Precision Alignment Mechanism (PAM) for the Roman Space Telescope

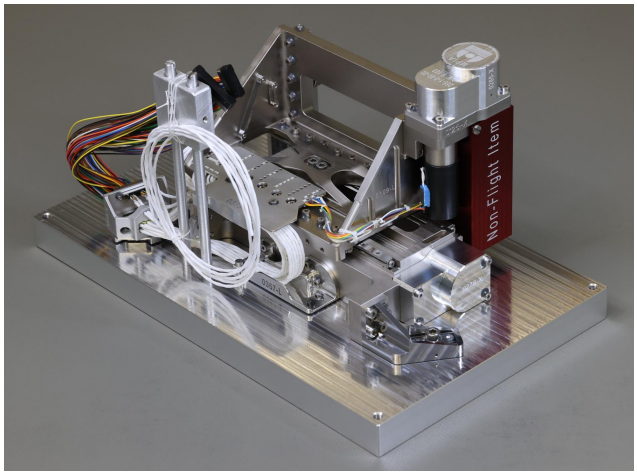

Fig. 1: One of the PAM flight models manufactured by MPIA and vH&S on its transport plate (w/o optical plate).

PAM Description

The Precision Alignment Mechanism (PAM) is used on the optical bench of the CoronaGraph Instrument (CGI) within the Roman Space Telescope (RST). The coronagraph instrument with its 2.4 m primary mirror will be used for direct imaging of exoplanets from its position at the Lagrange point L2.

There are 6 PAMs in total on the optical bench. All the PAMs are placed in the zigzag folded optical beam of the instrument. Each mechanism is carrying many individual optical elements, such as filters, mirrors, lenses and masks on 6 different optical plates. An optical plate is mounted on the movable part of the mechanism. These plates can be moved precisely in horizontal and vertical direction to position the needed optical elements into the optical beam of the coronagraph. Some optical elements are used to mask out an extrasolar star, to make planets beside the masked star visible. The PAMs are categorized in two models, small and large. The large ones have a longer mechanical travel range than the small ones.

The optical plates with the optical elements are supplied by the NASA Jet Propulsion Laboratory (JPL).

Functional Principle

The mechanism can be moved in 2 axes by dedicated brushless DC motors. The motors are equipped with hall sensors to measure motor axis angular position. Every motor comes with a planetary gear head which drives a precision spindle to move one mechanism axis. Every axis is guided by precision linear guides. The absolute plate position can be measured by dedicated optical linear encoders. The driving space electronics for these mechanisms was not part of the vH&S activity.

Specifications for a Small PAM

Dimensions L×W×H [mm]	$109.4 \times 173.1 \times 106.4$
Mass	976 g w/o optical plate
Travel range horiz.	46.828 mm
Travel range vert.	36.778 mm
Piston lifetime stability	typ. +2 µm/−5 µm
Clocking lifetime stability	typ. −12 arcsec
Tip/tilt lifetime stability, vert.	typ. −19.0 arcsec
Tip/tilt lifetime stability, horiz.	typ. −6.0 arcsec
Operating temp.	10°C to 30°C flight acceptance
Radiation tested	TID 12.5 krad(Si) TNID 1.4×10^{11} p/cm^2
Technical readiness level (01/2024)	TRL 8

Team Responsibilities

vH&S:

- BrushLess DC (BLDC) motor procurement and qualification. Type of motor and gear head was predefined by our customer.
- Linear encoder procurement and qualification. Type of encoder was predefined by our customer.
- Structural and thermal analysis.
- Shock and vibration testing analysis.
- Design optimizations based on test and analysis results.
- Harness design, simulation, manufacturing, and integration.
- Cleanliness and contamination control.
- Quality assurance.
- Documentation support.

MPIA (our customer):

- Everything else not covered by vH&S.

Contact

von Hoerner & Sulger GmbH
Schloßplatz 8, D-68723 Schwetzingen, Germany
`http://www.vh-s.de`
Guido Krein, Dr. Hartmut Henkel
0 62 02 / 57 56-16
krein@vh-s.de, henkel@vh-s.de