

CO₂ mode cleaner for Thermal Compensation System of Advanced Virgo+

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As planned for its fifth observation run O5, Advanced Virgo+ will have 80 Watts in main laser. The absorption of laser power in the interferometer's core optics leads to thermal effects causing optical aberrations, ultimately preventing interferometer's operation. To recover detector's ideal operation, Thermal Compensation System (TCS) is needed to correct wavefront distortions. In particular, to correct the axisymmetric part of the spurious thermal lens in the power recycling cavity, a heating pattern is projected on a compensation plate using Double Axicon System (DAS) where a 50 Watts CO₂ laser beam is reshaped using axicons. Due to O5 stringent requirements on the residual of DAS correction, heating pattern distortions caused by the known amount of higher-order modes (HOM) in the CO₂ beam cannot be tolerated. To remove these HOMs, we are constructing an optical mode cleaner which will allow us to retain 95% of the CO₂ laser power for compensation with a strong reduction of HOM related residual correction. To our knowledge, this is the first time a mode cleaner is designed for a high power CO₂ laser. We present here the requirements, motivation and current status of the work, discussing the issues related to the CO₂ wavelength and power.

Primary author: GIRI, P. (INFN Pisa)

Co-authors: CESARINI, E.; FAFONE, V.; LORENZINI, M.; LUMACA, D.; MINENKOV, Y.; NARDECCHIA, I.; ROCCHI, A.

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