

# PARAS-1 CCD DEWAR (cryogenic)

## Report for Proposal



### Introduction:

PARAS (PARAS-1) is a high resolution spectrograph coupled with the PRL 1.2m telescope at Gurushikhar, Mount Abu, Rajasthan, India. It has a 4K X 4K CCD detector which is cooled and maintained at the temperature of -120 degree Celsius with an accuracy of +/- 0.01 degree Celsius over an observational day and night. Presently, the CCD is cooled using pressurized Helium gas. PRL is envisaged to replace the current system with Liquid Nitrogen (LN2) based cooling system.

This proposal report delineates the pivotal design elements of the project, establishing binding guidelines for the vendor. **Adherence is mandatory, except for minor modifications aimed at enhancing system performance, subject to dual consultation with the user. It is imperative to comprehend each requirement; a mere "YES" without adequate explanation will render it null.** Technical clarifications should be sought through the appropriate channels.

### **List of Deliverables and bid conditions for the Vendor:**

- 1) The cryogenic dewar system along with its requisite electronics.
- 2) The vendor will be responsible for the complete design, analysis and testing of the system in close loop with PRL. All the test reports (Material test reports, fabrication test reports at each stage and functional test reports) must be submitted to the PRL at various stages of the project and seek dual approval from the PRL.
- 3) The vendor must submit the 2D drawings and 3D model of the entire system for approval from PRL prior to beginning the fabrication.
- 4) Detailed test reports of the above showing various specs mentioned in this document are met and any deviation from the spec should be immediately reported for inspection and may lead to rejection if found hindering the final expected performance. **The technical bid must contain the conceptual design of the system and the test procedures.**
- 5) The sensitive cryogenic system must be shipped in protective and inside cushions and are high strength storage/shipping containers that won't rust or dent.
- 6) **The vendor must clearly demonstrate their capability of in house manufacturing and testing such large cryogenic Dewar for CCD housing. Failing to submit the purchase order of such work done in past may lead to the rejection of the bid.**
- 7) Since this is a time bound program, the cryogenic system is expected to be delivered in about max 08 months of time from the time of accepting the work order.
- 8) The vendor must use the high quality material (SS-304L/SS-316; OFHC Copper, Al-6061, ultra-high vacuum compatible Peek/G-10 Material etc). The material testing certificates must be submitted to PRL before using it for fabrication.

## Mechanical Design and interface with the existing system:

The cryogenic system shall be designed to be compatible with the existing system. The dewar will be used to cool the a 4KX4K CCD through the cold fingers as mentioned above. The cryogenic system shall have a cold plate directly in contact with the LN2 temperature. Adequate no of cold fingers (size and no shall be estimated through thermal design and analysis) shall run and cool the CCD at -120 degree Celsius and maintain it within an accuracy of +/- 0.01 degree Celsius. As the CCD system is very delicate and fragile, the support system shall be designed comprehensively in close loop with PRL. Adequate Finite Element (FE) analysis (Static, Dynamic and Thermal) shall be carried out to support the design criteria. The mechanical and implementation plan is in the scope of the vendor. PRL will review and approve the mechanical design before the fabrication process begins. Fig-1 shows the schematic of the existing system.

