2.2.1. *Parameter values .*

$$
\begin{aligned}
\text{bunch frequency } f_0 &= 0.5\times 10^9\,\text{Hz},\\
\text{beam current } I_e &= 18\,\mu\text{A},\\
\text{electrons/bunch } N_e &= 1.25\times 10^5,\\
\text{penalty function } \mathcal{P}(\Theta) &= 1.0,\\
\text{electron energy } \mathcal{E}_e &= 5800\,\text{MeV},\\
\text{relativistic gamma } \gamma_{_V} &= 11350,\\
\text{electron magnetic moment } \mu_e^* &= -0.928\times 10^{-23},\ \text{J/T},\\
\text{Resonator Q}-\text{value } Q_r &= 21021,\\
\text{resonator frequency } f_r &= 0.75\,\text{GHz},\\
\text{resonator dimensions } a/b/d &= 0.292/0.146/0.274\,\text{m}\\
\frac{a\,b\,d\,\mu_0}{8} &= 3.67\times 10^{-9}\,\frac{\text{J}}{(\text{A/m})^2},\\
\sqrt{\frac{Q_{\text{rect.}}}{2\pi f_r}\,\frac{8}{abd\mu_0}\,\frac{1}{P^{\text{ext}}}} &= \frac{1.835}{\sqrt{P^{\text{ext}}}},\\
\frac{P^{\text{SG}}}{P^{\text{ext}}} &= \frac{0.99\times 10^{-5}\,\sqrt{\text{W}}}{\sqrt{P^{\text{ext}}\,[\text{W}]}}.
\end{aligned}
\tag{13}
$$

In order for the external excitation to match the anticipated S-G excitation one must set $P^{\text{SG}} = P^{\text{ext}}$. That is, $P^{\text{ext}} = 0.1\,\text{nW}$. Expressed in dBm, P^{ext}=-70 dBm.

A reason for formulating the calculation in the way it has been done was to make clear how very small the expected S-G signal is. For comparison purposes one can note that, in a resonant detector of beam position in a nanoamp extracted electron beam at ELSA[**14**], the lowest observable signal level reported was about -113 dBm.

3. Room temperature S-G polarimetry test at CEBAF

The S-G signal is extremely weak compared to direct beam charge excitation. The cleanest way to extract the S-G signal is for its frequency to differ from the frequency of the charge signal. This makes it essential to shift the S-G frequency away from the beam repetition frequency. In a storage ring it is possible to exploit the spin tune precession to perform this frequency shift.

In a linear accelerator, the fact that each bunch passes the S-G resonator only once, makes it hard to arrange for the polarization of successive bunches to be different. It can ony be done at the electron source, either by alternating the (circular) polarization of the laser of the photo-injector, or by swinging the electron polarization at the front end of the injector line where the electron energy is still quite low. The frequency with which the bunch polarization oscillates is thought to be limited to, perhaps, 10 kHz, which corresponds to a polarization oscillation period of $T_{\text{pol}} = 100\,\mu\,\text{s}$.