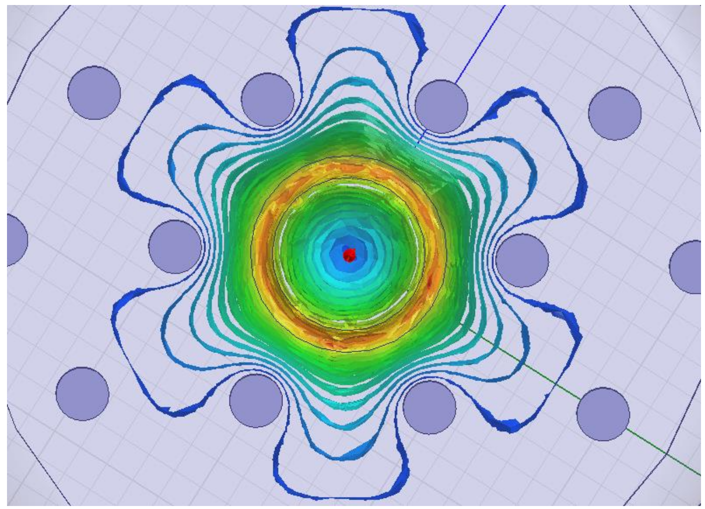
Latest cryogenic testing of the 2.1 GHz 5-cell SRF Cavity with a PBG* Coupler Cell



LINAC2016 in Lansing, Sep 27, 2016

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* PBG = Photonic Band Gap

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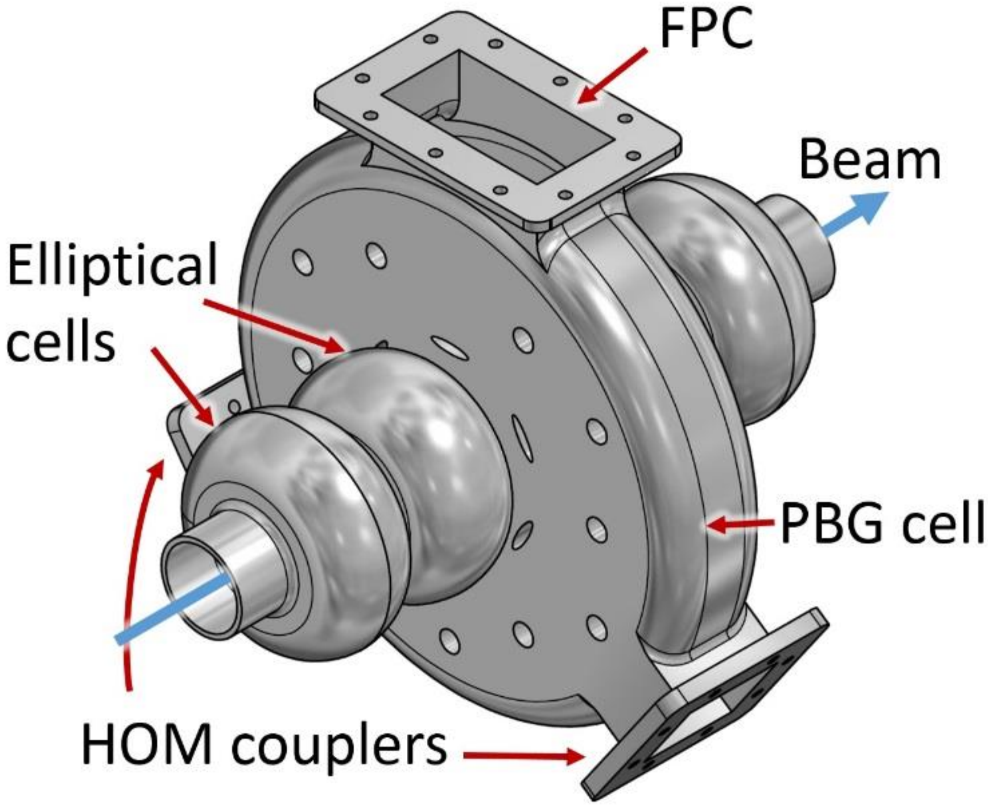
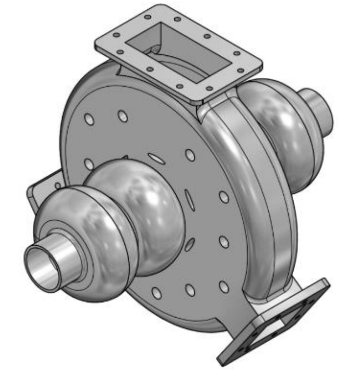
Motivation for the 5-cell SRF PBG cavity



