



Contribution ID: 19

Type: **Talk**

Ice growth on cryogenic mirrors - thermal noise effects

Thursday, 11 April 2019 16:40 (20 minutes)

Recent work has shown that cryopumping effects between the room-temperature and cryogenic vacuum ducts in a cryogenic gravitational-wave detector can result in the growth of a layer of ice on a cryogenic test mass. Work by Kagra colleagues has examined the effect of this ice layer on quantum noise. Here, we consider the thermal noise implications of a growing ice layer. We show that the coating thermal noise could increase significantly over one year of cryogenic operation - by up to a factor of 10 if the ice grows at the rate observed in Kagra. We consider methods for reducing the impact of an ice layer, including annealing to reduce the mechanical loss of the ice and reducing the growth rate by achieving lower vacuum pressure.

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Session Classification: ET technology

Track Classification: ET technology