17TH ADVANCED BEAM DYNAMICS WORKSHOP ON
FUTURE LIGHT SOURCES

APS Low-Energy Undulator Test Line Beam Diagnostics Development

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ARGONNE NATIONAL LABORATORY, ARGONNE, IL U.S.A.

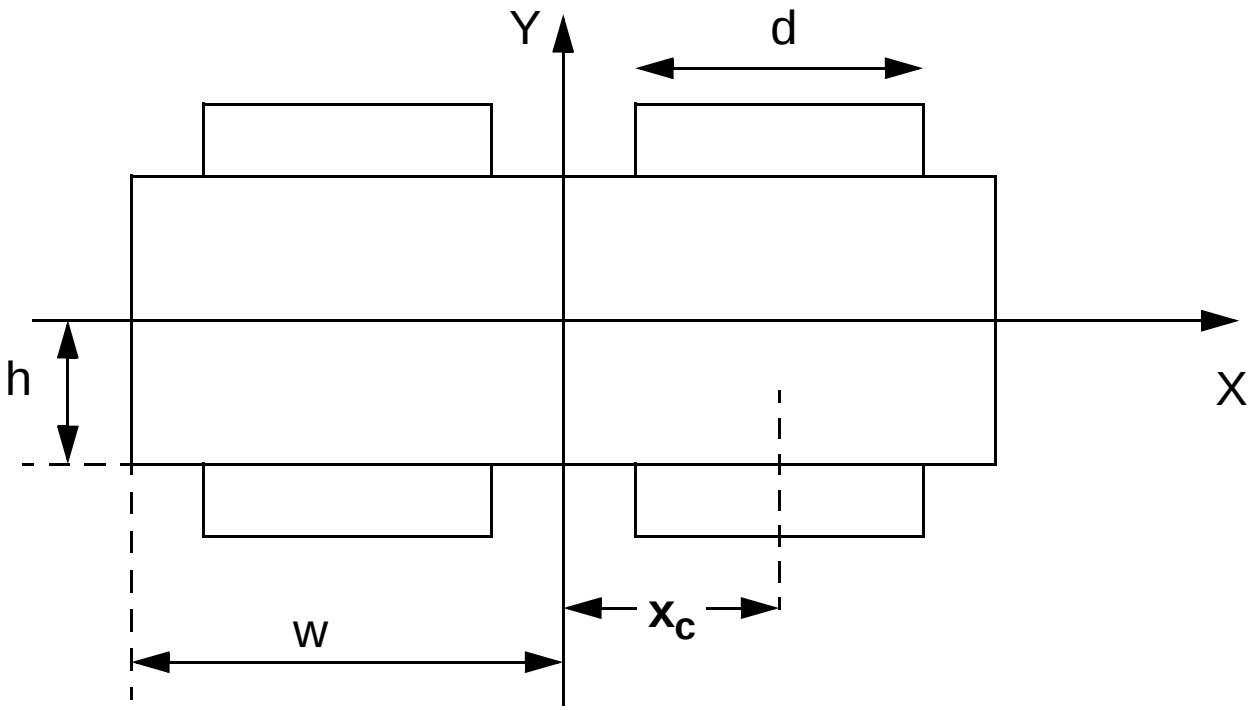
APS Low-Energy Undulator Test Line Beam Diagnostics Development

Glenn Decker, Alex Lumpkin, Bingxin Yang, Suk Kim

Purpose

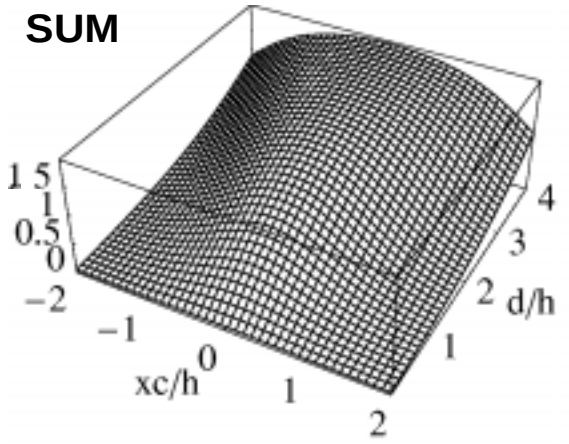
The purpose of this work is to develop particle beam diagnostics for ultra-short, ultra-bright particle beams. Specifically, a high-resolution single-pass beam position monitor (bpm) pickup electrode assembly has been designed, built, and tested, in addition to the development of electro-optic techniques using optical transition radiation. The long-range goal of this work is to support fourth-generation light source development.

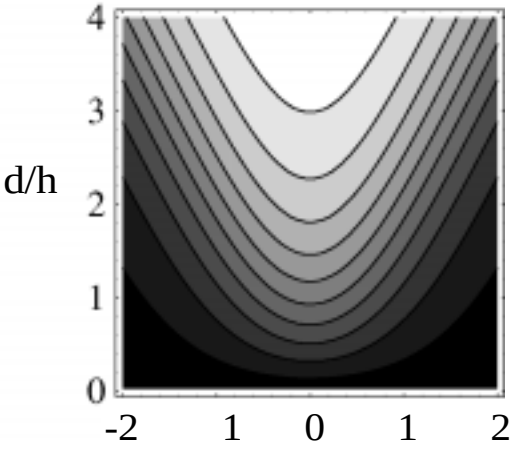
Geometry for BPM button geometry optimization



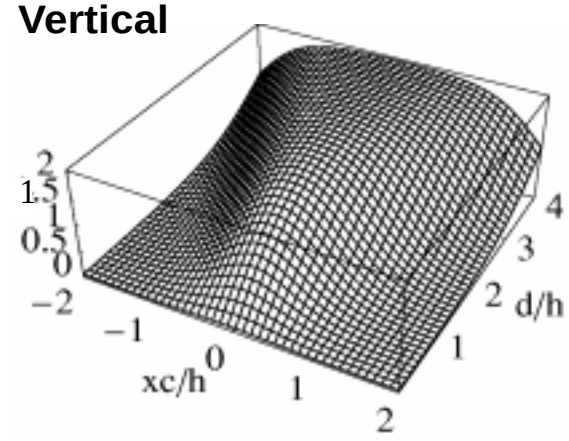
Optimization of BPM Sum, Position Sensitivity with Geometry

