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Optical simulation methods to study the losses in the stable recycling cavities of Advanced Virgo+

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In this talk, we present the methods used to study losses in the stable recycling cavities of the Advanced Virgo+ detector. The analysis is based on FFT simulation tools developed within the LIGO-Virgo collaboration, specifically the OSCAR and SIS codes.

We explore three simulation methods. First, we study beam reflection on curved mirrors at non-negligible angles of incidence. This highlights the limitations of the paraxial approximation and demonstrates the importance of accurately modeling mirror interfaces to better estimate aberration-induced losses.

Second, we compare the results produced by OSCAR and SIS regarding optimizing the mirrors'radius of curvature (RoC) to minimize coupling losses in the stable cavities. The comparison reveals some small discrepancies that will be worth investigating.

Finally, we introduce a new method to simulate vacuum-squeezed state losses in the signal recycling cavity —an analysis that was previously not feasible. This technique provides new insights into critical losses to the squeezing system of Advanced Virgo+.

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Classification de Session: Contributions (15' + 5' de questions)