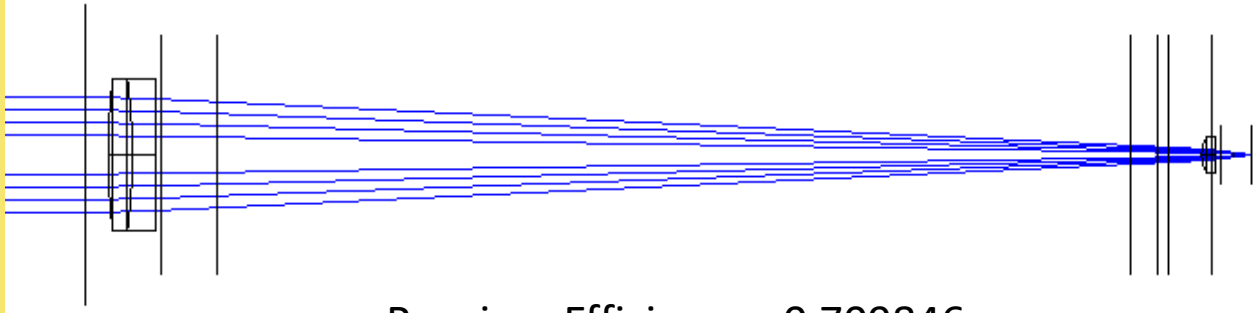
		Wavelength (µm)	Weight	Primary
☑	1	0,650	1,000	○
☑	2	0,700	1,000	○
☑	3	0,750	1,000	◉
☑	4	0,800	1,000	○
☑	5	0,850	1,000	○



Receiver Efficiency : 0,827839

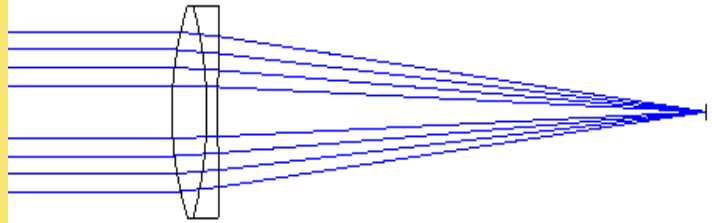


Receiver Efficiency : 0,717590



