Cornell Laboratory for
Accelerator-based Sciences and Education (CLASSE)

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COMPARISON OF SHAPES OF MULTICELL CAVITY CELLS

Abstract

Comparison of cell shapes for a multicell cavity can be done in terms of (1) the aperture radius for a given wave length, (2) the peak electric field normalized to acceleration field and (3) the wall slope angle. All other important figures of merit, when this choice is done, become a matter of optimization. Several geometries of cells of superconducting cavities are compared from this standpoint.

The elliptic shape used for optimizations not always reflects the actual shape of cells. Influence of the weld seams on the main cavity figures of merit is also discussed.

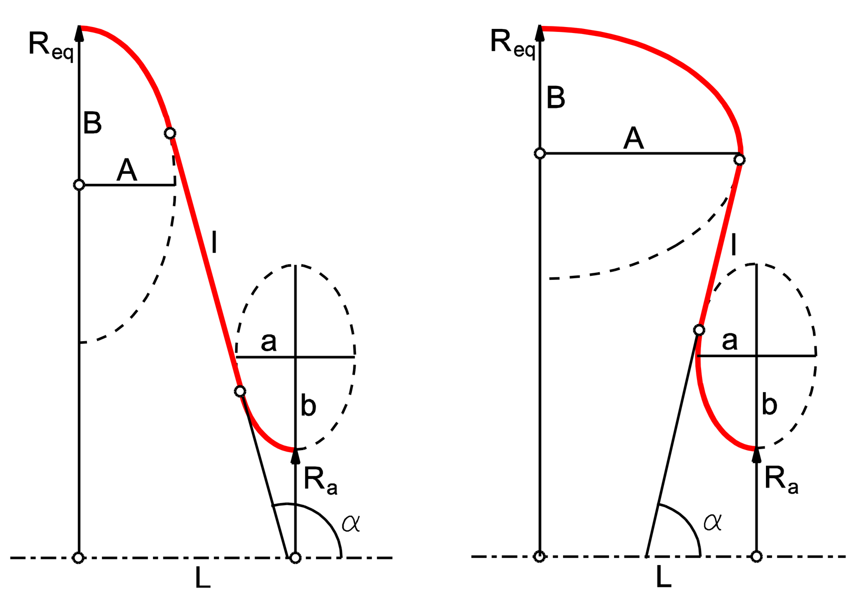


Figure 1. Geometry of the inner cell: non-reentrant (left) and reentrant shapes.

