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Modelling low-frequency control noise for the Einstein Telescope and deriving a requirements matrix

Angular sensing and control (ASC) noise will play a crucial role in designing the low-frequency interferometer of the Einstein Telescope (ET). We have to ensure at an early design stage of the project that we can achieve tolerable levels of ASC noise that won't limit the target sensitivity of ET. ASC noise arises at the interface of the optical and mechanical systems and sets requirements on both the suspension system and the controls of the optics. In the framework of the Low-Frequency Control Noise Work Package we are planning to investigate this interface. We are developing a Finesse model that will incorporate the high-fidelity suspension model provided by the Suspension Division as well as the optical layout of the Dual-Recycled Fabry-Perot Michelson Interferometer provided by the Optics Division. The two have to be integrated into a unified Finesse model to correctly take into account the radiation pressure effects with a given suspension design and optical layout. In particular, with such a model we can probe how the beam spot offset modulates the coupling of the angular sensing noise into the main degree of freedom (DARM). Requirements on the beam spot RMS and sensing noise are interdependent, therefore our first goal is to provide a requirements matrix: for a given set of beam spot RMS values, provide a set of acceptable sensing noise values and vice versa. As a next step we are planning to include the effects of the longitudinal sensing and control noise (LSC) and more realistic constraints on the sensing/actuation matrix.

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