Receiver Efficiency : 0,709846 -0,01 +0,02

Design Yves Bresson



Receiver Efficiency: 0,651543 -0,01 +0,05

Effect of the 2 achromats: Receiver Efficiency : 0,700749 -0,02 + 0,01

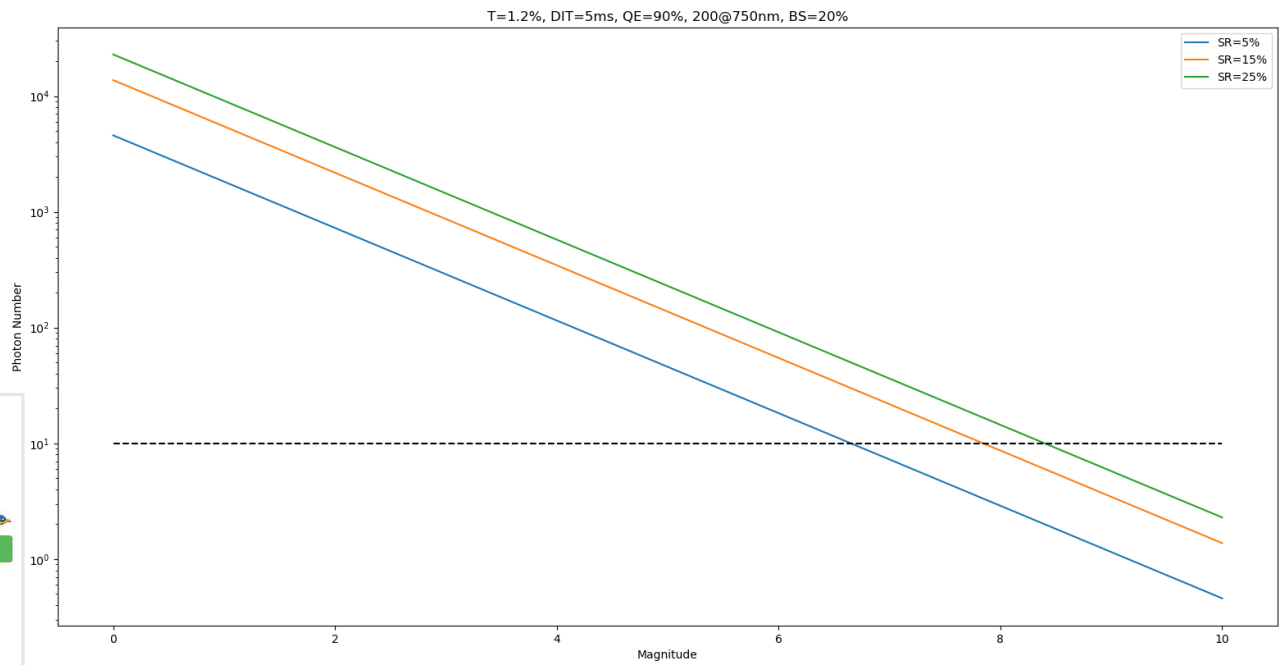
Fiber Injection: effect of beam centering error

