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Long-pulse, Ultra-high-gradient Radio-frequency Accelerator Structures –Better Performance through Smart Design, Manufacturing and Breakdown Suppression

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Future accelerator facilities such as the proposed MaRIE X-ray Free Electron Laser (XFEL) and compact accelerators for medical applications and National Security would greatly benefit from ultra-high gradient (UHG) radio-frequency (RF) accelerating structures. High gradient structures will reduce the construction and operational cost of large facilities and deliver engineering solutions for making compact accelerator systems transportable. Apart from high gradients, some applications need longer pulse durations that are often limited by RF pulse heating in the accelerator structure. This proposal brings together LANL experts from accelerator physics and engineering, metallurgy, and material science to undertake a systematic effort to develop a superior high gradient RF accelerating structure. The areas of research include high gradient cavity shapes (mostly standard nowadays), molecular dynamics modeling of metallic surfaces to study sources of break-down and potential suppression strategies and fabrication strategies that preserve metallurgic improvements when performing machining or forming. The object of study is a cryo-cooled copper C-band resonator.
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