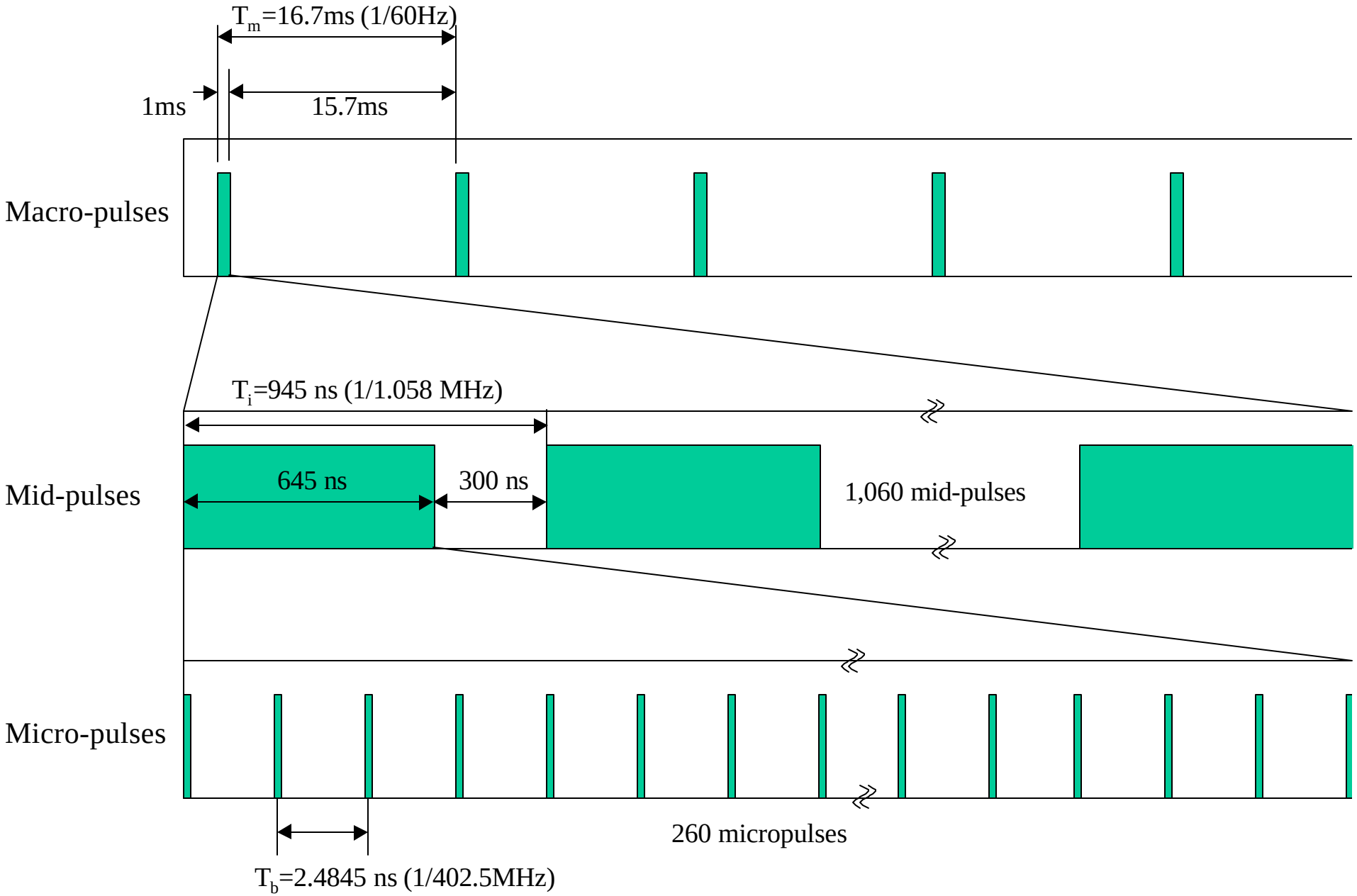
Time structure of SNS beam



HOM Power

Each HOM Power excited by beam

Power to the HOM coupler

$P_{HOMn,coupler}=(\pi f_n I_0 T_b)^2(R/Q)F^2/Q_{ex}$

f_n; HOM frequency,

I_0; beam current (52 mA during the mid pulse)

T_b; micro bunch distance (1/402.5MHz)

