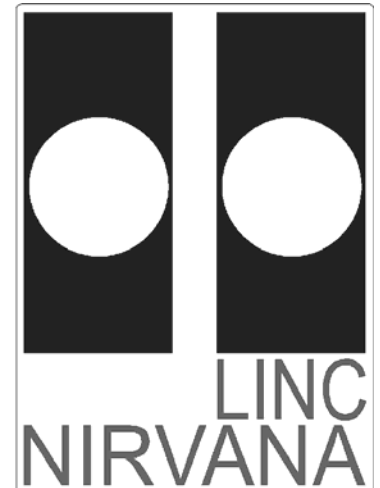


LINC-NIRVANA

The **L**BT **I**Nterferometric **C**amera and
Near-**I**nfra**R**ed / **V**isible **A**daptive
iNterferometer for **A**stronomy

A collaborative project of the MPIA Heidelberg, INAF-Arcetri,
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DM - Moving Stage

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1 Scope

This document describes the mechanical design of the deformable mirror stage unit.

2 Applicable documents

No.	Title	Number & Issue

3 External Interfaces

Item	Short description

4 Acronyms and abbreviations

CFRP	Carbon Fiber Reinforced Plastic
DM	Deformable Mirror
FFTS	Fringe and Flexure Tracking System
GWS	Ground-Layer Sensing System
HW	Hardware
LBT	Large Binocular Telescope
LN	LINC-NIRVANA
MPIA	Max-Planck-Institut fuer Astronomie Heidelberg, Germany
MHWS	Mid-High-Layer Wavefront Sensing System
PDR	Preliminary Design Review
SW	Software
TBD	To Be Defined/Determined
UPS	Un-Interruptable Power Supply
US	United States of America
Units	
m	Meter
cm	Centimeter
kg	Kilogram
V	Volt
Hz	Hertz

5 Introduction

Multi-conjugate adaptive optics works by placing the various DMs at conjugates or images of atmospheric turbulence layers. The adaptive secondaries are conjugated to the ground layer. The Xinetics DMs in the collimator optics assembly are also conjugated to atmospheric layers. Conjugating the various DMs to the actual layers causing image degradation produces the maximum quality of adaptive correction. Therefore, the DMs are on a linear stage, allowing the observer to adjust for the best altitudes.

Both DMs are adjustable (motorized) in tip and tilt to compensate for alignment errors at different positions.

