

# LYRA on PROBA 2



Weltstrahlungszentrum Centre Mondial de Rayonnement World Radiation Centre  
*Physikalisch-Meteorologisches Observatorium Davos*

## Opto-Mechanical Properties

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Prepared by: Silvio Koller, PMOD/WRC

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### Change Record and Approval

1. Version 1.00, prepared by Silvio Koller, 05.01.2004
2. Version 1.01, updated based on JFH comments, 14.01.2004
3. Version 1.02, updated: precision aperture tbc, 06.02.2004

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## 1 Document History

Version	Issue Date	Changes
1.00	05.01.04	Initial issue (Silvio Koller)
1.01	14.01.04	Calculation off-pointing changed
1.02	06.02.04	Precision aperture diameter tbc because of non-satisfying off-pointing capability

## 2 Reference Documents

Item	Doc. Nr.	Description
RD1	WRC 0311-100-1	Mechanical drawing LYRA package
RD2	WRC 0310-103	Mechanical drawing Detector head

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## 3 Introduction

This document describes the opto-mechanical properties of LYRA. The **Lyman-Alpha Radiometer** comprises three identical filter radiometers or units. Each unit is equipped with four different channels, detecting different wavelengths or wavelength ranges. The LYRA package is mounted on the PROBA-2 platform and connected to the LYRA/SWAP interface box.

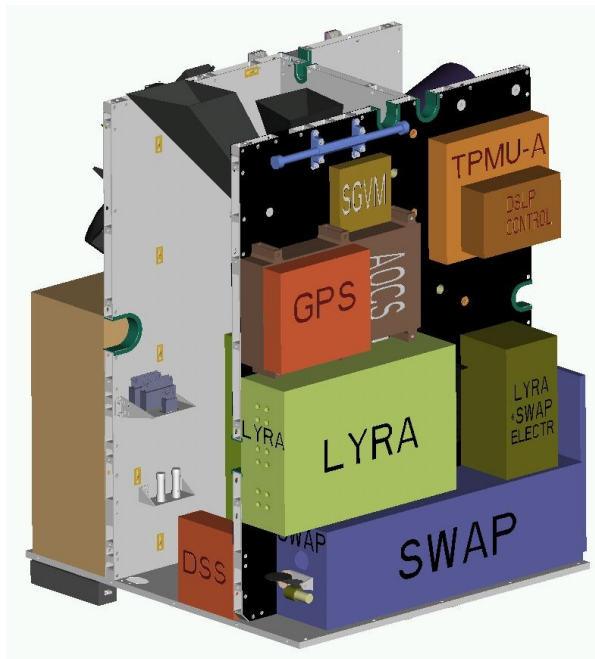


Figure 1 LYRA on PROBA-2 S/C

The following graph shows the configuration of the filter radiometers within LYRA. One unit will be chosen as nominal instrument, the two other units are switched on temporarily to detect degradation of optical filters, detectors and others.

