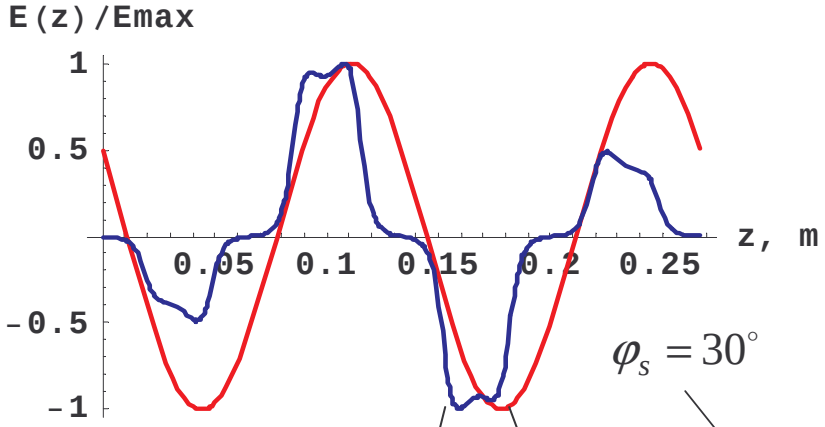
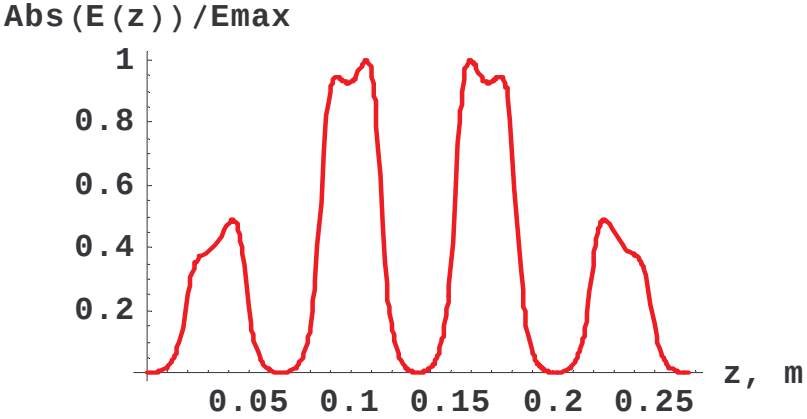
On RF losses in RT CH

Shunt impedance R_{sh} and losses (1/12/2006).



$\varphi_s = 30^\circ$



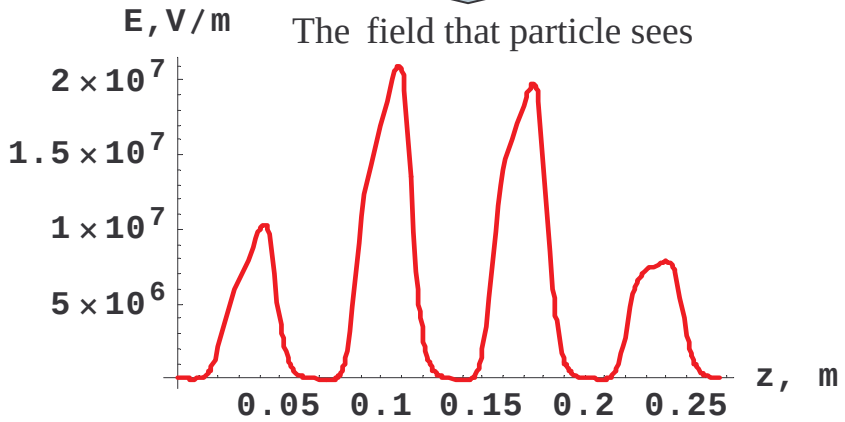
This is usually demonstrated

$$E_p(z,\beta,\varphi_s,\lambda) = E_z(z)\cdot\sin\left(\frac{2\pi c}{\lambda}\left(\frac{z}{\beta c} - t_0\right)\right)$$