R/Q; HOM R/Q

Q; quality factor of cavity (intrinsic)

F; multiplication factor of spectral lines (from time structure)

Q_{ex}; HOM external Q

Each HOM Power dissipation on the cavity wall

$$P_{HOMn,c}= P_{HOMn,b} Q_{ex}/Q= P_{HOMn,b} /(1+\beta) \approx P_{HOMn,b} /\beta$$

β; coupling constant

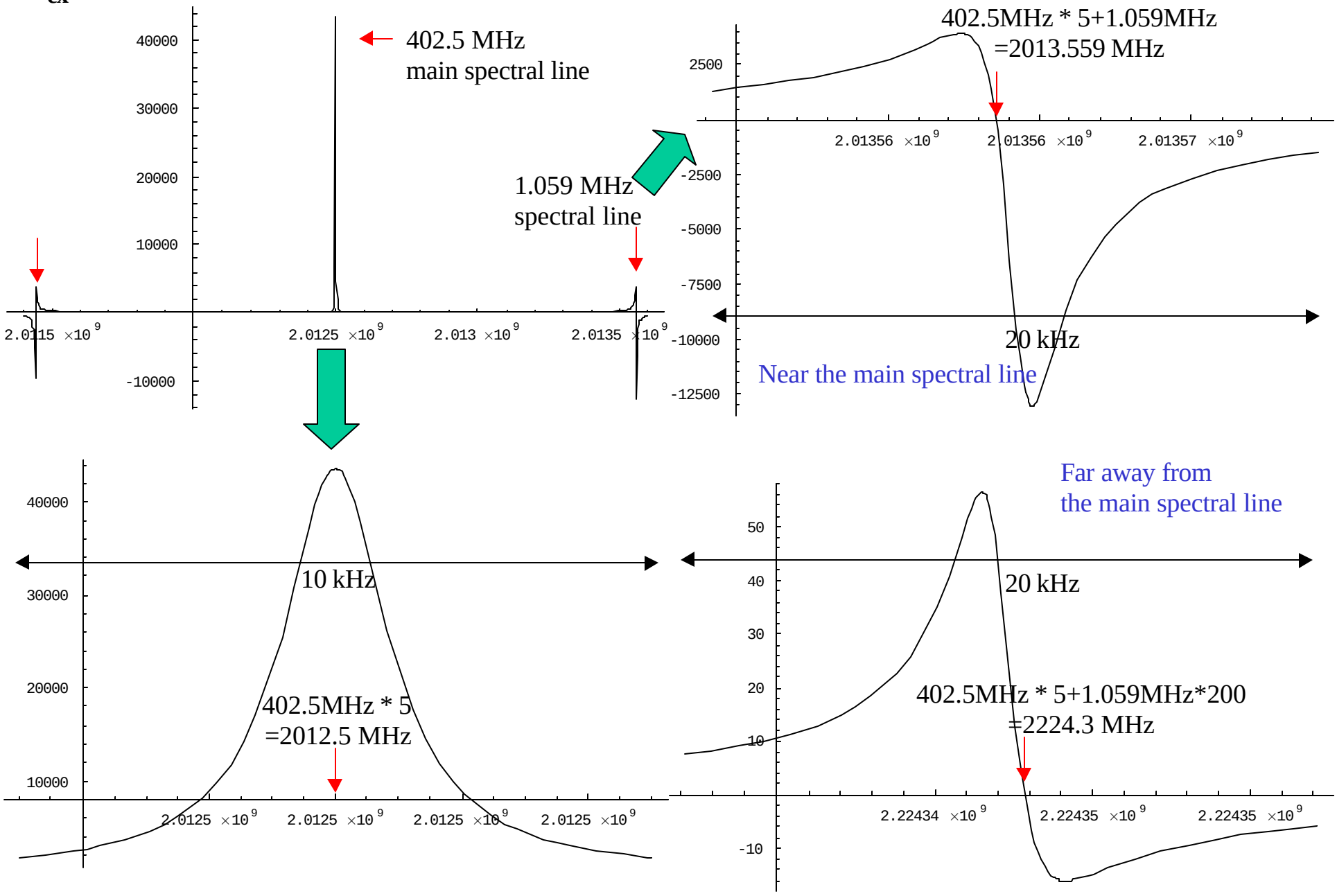
Generally Q; order of 10^9,

Q_{ex}; order of 10^6 for untrapped mode

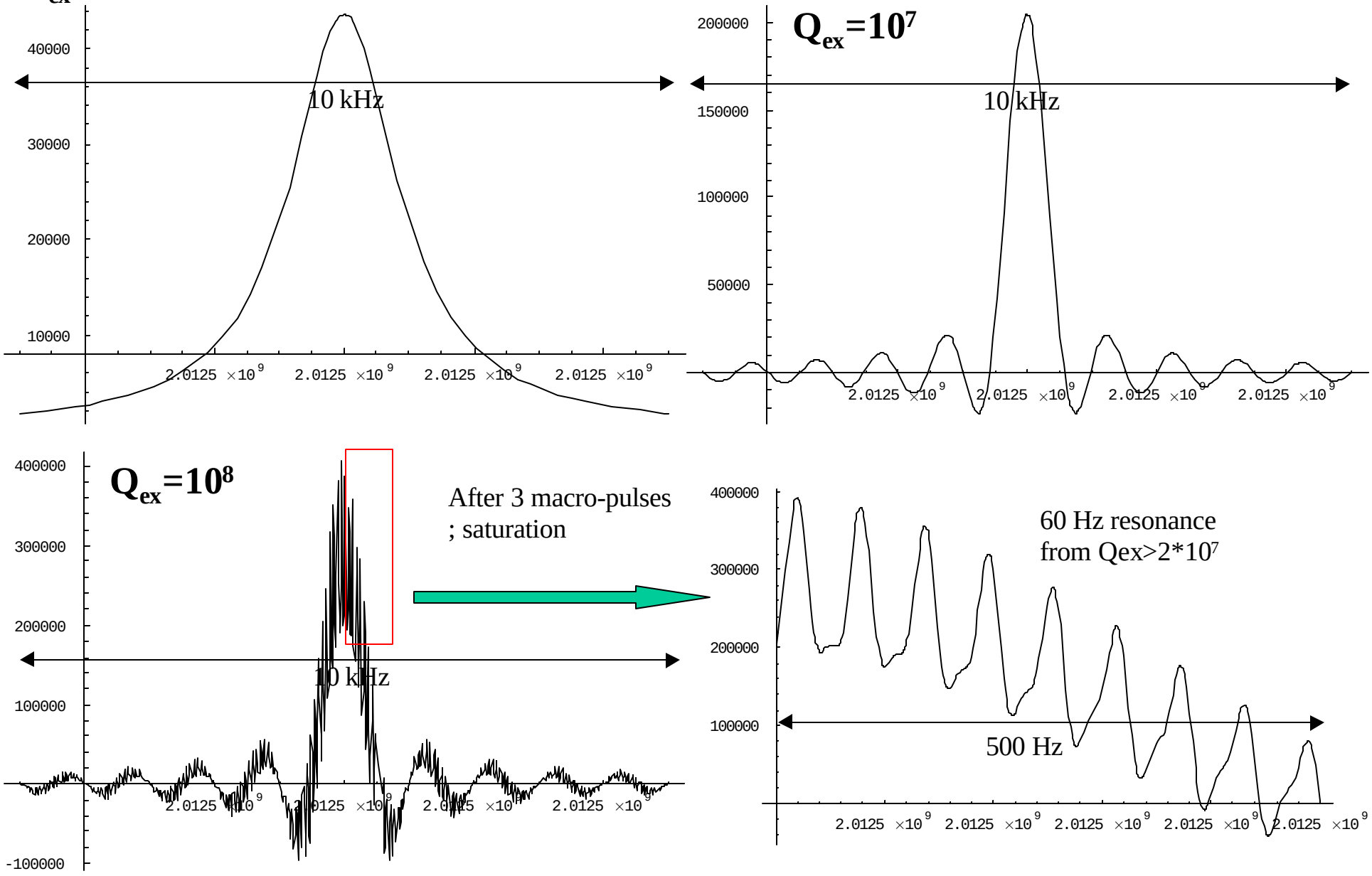
(TTF HOM coupler; damping~30dB)

F; multiplication factor of spectral lines (I)

$Q_{ex}=10^6$



F; multiplication factor of spectral lines (II)