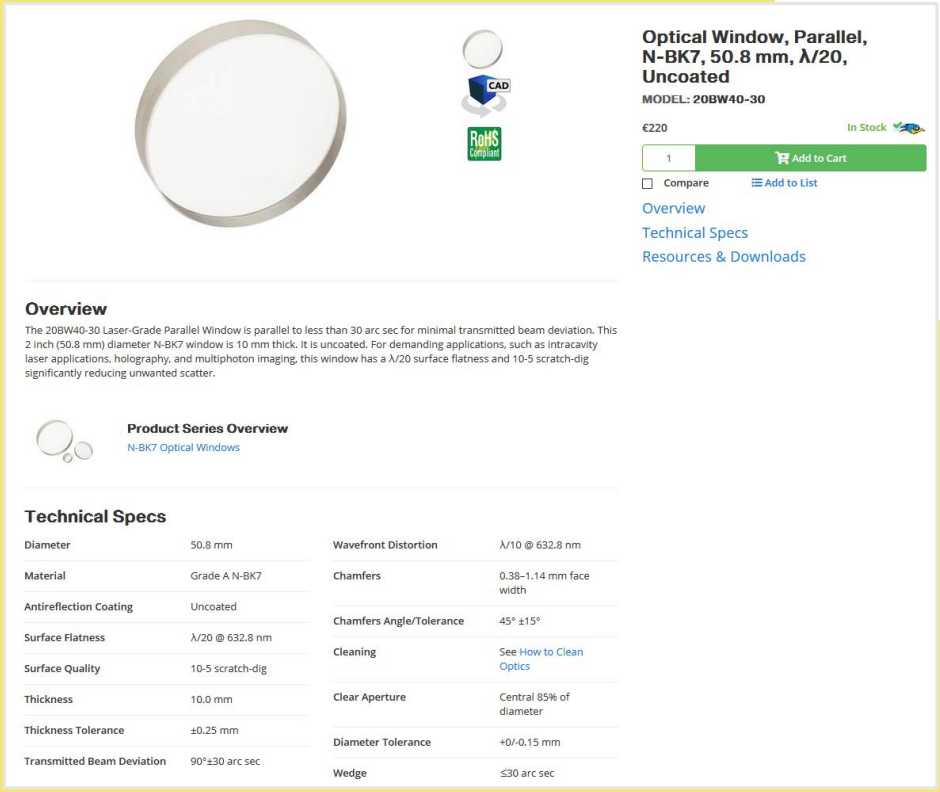
Pupil lateral shift (mm)	0	1	2	3	4	5	6	7	8	9	10
Syst efficiency (vignetting)	0,937	0,937	0,937	0,929	0,882	0,819	0,753	0,688	0,620	0,552	0,486
Receiver efficiency (injection quality)	0,711	0,697	0,651	0,586	0,538	0,495	0,447	0,393	0,339	0,290	0,241
Coupling efficiency	0,666	0,653	0,610	0,544	0,475	0,405	0,336	0,270	0,211	0,160	0,117