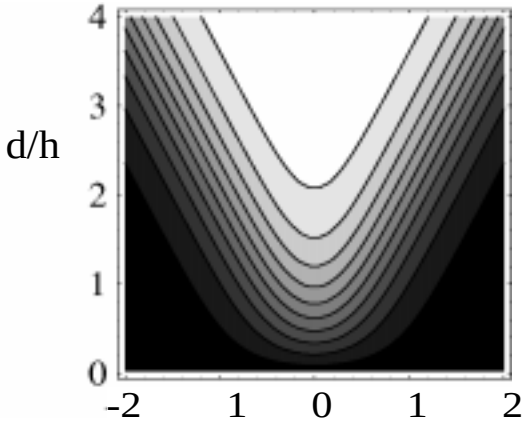
SUM



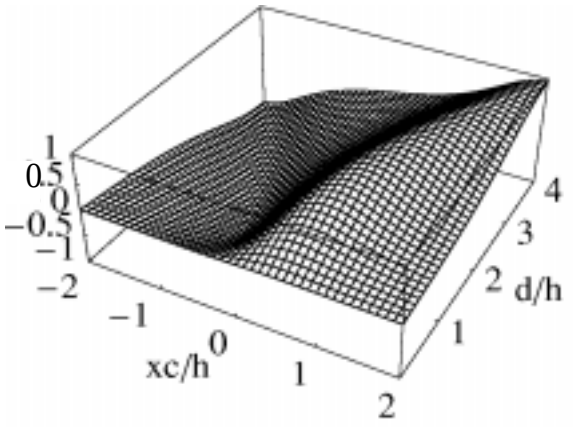


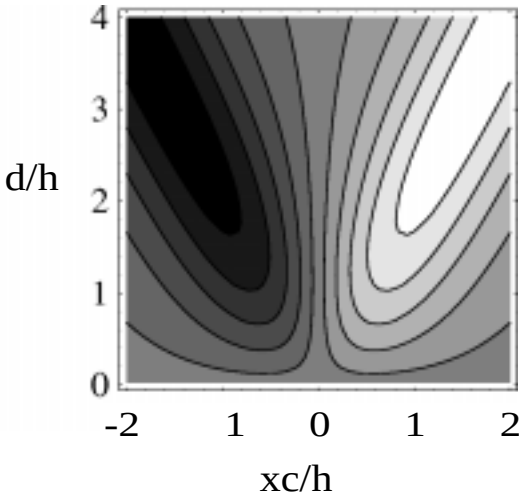
Vertical





Horizontal





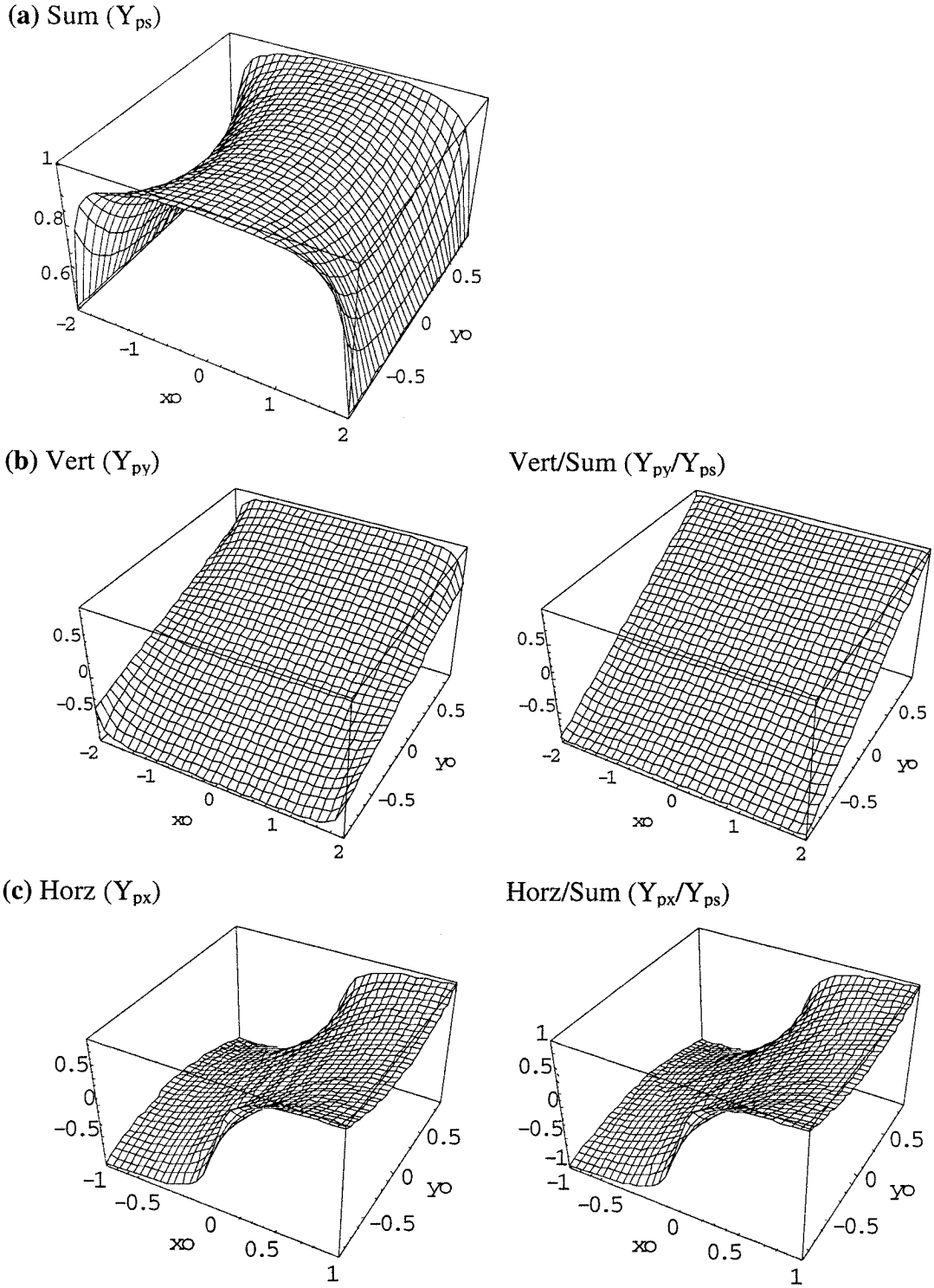
$$V_{ps}(x_o, y_o) = \frac{V_p}{\pi}\left[\tan^{-1}\{\frac{\sinh p(x-x_o)}{\cos py_o}\} + \tan^{-1}\{\frac{\sinh p(x+x_o)}{\cos py_o}\}\right]_{x=x_1}^{x=x_2},$$

$$V_{py}(x_o, y_o) = \frac{V_p}{\pi}\left[\tan^{-1}\{\frac{e^{2p(x-x_o)} + \cos 2py_o}{\sin 2py_o}\} - \tan^{-1}\{\frac{e^{-2p(x+x_o)} + \cos 2py_o}{\sin 2py_o}\}\right]_{x_1}^{x_2},$$