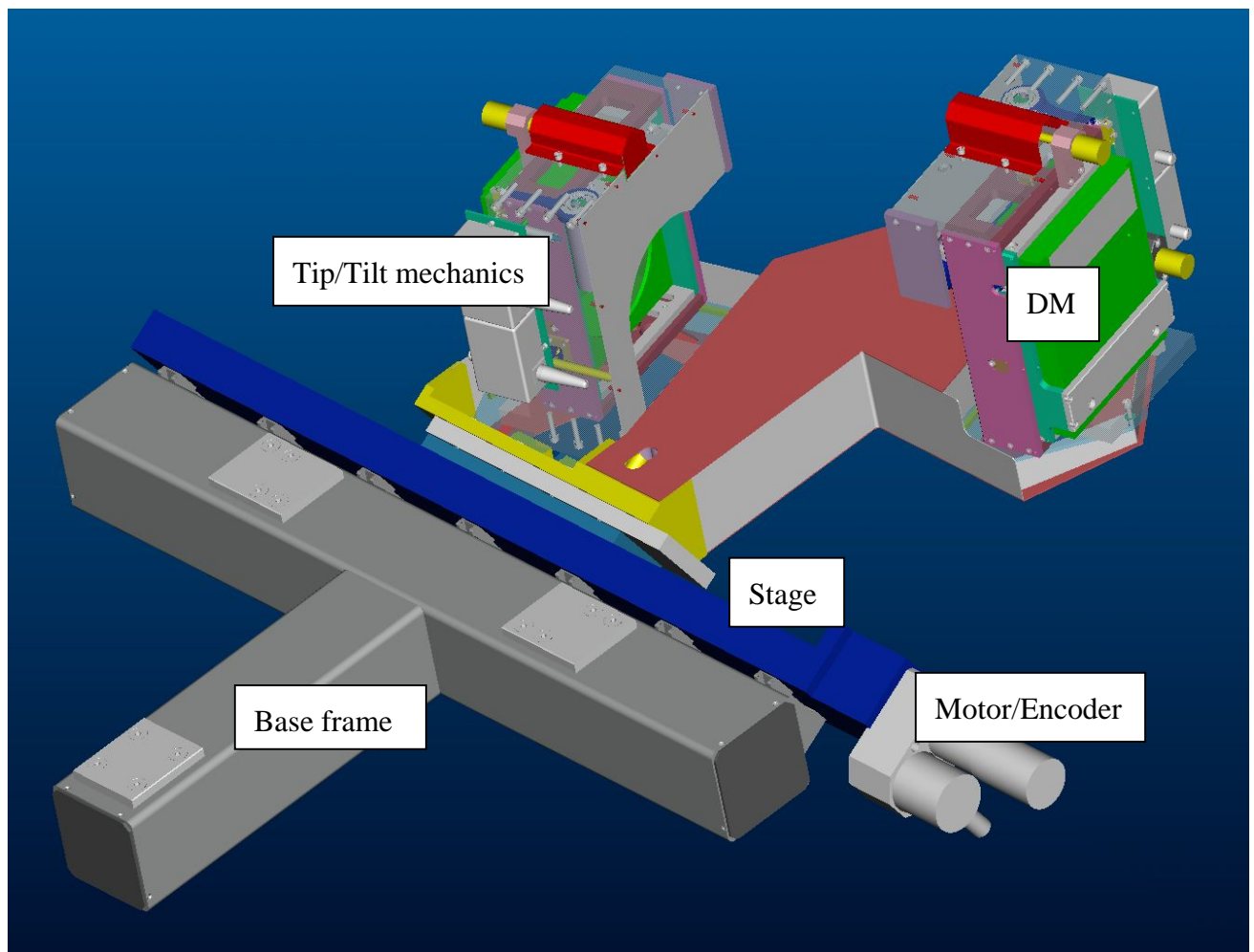


Figure 1: Left DM-moving stage with two DMs

6 Requirements

Table 1 shows the list of requirements and boundary conditions for the left and right DM-moving stages.

This list was the baseline for an industrial call for proposals.

Requirements / Boundary conditions	Value or description
Number of units	2 (left and right)
Stage motion range	550 mm (absolute encoder), parallel to optical axis
DM mass (1 unit)	9 kg
Manual adjustment range of one complete DM-unit	± 5 mm
Telescope working range (operation)	60° from zenith
Absolute positioning accuracy - stage	0.1 mm (absolute encoder)
Temperature range	-15 C° to 25 C°
Humidity (operating)	5 % - 95 %
Mounting interface CFRP (bench) and DM-unit (steel)	Thermal compensation in DM-unit
Tip/Tilt DM adjustment range (motorized)	$\pm 2.5^\circ$ (absolute encoder)
Tip/Tilt adjustment sensitivity	10 arcsec
Maximum wobble of mirror surface	20 arcsec (at each position)
Maximum decentration of mirror surface	$15\mu\text{m}$ (at each position)

Table 1: List of requirements and boundary conditions

7 Layout

We have chosen the German company Ingenieurbüro Steinbach as vendor for the DM-moving stage of LN.

The document “DM units - Technical Description” describes the technical details of the DM-moving stage (see Appendix A).

Figure 2 and 3 show pictures of the completed unit.