➔ Beam should be centerd within 1mm (5%)

Science/Tracking beam ratio

Simulation of the number of photons on the tracking detector, function of magnitude, for different Strehl ratios *(simulation by Ph Berio)*





Optical Window, Parallel, N-BK7, 50.8 mm, λ/20, Uncoated

MODEL: 20BW40-30

€220 In Stock

1 Add to Cart

Compare Add to List

Overview
Technical Specs
Resources & Downloads

Overview

The 20BW40-30 Laser-Grade Parallel Window is parallel to less than 30 arc sec for minimal transmitted beam deviation. This 2 inch (50.8 mm) diameter N-BK7 window is 10 mm thick. It is uncoated. For demanding applications, such as intracavity laser applications, holography, and multiphoton imaging, this window has a λ/20 surface flatness and 10-5 scratch-dig significantly reducing unwanted scatter.

Product Series Overview

N-BK7 Optical Windows

Technical Specs

Diameter	50.8 mm	Wavefront Distortion	λ/10 @ 632.8 nm
Material	Grade A N-BK7	Chamfers	0.38–1.14 mm face width
Antireflection Coating	Uncoated	Chamfers Angle/Tolerance	45° ±15°
Surface Flatness	λ/20 @ 632.8 nm	Cleaning	See How to Clean Optics
Surface Quality	10-5 scratch-dig	Clear Aperture	Central 85% of diameter
Thickness	10.0 mm	Diameter Tolerance	+0/-0.15 mm
Thickness Tolerance	±0.25 mm	Wedge	≤30 arc sec
Transmitted Beam Deviation	90°±30 arc sec		

- Custom beamsplitter, R/T = 20/80
- Wedge to avoid ghost
- Max wedge to minimise dispersion effect: 1’
- Min wedge to exclude ghost injection into fiber: a few arcsec

➔ Newport window, 10’’ – 30’’ wedge

Image/Pupil Camera

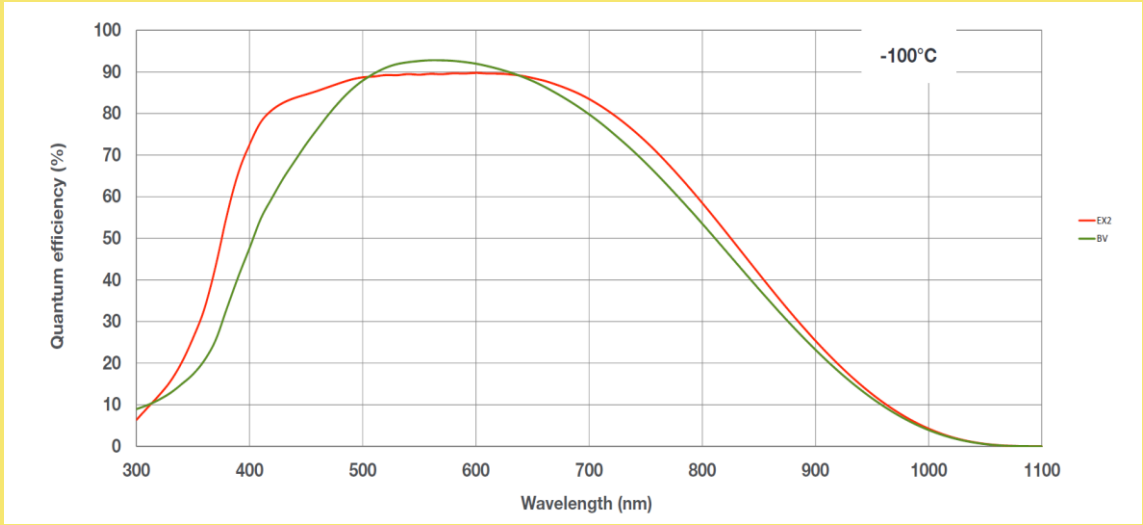
Fast camera with windowing to stabilize injection into fibers.
2,44 L/D on 5-6 pixels
➔ F = 1000 mm?