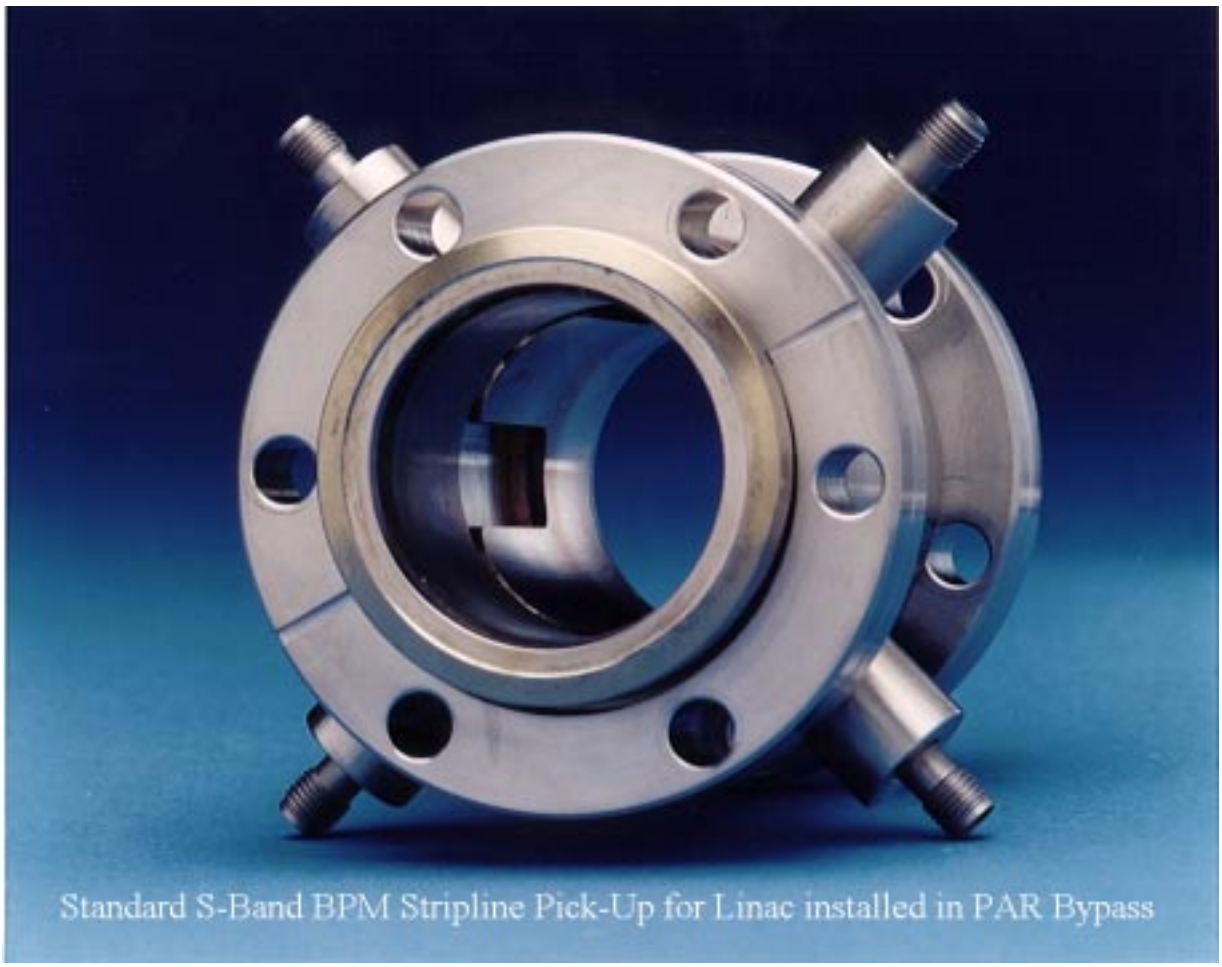
$$V_{px}(x_o, y_o) = \frac{V_p}{\pi}\left[\tan^{-1}\{\frac{\sinh p(x-x_o)}{\cos py_o}\} - \tan^{-1}\{\frac{\sinh p(x+x_o)}{\cos py_o}\}\right]_{x_1}^{x_2}.$$

$p = \pi/2h$, h = half-gap height of the chamber

$x_1 = 0$, $x_2 = 2h$ for the optimized configuration

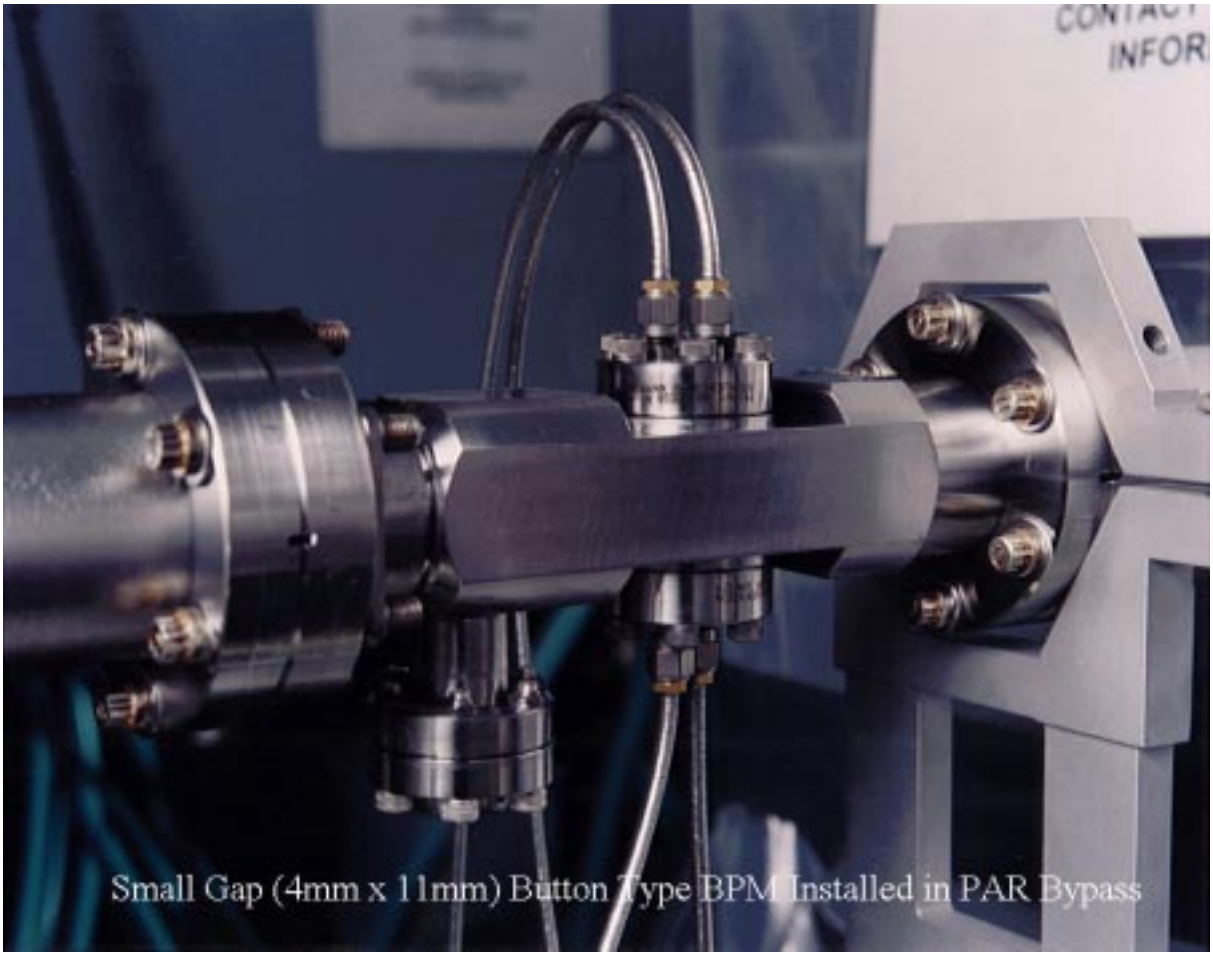


3-D plots for **(a)** sum (Y_{ps}), **(b)** vertical (Y_{ps}) and normalized vertical (Y_{py}/Y_{ps}), and **(c)** horizontal (Y_{px}) and normalized horizontal (Y_{psx}/Y_{ps}) signals in the plane of xo = x_o/h and yo = y_o/h for the optimized configuration.



