Ref No: PUR/GT/IMP/VELC-ADITYA/20/2016-17.

September 19, 2016.

M/s.

Dear Sir/s,

The Director, Indian Institute of Astrophysics, Bangalore, invites Sealed Tenders (both price bid & technical bid) for the Import of **"Narrow Band Filter and Dichroic Beam Splitters for Visible Emission Line Coronagraph" as per the Technical Specifications attached".** The terms and conditions may be noted from IIA Website and if you are in a position to quote for the supply in accordance with the requirements, please submit your quotation. The Tender documents and other details are available on IIA web site <u>www.iiap.res.in/tenders.htm</u>

Eligibility Criteria of Vendor: The vendor must have the knowledge, infrastructure and heritage in manufacturing of Narrow band and Ultra Narrow band filters of similar kind of space applications. List of the Project and end user shall be provided in case of heritage. A profile of the company and its past experience in the design and development of Filters should be enclosed with the Technical bid.

The Tender bids must be in foreign currency only. Your completed Tender bids (both Price bid & technical bid) must reach our office on or before 19/10/2016 by 15 00 hrs. The bids must be in a separate Sealed envelopes duly superscibed with the name of the supply, the Due Date and all the envelopes kept in a bid envelopes mentioning Quotation for **"Narrow Band Filter and Dichroic Beam Splitters for Visible Emission Line Coronagraph"** must reach this Office within the Due Date and time. The Technical bids will be opened in the presence of the bidders or their authorized representative of the Company by 15.30 hrs on 20/10/2016. The Price bids will be opened only those vendors quotes qualify in Technical Evaluation. The Price bid opening date will be intimated later. Incomplete Bids are liable for rejection.

For any Technical clarification you may contact during Office hours Rajkumar N (Phone No.22541393) and for commercial clarifications can be had from Shri K.P.Vishnu Vardhan, Stores & Purchase Officer (Phone No.22541244).

Thanking you,

Yours faithfully,

K.P.Vishnu Vardhan Stores & Purchase Officer

GLOBAL TENDER DOCUMENT No : PUR/GT/IMP/VELC-ADITYA/2016-17. DT : 19/09/2016.

TENDER FORM

FROM:

TO

THE DIRECTOR Indian Institute of Astrophysics, Bangalore - 560 034.

Sir,

I/We hereby offer to supply the Items/Equipment indicated below at the price hereunder quoted and agree to hold this office open till . I/We shall be bound to supply the items/Equipment hereby offered upon the issue of the Purchase Order communicating to the acceptance thereof on or before the expiry of the last mentioned date. You are at liberty to accept any one or more of the items such Items/Equipment. I/We not withstanding that the offer in this tender has not been accepted in whole, shall be bound to supply such items and such portion or portions of one or more of the items as may be specified in the said Purchase order communicating the acceptance.

S No.	Description of the item(s)	Qty.	Unit Rate	Dely. Period
1.	"Narrow Band Filter and Dichroic Beam Splitter Visible Emission Line Coronagraph" as per the Technical Specifications and Instructions.			
	(Tender bids should be in Foreign currency only)	(Two Bi	ds system)	

Place at which the Delivery is required : Indian Institute of Astrophysics, Bengaluru - 560 034.

Date by which the supplies are required : 5 months from the issue of Purchase order.

2 I/We have understood the items of the tender annexed to the invitation to the Tender and have thoroughly examined the specifications/drawing and / or pattern quoted or referred to herein and / are fully aware of the nature of the items/ Equipment required and my / our offer is to supply the items/ Equipment strictly in accordance with the requirements subject to the terms and conditions contained in the Purchase order communicating the acceptance of this tender either in whole or in part.

Date :

Signature and Seal of Supplier

Annexure - A

INSTRUCTIONS TO SUPPLIERS

- 1. Tenders should be sent in a sealed and superscribed envelopes with mention of Tender No. date and date of opening. Only one Tender should be sent in each envelope.
- 2. Late and Delayed tender will not considered at all.
- 3. Duties, Taxes where legally leviable and intended to be claimed should distinctly shown separately in the Tender.
- 4. a) Your quotation should be valid for 90-120 days from the date of opening of Tender.

b) Prices are required to be quoted according to the units indicated in the annexed tender form. When quotations are given in terms of units other than those specified in the Tender from, relationship between the two sets of units must be furnished.