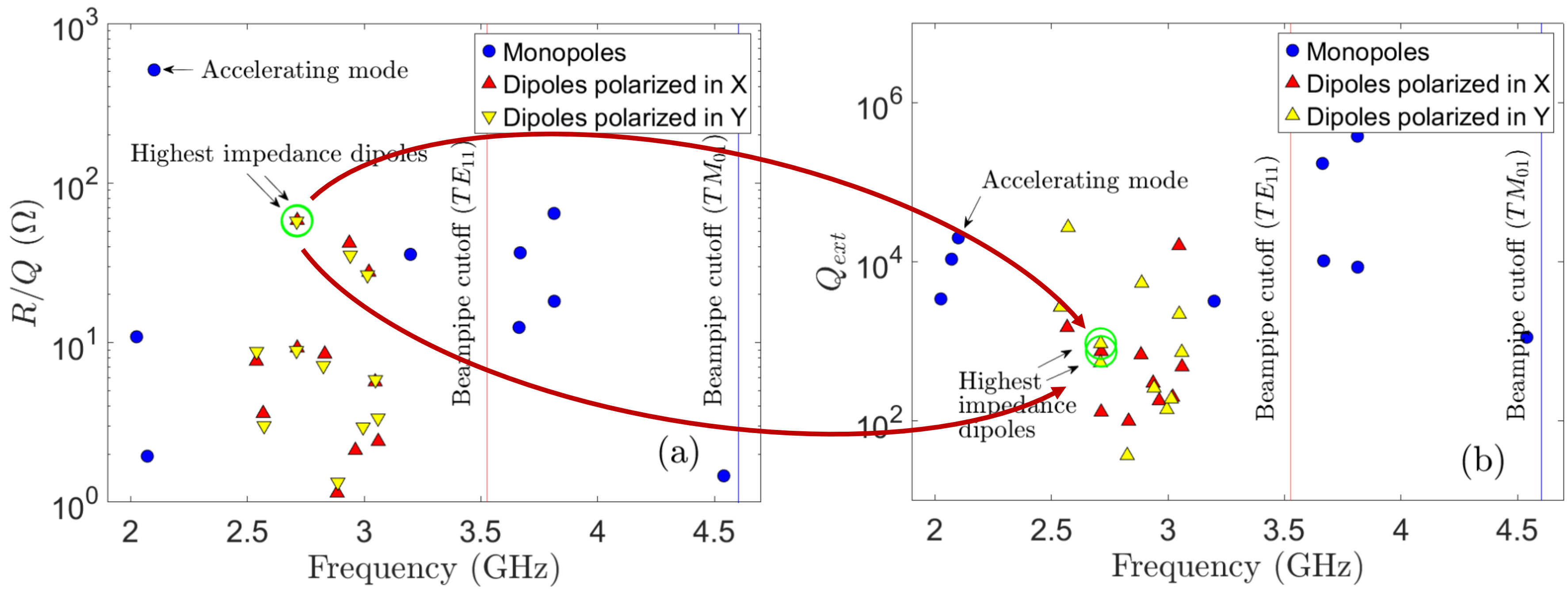
- **Beam break-up** (BBU) limits max current.
- BBU is caused by parasitic **higher order modes** (HOMs).
- PBG accelerating cavity provides **HOM suppression**.
- The 5-cell structure with a PBG cell has an increased **real estate gradient.**