➔ Parabole Edmund diam. 203,2 – F1016
➔ 6,1 pixels @ 750 nm

iXon Ultra 897

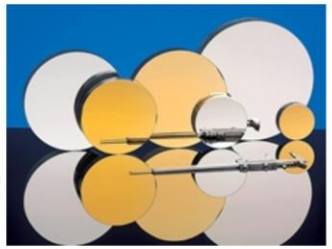
Key Specifications

Active pixels (H x V)	512 x 512
Pixel size (W x H; µm)	16 x 16
Image area (mm)	8.2 x 8.2
Active Area Pixel Well Depth (e^-)	180,000
Max Readout Rate (MHz)	17
Frame rates (fps)	56 (full frame) - 11,074
Read noise (e^-)	<1 with EM gain
QE Max	>95%



Dia. (mm)	EFL (mm)	Ouverture (f/#)	Traitement	Spécification du Traitement	Comparer	Numéro de Stock	Prix
203.20	1016.00	f/5	Uncoated	-	☐	#32-073-000	€745,00 PRIX SUR QUANTITÉ Demande de Devis

TECHSPEC® **Miroirs Paraboliques de Précision**



- Précision de Surface de λ/8
- Excellente Stabilité Thermique
- Différents Traitements Disponibles

Spécifications

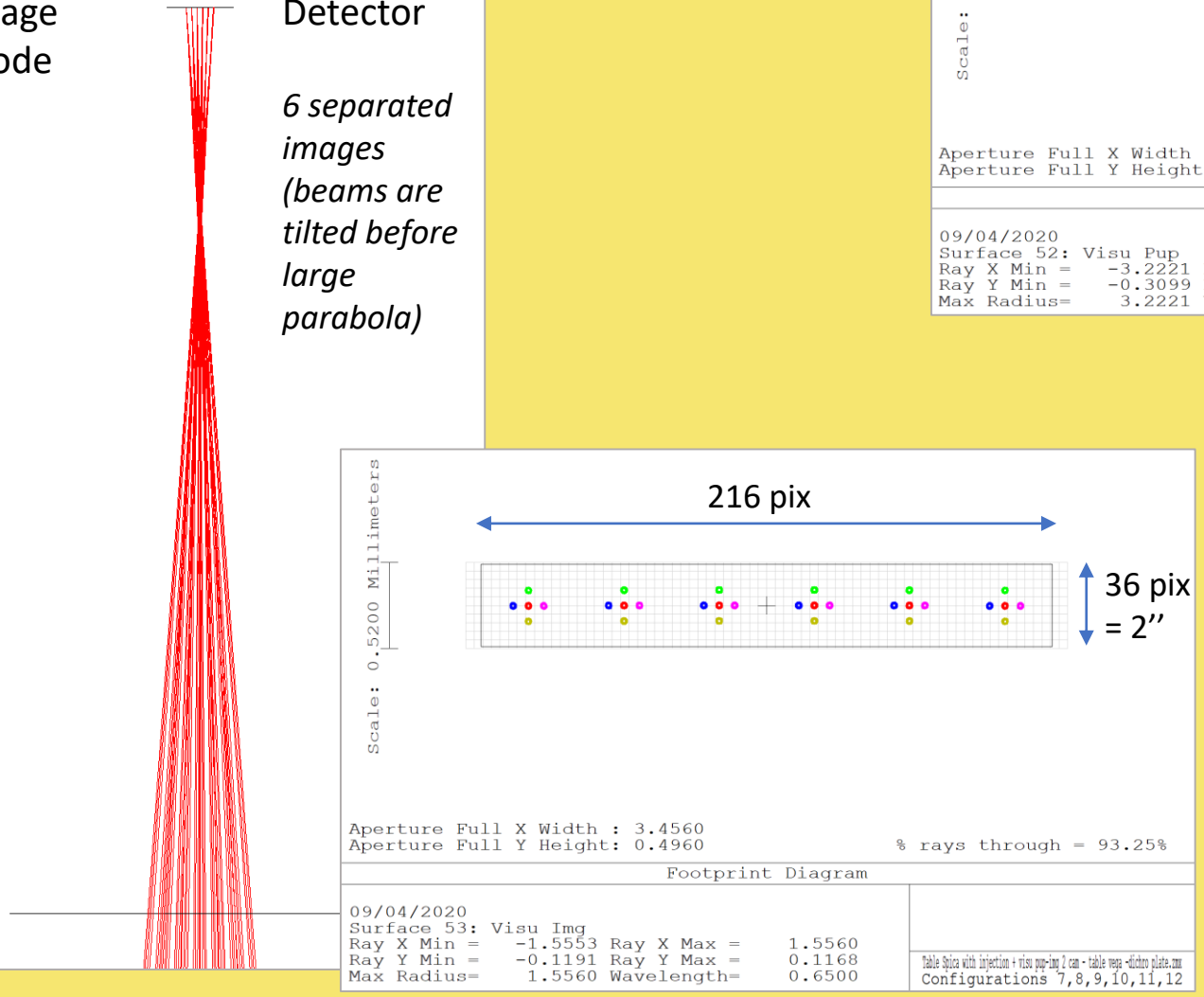
Qualité de Surface:	60-40
Surface Arrière:	Ground