5. a) All available Technical Literature(s), Catalogue(s) and other data in support of the specifications and details of the item(s) should be furnished along with the offer.

b) Approximate net and gross weight of the items offered shall be indicated in your offer. If dimensional details are available the same should indicated in your offer.

c) Air freight/sea freight charges up to Bangalore Airport may be sent along with the offer.

d) Specifications:

Items / Equipment offered should strictly conform to our specifications. Deviation, if any should be clearly indicated by the Supplier in their quotation. The supplier should also indicate the Make / type No. of the stores offered and provide catalogue(s), Technical literature(s) and sample(s), wherever necessary along with the quotations. Test certificates wherever necessary should be forwarded along with the supplies. Whenever options are called for in our specifications, the Supplier should address all such options. Wherever specifically mentioned by us, the Supplier could suggest changes to specifications with appropriate response for the same.

- 1. Corrections, if any, must be attested. All amounts shall be indicated both in words as well as in figures. Where there is difference between amounts quoted in words and figures, amount quoted in words shall prevail.
- 2. The supplier should supply along with the tender, the Banking information for payment or any other purpose.
- 3. A complete set of instruction and operation manual should be supplied.
- 4. Final performance should be guaranteed.

TERMS AND CONDITONS OF CONTRACT

1. **DEFINITIONS:**

- **a)** The terms 'Purchaser' shall mean the Director, Indian Institute of Astrophysics, Bangalore 560 034.
- **b)** The term 'Supplier' shall mean, the person, firm or company with whom or with which the order for the supply of Items / Equipment is placed.
- **c)** The terms 'Purchase Order' shall mean the communication signed on behalf of the Purchaser by an officer duly authorized intimating the acceptance on behalf the Purchaser on the terms and conditions mentioned or referred to in the said communications accepting the tender or offer of the supplier for supply of Items/Equipment.

2. <u>PRICES:</u>

The price may please be indicated on unit basis only.

Duty Exemption:

Please note that we may issue "Customs duty Exemption Certificate", if acceptable under the Govt. of India notification No.51/96 valid till 2016.

3. GUARANTEE AND REPLACEMENT:

The Supplier shall guarantee that the Items/Equipment supplied shall comply fully with the specifications laid down, for material workmanship and performance. The Guarantee should be for a period of one year minimum from the date of supply.

4. PACKING, FORWARDING AND INSURANCE:

The Contractor will be held responsible for the stores being sufficiently and properly packed for transport by air / Sea to withstand transit hazards ensure safe arrival at the destination. The packing and marking of packing shall be done by and at the expenses of the contractor. The Purchaser will not pay separately for transit insurance, all risks in transit being exclusively of the supplier and the Purchase shall pay only for such Items/Equipment as are actually received in good condition, in accordance with contract.

5. TEST CERTIFICATE:

Wherever required Test Certificate should be sent before dispatch of the items.

6. ACCEPTANCE OF ITEMS / EQUIPMENT:

a)It is expressly agreed that the acceptance of Items/Equipment, is subject to final approval by the Purchase, whose decision shall be final.

7. DELIVERY PERIOD:

Delivery is the essence of the contract. The supplier should adhered to delivery schedule as indicated in the Purchase order.

8. EXTENTION OF DELIVERY TIME:

As soon as it is apparent that Supplier dates cannot be adhered to, an application shall be sent by the Supplier to the Purchaser. If failure, on the part of the Supplier to deliver the Items/Equipment in proper time shall have arisen from any cause which the Purchaser may admit as reasonable ground for an extension of the time (and his decision shall be final he may allow such additional time as he considers it to the justified by the circumstances of the case). In case of Letter of Credit the banking charge for the LOC amendment will be on suppliers account.