Accelerating properties

The PBG design is very similar to 5 elliptical cells, but is about 20% shorter

	5 elliptical cells (from H. Wang et al) 	**5-cell PBG cavity** 	
Frequency	0.75 GHz	2.1 GHz	
Shunt impedance R/Q	525 Ω	515 Ω	-2%
Geometry constant G	276 Ω	265 Ω	-4%
Peak surface electric field ratio E_{peak}/E_{acc}	2.50	2.65	+6%
Peak surface electric field ratio B_{peak}/E_{acc}	$4.27\,\frac{\mathrm{mT}}{\mathrm{MV}/m}$	$4.48\,\frac{\mathrm{mT}}{\mathrm{MV}/m}$	+5%
Length of cavity + couplers	44 cm	36 cm	-19%

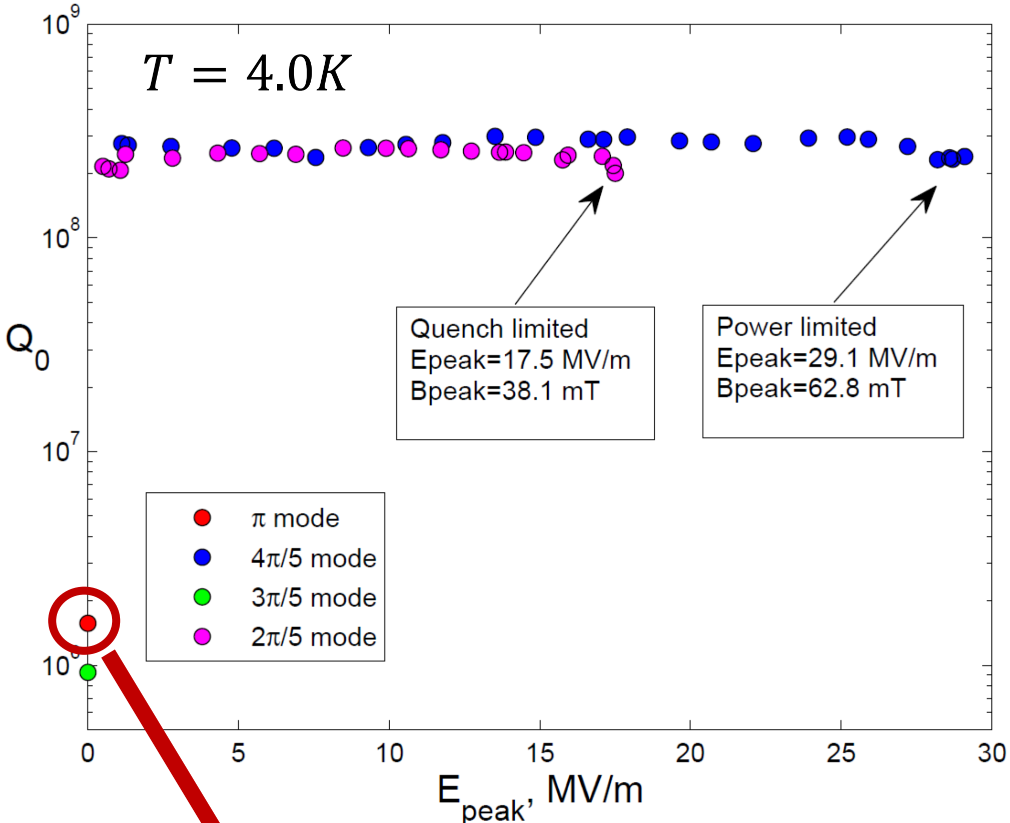
HOM damping

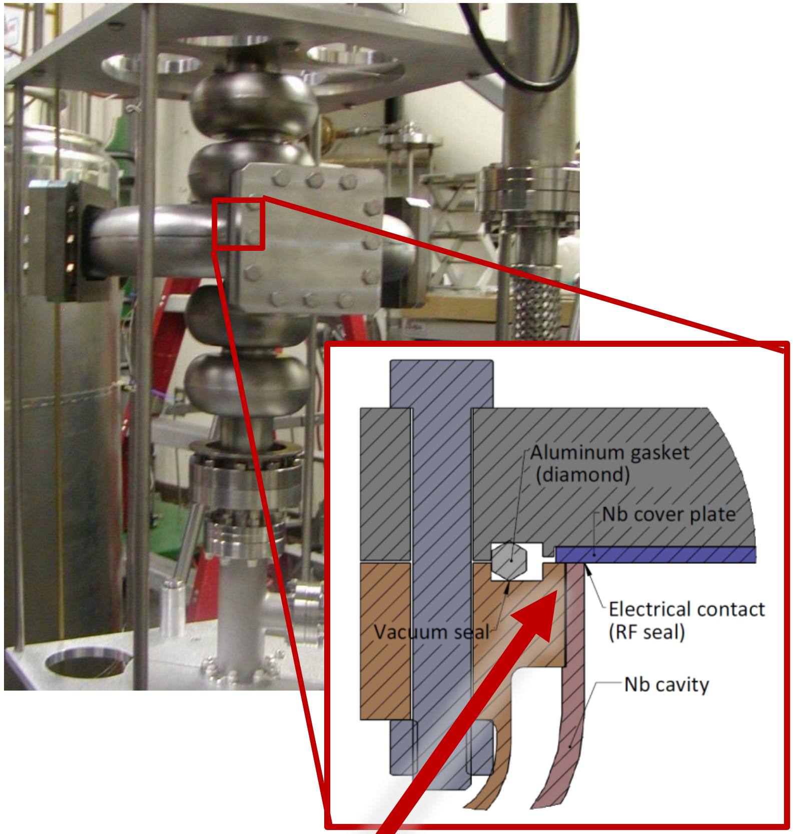


Simulated shunt impedances and loaded Q factors for monopole and dipole modes