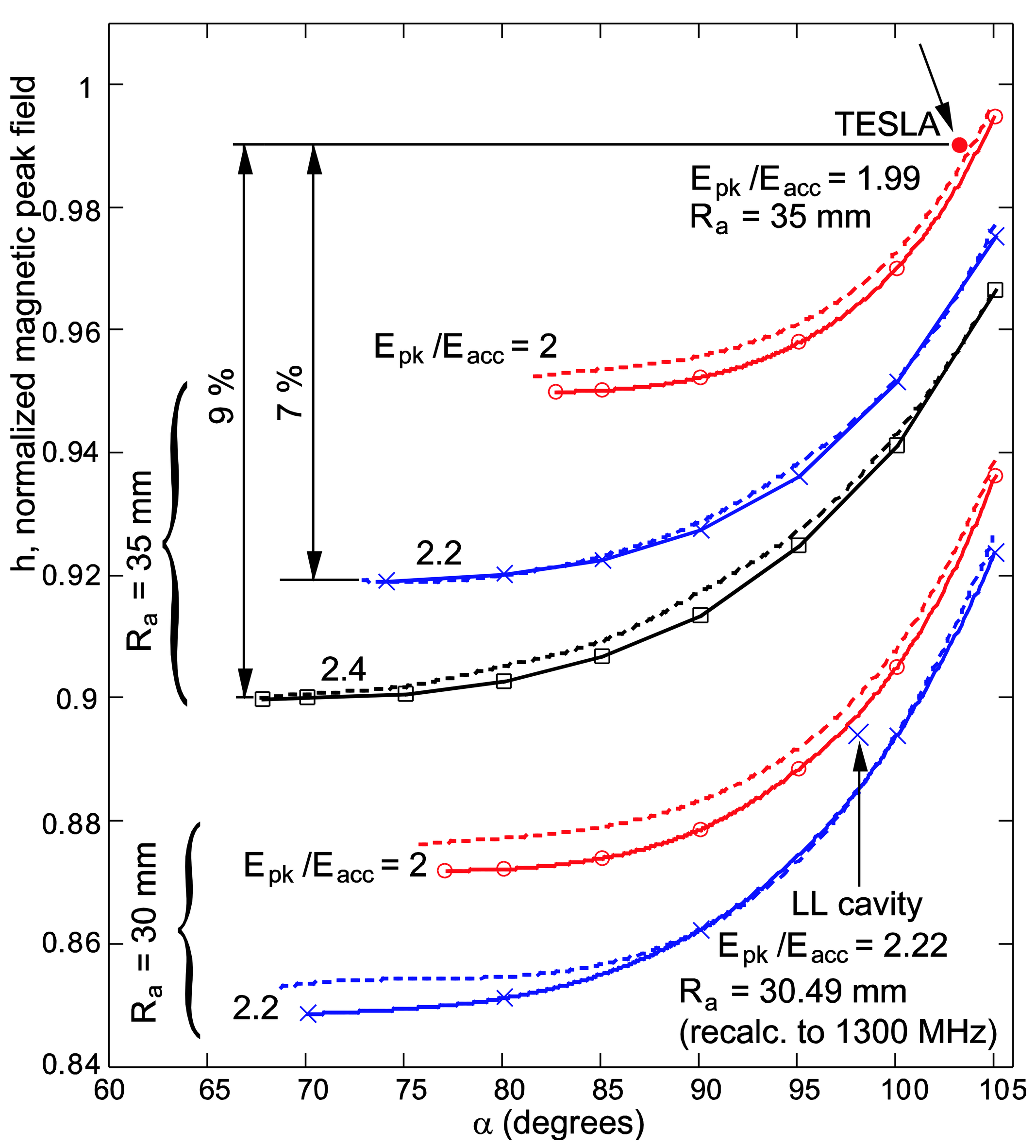


Figure 2. Normalized magnetic peak field for different wall slope angle of wall slope. Solid lines present optimization for min h, dash lines are for max GR/Q.

Figures from 2 to 4 are universal curves for optimized elliptic cells.

TESLA and Low Loss cavity can be found here.

