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Cooling away the absorption - Silicon mirror development for future gravitational wave detectors

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Silicon is the substrate material chosen for future gravitational wave detectors such as ET mainly because of the low optical absorption together with a high mechanical quality factor. To optimize the coatings deposited on these silicon substrates, they have to be annealed to temperatures above 600◦C. At temperatures between 450◦C and 600◦C thermal donors start to form, increasing the optical absorption. A careful procedure consisting of heating and cooling has to be found to minimize the impact of these effects. Furthermore, characterizing and understanding the effect of annealing and rapid cooling on internal stress and related birefringence, as well as resulting wavefront distortions and their effect on the laser beam is essential to understand and minimize the effect on the detector performance.

Author: WOEHLER, Janis

Presenter: WOEHLER, Janis

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