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Strain noise induced by dust contamination in ET and cleanliness requirements

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Dust particles present inside the Einstein Telescope vacuum pipes can be a possible source of scattered light. It is therefore important to accurately model the light-dust interaction mechanisms and the noise they can generate, so as to be able to put constraints on the maximum allowed population of particles in the vacuum pipes. It is also important to identify the processes/events that may introduce particles inside the vacuum pipes, as well as understand how the population of particles that can interact with the laser beam changes during the lifetime of ET.

In this work, we study two possible occurrences of light-dust interaction: one with dust deposited on baffles and the other with particles moving in space. Particle contamination of the baffles worsen the scattering properties of their surfaces, while particles moving in space cross the beam and scattering light. We briefly summarize the results obtained for dust deposited on baffles and report our advances on sizing the stray light noise contributed by moving particles. For this latter contribution we have developed an original method to quantify the strain noise induced by particles detaching from the tube.

From our results we study how installation procedures and general operations on beam-pipes can contribute in terms of dust contamination. This allows us to place upper limits on the dust particles (number and size) that we can tolerate inside the pipe and hence set constraints on the cleanliness of environments and installation procedures.

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