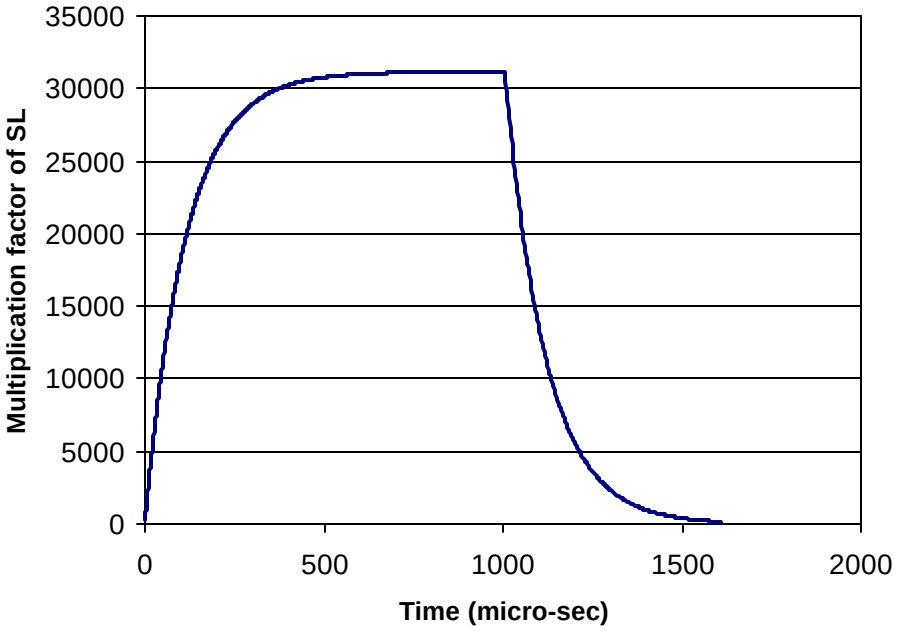
Voltage Multiplication and Decay (time dependency)

$V_{HOMn}=\pi f_n I_0 T_b(R/Q)F$

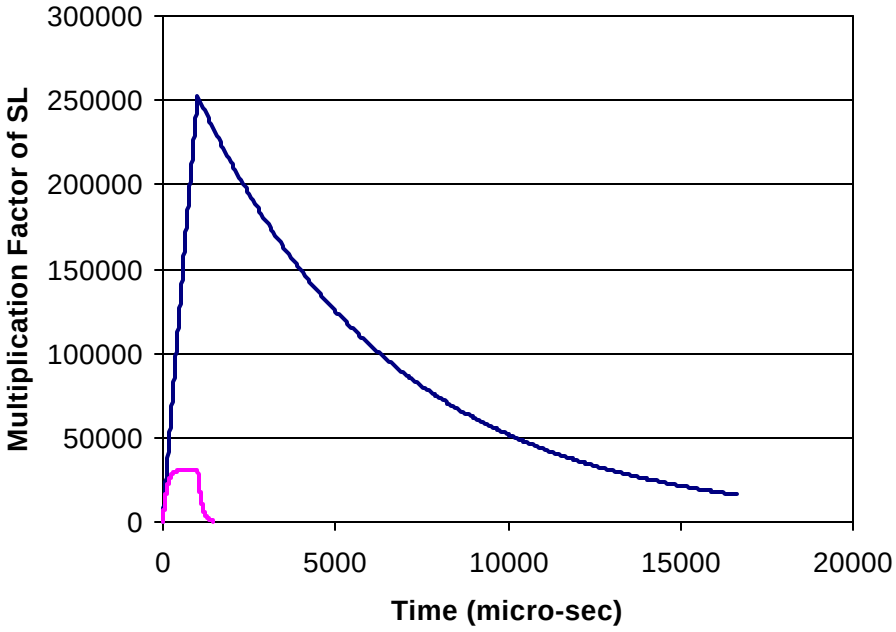
$P_{HOMn,b}=V_{HOM,n} * I_0$ (During the mid-pulse)

Example; fn=2.8175 GHz (Main resonance frequency)