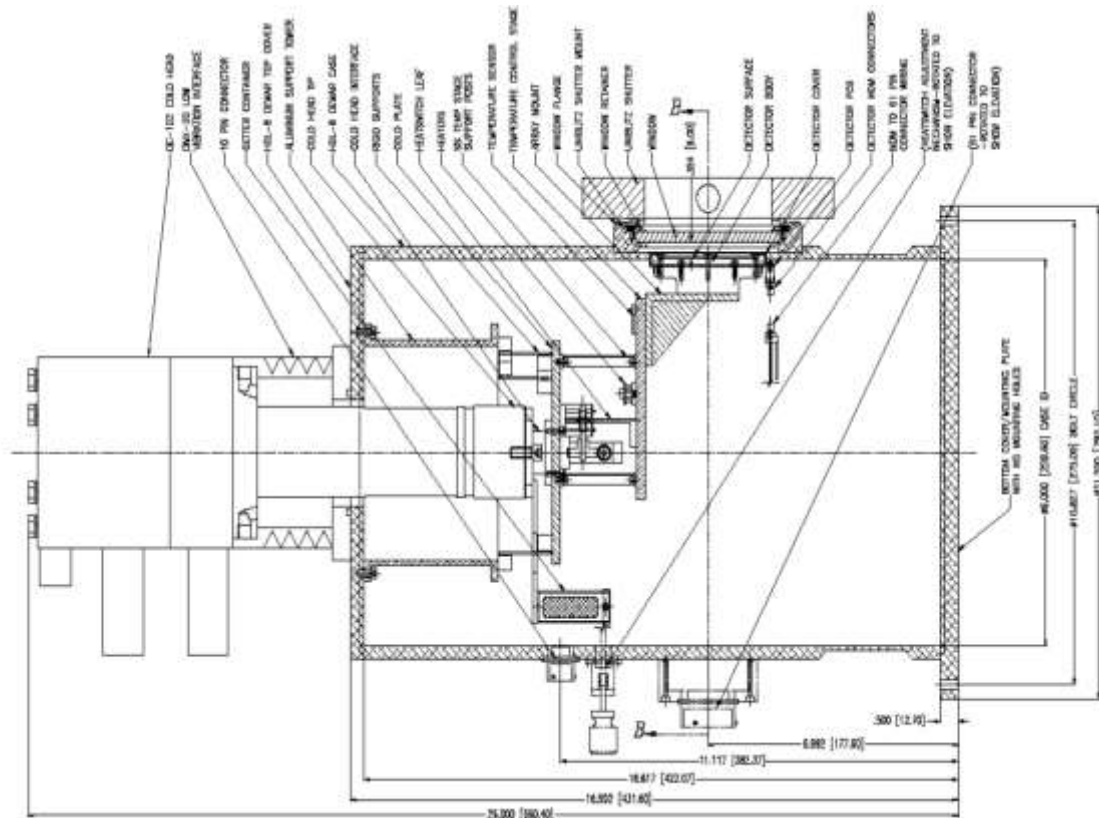


Fig-1 This is a schematic of the existing system and is not to the scale. The figure shows the bare minimum existing subsystem of the cryogenic dewar (Helium based). The cooling system has to be upgraded to the LN2 based.

## **System Compliance Statement**

Vendors must fill up details against each of the requirements of the compliance statement. Silence on any point shall be treated as non-compliance. Simple compliance without details, lack of information or information without proper explanation shall also be treated as non-compliance. **Hence, in order to strengthen the merit of the offer, please provide a detailed explanation about how the vendor intends to comply with each and every specification of this tender. This is an essential part of the offer and offer without detailed compliance report shall be treated as incomplete liable for rejection without assigning any reason thereof.**

<b>Sr. No</b>	<b>Item</b>	<b>Description</b>	<b>Comments/ Remarks/ Offered specifications (To be filled by the Vendor)</b>	<b>Yes/No (To be filed by Vendor)</b>
1	CCD Dewar	The base design of the existing system is shown in Fig-1. Vendor shall come up with detailed design of the LN2 based cooling system as per requirements mentioned above.		
2	Material	The materials to be used are AL6061-T6; OFHC Copper; SS-304L; SS-316; Peek; G-10. All these and other materials used shall be high vacuum compatible		
3	O-Rings material	Only Buna-N O-rings to be used in this system. The O-rings shall withstand the cryo temperature (up to -60 degree Celsius) without leak		
4	Material Test reports	All the requisite material test reports to be submitted to PRL		

		before beginning the fabrication.		
5	FE Static Analysis	The static FE analysis shall be carried out to show the stress and strain are within allowable limits		
6	FE Dynamic analysis	FE dynamic analysis shall be carried out to calculate the Eigen frequencies of the system		
7	Thermal Estimation	This cryogenic system will be used to cool the 2K X 2K CCD at -120 degree Celsius and maintain it within the +/-0.01-degree Celsius precision. A small heater will be used at the back of the CCD cold plate support to actively control the temperature of the chip. The design of the cold finger shall ensure that even in case of the failure of the heater, the CCD must never see the temperature below -130 degree Celsius. A comprehensive thermal modeling and analysis shall be carried out by the vendor for the thermal design of the system. <b>The vendor must put the thermal estimation and design description here in this compliance matrix, failing to do so may lead to the rejection of the offer.</b>		
8	LN2 tank Capacity	The LN2 tank capacity must be estimated with proper thermal analysis and the tentative cold finger design shall be presented with the bid		
9	Temperature at the CCD mosaic	-120 degree Celsius +/- 0.01 degree Celsius		

10	Vacuum level	The Dewar shall be reach a pressure level of $\sim 10^{-6}$ mbar with LN2 filling.		
11	Vacuum Leak Rate	$1 \times 10^{-9}$ mbar·L/s		
12	Material Testing	Quality assurance material testing		
13	Cables/wires	Vacuum Compatible cables/wires wherever required		
13	Vacuum Leak testing	The mechanical and opto-mechanical design has to be carried out by the vendor at PDR level and get it approved by PRL before beginning the fabrication		
14	Anodization	The dewar's extended tube inside the vacuum chamber must be black anodized. The anodization shall be vacuum compatible. The outer part must have anti-static (Gold) coating.		
15	Deliverables:	<ul style="list-style-type: none"> <li>● CCD Dewar with Ln2 tank, automated Ln2 filling lines, getter assembly, necessary radiation shields, necessary mounting provisions</li> <li>● vacuum line with valves, seals etc.</li> <li>● cold finger system</li> <li>● heater for chip controlled heating,</li> <li>● Housing for CCD with minimum deformation in all orientation of dewar</li> <li>● OHFC copper heat sink and OHFC copper strips</li> <li>● Arrangement for glass window and shutter</li> </ul>		

		<ul style="list-style-type: none"> <li>● black anodization and anti-static coating wherever required</li> </ul>		
16	Tests	<ul style="list-style-type: none"> <li>● CCD chip cool down and warming up time</li> <li>● detailed thermal load analysis</li> <li>● detailed vacuum time and hold time</li> <li>● Ln2 tank hold time analysis</li> <li>● &lt;1-micron deformation at ccd chip mounting in all configuration/orientations of dewar</li> <li>● Vacuum Compatible cables/wires wherever required</li> </ul>		