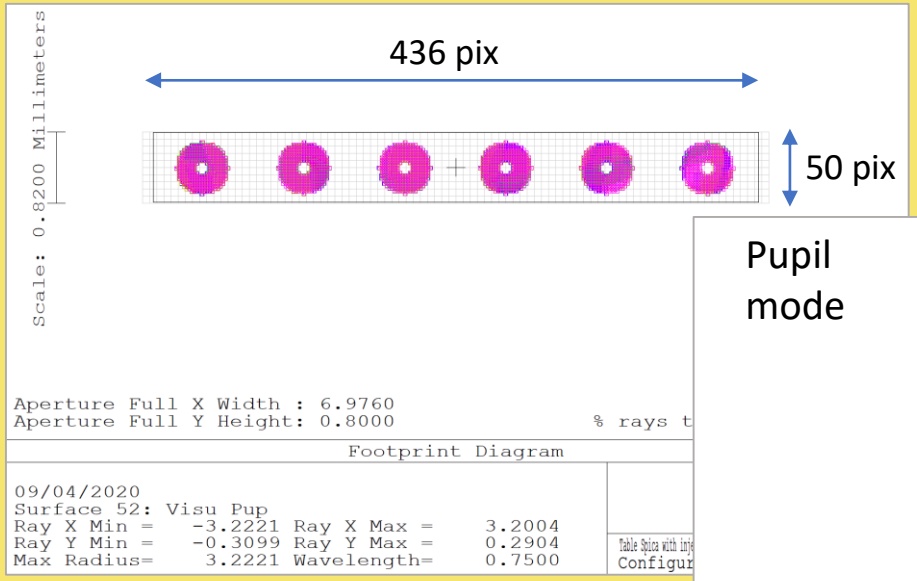
Image/Pupil visualization system

Image mode

Detector

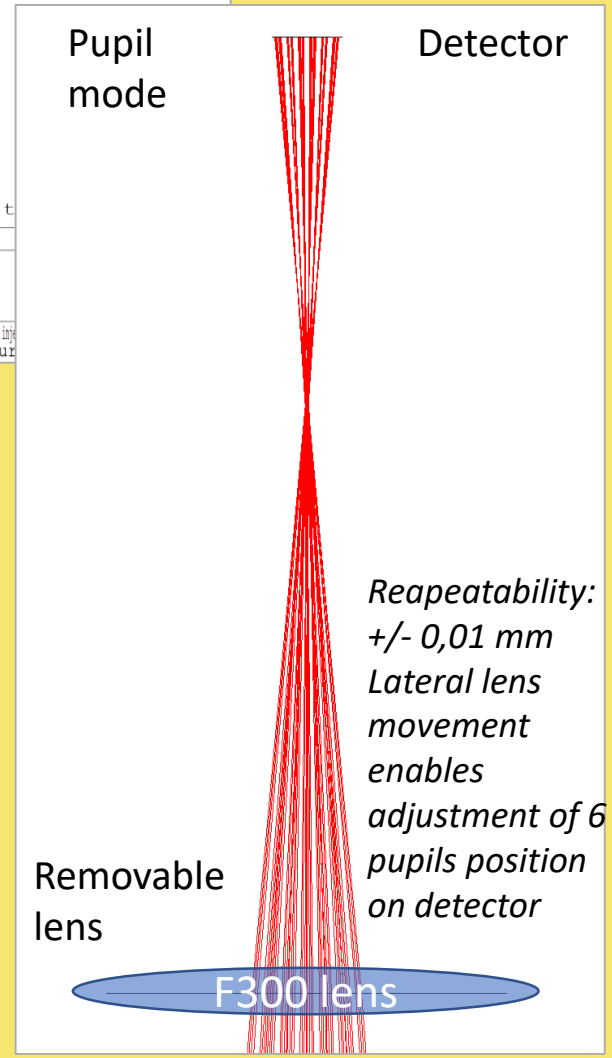
6 separated images (beams are tilted before large parabola)