Standard S-Band BPM Stripline Pick-Up for Linac installed in PAR Bypass

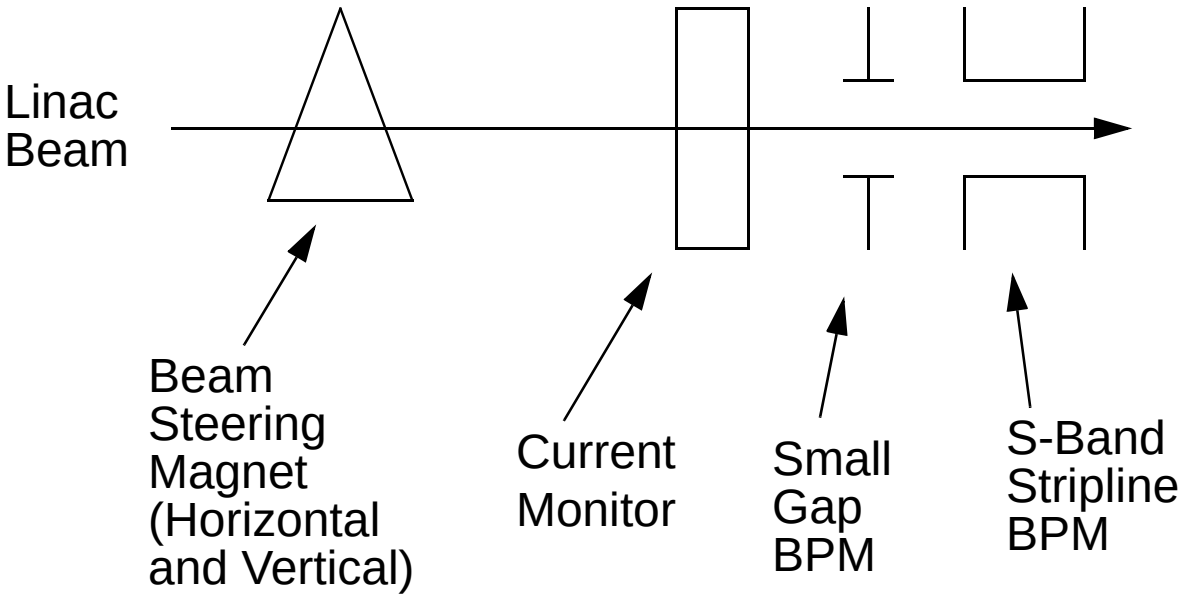

Small Gap (4mm x 11mm) Button Type BPM



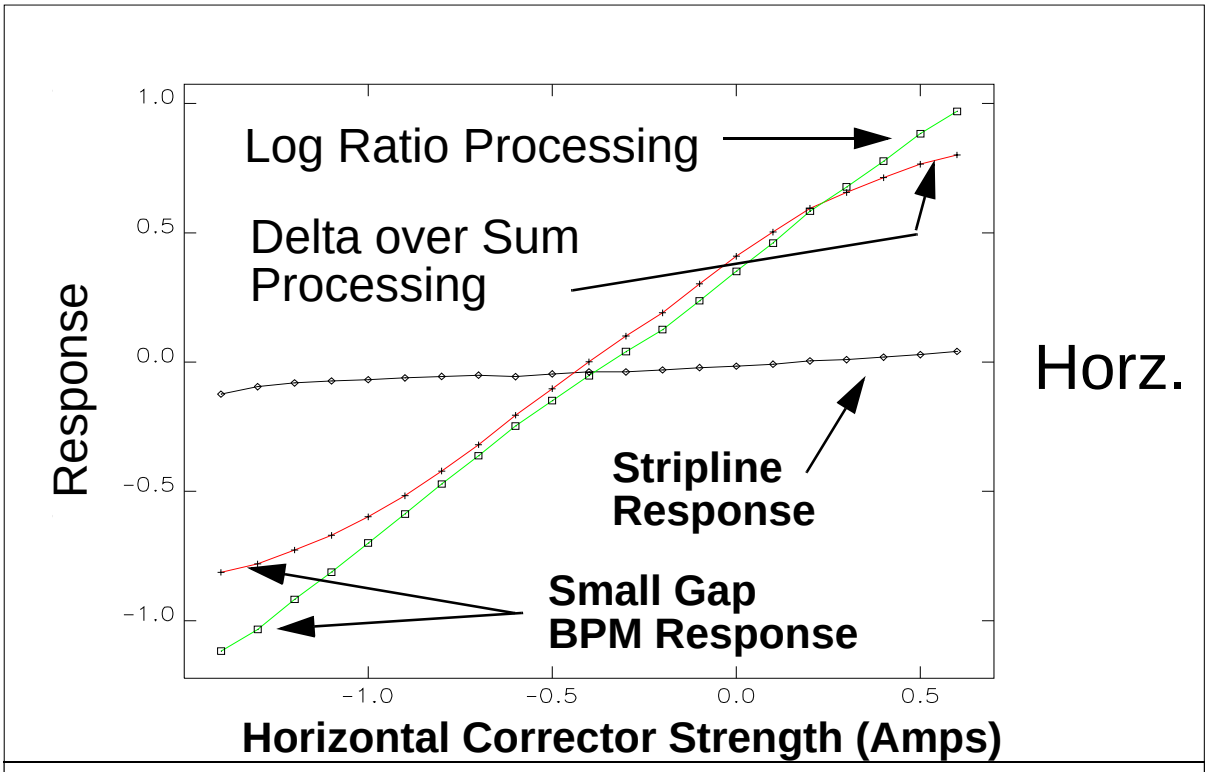
Small Gap (4mm x 11mm) Button Type BPM Installed in PAR Bypass