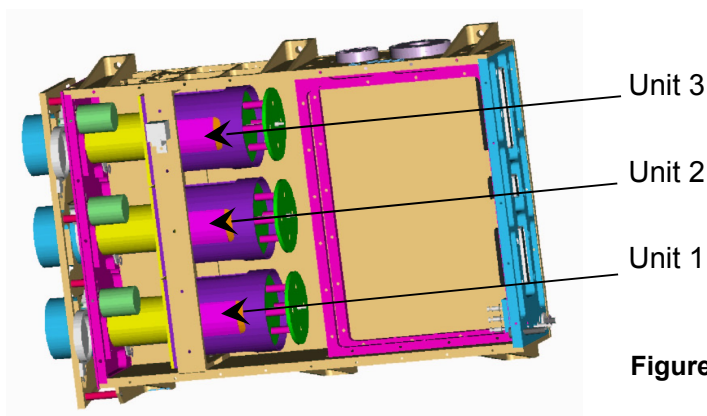


Figure 2 LYRA with removed side wall

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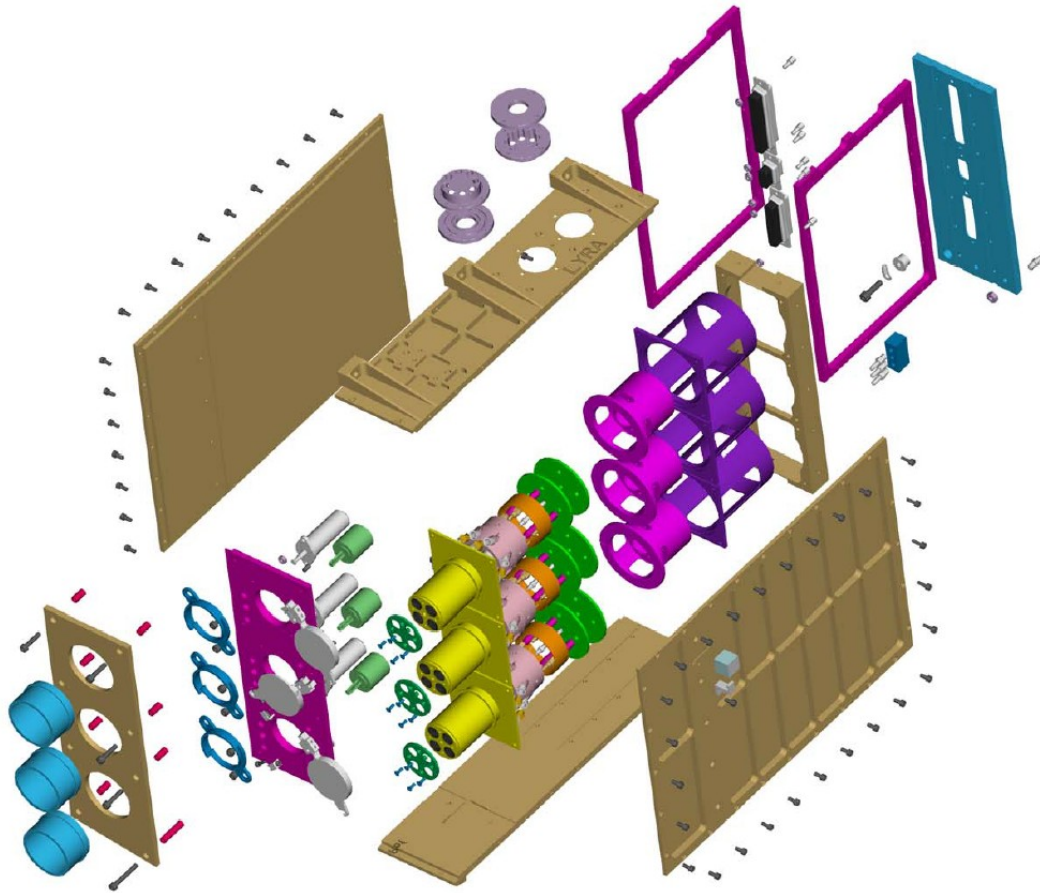


Figure 3 Exploded view of LYRA

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## 4 Opto-mechanical configuration

The optical path of one channel (four in one unit) consists of a view-limiting aperture (1), a precision aperture (2), an optical filter (3) and the detector (4).

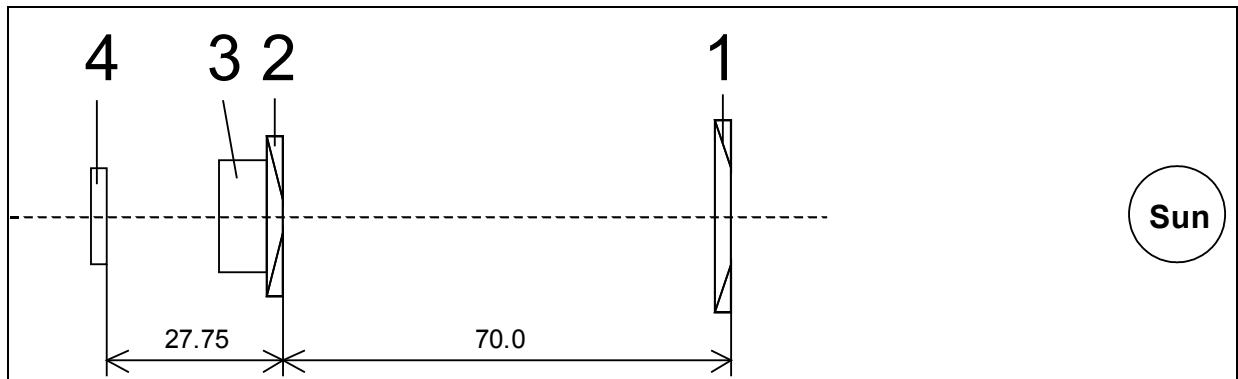


Figure 4

### 4.1 Mechanical Dimensions

1	View-limiting aperture	$d_i$	8 mm
		$d_o$	n.a.
2	Precision aperture	$d_i$	3 mm (tbc)
		$d_o$	12.6 mm
3	Optical filter	$d_i$	> 5 mm
		$d_o$	$10^{+0/-0.2}$ mm
		$l$	$\leq 7.5$ mm
4	Detector sensitive area	$d_o$	4 mm
	Detector diameter	$d_{om}$	5 mm
	Distance 1 to 2	$a$	70 mm
	Distance 2 to 4	$b$	27.75 mm

$d_i$  inner diameter  
 $d_o$  outer diameter  
 $d_{om}$  outer diameter maximum

