# Magnetic breakdowns in side-coupled x-band accelerating structures

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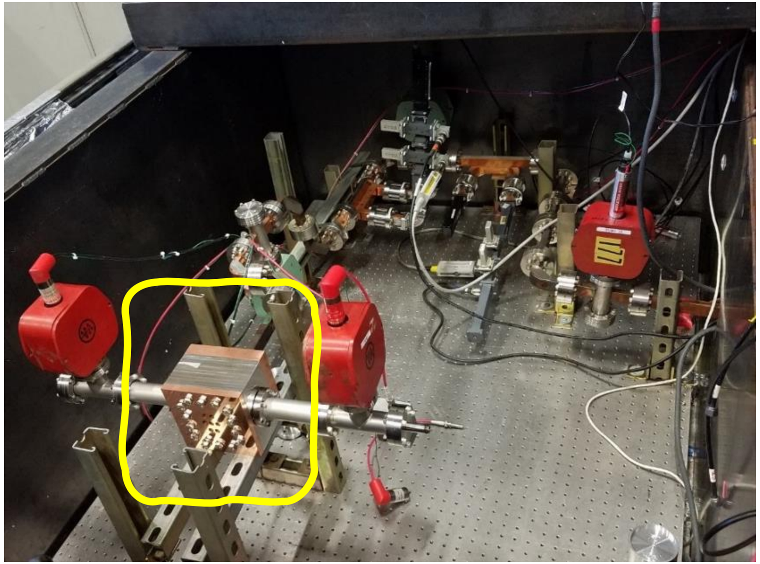
Side coupled accelerating structures are popular in the industrial realizations of linacs due to their high shunt impedance and ease of tuning. We designed and fabricated a side-coupled X-band accelerating structure that achieved 133 MOhm/m shut impedance. This structure was fabricated out of two halves using a novel brazeless approach. The two copper halves are joined together using a stainless steel joining piece with knife edges that bite into copper. This structure had been tested at high power at SLAC National Accelerator Laboratory. The performance of the structure had been limited by magnetic breakdowns on the side-coupling cells. In this paper we will present results of the high gradient tests and after-test analysis. Scanning electron microscopy images show a typical magnetic-field induced breakdown.



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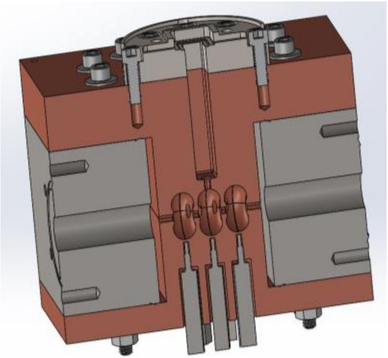
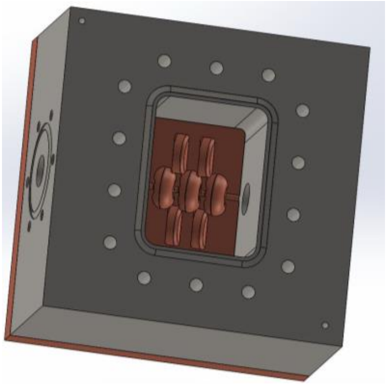
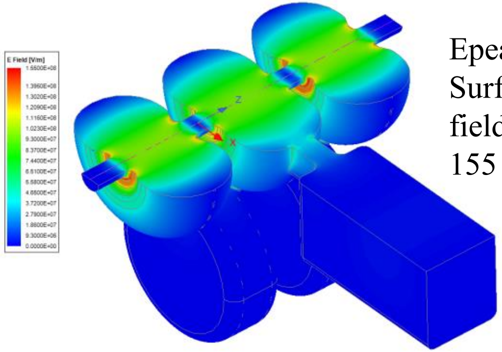
# X-band Brazeless side-coupled accelerator