9. **<u>PAYMENT:</u>**

Preference will be given to the supplier whose payment terms is on Site Draft.

10. SECURITY FOR PAYMENT:

Successful Supplier will have to furnish in the form of a Bank Guarantee or any other form as called for by the Purchase towards any payments before supply of items/equipment. In case of payment through Letter of Credit the Banking charges outside India and inside India will be on suppliers account.

11. IIA reserves the right to reject any or all the Tenders without assigning any reason.

Stores Purchase Officer

Technical Specifications, Important NOTES and instructions for submitting the Proposal for the supply of "NARROW -BAND FILTERS & DICHROIC BEAM SPLITTERS

Name of the proposal:

Narrow band filters and Dichroic beam splitters for Visible Emission Line Coronagraph (VELC).

- 1) Narrow Band Filters (NBF)
- 2) Dichroic Beam Splitters (DBS)

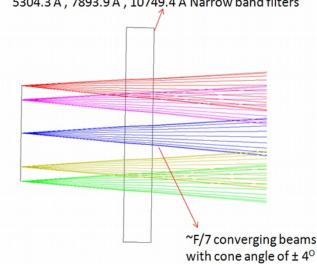
Important Notes:

- 1. All the wavelengths (CWL's and filter or DBS profiles) mentioned in this RFP are the operational wavelengths in space environment. Appropriate care should be taken by the vendor for design and measurements to meet these specifications.
- 2. Filter design results should be submitted to Indian Institute of Astrophysics (IIA), before taking up the fabrication of filters.
- 3. Designed filter profiles (with numbers) and CWL in converging beam of 4^o cone angle shall be provided before the fabrication of filters.
- 4. Designed filter profiles (with numbers) and CWL between 0^o and 4^o tilt of NBF (in steps of 0.5^o), shall be provided before the fabrication of filters.
- 5. Inspection certificate as per MIL-PRF-13830B on substrate's geometrical and metrology parameters to be provided by vendor before coating. The same shall be cleared by IIA.
- 6. Vendor shall supply the test results of witness samples to IIA before the dispatch of filters.
- 7. IIA shall study the same and based on the acceptance of test results by IIA, Actual filters shall be supplied.
- 8. IIA reserves the rights to participate during the testing of witness coupons at vendor's site.

Intended use of Narrow band filters:

Four narrow band filters discussed in this RFP will be used in converging beam as mentioned below. Specifications like center wavelength (CWL), Typical transmission profile, Blocking range & density, Thermal stability, Peak transmission are for using in a converging beam. Figures 1&2 show the NBF's in converging beam. Fig1 shows the 5304.3Å., 7893.9Å, 10749.4Å filters in converging beam with a cone angle of $\pm 4^{\circ}$. Fig 2 Shows the 5000Å filter in converging with a cone angle of \pm 1.8°.

1. 5304.3 Å filter, 7893.9 Å filter, 10749.4 Å filter will be used in a converging beam of ~F/7 with a cone angle of $\pm 4^{\circ}$ as shown in Figure 1.



5304.3 Å , 7893.9 Å , 10749.4 Å Narrow band filters

Figure 1: 5304.3Å., 7893.9Å, 10749.4Å filters in converging beam with a cone angle of $\pm 4^{\circ}$

2. 5000 Å filter, will be used in a converging beam of \sim F/16 with a cone angle of $\pm 1.8^{\circ}$ as shown in Figure2.

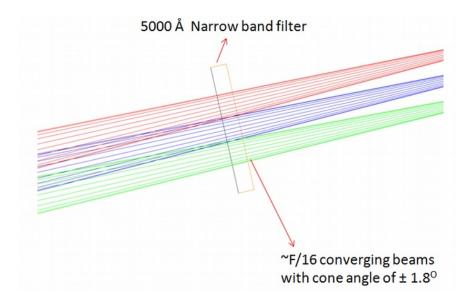


Figure 2: 5000Å filter in converging with a cone angle of \pm 1.8 $^{\rm o}$

Intended use of Dichroic beam splitters:

