TUPSM034

OPTIMIZATION OF SMALL APERTURE BEAM POSITION MONITORS FOR NSLS-II PROJECT

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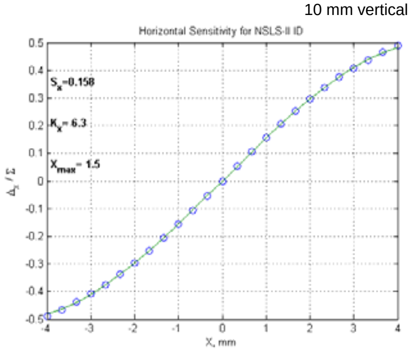
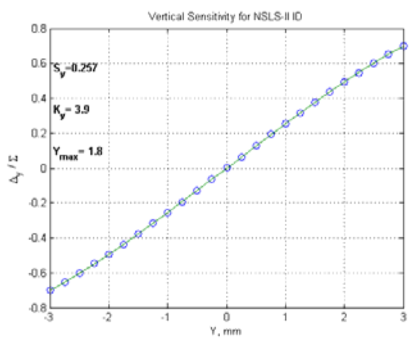
Abstract
The NSLS-II Light Source is being built at Brookhaven National Laboratory. It will provide users with ultimate brightness beam and full realization of its capabilities requires corresponding stability of the beam orbit. The small aperture beam position monitors (BPMs) will provide better sensitivity to the beam position but also requires thorough design. In this paper we present the results of the optimization including signal power levels and button heating.

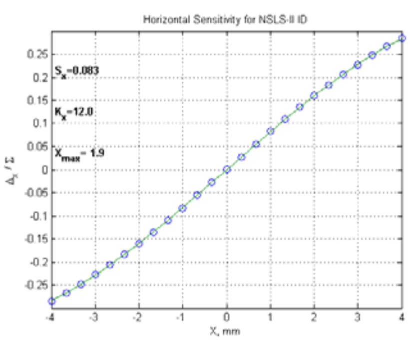
The MATLAB script was used for optimization of the distance between centers of the buttons. The scripts calculates difference over sum ratio for the varying beam position

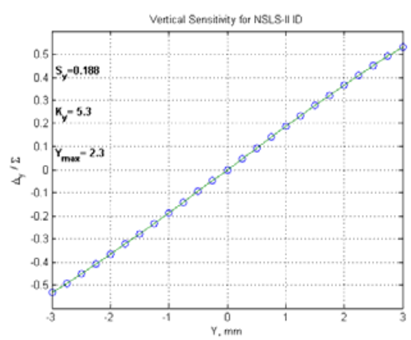
10 mm vertical gap



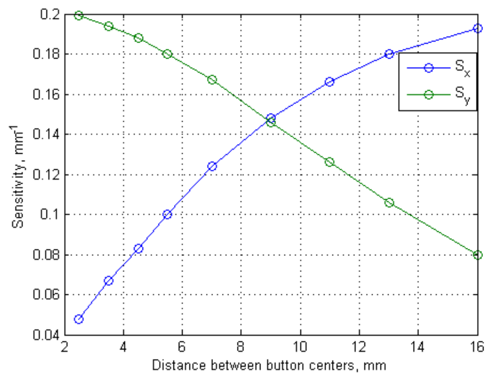


15 mm vertical gap





From the calculations the separation between the button centers is chosen to be 4.5 mm. In this case sensitivity to the vertical motion doubles in comparison with the regular BPMs when horizontal is not changed.



To estimate power dissipated in a button we uses figure-of-merit, which value depends on vacuum chamber vertical gap, button diameter, bunch length, circulating current, number of bunches and the revolution frequency.

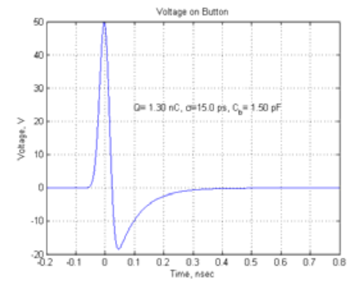
$$FOM = N f_{rev}\left(\frac{Q}{a}\exp\left[-\frac{F_{button}^2}{2F_{beam}^2}\right]\right)^2$$

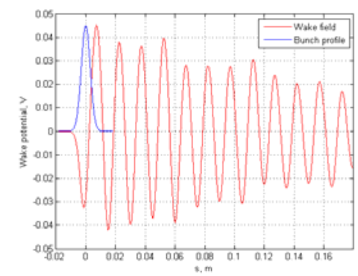
$$F_{button} = \frac{c}{\pi D_{button}}$$

$$F_{beam} = \frac{1}{2\pi\sigma}$$

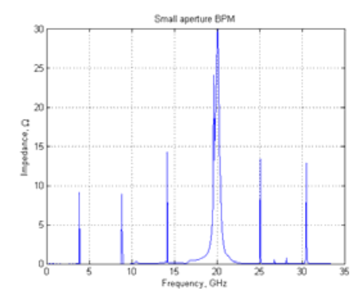
For the regular BPMs figure of merit is 809, when for the small aperture it is 200 for a 15 mm gap and 460 for a 10 mm gap. The reduction is due to the smaller button diameter.

The MATLAB script used for the geometry optimization also performs the evaluation of power for the on axis beam. With 500 mA circulation current the buttons with 4.5 mm diameter installed on a vacuum chamber with 15 mm vertical gap will induced -8.2 dBm signal at the RF frequency of 499.68 MHz. For a vacuum chamber with 10 mm gap the power will rise to -6.8 dBm. Such levels of the signal are in line with standard BPMs.





Longitudinal long range wake potential.



Real part of longitudinal impedance