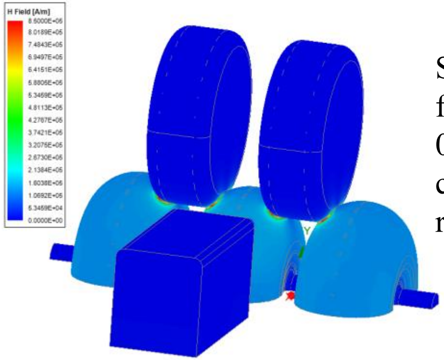
Shunt Impedance: 130 MOhm/m



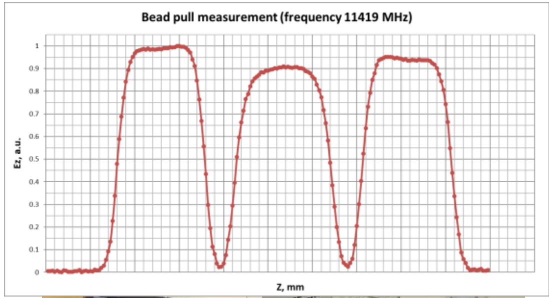


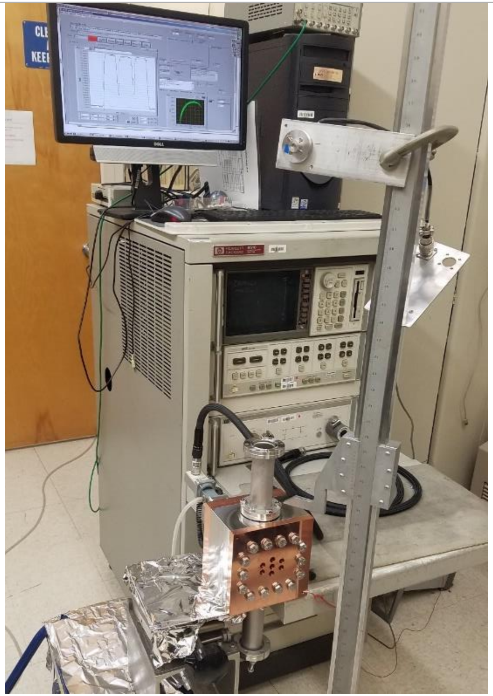



Epeak/Eacc = 2.65, Surface electric fields with peak of 155 MV/m@1MW.

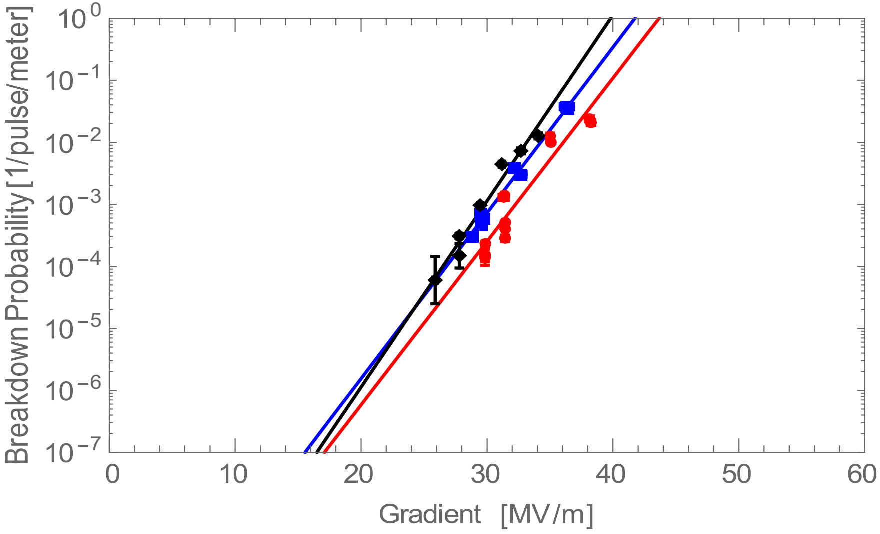



Surface magnetic fields with peak of 0.85 MA/m, calculated with fillet rounding of 0.1 mm



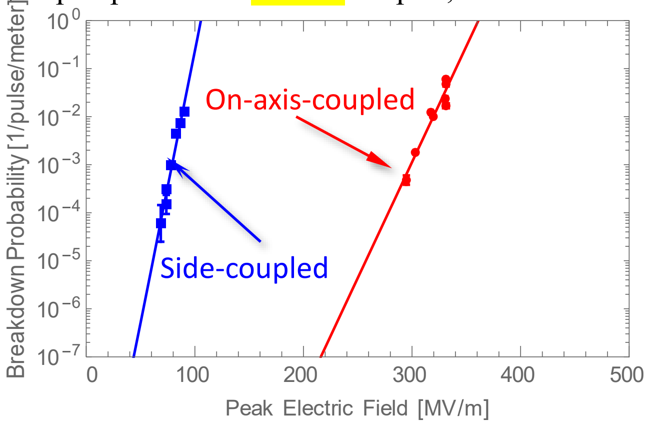
# Results Analysis

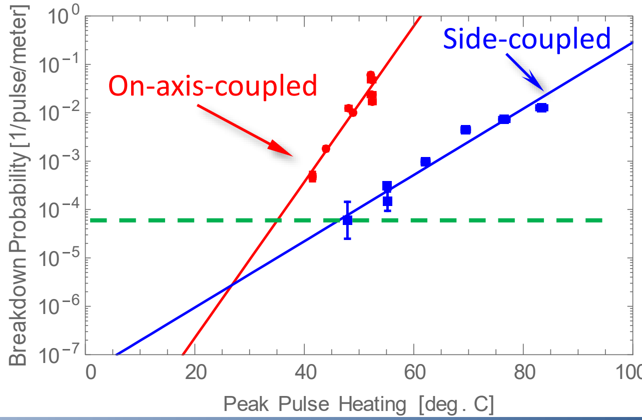



When we compare structure with the same Epeak/Eacc and wildly different Hmax*Z0/Eacc (5.3 in side-coupled vs 1.1 in on-axis coupled), we see that peak magnetic field or associated with it peak pulse surface heating is much better predicator of breakdown rates than the peak surface electric field.

