# A NUMERICAL STUDY OF THE MICROWAVE INSTABILITY AT APS


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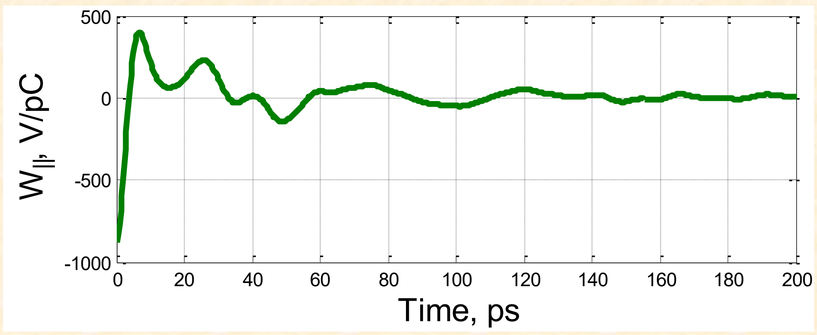
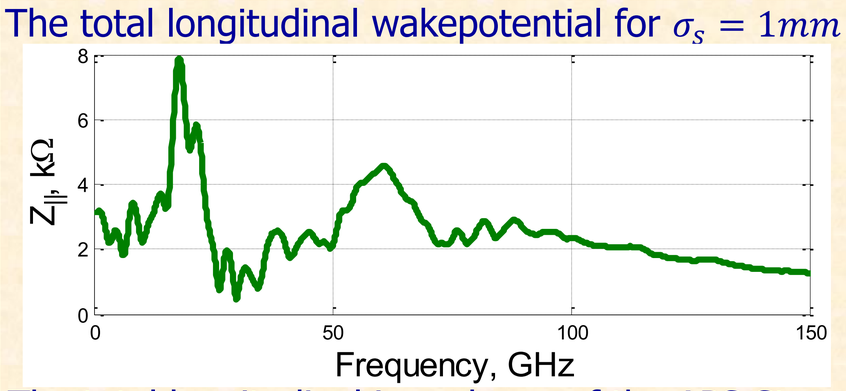
Two particle tracking codes, ELEGANT and SPACE, have been used to simulate the microwave instability in the APS storage ring. The total longitudinal wakepotential for the APS vacuum components, computed by GdfidL, has been used as the input file for the simulations. The numerical results have been compared with bunch length and the energy spread measurements for different single-bunch intensities. The total longitudinal wakepotential has been computed by the GdfidL code for the APS vacuum components distributed around the ring. The longitudinal wakepotential for a 1mm bunch length is shown in Fig. 1. This wakepotential was simulated by Y.-C. Chae.



