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Development of cryogenic technologies for future gravitational-wave detectors

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The discovery of gravitational waves paved the way for a new way of seeing the Universe, but above all, it paved the way for the development of new technologies.
Since the first gravitational-wave detection much progress has been made and the technology that allowed us to explore this new field has been renewed.
The cornerstone of this research remains the Michelson interferometer, whose sensitivity is, however, limited by the thermal noise to which its mirrors, called test masses, are subjected.
Thermal noise has been reduced so far thanks to the study of new mirror materials and this has contributed to the observation of new events in the cosmos.
Now, a new generation of gravitational wave detectors, such as the Einstein Telescope, is just around the corner and will operate at cryogenic temperatures.
Every new technology brings new challenges, and one of the most significant is the formation of a low density amorphous-state ice on the test mass surfaces. This ice layer grows with time and continuously changes the optical and mechanical properties of the mirrors.
The work presented on this poster illustrates the instruments and methodologies used to face these challenges, in particular the ice formation, starting from understanding how such ice affects the thermal noise.

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