John Adams Institute for Accelerator Science

John Adams Institute for Accelerator Science Lecture Series

Monday 19th June 2017 at 4:15 pm
Dennis Sciama Lecture Theatre, Denys Wilkinson Building

Cryogenic Normal Conducting RF Accelerators - Experiments That Enable High Brightness RF Guns

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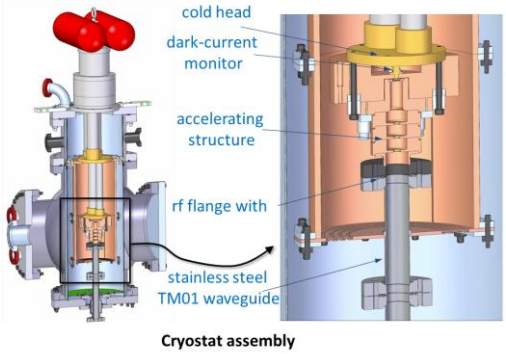
RF breakdown is one of the major factors limiting the operating accelerating gradient in thus length and cost of rf particle accelerators. During work on normal conducting linear colliders the statistical nature of rf breakdown in the accelerating structures became apparent and the rf breakdown rate turn into a quantitative measure of the linac's high gradient performance.

We conjecture that the breakdown rate is linked to the movements of crystal defects induced by periodic mechanical stress due to exposure of metal to the rf fields. Therefore, by decreasing crystal mobility and increasing yield strength we will reduce the breakdown rate for the same accelerating gradient. We can achieve these properties by cooling a copper accelerating cavity to cryogenic temperatures. As a part of our study of basic physics of the rf breakdown, we tested an 11.4 GHz cryogenic copper accelerating cavity at high power. We measured low rf breakdown rate for surface electric fields near 500 MV/m at a flat gradient of 150 ns.

We are currently planning to use this improved high gradient performance of cryogenic accelerating cavities for an rf photoinjector, where a very large gradient could help to produce electron bunches with high brightness and low transverse emittances. These better beam parameters could in turn lead to shorter undulators and thus more compact FELs.



Cryostat assembly

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