1. Dichroic beam splitters discussed in this RFP will be used in converging beam. DBS 1will be used in a converging beam of \sim F/16 at an angle of incidence of 9° as shown in Figure 3

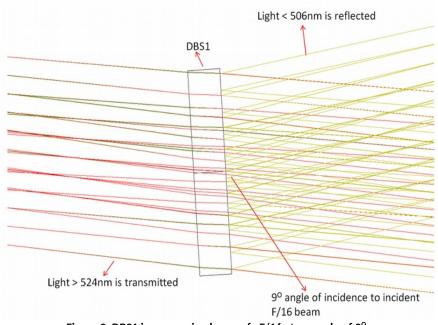
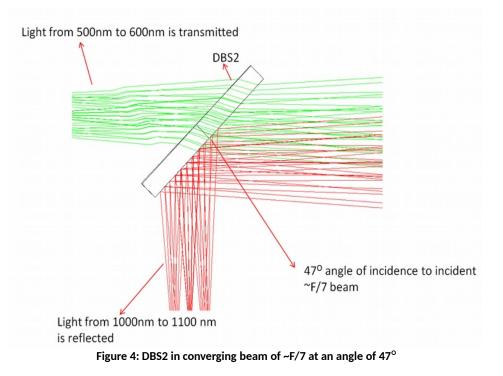


Figure 3: DBS1 in converging beam of ~F/16 at an angle of 9°

2. DBS2 will be used in a converging beam of $\,{\sim}F/7$ at an angle of incidence of $47^{\rm O}$ as shown in Figure 4.



1) NARROW BAND FILTERS (NBF)

I. Physical dimensions and quantities of Narrow band filters:

Four different filters with the dimensional specifications and quantities mentioned in the Table1 are required for VELC project.

		Diameter	Thickness		Witness samples
Sl.No	Name	(mm)	(mm)	Quantity	(Ø30x4mm)
1	5304.3 Å filter	30	4	4	4
2	7893.9 Å filter	30	4	4	4
3	10749.4 Å filter	35	5	4	4
4	5000 Å filter	80	10	4	4

Table 1: Required narrow band filters, dimensions and quantities:

II. Technical specifications of Narrow band filters

This section gives the technical specifications of each filter in detail. <u>Table 2: Specifications of 5304.3 Å filter.</u>

Specifications of 5304.3 Å narrow band filter				
S.NO	Parameter	Nominal value	ominal value Tolerance	
1	Filter Diameter	30 mm	+0.0mm	-0.1mm
2	Thickness	4 mm	+0.05mm	-0.05m m
3	Clear aperture	>27.5mm	010011111	
4	Substrate	N-BK7 (NH4 quality)		
5	Micro roughness (rms)	<15Å		
6	Centre Wavelength (CWL)	5304.3Å (In converging		
	Over the clear aperture	beam)	+1 Å	-1Å
		With best effort target as ± 0.7	Å	
7	Band width (FWHM)	≥5Å		
8	Transmission Non-uniformity	< 1% over clear aperture		
9	Typical transmission profile of filter	Refer table 2a		
10	Blocking range & density	OD4 < 5289Å upto 4000Å & >	5319Å upt	o 11000Å
11	Thermal spectral stability of CWL	≤ 1Å ,Temp range (22 ± 3°C)		
12	Peak transmission	>70%		
13	Environmental durability	Described in section III		
14	Transmitted wavefront error (PTV)	$\lambda/4$ (with power)		
15	Power on each surface	<0.5 fringe on each surface		
16	Ripples in transmission profile(PTV)	<3%		
17	Cosmetic quality	20/10		
18	Wedge	0"	+20"	-20''
19	Cone angle of incidence	$+4^{\circ}$ to -4°		

Table 2a : Typical transmission profile of 5304.3 Å filter in converging beam of ±4^o cone angle.