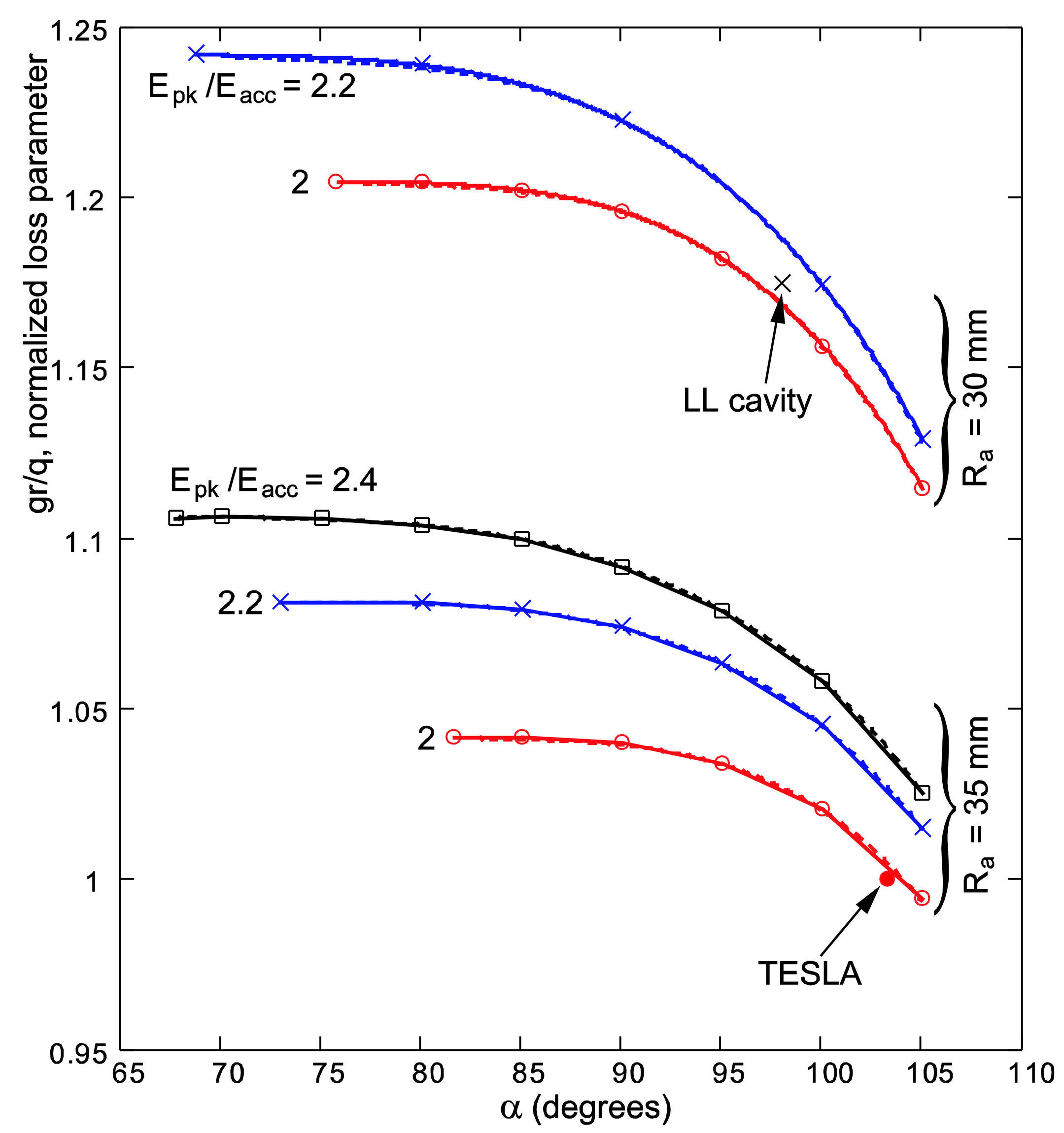


Figure 3. Normalized loss parameter for different angles of slope. Solid lines are for max GR/Q. dash lines are for minimal h (graphically both shapes nearly overlap).

