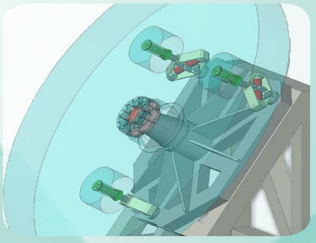


# Piezo actuators for astronomical instrumentation

In astronomical instrumentation, the trend is currently to build up large telescopes. Such structures enable to gather more light and hence, to see our universe brighter. Numerous projects like VLT, ELT, TMT … are well known cases showing the tendency.

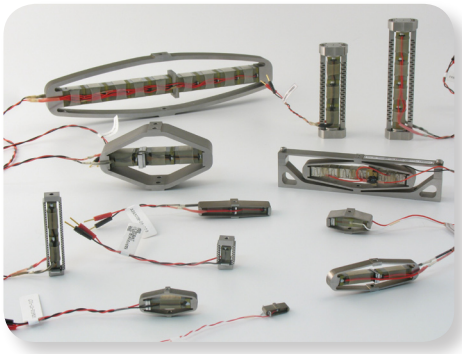
## Objective

The full-size telescopes are sensible to their environment. The challenge is to eliminate the external disturbances which lower the image quality. The disturbances can be environmental factors like gravity, wind, telescope axis deformation… or less intuitive factors like wave front distortion by the atmosphere.
Telescopes are hence equipped with real-time monitoring systems controlling and adapting the position and shape of the mirrors by piston, tilt and steering operations.

## CEDRAT TECHNOLOGIES actuators

CEDRAT TECHNOLOGIES designs two main types of actuators: PPA (Parallel Pre-stressed actuators) and APA® (Amplified Piezo Actuators).
The main features of these actuators are pointed out:

- A good compacity relative to their stoke achieving deformation up to 10%
- A simple internal design and an easy interface
- A ceramic preload sizing with the shell structure
- An operation with a wide frequency range from quasistatic to ultrasonic applications

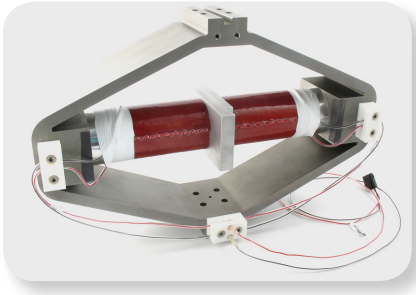


*CEDRAT TECHNOLOGIES piezoelectric actuators.*

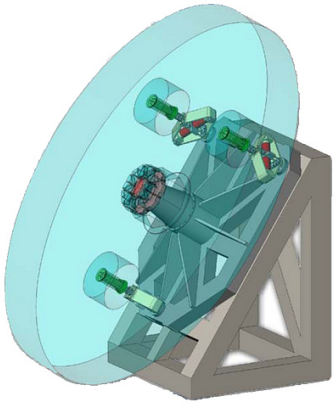
## Some applications

### ELT - M5 Field stabilization unit – ESO

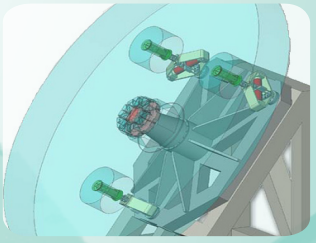
The aim is to generate a dynamic tip-tilt motion with stabilized piston motion on the M5 (2.5m*3m, 400kg) in the Extremely Large Telescope (ELT). The actuation is made by three heavy duty APA500XXL piezo actuators with 500µm stroke, 5 nm resolution and a 100 Hz bandwidth, a 20 kN blocked force and a certified resistance to earthquakes. The prototypes delivered to NTE for ESO fulfil the specifications. For the case of a heavier mirror M5Z, a APA500EXL piezo actuator offering twice more blocked force and stiffness has also been designed in collaboration with CSEM.



*Actuator APA500XXL for M5 field stabilization.*



*M5 Mirror layout.*

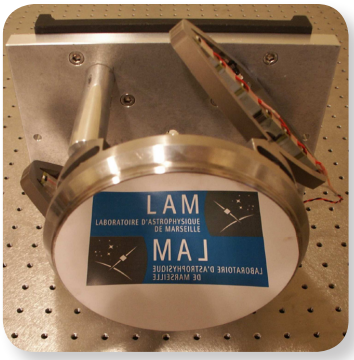


# Piezo actuators for astronomical instrumentation

## Beam steering mirror (CELTIC project) - LAM

The astronomical laboratory of Marseille (LAM) has developed a beam steering mirror (BSM) using actuators APA230L and power electronics from CEDRAT TECHNOLOGIES. The BSM has been designed according to the specifications required on an ELT instrument and can perform translation, tip tilt and deformation.

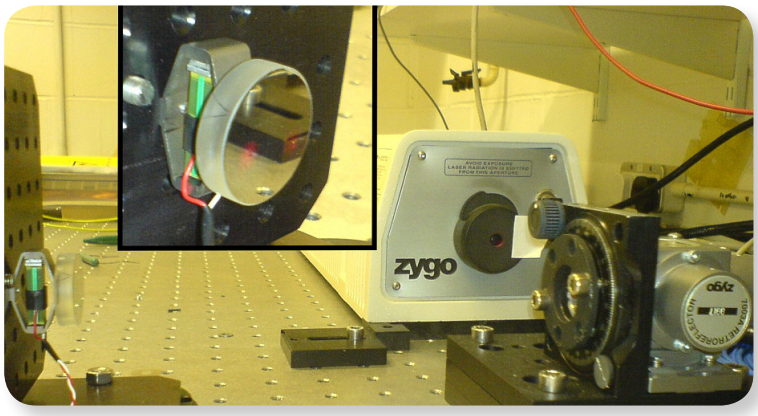
The active surface deformation is meant to compensate for astigmatism introduced by spherical pickoff mirrors. A prototype has shown that this design allows to generate pure astigmatism and focus.
Perceived as a good compromise between stroke (Up to 230µm) and dynamic force (Up to 675N), 4 APA230L are integrated in the device to generate the deformation.




*The Beam Steering Mirror with APA230L.*

## A fast amplified fringe modulator - University of Cambridge

For temporally modulated fringe patterns, stellar interferometric fringe acquisition rates must generally exceed 1kHz to avoid significant atmospheric related loss of contrast and crosstalk between fringe components. Furthermore, sufficient travel and high waveform stability in the temporal phase modulation are essential to clean fringe visibility extraction. The system uses a piezoelectric actuator APA40SM that takes advantage of a resonating stage to achieve an accurate and stable high amplitude motion. Nanometre accuracy in waveform optimisation and in continuous waveform stability is demonstrated.




*Interferometric fringe modulator with APA40SM.*

GROUPE CEDRAT

www.cedrat.com

For more information, please contact:

CEDRAT TECHNOLOGIES
15 Chemin de Malacher - Inovallée
38246 Meylan Cedex - France
***actuator@cedrat.com***
Phone: +33 (0)4 76 90 50 45 - Fax: +33 (0)4 56 38 08 30