Typical transmission profile of 5304.3 Å filter			
% of peak Transmission	Full width (Å)		
90%	≥3		
50%	≥5		
0.1%	≤14		

Specifications of 7893.9 Å narrow band filter					
S.NO	Parameter	Nominal value	Tolerance		
1	Filter Diameter	30 mm +0.0mm		-0.1mm	
				-0.05m	
2	Thickness	4 mm	+0.05mm	m	
3	Clear aperture	>27.5mm			
4	Substrate	N-BK7 (NH4 quality)			
5	Micro roughness (rms)	<15Å			
6	Centre Wavelength (CWL)	7893.9Å(In converging			
	Over the clear aperture	beam)	+1Å	-1Å	
		With best effort target as $\pm 0.$	7 Å		
7	Band width (FWHM)	≥8Å			
8	Transmission Non-uniformity	< 1% over clear aperture			
9	Typical transmission profile of filter	Refer table 3a			
10	Blocking range & density	OD4 <7879 Å upto 4000 Å& >7909Å upto 11000Å			
10	Thermal spectral stability of CWL	≤ 1 Å ,Temp range (22 ± 3°C)			
11	Peak transmission	>70 %			
13	Environmental durability	Described in section III			
14	Transmitted wavefront error (PTV)	$\lambda/4$ (With power)			
15	Power on each surface	<0.5 fringe on each surface			
16	Ripples in transmission profile(PTV)	<3%			
17	Cosmetic quality	20/10			
18	Wedge	0"	+20"	-20"	
19	Cone angle of incidence	$+4^{\circ}$ to -4°			

Table 3 : Specifications of 7893.9 Å filter.

Table 3a : Typical transmission profile of 7893.9 Å filter in converging beam of ±4° cone angle.

Typical transmission profile of 7893.9 Å filter			
% of peak Transmission Full width (Å)			
90%	≥3		
50%	≥8		
0.1%	≤16		

Specifications of 10749.4 Å narrow band filter					
S.NO	Parameter	Nominal value	Tole	rance	
1	Filter Diameter	35 mm	+0.0mm	-0.1mm	
2	Thickness	5 mm	+0.05mm	-0.05mm	
3	Clear aperture	>31.5mm			
4	Substrate	N-BK7 (NH4 quality)			
5	Micro roughness (rms)	<15Å			
6	Centre Wavelength (CWL)	10749.4Å (In converging			
	Over the clear aperture	beam)	+2Å	-2Å	
		With best effort target as ± 1 Å			
7	Band width (FWHM)	≥10Å			
8	Transmission Non-uniformity	< 1% over clear aperture			
9	Typical transmission profile of filter	Refer table 4a			
10	Blocking range & density	OD4 <10724Å upto 7000Å& >10774Å upto 18000Å			
11	Thermal spectral stability of CWL	$<1\text{\AA}$,Temp range (22 ± 3 ^o C)			
12	Peak transmission	>70 %			
13	Environmental durability	Described in section III			
14	Transmitted wavefront error (PTV)	$\lambda/4$ (With power)			
15	Power on each surface	<0.5 fringe on each surface			
16	Ripples in transmission profile(PTV)	<3%			
17	Cosmetic quality	20/10			
18	Wedge	0"	+20"	-20"	
19	Cone angle of incidence	$+4^{\circ}$ to -4°			
20	S&P polarization differential transmission	<1%			

Table 4: Specifications of 10749.4 Å filter.

Table 4a : Typical transmission profile of 10749.4 Å filter in converging beam of ±4° cone angle.

Typical transmission profile of 10749.4 Å filter			
% of peak Transmission Full width (Å)			
90%	≥5		
50%	≥10		
0.1%	≤30		

Table 5: Specifications of 5000 Å filter.

