Modeling Arcs

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Although vacuum arcs seem to have been first identified over 110 years ago, and limit many technologies, they remain somewhat difficult to understand. Our effort began as a way to understand the x ray backgrounds coming from low frequency rf accelerators cavities in a high energy physics experiment, where we discovered (by fitting field emission parameters) that the structures seemed to break down when the local fields reached 10 GV/m. We have since developed a model of breakdown and gradient limits that tries to explain, in a self-consistent way: arc triggering, plasma initiation, plasma evolution, surface damage and gradient limits [1-3]. We use simple PIC codes for modeling plasmas, molecular dynamics for modeling surface breakdown, and surface damage, and mesoscale surface thermodynamics and finite element electrostatic codes for to evaluate surface properties. Since any given experiment seems to have more variables than data points, we have tried to consider a wide variety of arcing (rf structures, e beam welding, laser ablation, etc.) to help constrain the problem, and concentrate on common mechanisms. While the mechanisms are comparatively simple, modeling can be challenging.

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