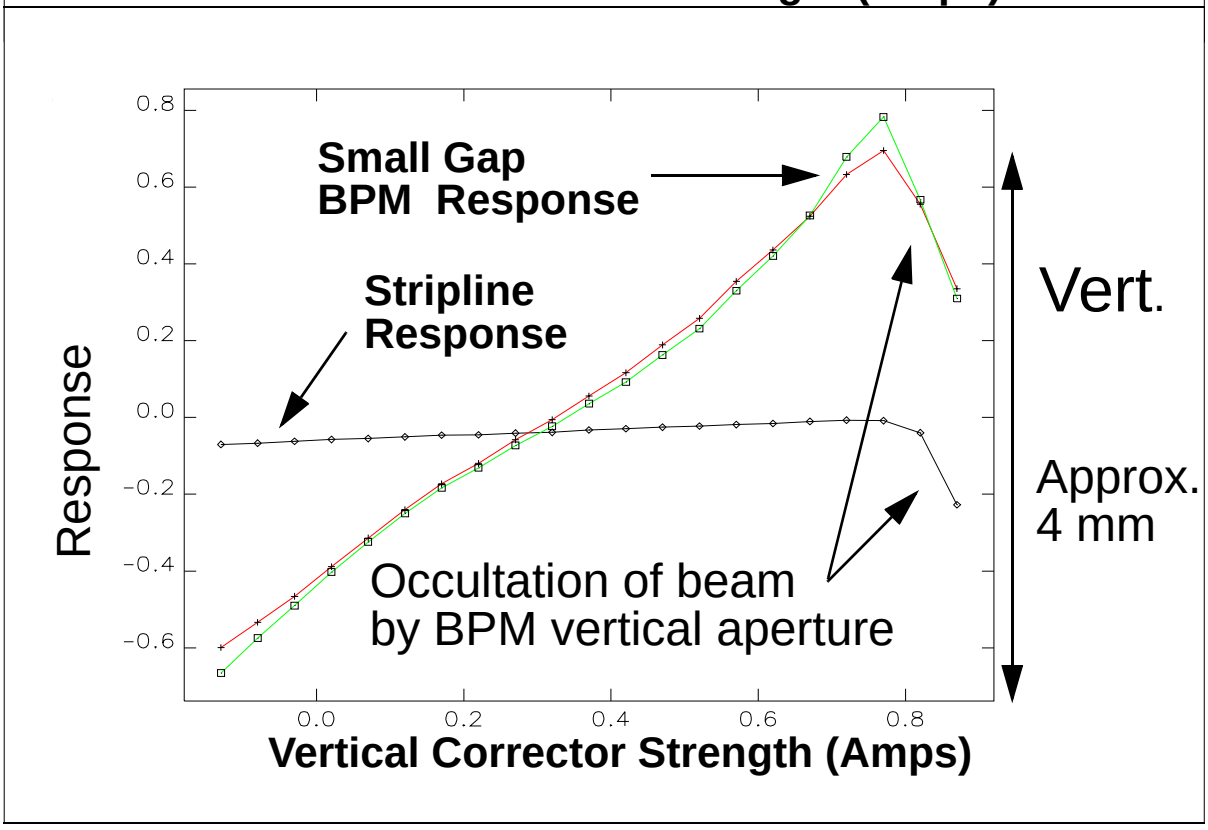
Small Gap Beam Position Monitor Tests

Positron Accumulator Ring Bypass Transport Line

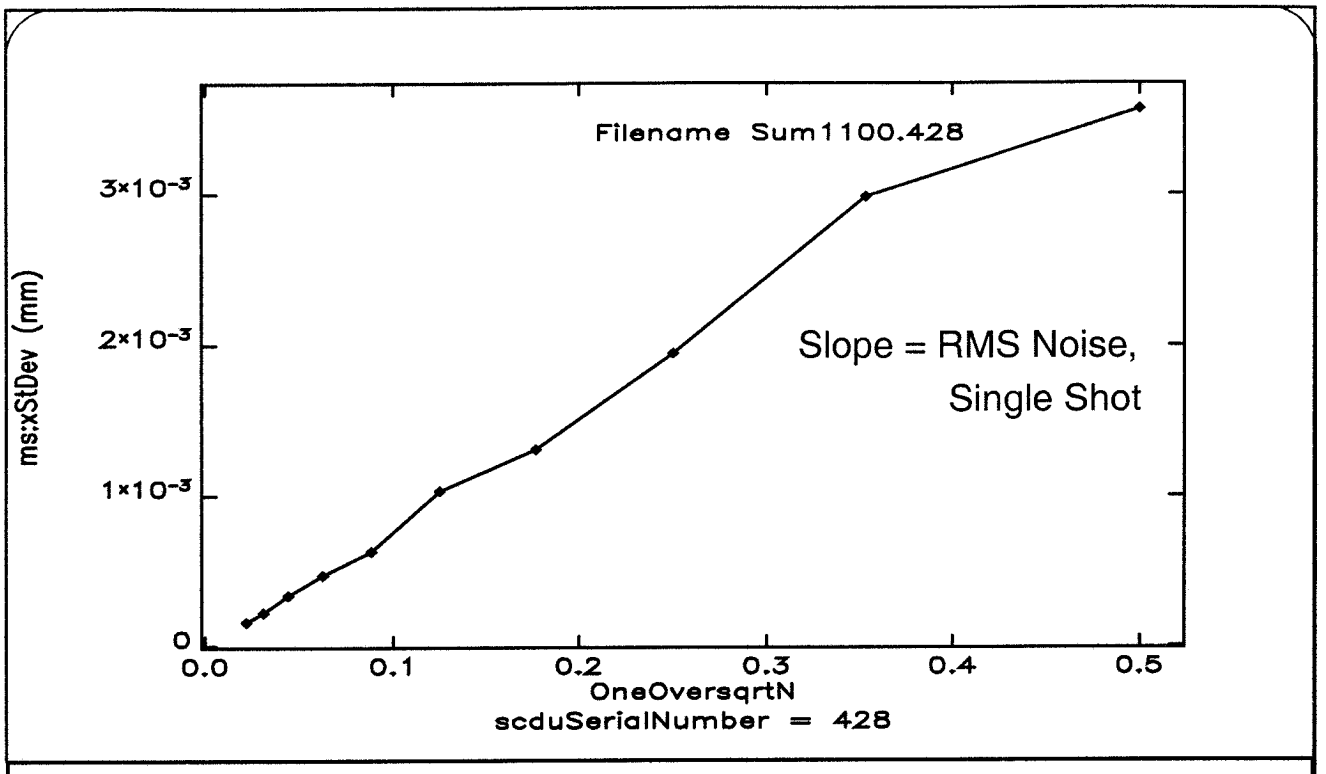


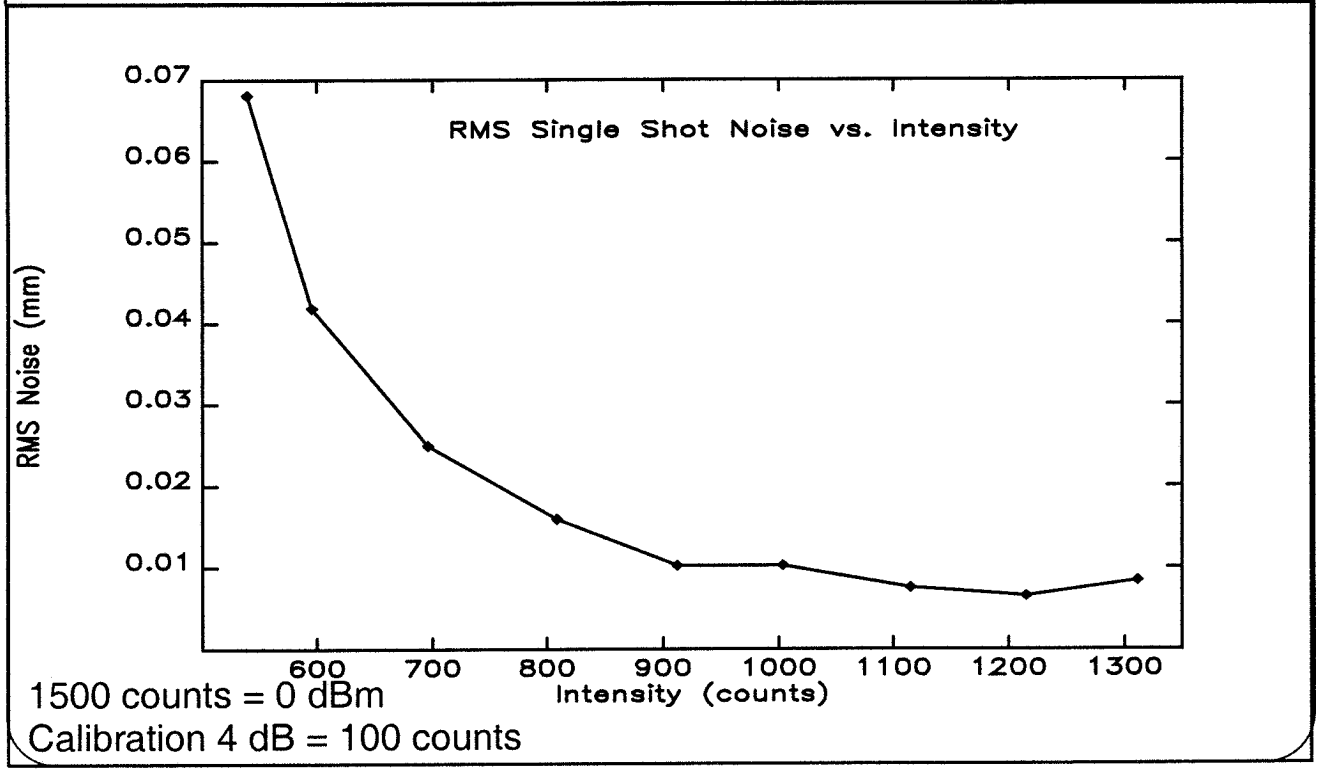
Comparison of Small Gap vs. Standard Stripline BPM





