

The Cryomirror project for fast payload cooldown

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Cryogenics, currently pioneered by KAGRA, is a common feature of basically any 3G GW interferometer (IFO) proposal and many mid-term upgrades. One of the main issues in the operation of cryogenic GW IFOs is that the extreme vibration isolation needed for the best sensitivity demands a tradeoff between cooling power and additional mechanical noise. The priority is obviously given to science performance and the minimization the noise while the detector is in operation, thus reducing the heat-extraction capability to the minimum necessary to maintain the IFO in steady state when cold. This poses a serious limit during initial cool-down, when the required heat flux is much larger. Depending on the specific detector design, the time required for cooling down the mirrors from room temperature can be of few weeks or even much longer. This represents a severe constraints on the schedule of commissioning and maintenance activities, and could have a potentially disastrous impact on overall duty cycle.

The “Cryomirror” project explores a convenient solution to this problem by disentangling the process of initial cooldown of the mirrors from that of keeping them cold during operation, exploiting the widely different set of requirements and constraints of the two phases. The basic idea is that of establishing an efficient temporary thermal link between the mirror and a cold source; the link must be able to be completely disengaged once the target temperature has been reached, leaving the cooled mirror ready for operation and with no impact from the presence of the cooling device.

The goal is to lower to the order of 1 week or less the time required for cooling the payload of an ET-like detector, substantially improving the overall duty cycle and with no negative impact on the mechanical noise isolation performance during operation.

The project has been the subject of a proposal currently not funded. During the talk we will present some of the details the proposal, including key aspects that have been identified and possible tackling strategies. The intent is that of initiating a wider discussion and establish possible collaborations.

Primary authors: CIANI, Giacomo; CONTI, livia; BAZZAN, Marco; VOCCA, Helios (Università di Perugia); ZENDRI, Jean Pierre; PIERGIOVANNI, Francesco; TRAVASSO, Flavio; PERRECA, Antonio; Dr TAF-FARELLO, Luca (INFN Padova)

Presenter: CIANI, Giacomo

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