Specifications of 5000 Å narrow band filter					
S.NO	Parameter	Nominal value	Nominal value Tolerance		
1	Filter Diameter	80 mm	+0.0mm	-0.1mm	
				-0.05m	
2	Thickness	10 mm	+0.05mm	m	
3	Clear aperture	>76mm			
4	Substrate	N-BK7 (NH4 quality)			
5	Micro roughness (rms)	<15Å			
6	Centre Wavelength (CWL)	5000Å (In converging			
	Over the clear aperture	beam)	+2.5Å	-2.5Å	
		With best effort target as ± 1 .	5 Å		
7	Band width (FWHM)	10Å	+1Å	-1Å	
8	Transmission Non-uniformity	< 3% over clear aperture			
9	Blocking range & density	OD4 <4975Å upto 4000Å& >5025Å upto 11000Å			
_		$<2\text{\AA}$,Temp range (22 ±			
10	Thermal spectral stability of CWL	3°C)			
11	Peak transmission	>90 %			
12	Environmental durability	Described in section III			
13	Transmitted wavefront error (PTV)	$\lambda/4$ (With power)			
14	Power on each surface	<0.5 fringe on each surface			
15	Ripples (PTV)	<3%			
16	Cosmetic quality	40/20			
17	Wedge	0"	+20"	-20"	
18	Cone angle of incidence	+1.8° to -1.8°			

Additional details:

1. Filters with S.No:1, 2 and 3 will be used in converging beam of "f/7" and filter with S.No: 4 will be used in "f/16".

2. All filters will be operated at an operating temperature of 22° C $\pm 3^{\circ}$ C.

3. Each filter should be made of a single N-BK7 (NH4 quality) substrate with thickness equal to specified thickness of the filter.

4. Reflectivity of the second surface should be <1% with best effort target as 0.5% to minimise the intensity of ghost reflections.

5. Witness samples should undergo environmental tests described in section III.

6. All the materials used in the fabrication should be space qualified.

7. Actual filters and witness coupons should be made of substrates from same batch.

III. Environmental specifications of Narrow band filters

Following environmental tests should be carried out on the witness samples coated in the same batch as the actual filters. Parameters to be measured on the witness sample before and after environmental tests are discussed in this section.

1. Coating durability & cosmetics specifications:

Witness samples should undergo the adhesion and abrasion tests as per MIL-C-675A. Cosmetic quality of the witness samples shall be provided as per MIL-PRF-13830B in photographs before and after adhesion and abrasion tests.

Environmental Tests:

1) Thermo vacuum test:

Witness samples should undergo a thermo vacuum test, as per below specifications

No. of cycles	:	5	
Temperature range (deg C)		:	9 to 35 deg C.
Duration at each temperature	:	2 hou	ırs.
Rate of temperature change		:	~2 deg C/minute
Vacuum level		:	$1 \ge 10^{-5}$ mbar or better.

2) Humidity Exposure (as per MIL-C-675A)

Relative humidity	:	95%
Temperature	:	$50^{\circ} \mathrm{C} \pm 2^{\circ} \mathrm{C}$
Exposure duration	:	24 hrs

3) Acceptance test plan matrix:

1 st sample		: Adhesion & Humidity
2 nd sample	:	Abrasion & Thermo-Vac
3 rd &4 th sample	:	Control sample

Spectral properties like Transmission profile, central wavelength, peak transmission, Non-uniformity, blocking range, wavefront error etc. of the witness coupons should be measured before and after environmental tests and should meet the corresponding specifications mentioned in Tables 2-5. All witness samples should meet the corresponding cosmetic quality specifications as per MIL-PRF-13830B in Table 2-5 before and after environmental tests.

Deliverables

1. Narrow band filters listed in Table1, meeting the corresponding specifications in Tables 2 to 5.

2. Witness samples listed in Table1, coated in the same batch as the final filters, two of which have undergone environmental tests and two control samples.

3. Conformance certificates for the specifications in Tables 2-5.

4. Certificates of substrate glass material should be provided.

5. Inspection certificate on the substrate geometrical and metrology parameters as per MIL-PRF-13830B to be provided by vendor before coating. The same shall be cleared by IIA.

6. Measured transmission profiles of all the filters in collimated beam for 0^o to 4^o tilt of filter (in steps of 0.5^o).

7. Measured transmission profiles of all the witness samples in collimated beam for 0° to 4° tilt of witness sample (in steps of 0.5°), before and after each environmental test.

8. Performance of all the filters in corresponding F/# as per specifications should be provided based on measurements in points 6 &7.