Loaded Qs are in the range $10^2 - 10^4$, with most dangerous HOMs damped to Q in the order of $\mathbf{10^3}$.

First cryogenic tests and low Q_0



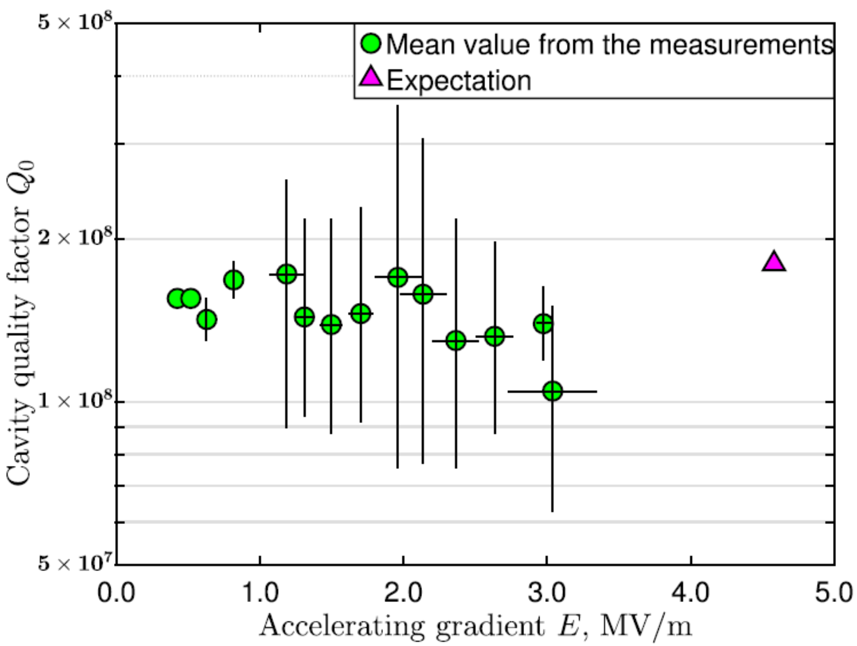


Q_0 of the accelerating mode was in the 10^6 range

Waveguide joint design had to me modified

Latest cryogenic testing

$T = 4.2K$



Mode	β	Simulated Q_0	Measured Q_0, assuming simulated β
$\pi/5$	0.23	1.5×10^8	1.46×10^8
$2\pi/5$	4.8	1.87×10^8	3.21×10^8
$3\pi/5$	5.9	1.72×10^8	3.17×10^8
$4\pi/5$	9.6	1.87×10^8	1.82×10^8
π	6.4	1.81×10^8	1.55×10^8

- Measured Q_0 of the accelerating mode agreed with expectations.
- No “hard barriers” were observed at gradients up o 3 MV/m.
- The tested cavity is ready to be put into a complete cryomodule assembly.