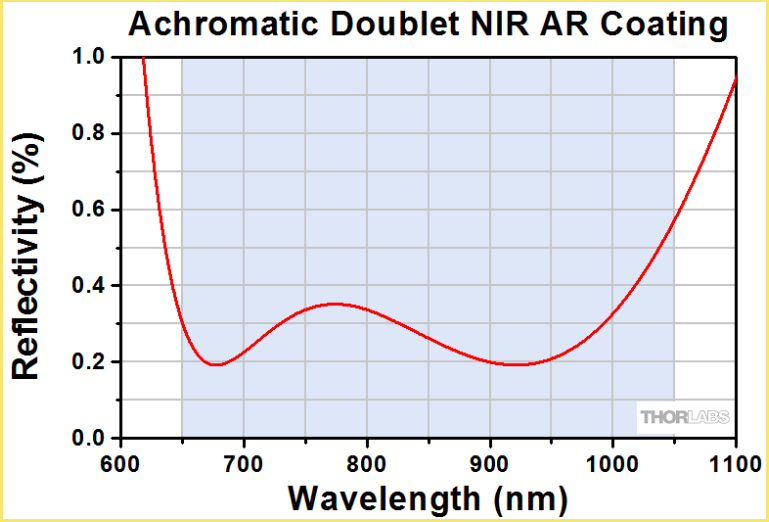
Pupil mode

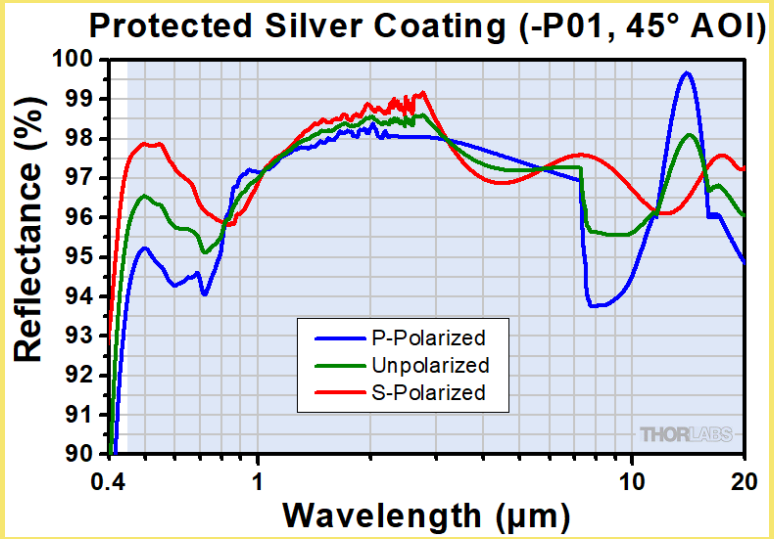
Detector

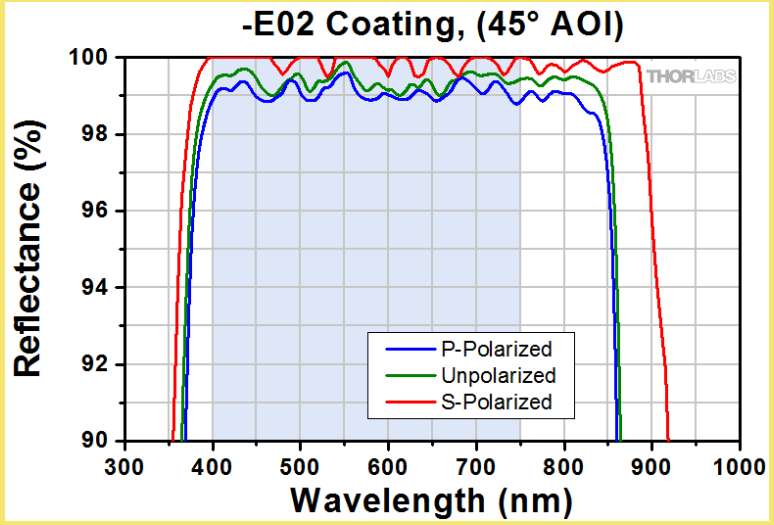


Reapeatability: +/- 0,01 mm
Lateral lens movement enables adjustment of 6 pupils position on detector

Coatings


Achromatic Doublet NIR AR Coating
Reflectivity (%)
1.0
0.8
0.6
0.4
0.2
0.0
600
700
800
900
1000
1100
Wavelength (nm)
THORLABS


Protected Silver Coating (-P01, 45° AOI)
Reflectance (%)
100
99
98
97
96
95
94
93
92
91
90
0.4
1
10
20
Wavelength (µm)
P-Polarized
Unpolarized
S-Polarized
THORLABS


-E02 Coating, (45° AOI)
Reflectance (%)
100
98
96
94
92
90
300
400
500
600
700
800
900
1000
Wavelength (nm)
P-Polarized
Unpolarized
S-Polarized
THORLABS