Acceptance criteria:

Acceptance criteria, is that all the NBF's should meet the corresponding specifications mentioned in Tables 2-5. Witness samples should undergo the environmental tests as per the acceptance test plan matrix, and should retain their mechanical integrity, should not have any edge chipping or cracks. Witness samples should meet the specifications in Tables 2-5 before and after environmental tests.

Shelf life:

Supplied filters should have a storage shelf life of 3 years and further operational period of 5 years without any degradation in the performance. Vendor shall specify the suitable storage conditions.

Packaging:

All Filters and Witness samples shall be packed in class 100 clean room compatible containers that do not make contact with filter surfaces. Packing should be done under clean room conditions.

2) DICHROIC BEAM SPLITTERS (DBS)

IV. Physical dimensions and quantities of Dichroic beam splitters:

Dimensions and quantity of Dichroic beam splitters				
		Diameter	Thickness	
S.No	Name	(mm)	(mm)	Quantity
1	DBS1	94	15	4
2	Witness sample DBS1	25	5	4
3	DBS2	60	7	4
4	Witness sample DBS2	25	5	4

Table 6: Required Dichroic beam splitters, dimensions and quantities.

V. Technical specifications of Dichroic beam splitters

This section gives the technical specifications of each DBS in detail. Table 7& 8 gives detailed technical specifications of DBS1& DBS2.

Table 7: Specifications of DBS1.

Specifications of Dichroic beam splitters 1 (DBS1)					
S.No	Parameter	Nominal	Tolerance (max/min)		
1	Shape	Circular			
2	Physical diameter	94mm	+0mm	-0.1mm	
3	Clear Aperture	>89mm			
4	Centre thickness	15mm	+0.05mm	-0.05mm	
5	Substrate	N-BK7 (H4)/ Fused Silica			
6	Wedge angle	342"	+20"	-20"	
7	Transmitted wavefront error (PTV)	$\lambda/4$ (with power) λ : 632.8nm			
		<0.5 fringe on each			
8	Power on each surface	surface			
9	Micro roughness	<15Å			
10	Mean Reflectivity (R)	480nm to(508nm,±1nm) : > 95%			
11	Mean Transmission (T)	(522nm,±1nm) to 1100nm : >95%			
12	Ripples in Reflection & Transmission	<5%			

13	T&R Non-Uniformity over active area	<2%		
14	Angle of Incidence	9 ⁰		
15	Cone angle of incidence	+1.8° to -1.8°		
	S&P polarization differential			
16	transmission	<1% (average value)		
17	Cosmetic quality	60/40 , With best efforts to achieve 40/20.		20.
18	Environmental durability	Described in section VI		
19	Operating temperature	$22 {}^{\rm o}{\rm C} \pm 3^{\rm o}{\rm C}$		

Table 8 : Specifications of DBS2.

Specifications of Dichroic beam splitters 2 (DBS2)				
S.No	Parameter	Nominal	(max/min)	
1	Shape	Circular		
2	Physical diameter	60mm	+0mm	-0.1mm
3	Clear Aperture	>57mm		
4	Centre thickness	7mm	+0.05mm	-0.05mm
5	Substrate	N-BK7 (H4)		
6	Wedge angle	1726"	+20"	-20"
7	Transmitted wavefront error (PTV)	$\lambda/4$ (with power) λ : 632.8nm		
8	Power on each surface	<0.5 fringe on each surface		
9	Micro roughness	<15Å		
10	Mean Reflectivity (R)	1025nm-1125nm : >95%		
11	Mean Transmission (T)	500-560nm : >95%		
12	Ripples in Reflection & Transmission	<3%		
	T&R Non-Uniformity over active			
13	area	<2%		
14	Angle of Incidence	47 ⁰		
15	Cone angle of incidence	$+4^{\circ}$ to -4°		
	S&P polarization differential			
16	reflection	<5% (average value)		
17	Cosmetic quality	60/40 , With best efforts to achieve 40/20.		
18	Environmental durability	Described in section VI		
19	Operating temperature	$22 {}^{\rm o}{\rm C} \pm 3^{\rm o}{\rm C}$		