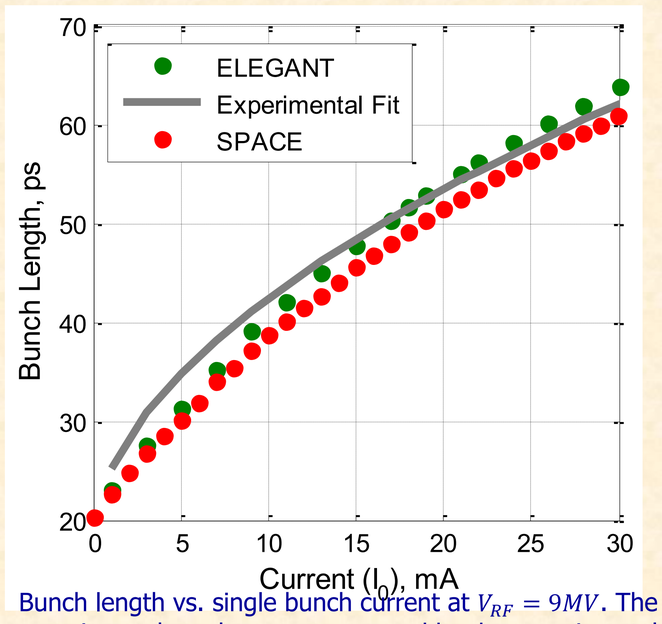

The total longitudinal wakepotential for $\sigma_s = 1mm$



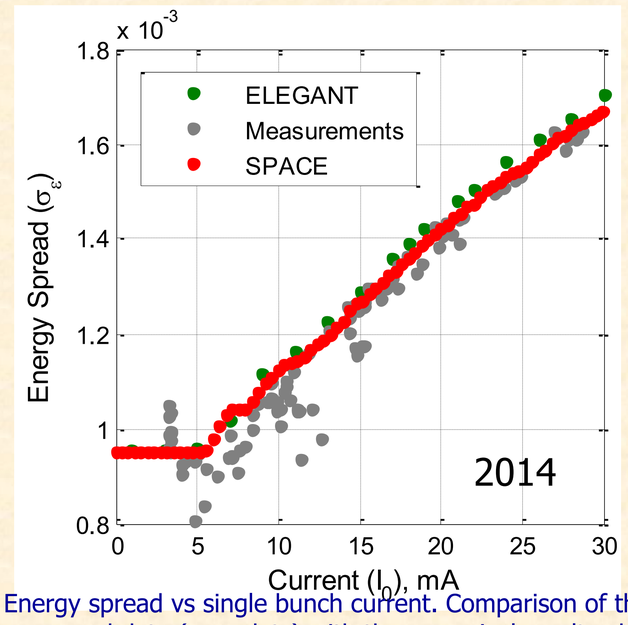

The total longitudinal impedance of the APS Storage ring

Table 1: Main APS Storage Ring Parameters [3]

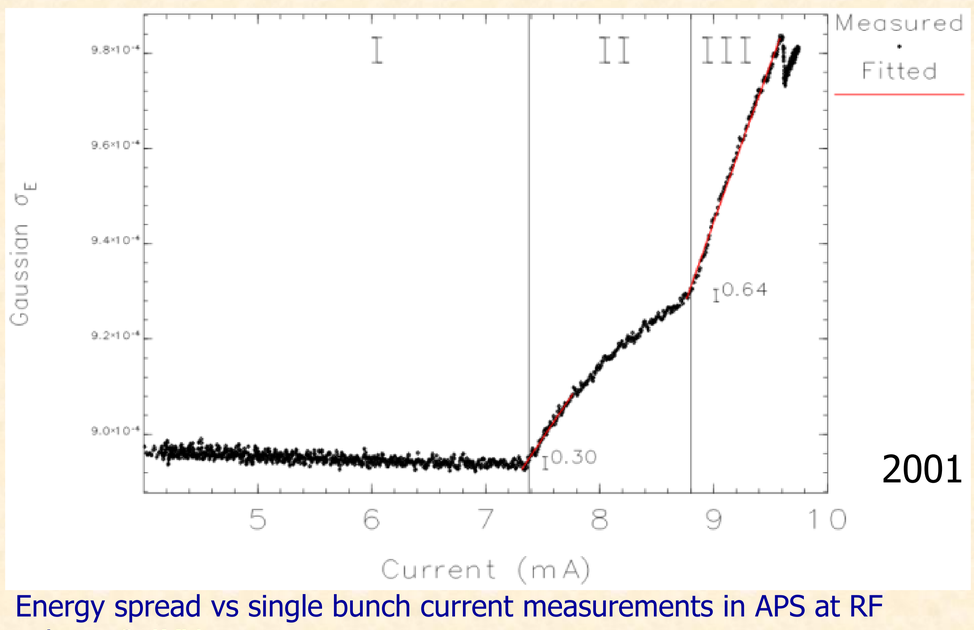
| | | |
|---|---|---|
| Energy | $E[GeV]$ | 7 |
| Revolution Period | $T_0[\mu s]$ | 3.682 |
| Momentum Compaction | $\alpha$ | $2.82 \times 10^{-4}$ |
| Energy Loss | $U\ [MeV]$ | 5.353 |
| RF Voltage | $V\ [MV]$ | 9 |
| Synchrotron Tune | $\nu_s$ | 0.0078 |
| Damping Time | $\tau_{x,y/s}\ [ms]$ | 9.6/4.8 |
| Energy Spread | $\sigma_{\varepsilon 0}\ [\%]$ | 0.096 |
| Bunch Length | $\sigma_{t0}\ [ps]$ | 20 |