SCDU Noise Floor Results





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ASD Diagnostics

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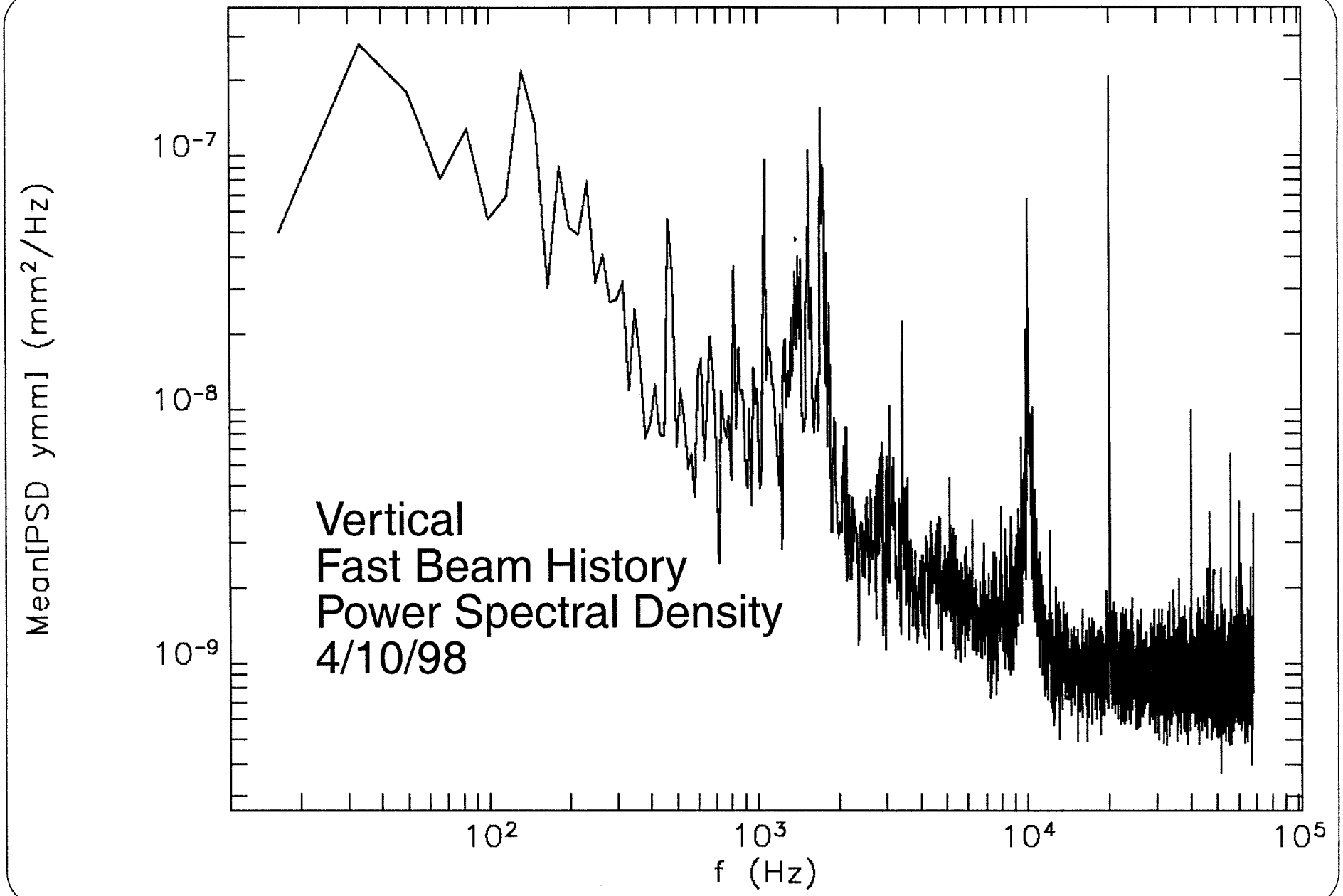
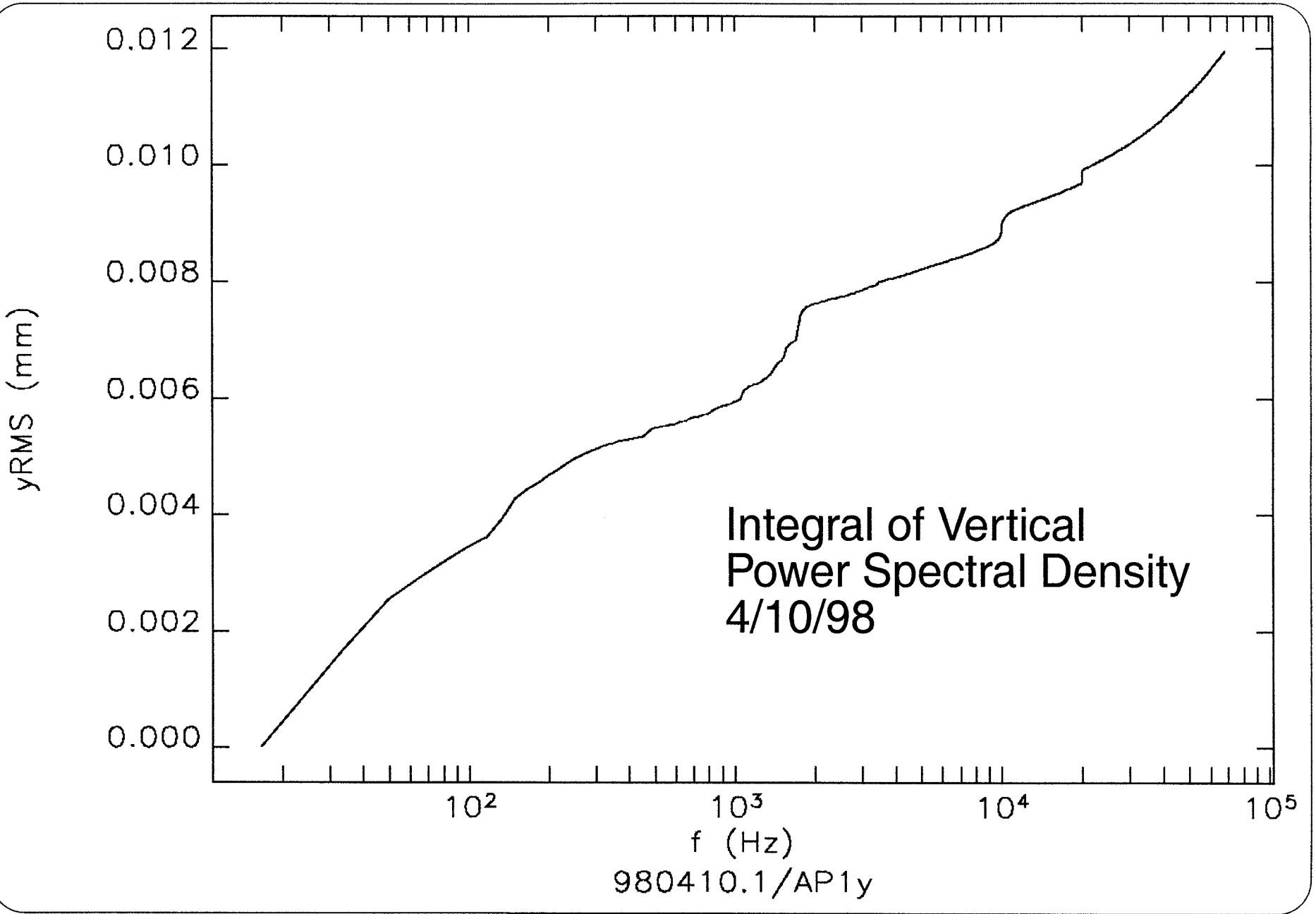
BIW'98
Glenn Decker
May 7, 1998


