

# Electromagnetically Actuated Deformable Mirror Technology

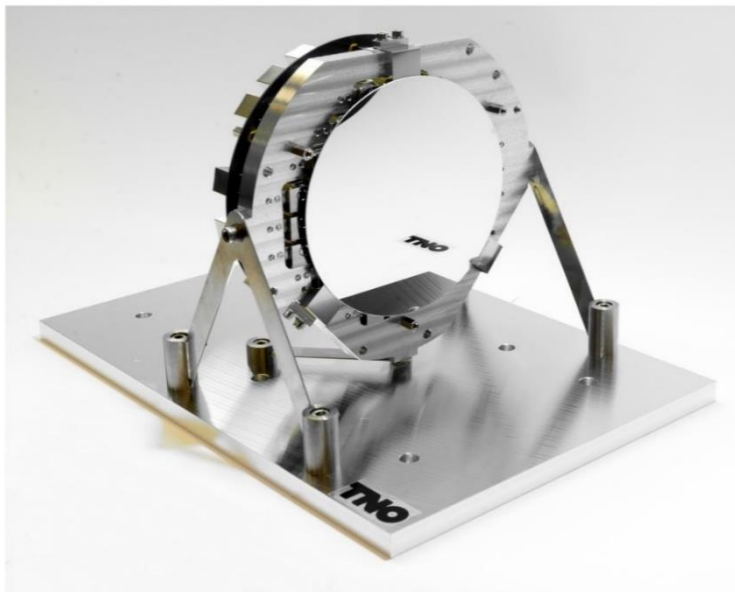
Stefan Kuiper, Rudolf Saathof, (many others)

TNO

**TNO** innovation for life



## 57-actuator DM by TNO



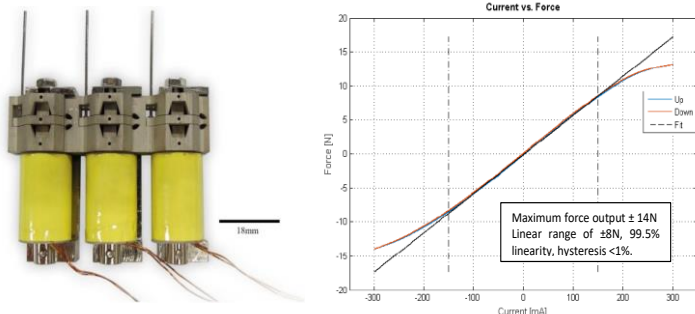
## DM-specifications

Specifications	
Mirror diameter	Ø160mm
Number of actuators	57 (extendable to several >1000)
Actuator pitch	18mm (scalable down to 4mm)
Actuator stroke	40µm, Free stroke 10 µm, inter-actuator
Linearity	>99%
Max Power dissipation	<10mW per actuator
Best flat	<30 nm RMS (TBD)
Actuator coupling	40%

## Actuator technology

TNO's DM technology is based on a unique electromagnetic actuator. The key benefits of this technology for are

- **Large linear range:** >40µm stroke with 99,5% linearity, less than 1% hysteresis
- **Low power consumption:** few milliwatts per actuator
- **Scalable:** Actuator technology scalable down to 5mm spacing
- **High Reliability:** No wear or aging, minimal components



Left; set of three DM-actuators by TNO (18mm spacing). Right; Actuator force response for a ±300mA driving current (blue and red curve). The black solid line shows the linear fit over the ±150mA range over which the force output is ±8N. The linearity over this range is 99.5%, and the hysteresis is less than 1%.

## DM development

TNO is targeting the DM development for applications for atmospheric corrections in both astronomy and laser communication applications. Ongoing developments are aimed at:

- **High optical power applications:** Handling optical powers of more than 1kW in future laser communication applications.
- **Miniatuizes actuators DM,** with spacing down to 5mm and up to several hundreds of actuators.
- **Adaptive Secondary Mirrors** for Astronomy applications.