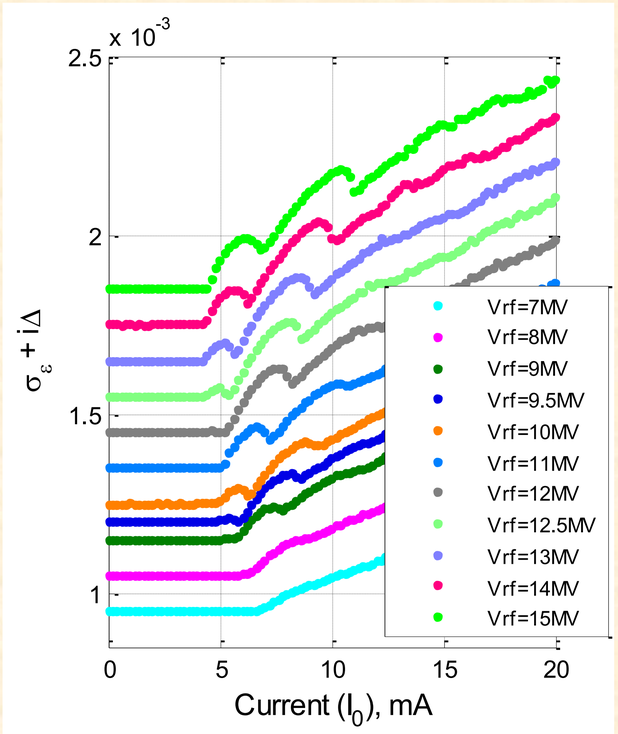

Bunch length vs. single bunch current at $V_{RF} = 9MV$. The experimental results are represented by the experimental fit obtained during several measurements in APS.



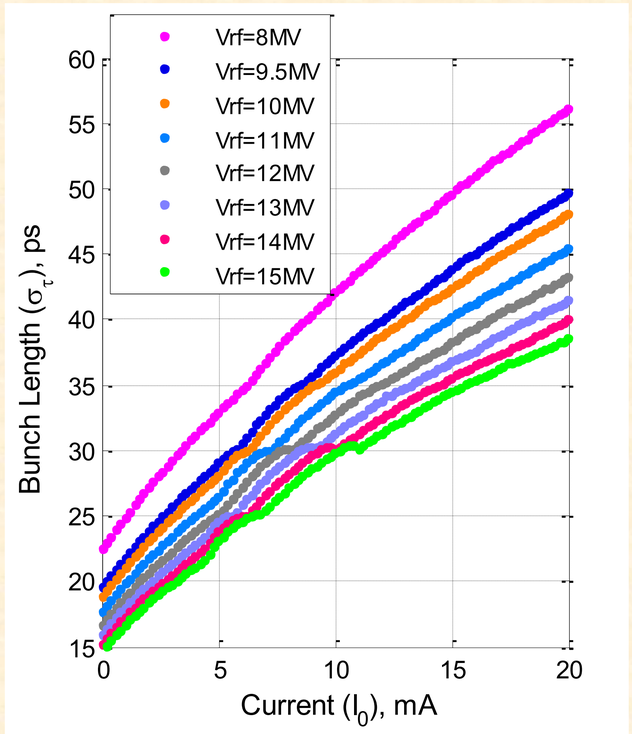

Energy spread vs single bunch current. Comparison of the measured data (grey dots) with the numerical results obtained with the ELEGANT (green dots) and SPACE (blue dots) codes.



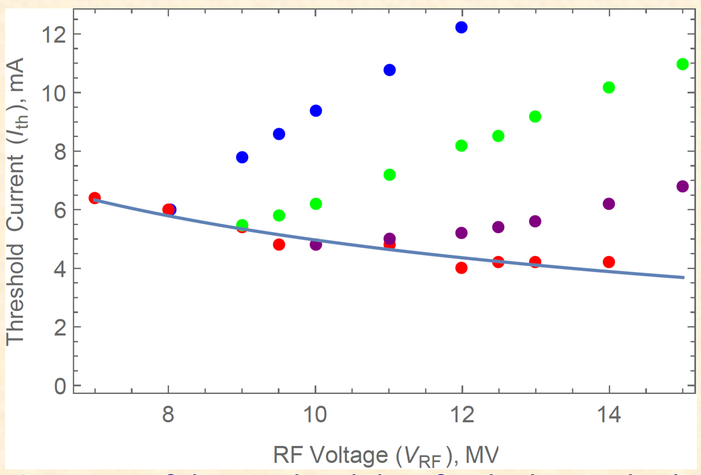

Energy spread vs single bunch current measurements in APS at RF voltage 9.4MV



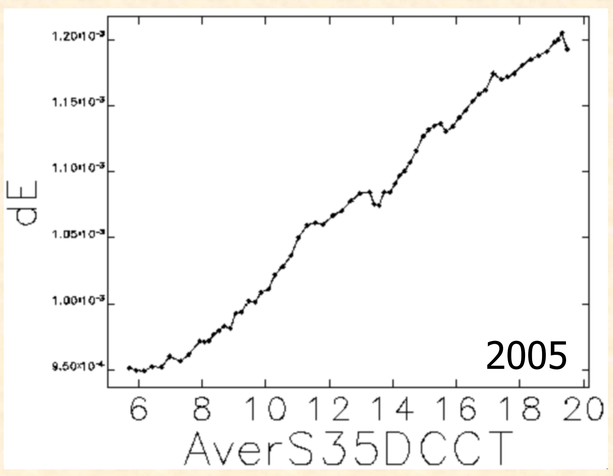

SPACE simulations of the energy spread ($\sigma_\varepsilon$) vs single bunch current ($I_0$) at different RF voltages