Qex=10^6



Qex=$5*10^7$



HOM Power

Recall HOM power equation;

$$P_{HOMn,coupler}=(\pi f_n I_0 T_b)^2(R/Q)F^2/Q_{ex}$$

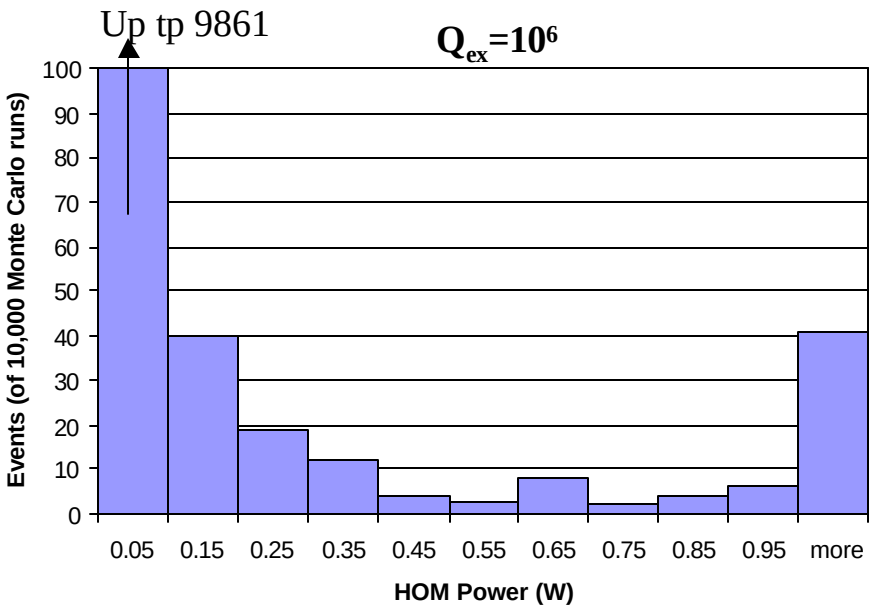
I_0; beam current (52 mA during the mid pulse) → fixed
T_b; micro bunch distance (1/402.5MHz) →fixed
R/Q; HOM R/Q →from code result
Q; quality factor of cavity (intrinsic)→ variation is very small
F; multiplication factor of spectral lines (from time structure)
strongly depends on HOM frequency
f_n; HOM frequency (frequency spread~0.3%)
Q_{ex}; HOM external Q (depends on stored energy in end cells)

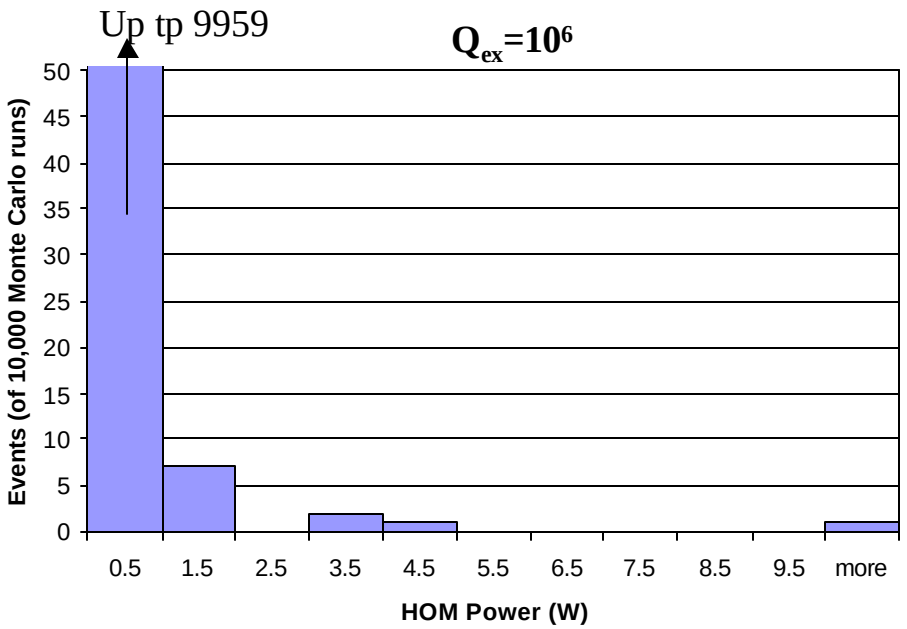
HOM Power estimation

Stochastical results

HOM Power Estimation (example)

TM monopole mode no. 35, f=2818.8 MHz (MAFIA result), R/Q=0.4
Stored energy at both end cell combined; ~18 %





Possible maximum heat load; at 2817.5 MHz and Qex=10^6, Ppeak~508 W, Pavg~21W
at 2817.5 MHz and Qex=10^7, Ppeak~1630 W, Pavg~67W
(but probability is very small)

For other TM monopoles; in progress (results will be coming soon)