$$V_{eff} = \left|\int_0^L E_p(\varphi_s = 0)dz\right| =$$

= maximum energy gain possible during transit / q

The field that particle sees



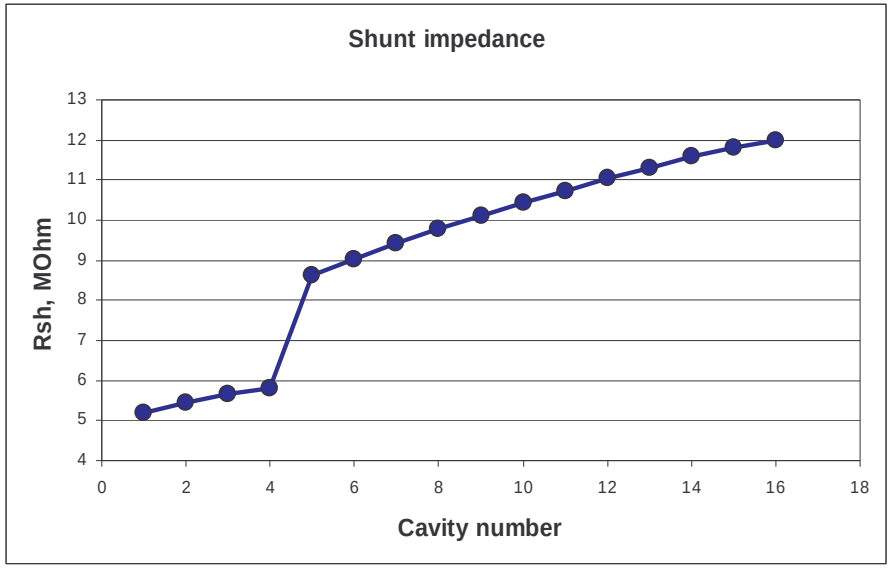
MWS calculates directly

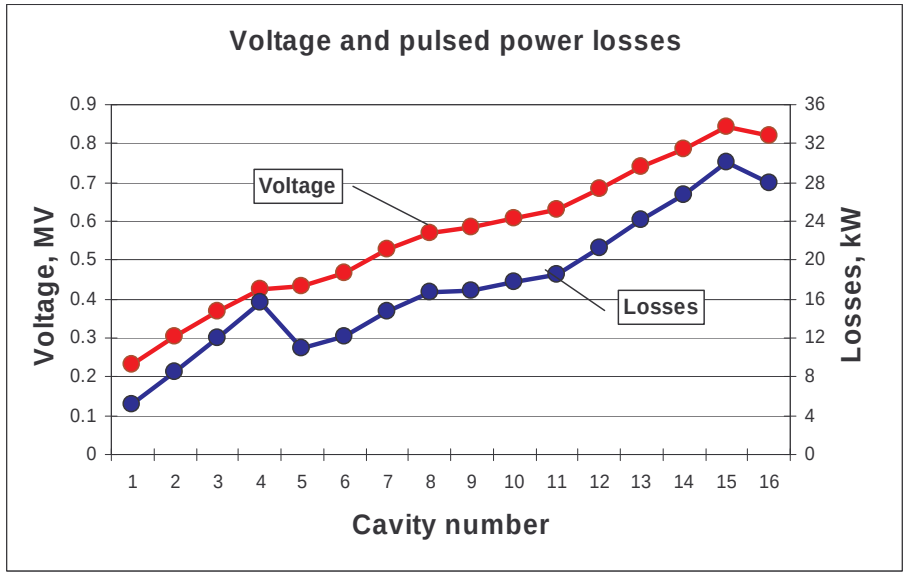
$$R_{sh} = \frac{V_{eff}^{\ 2}}{P_{losses}}$$

RF design - maximization of R_{sh} keeping surface field $E_s \approx 30$ MV/m (< 50 MV/m - experimental breakdown limit for copper). We can not afford non-effective cavities. This is the only more or less constant parameter for RT CH.

Often used formula $V_{eff} = E_0 \cdot T \cdot L$

- E_0 – drift tube shape and dimensions
- T – gap coefficient and beta
- L – just proportional to beta*lambda
- P_{loss} – overall geometry, EM field type and mode.





Final table. It is slightly wrong now, because beta of cavities does not correspond to actual beta of particles –transit time is not optimal.

Version from November 2006 revised February 2007

Cavity number	Beta of cavity	Rsh MOhm	Q	Voltage eff MV	Phi_s degrees	W kin MeV out	dW MeV	Pcopper kW	Pbeam kW I=25 mA	Ptotal kW
0						2.50639				
1	0.07437	5.196	9270	0.14385	-90	2.50639	0.0	1.991226	2.2E-16	1.991226
2	0.077096	5.45	9662	0.248851	-50	2.666348	0.159958	5.681364	3.99896	9.680324
3	0.080441	5.65	10051	0.329405	-50	2.878086	0.211738	9.602462	5.29344	14.8959
4	0.084211	5.792	10461	0.386723	-50	3.126667	0.248581	12.91047	6.214523	19.12499
5	0.088233	8.617	10772	0.479458	-50	3.434857	0.30819	13.33876	7.704745	21.04351
6	0.09235	9.02	11078	0.506082	-45	3.792711	0.357854	14.19729	8.946352	23.14364
7	0.096797	9.41	11374	0.574325	-45	4.19882	0.406109	17.52655	10.15274	27.67929
8	0.101528	9.766	11680	0.614332	-40	4.669426	0.470605	19.32231	11.76513	31.08744
9	0.106271	10.12	11945	0.729671	-35	5.267137	0.597712	26.30535	14.94279	41.24814
10	0.111067	10.45	12220	0.705146	-33	5.858522	0.591385	23.79093	14.78462	38.57555
11	0.115949	10.737	12465	0.738678	-33	6.47803	0.619508	25.40959	15.48769	40.89728
12	0.120984	11.04	12750	0.801553	-33	7.150269	0.672239	29.09813	16.80597	45.9041
13	0.126222	11.31	13005	0.861922	-33	7.873137	0.722869	32.84304	18.07172	50.91476
14	0.131596	11.584	13271	0.918191	-33	8.643197	0.77006	36.38964	19.2515	55.64114
15	0.137085	11.79	13494	0.988219	-33	9.471988	0.828791	41.4155	20.71976	62.13526
16	0.142159	11.977	13723	0.967131	-40	10.21285	0.740865	39.0474	19.26249	58.30989
								348 kW	193 kW	543 kW