# LYRA Opto-Mechanical Properties



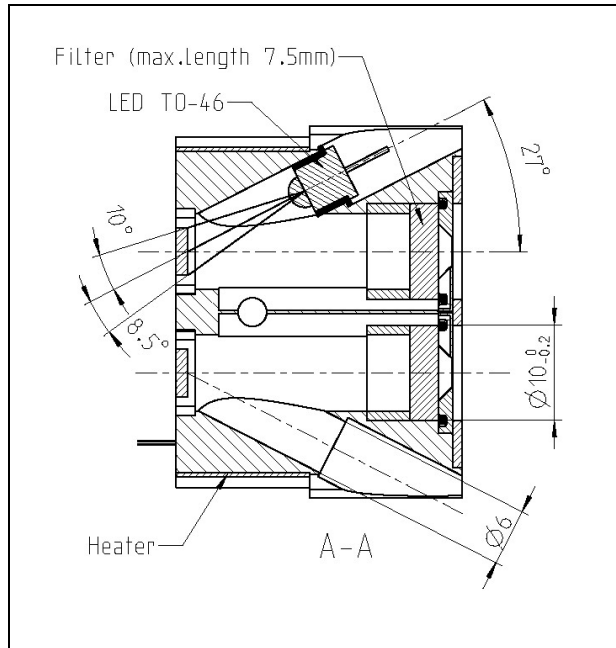
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## 4.2 Mechanical mounting

The major elements of the opto-mechanical parts are mounted within the detector heads (see also RD2).



**Figure 5**      **Detector Head**

The detector head itself is a solid aluminum block. The detectors are placed into a rectangular pocket, which provides exact mechanical positions. The detectors are secured with epoxy glue. Mounting tolerance of the detectors is  $< 0.1\text{mm}$  in all three directions. The filters and precision apertures are set into a blind hole. A spacer ring provides the exact distance for adapting to different filter thickness. The precision aperture is pressed against the detector head, whereby an O-ring acts as a spring.

The view-limiting aperture is screwed onto the muffler tube (see Figure 3).

The visible and UV LED's are captured with thin Delrin™ cylinders. The cylinder and LED's are placed into a blind hole and secured with epoxy glue to the detector head.

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## 5 Field of View / Off pointing limitations

The crucial numbers for the calculation of the FOV are:

Distance detector – precision aperture  $b = 27.75 \text{ mm}$   
Distance prec. aperture – view-limiting aperture  $a = 70.00 \text{ mm}$

Diameter detector  $d_d = 4 \text{ mm}$   
Diameter precision aperture  $d_p = 3 \text{ mm (tbc)}$   
Diameter view-limiting aperture  $d_v = 8 \text{ mm}$

### a) Unobstructed half FOV:

View-limiting aperture:  $\arctan((d_v-d_p)/2/a) = 2.05^\circ$   
Precision aperture:  $\arctan((d_d-d_p)/2/b) = 1.03^\circ$

### b) Full opening angle

The full opening angles of the apertures are:

View-limiting aperture:  $2 \cdot \arctan((d_v/2)/(a+b)) = 4.69^\circ$   
Precision aperture:  $2 \cdot \arctan((d_p/2)/b) = 6.19^\circ$

The view-limiting aperture defines the full opening angle.

### c) Off pointing limitations

The off pointing limitation of sun observations (target size =  $0.5^\circ$ ) is the unobstructed half FOV minus half target size.

Off pointing limitation =  $(1.03^\circ - 0.25^\circ) = 0.78^\circ$ .

The off pointing limitation will be reduced by a possible jitter (assumption  $0.3^\circ$ ) to  $0.48^\circ$ . Thus the safe unobstructed FOV is  $0.96^\circ$ .

### d) Mounting tolerances

The mounting detector housing- and detector placement tolerances (sum =  $0.2\text{mm}$ ) reduce the unobstructed half FOV and off pointing capabilities by “reducing” the semi-diameter of the detector:

*Unobstr. half FOV prec. aperture* =  $0.62^\circ = 37'$   
*Unobstructed FOV prec. aperture* =  $1.24^\circ = 74'$   
*Off pointing limitation* =  $0.37^\circ$   
*Safe unobstructed FOV* =  $0.14^\circ$



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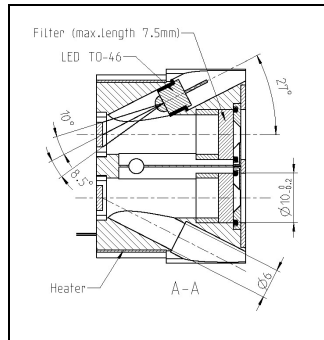
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## 6 VIS LED's / UV LED's

The angle of incidence for the visible and the UV LED's is 27°. The LED – Detector distance is chosen so that a 20° opening angle of the LED would cover the whole detector surface.



### 6.1 Visible LED's

Type: 10 Degree Angle UV LED  
Manufacturer: TheLEDLight.com  
Peak WL: 375nm  
Full Opening Angle: 10°

Housing: TO-46

### 6.2 UV LED's

Type:  
Manufacturer: Tokyo GAS  
Peak WL: 235 nm (external quantum efficiency 0.032%)  
Full Opening Angle: 20°

Housing: TO-46