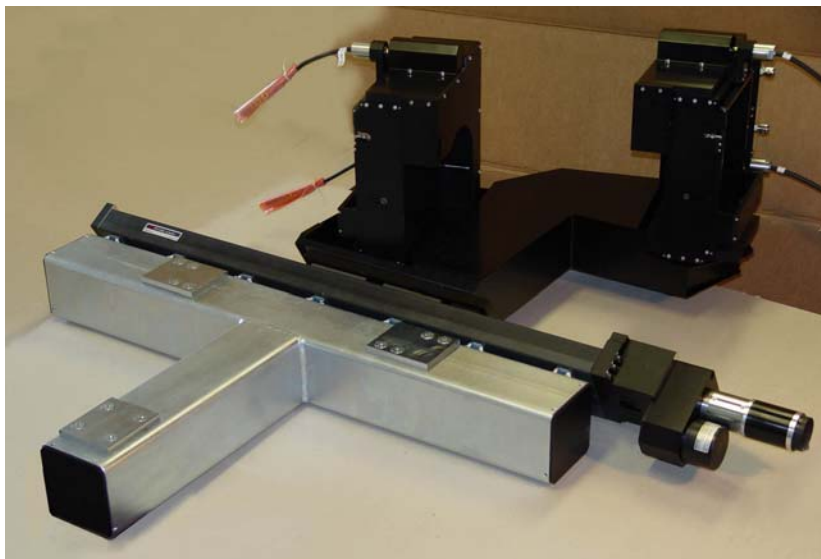


Figure 2: Completed left DM-moving stage

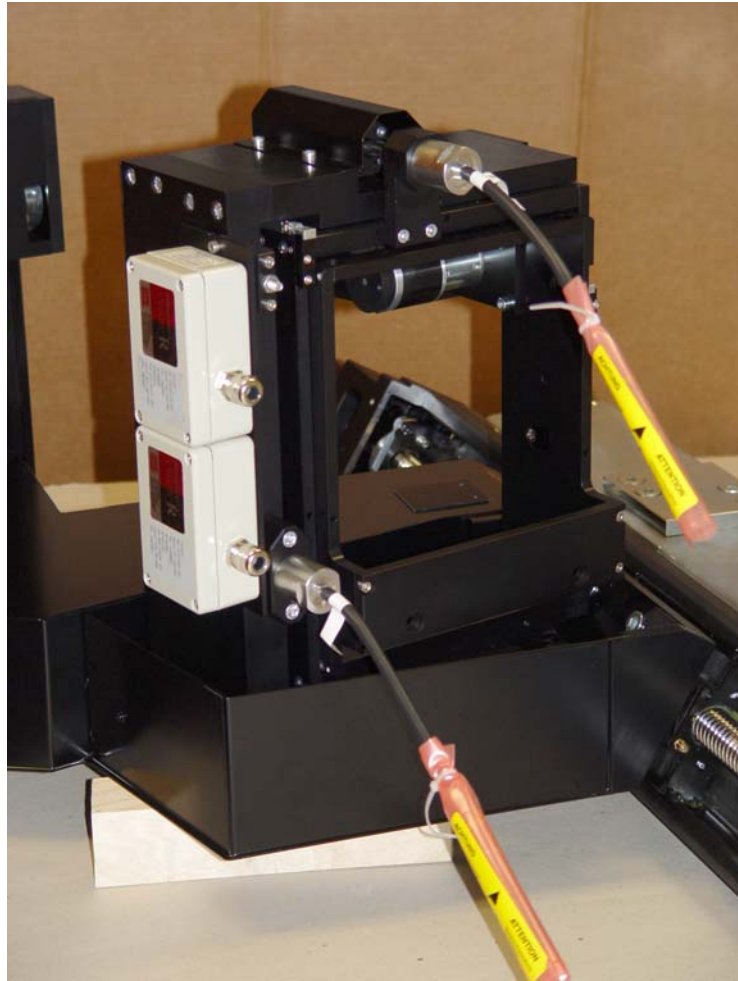


Figure 3: DM mirror mount with adjustment motors and absolute encoders

8 Capability

Tests have shown that the maximum wobble is currently larger than 20 arcsec. We are in discussion with the vendor about the necessary improvements.

