ELT M4 Adaptive Mirror Actuator: Magnetic Optimization and Future Developements

C. Del Vecchio[1], R. Biasi[2], D. Gallieni[3], A. Riccardi[1]

[1]National Institute for Astrophysics - Arcetri Astrophysical Obesrvatory - Florence, Italy
[2]Microgate Spa - Bolzano, Italy
[3]ADS International Srl -Valmadrera (LC), Italy

Abstract

The quaternary mirror (M4) of the Extremely Large Telescope will be equipped with an Adaptive Optics Unit, in order to compensate the effects of the atmospheric turbulence. The highly accurate, closed loop actuation of the thin mirror is provided by 5316 contactless actuators. Their core is a voice-coil device, whose magnetic design exploits the concept adopted in all previous units. As some implementation details were changed to deal with the challenges imposed by the performances of the M4 unit, in the present paper we discuss the optimization design of the magnetic circuit carried out by means of COMSOL Multiphysics®, as well as the possible, future study of the dynamic magneto-mechanical behaviour when operating in open and closed loop.

The previous actuators, equipping the LBT, VLT, and Magellan telescopes, are demonstrating to fully accomplish the very demanding task of the turbulence correction. The day-to-day experience gained through the use of those units has allowed to point out possible improvements, in order to increase the efficiency of the actuator and its dynamic response. The role played by the various factors potentially able to enhance the performances of the device are analyzed in this paper, in terms of materials and geometry of the magnetic general arrangement.

The optimization process allows to increase by approximately 20% the efficiency of the proposed geometry with respect to the LBT and VLT ones, while the preliminary, multi-physics dynamic runs make it possible to anticipate some rather interesting capabilities in terms of closed loop performances.

Figures used in the abstract

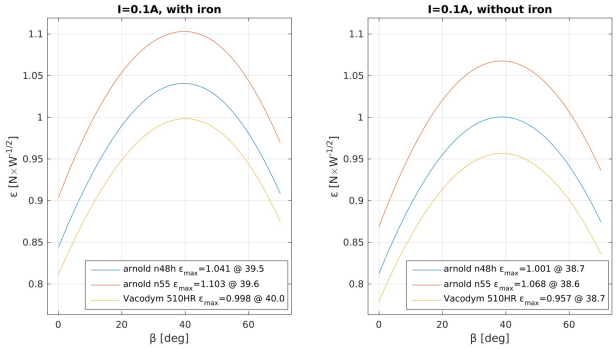

Figure 1: The efficiency of the magnetic circuit with and without the iron piece, as a function of the bias angle of the magnetization of the main magnet and the permanent magnet material.