3SW A1.5 T3.03 Braz Euclid 1150 ns
3SW A1.5 T3.03 Braz Euclid 1400 ns
3SW A1.5 T3.03 Braz Euclid 1600 ns

Comparison of performance of this prototype side-coupled and SLAC on-axis coupled (SLAC A3.75-T2.2-Cu) structures with similar ration Epeak/Eacc ~ 2.6,shaped pulse with **600 ns** flat part, all breakdowns



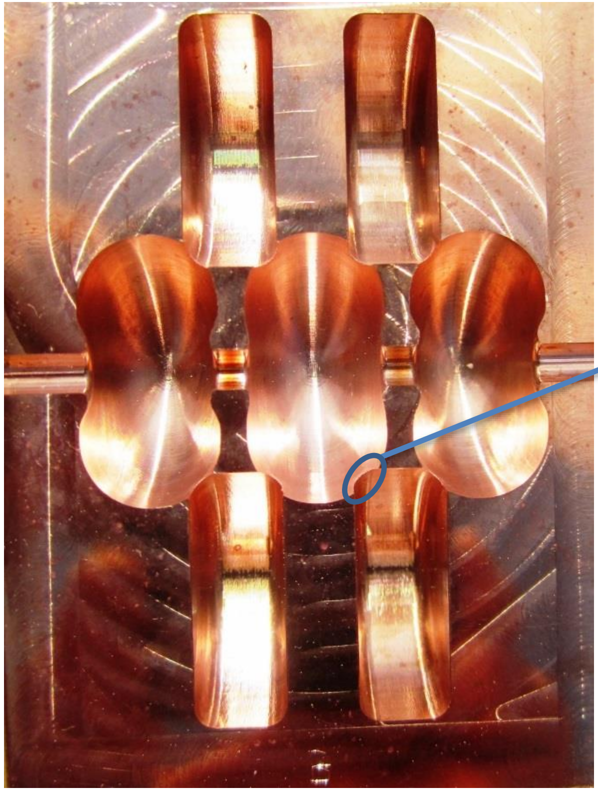



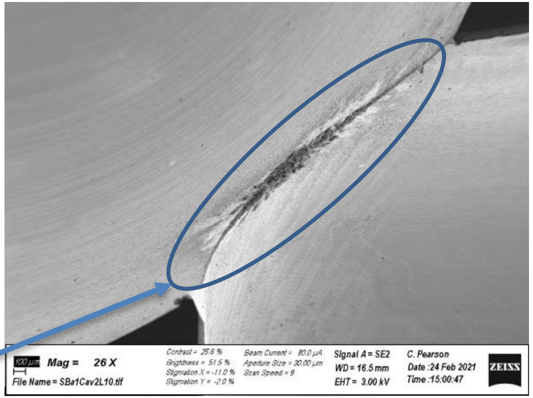
# Post Test Examination

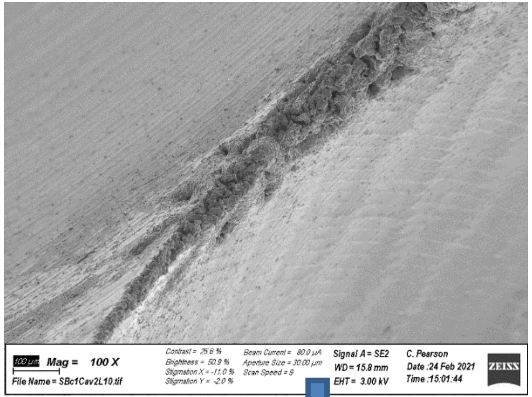
## Coupling holes have significant rf damage

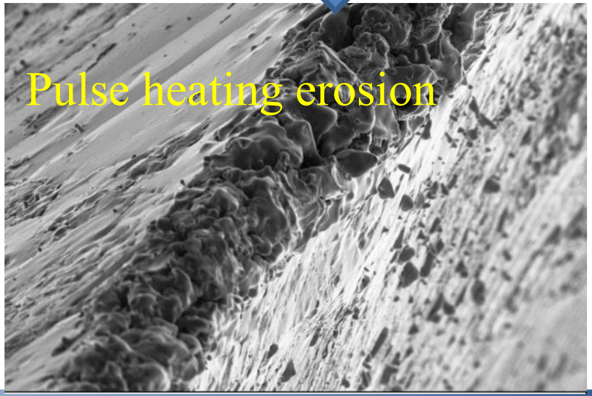
The sharp edge located at the coupling hole between the side cavities and the main cavities have the most severe rf damage

Areas for SEM






*Remarks*: The side-coupled cavities require special attention to the high magnetic fields; need to avoid the sharp edge of the coupling cell.