9 Availability

The two units were delivered in July 2004 and are undergoing testing.

10 Appendix A

DM units - Technical description (provided by Ingenieurbüro Steinbach)

The DM units are to be mounted onto the desk of the LINC according to the arrangement of the inserts. Their purpose is the positioning and position measurement of the deformable mirrors. The DM units consist of a right and a left partial unit which are both equal, but mirror imaged. Because of that fact we will describe in the following only the left partial unit.

The left unit consists of:

- 1 pc. linear drive left
- 1 pc. basic plate left
- 2 pcs. DM group left

The right unit consists correspondingly of:

- 1 pc. linear drive right
- 1 pc. basic plate right
- 2 pcs. DM group right

Each linear drive has three feet which are to be connected with three inserts each. The inserts have bolt ends of 30 mm in diameter and lengths of 95 mm above the upper surface of the desk. Insert bolts and feet are clamped together with the aid of socket-head screws M8x20. For working step of clamping the three plastic caps are to be removed. The height of 262 mm is to be setted. The adjustment range is ± 5 mm in each direction. The complete partial unit (left or right) can be pushed onto the large desk or be removed in the case of released clamping screws.

For shifting the partial units in the plane of the desk the socket-head screws M10 must be slightly loosed (but not removed). In this situation the adjustment in x- and y-direction becomes possible, and also the rotation around the z-axis. After that the screws M10 have to be tightened again.

Linear guide

The linear guide has a ball screw with 5 mm pitch. The spindle is driven by a stepper motor PLG_52 with gear ZSS_57. The usable range is 550 mm maximum.

Basic plate

The basic plate, holding the two DM-mirror groups, has to fix the distance between the both DM groups. In the range of bores of the DM groups the mirror groups are adjustable against each other. In the zero position the mirror surfaces are parallel. By a prescribed lateral displacement of the DM groups of 114,063 mm a distance of the centers of the parallel mirrors of 433,391 mm must be fixed.

DM group

The DM group has an inner and an outer frame, the latter is beared in a C-shaped chassis. Because of that arrangement tilting movements around the horizontal and the vertical axis are possible. The bearings are free-flex pivots (or with other words cross spring hinges) with an allowed movement range of $\pm 7.5^\circ$, from which $\pm 2.5^\circ$ are used in the DM groups. Also the tilt drives are backlash-free coupled. – The mirror with its housing can be mounted without demounting of the group. For that the flap at the back has to be unscrewed and after that to be screwed onto the mirror box from the back. For adjusting the distance between the both mirrors faced each other the use of shim rings of e.g. 0,5 mm per screw between flap and mirror box is foreseen. After that the flap is to screw loosely onto the back of the mirror box, and the unit has to be put from the back into the frame. Now the flap is to be tightened strongly. After that the inner frame is tilted in such a way that the two upper countersinks for the fillister head screws are free. The mirror box is now fixed by the four $\frac{1}{4}$ "-screws at the inner frame.

In the eventual case of needed demounting of the frame group one must deplace some parts to avoid damaging. The both length measuring systems (MSE) are to be disassembled. They have to be unscrewed together with their holders and then to be pulled out. After that the protection cover of the MSE has to be removed. Underneath the fixing sheets for the electronic boxes compressing springs are arranged, pressing

on the screw pins M5x25. The compressing spring has to be tightened with a suitable tool for relieving the load of the screw pin. After that the ring holder is to be unscrewed from the upper frame part and to be pulled to top. Now at the drive of the vertical axis the screw M3x6 with the small plate for connection with the thread hinge is to be removed. Furthermore the cover sheet of the horizontal drive has to be removed. The upper and the lower cover sheet are clamped with two hexagon socket set screws which must press onto pressure pieces. After unscrewing the set screws one can pull out the hinges. The frame group is now free and can be taken out.

The assembly has to be made in reverse order.

The mirror is protected by a perspex plate. Nevertheless special care is recommended at all works in the neighbourhood of the deformable mirrors.

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