Mean[PSD ymm] (mm²/Hz)
10⁻⁷
10⁻⁸
10⁻⁹
Vertical
Fast Beam History
Power Spectral Density
4/10/98
10²
10³
10⁴
10⁵
f (Hz)



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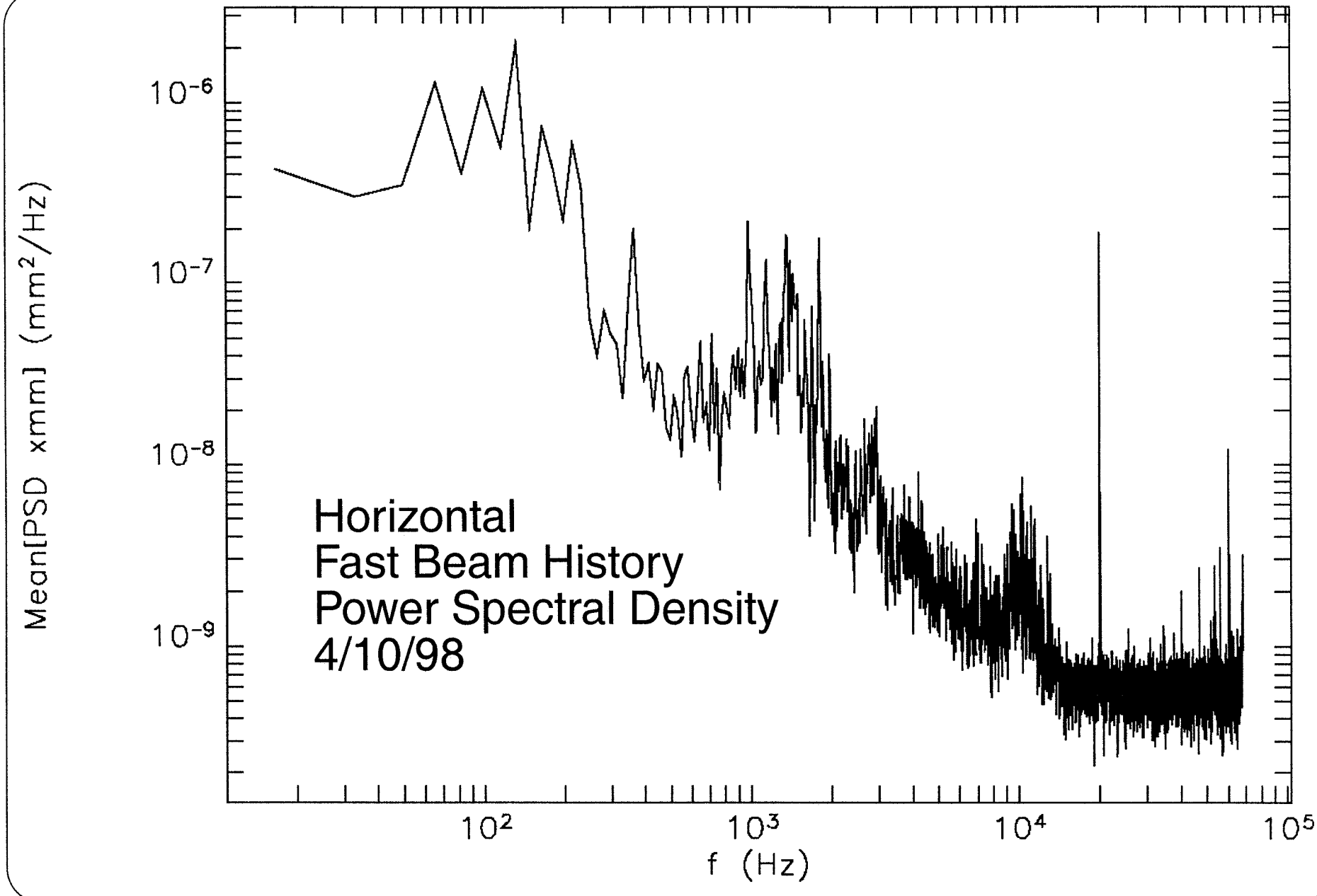
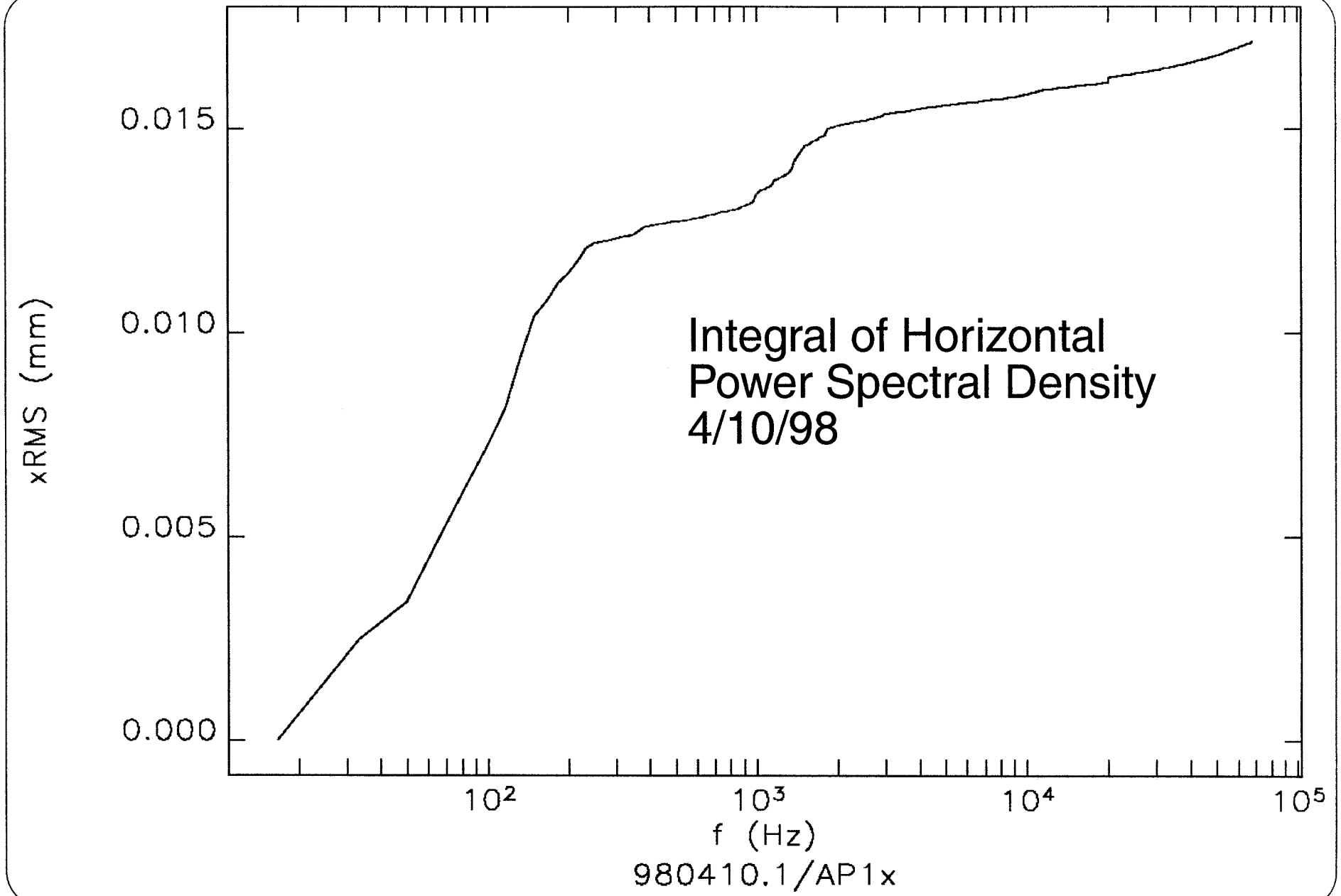
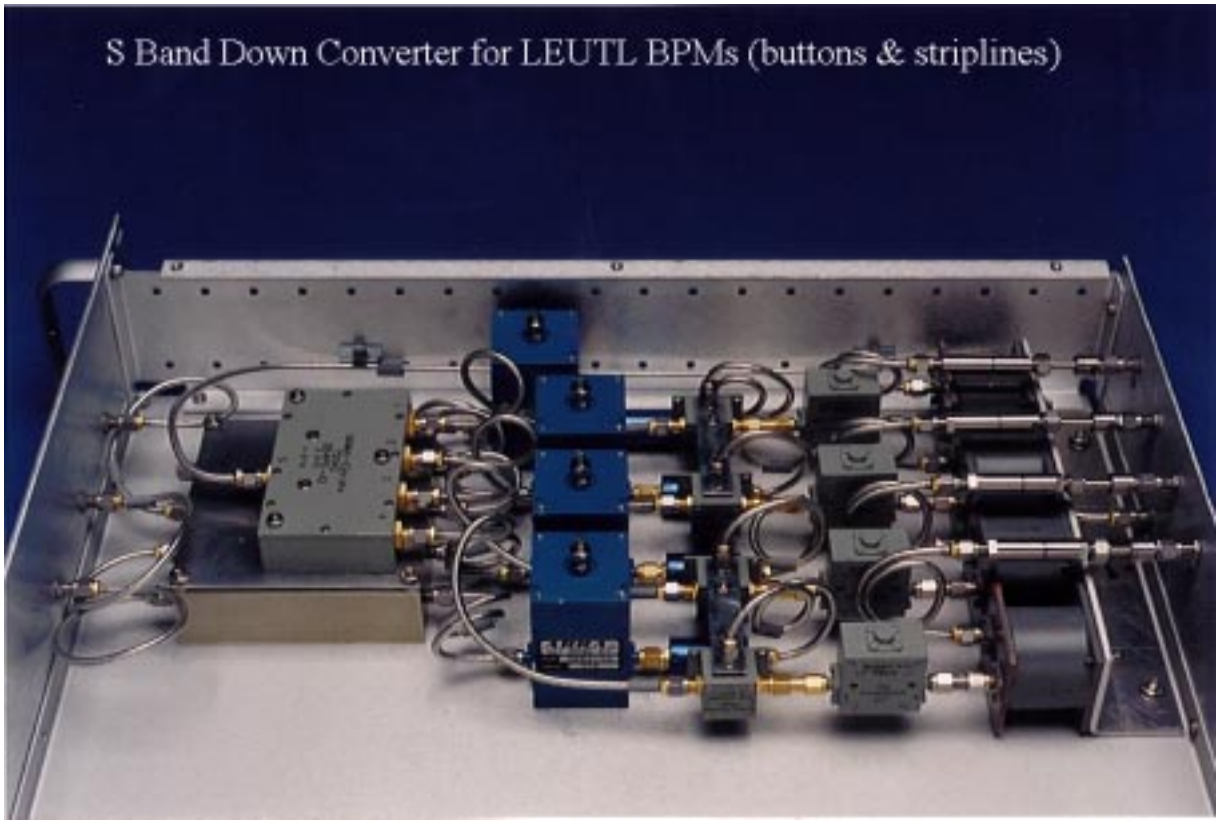

Mean[PSD xmm] (mm²/Hz)
10⁻⁶
10⁻⁷
10⁻⁸
10⁻⁹
10²
10³
10⁴
10⁵
f (Hz)
Horizontal
Fast Beam History
Power Spectral Density
4/10/98


Integral of Horizontal
Power Spectral Density
4/10/98
xRMS (mm)
0.015
0.010
0.005
0.000
10^2
10^3
10^4
10^5
f (Hz)
980410.1/AP1x


S Band Down Converter for LEUTL BPMs (buttons & striplines)