Additional details:

- 1. DBS1 will be used in converging beam of f/16 at an angle of 9°.
- 2. DBS2 will be used in converging beam of F/7 at an angle of 47° .
- 3. DBS1& DBS2 should operate at 22° C ± 3° C.
- 4. Reflectivity of the second surface should be < 2% with best effort target as \leq 1% to minimise the intensity of ghost reflections.
- 5. Witness samples should undergo environmental tests described under Section VI.
- 6. Direction of wedge should be indicated on the sides of the DBS1& DBS2.
- 7. All the materials used in the fabrication should be space qualified.
- 8. Flight DBS and witness coupons should be made of substrates from same batch.

VI. Environmental specifications of Dichroic beam splitters

Following environmental tests should be carried out on the witness samples coated in the same batch as the actual DBS. Parameters to be measured on the witness sample before and after environmental tests are discussed in this section.

1. Coating durability & cosmetics specifications:

Witness samples should undergo the adhesion and abrasion tests as per MIL-C-675A. Cosmetic quality of the witness samples shall be provided as per MIL-PRF-13830B in photographs before and after adhesion and abrasion tests.

Environmental Tests:

1) Thermo vacuum test:

Witness samples should undergo a thermo vacuum test, as per below specifications

No. of cycles	:	5
Temperature range (deg C)		: 9 to 35 deg C.
Duration at each temperature	:	2 hours.
Rate of temperature change		: ~2 deg C/minute
Vacuum level		: $1 \ge 10^{-5}$ mbar or better.

2) Humidity Exposure (as per MIL-C-675A)

Relative humidity	:	95%
Temperature	:	$50^{\circ} \text{ C} \pm 2^{\circ} \text{ C}$
Exposure duration	:	24 hrs

3) Acceptance test plan matrix:

1 st sample		: Adhesion & Humidity
2 nd sample	:	Abrasion & Thermo-Vac
3 rd &4 th sample	:	Control sample

Spectral properties like transmission & reflection bands and wavefront error of the witness sample should be measured before and after environmental tests and should meet the corresponding specifications mentioned in Tables 7&8. All witness samples should meet the corresponding cosmetic quality specifications as per MIL-PRF-13830B in Tables 7&8 before and after environmental tests.

Deliverables:

1. Dichroic beam splitters listed in Table 6, meeting the corresponding specifications in Table7&8.

2. Witness samples listed in Table 6, coated in the same batch as the flight DBS and undergone environmental tests as per Section VI.

3. Conformance certificates for the specifications in Table7&8.

4. Certificates of substrate glass material should be provided.

5. Measured surface figure data on both sides and wedge angle should be provided.

6. Measured transmission and reflection profiles of all DBS at corresponding angle of incidence as per Table 7&8.

7. Measured transmission and reflection profiles of all the witness samples at corresponding angle of incidence as per Table 7&8 before and after each environmental test.

Acceptance criteria:

Acceptance criteria is that, all the DBS should meet the corresponding specifications mentioned in Tables 7&8. Witness samples should undergo the environmental tests as per the acceptance test plan matrix, and should retain their mechanical integrity, should not have any edge chipping or cracks. Witness samples should meet the specifications in Tables 7&8 before and after environmental tests.

<u>Shelf life:</u>

Supplied DBS should have a storage shelf life of 3 years and further operational period of 5 years without any degradation in the performance. Vendor shall specify the suitable storage conditions.

Packaging:

All DBS and Witness samples shall be packed in class 100 clean room compatible containers that do not make contact with DBS surfaces. Packing should be done under clean room conditions.

Reference documents:

1. MIL-PRF-13830B: Optical component inspection.

2. MIL-C-675A: Thin film coatings, adhesion, abrasion resistance, humidity tests.

Expected delivery schedule:

4 to 5 months from the date of release of purchase order.

For further information/clarifications

For any other technical clarifications, the indentor "*rajkumarn@iiap.res.in / brp@iiap.res.in*" may be contacted. For any administrative matters, the Purchase Officer "*purchase@iiap.res.in*" may be contacted.