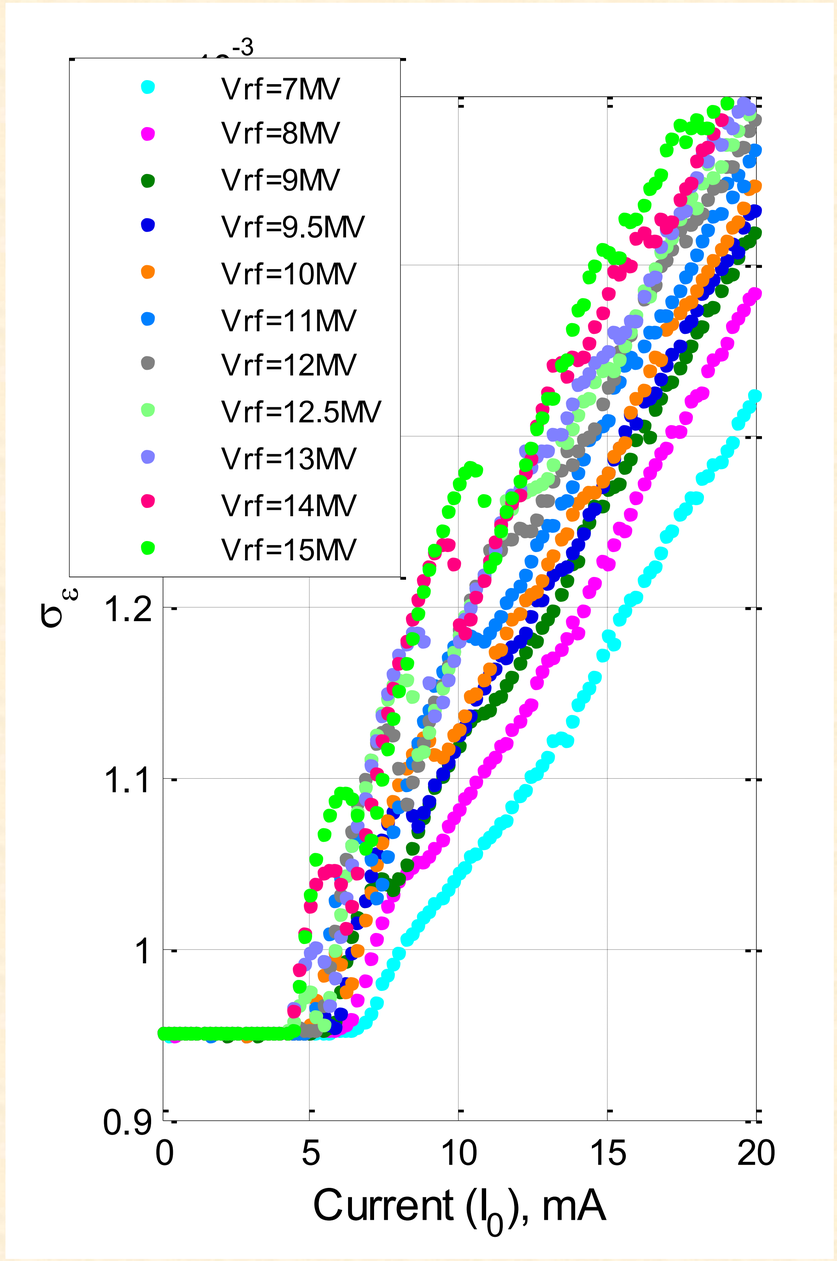

SPACE simulations of the bunch length ($\sigma_\tau$) vs single bunch current ($I_0$) at different RF voltages




Summary of the simulated data for the longitudinal instability thresholds vs the RF voltage




Energy spread vs single bunch current measurements in APS at RF voltage 7MV




Numerically simulated energy spread vs single bunch current for different RF voltage

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