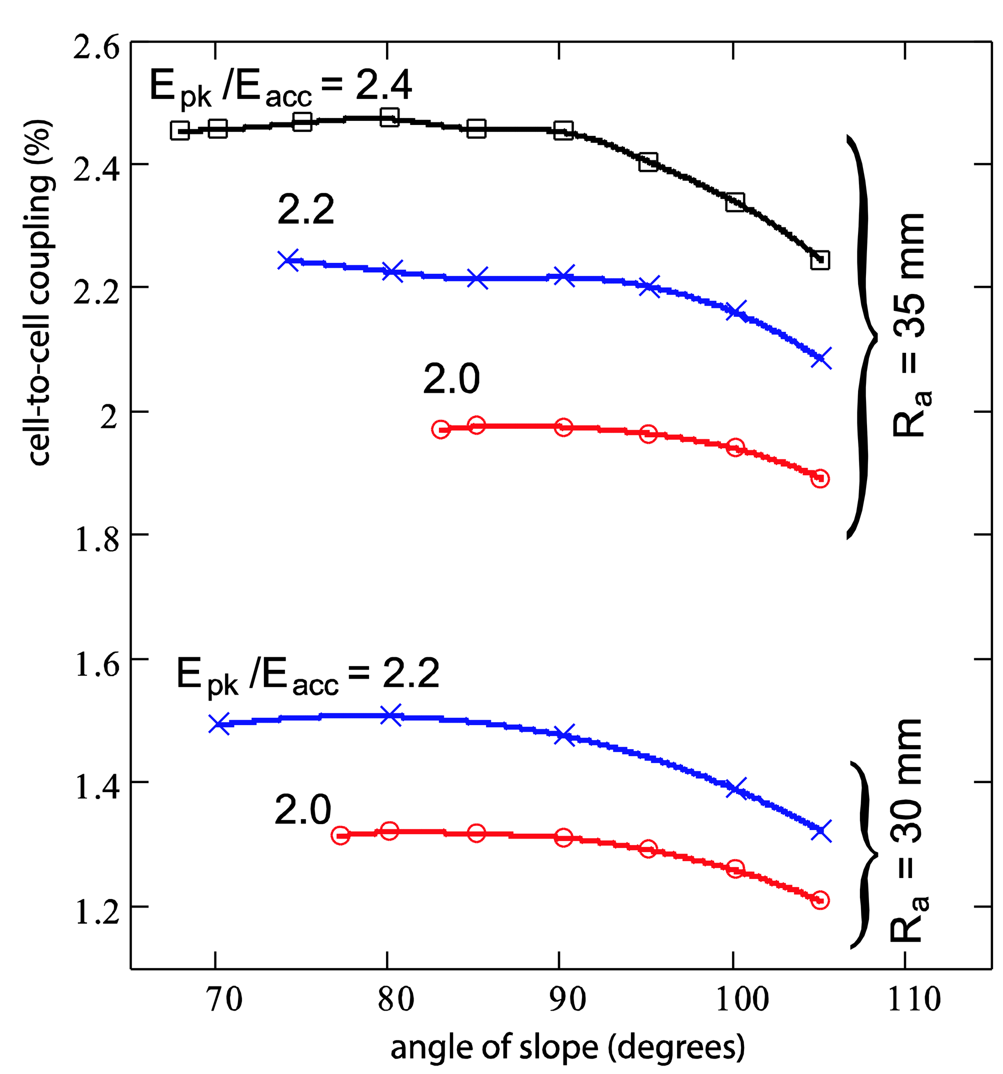
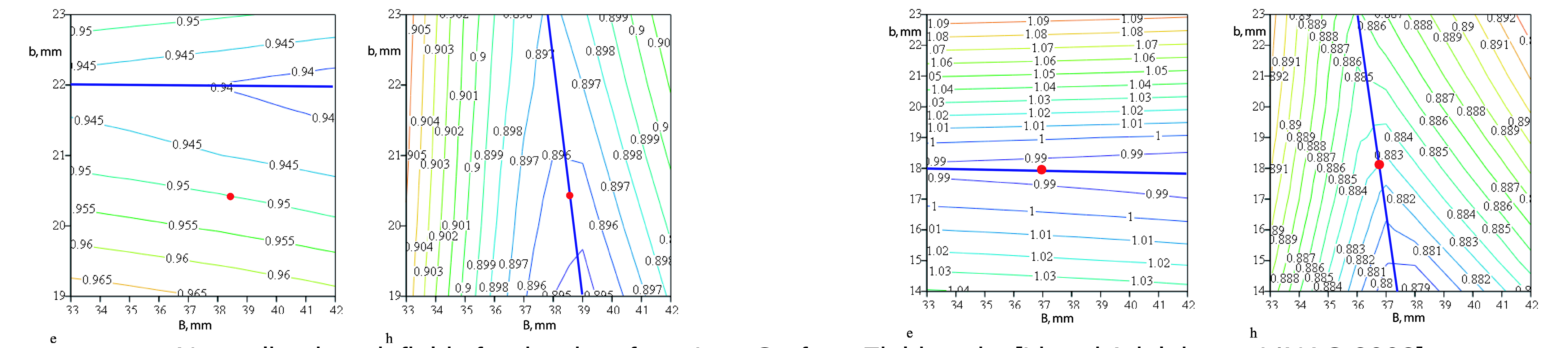