Shopping…

My Shopping Cart

Forward Your Shopping Cart

Item	Image	Part Number	Ship Date	Qty	Price	Subtotal	Remove
3		PF20-03-P01- **(WEIGHT (Total)):**1.01 Kgs Ø2" Protected Silver Mirror	Today	12	~~€ 99,32~~* € 97,33	€ 1.167,96	☐
5		PF05-03-P01- **(WEIGHT (Total)):**0.26 Kgs Ø1/2" Protected Silver Mirror	Today	12	~~€ 29,85~~* € 29,25	€ 351,00	☐
7		AC508-400-B-ML- **(WEIGHT (Total)):**1.06 Kgs f=400 mm, Ø2" Achromatic Doublet, SM2-Threaded Mount, ARC: 650-1050 nm *** NOTE: *** The quantity you have requested for part number AC508-400-B-ML exceeds available stock. After you have finalized your order, a customer representative will contact you with an exact delivery date, or you are welcome to contact us by phone at +33 (0) 970 444 844 or by email at sales.fr@thorlabs.com.	* See Note	12	~~€ 164,27~~* € 160,98	€ 1.931,76	☐
8		AC254-200-B-ML- **(WEIGHT (Total)):**0.27 Kgs f=200 mm, Ø1" Achromatic Doublet, SM1-Threaded Mount, ARC: 650-1050 nm	Today	6	~~€ 109,19~~* € 107,01	€ 642,06	☐
9		LA1470-B- **(WEIGHT (Total)):**0.12 Kgs N-BK7 Plano-Convex Lens, Ø6.0 mm, f = 12.0 mm, AR Coating: 650 - 1050 nm *** NOTE: *** The quantity you have requested for part number LA1470-B exceeds available stock. After you have finalized your order, a customer representative will contact you with an exact delivery date, or you are welcome to contact us by phone at +33 (0) 970 444 844 or by email at sales.fr@thorlabs.com.	* See Note	6	~~€ 28,52~~* € 27,95	€ 167,70	☐
10		MRA25-P01- **(WEIGHT (Total)):**0.23 Kgs Right-Angle Prism Mirror, Protected Silver, L = 25.0 mm	Today	6	~~€ 81,66~~* € 80,03	€ 480,18	☐
11		PS975M-B- **(WEIGHT (Total)):**0.37 Kgs TIR Retroreflector, SM1-Threaded Mount, AR Coating: 650 - 1050 nm	3-5 Days	6	~~€ 186,89~~* € 183,15	€ 1.098,90	☐
12		AC254-300-B-ML- **(WEIGHT (Total)):**0.04 Kgs f=300 mm, Ø1" Achromatic Doublet, SM1-Threaded Mount, ARC: 650-1050 nm	Today	1	~~€ 109,19~~* € 107,01	€ 107,01	☐
* For Thorlabs Price and Discount Policy please see Thorlabs Price Policy . **WEIGHT (Total):** 3.36 Kgs						**TOTAL:**	**€ 5.946,57**	

MY CART - 1 product

EXPORT YOUR CART | IMPORT YOUR CART | REQUEST A QUOTE

ADD A REFERENCE Type here your product ref x 1 ADD IT

	Stock	UP	Qty	Total
WEDGED SUBSTRATE BK7 50MM DIAMETER 1 DEGREE WEDGE ANGLE λ/20 REF : WSB-50C08-20-1	DELIVERY IN 3-6 WEEKS	€345.30	12	€4,143.60

EMPTY MY BASKET

COUPON CODE ? APPLY

SUBTOTAL	€4,143.60
VAT	€828.72
TOTAL	€4,972.32

CHECKOUT

Cart Overview

— Cart Items (6 items)

Review complete standard product pricing and availability details below. Select 'Request a Quote' for full quote item pricing and availability details.

Description	Availability	Price	Qty.	Total
Optical Window, Parallel, N-BK7, 50.8 mm, λ/20, Uncoated **Model:** 20BW40-30	4 on 4/15/2020 2 on 5/4/2020	€220	6 Save for Later | Delete	€1,320

Proceed to Checkout

Request a Quote

Continue Shopping

Cart Summary

Quote Items (0):	€0
Standard Items (6):	€1,320
Subtotal:	€1,320

Votre panier

‹ Continuez vos Achats | Sauvegarder votre Panier | Demande de Devis | Exporter le panier

RÉSUMÉ DE LA COMMANDE

Composants (1):	€745,00
Total Estimé de la	A
Livraison:	Déterminer
Sous-total HT:	**€745,00**

PASSER COMMANDE

Ajouter un code promotionnel APPLIQUER CODE

Ajouter Produit par Référence AJOUTER PRODUIT

8" de Dia. x 40" FL Non Traité, Miroir Parabolique

2-3 JOURS **No. de Stock** #32-073-000 **€745,00**

+ Ajouter à ma liste d'achats | Demande de Devis | Retirer

Numéro de pièce client:

- 1 + PRIX SUR QUANTITÉ

Total: €745,00