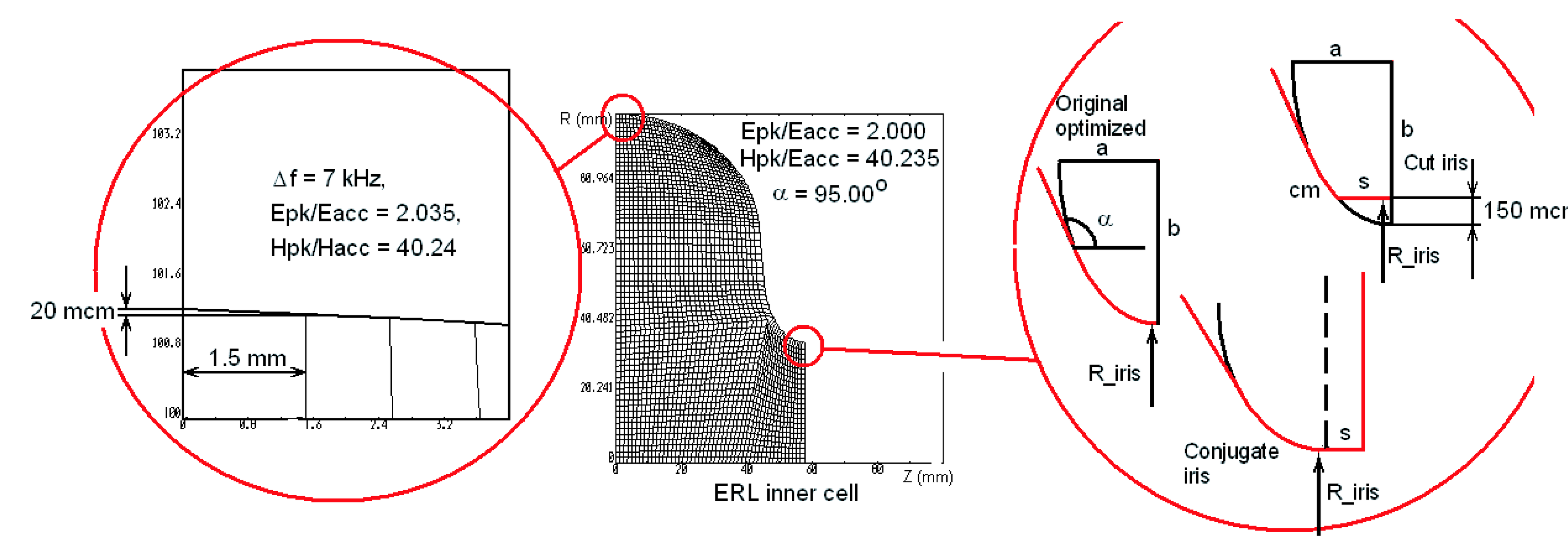
Figure 4. Cell-to-cell coupling vs angle of slope for inner cell optimized for minimal h.



Normalized peak fields for the data from Low Surface Field cavity [Li and Adolphsen, LINAC 2008] with given A = 45.85, a = 11.8 mm (left picture) and A = 47.15, a = 10.5.

Data close to the best point can be found in the Table for the universal curves [V. Shemelin, Cornell LEPP Report SRF 070614-02]

LIMITATIONS OF THE ELLIPTIC SHAPE: FLAT WELDING SEAMS



Parameter \ Geometry	Original optimized	Cut iris	Conjugate iris (tuned)
A, mm	43.99	43.99	41.4
B, mm	35.08	35.08	32.5
a, mm	12.53	12.53	12.1
b, mm	20.93	20.93	22.91
s, mm	0	1.5	1.5
R_iris	35	35.151	35
α, degrees	95.00	95.00	95.00
Req, mm	101.205	101.205	100.583
Δf, kHz	0	51	0
Epk/Eacc	2.00	2.13	2.00
k, cell-to-cell coupling, %	1.965	1.969	1.768
Hpk/Eacc,Oe/(MV/m)	40.23	40.25	40.71
G*R/Q, Ohm^2	31839	31820	31799 (-0.1 %)

CONCLUSION

Three primary parameters, Ra, Epk/Eacc, and the wall slope angle *α* are a good basis for comparison of cavities' figures of merit because most of them depend monotonously on these parameters. All the main properties of the REENTRANT shape appear to be the best if compared with other shapes having same Ra and Epk/Eacc. Different proposed shapes of the cavities either fit the proposed universal curves or are worth in terms of GR/Q, Hpk/Eacc, or cell-to-cell coupling.

The real cells can be different from the elliptic shape having flat welding seam areas and this can influence much more significantly on the figures of merit than some optimizations.

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