
SPS Transverse Impedance Localization

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Intensity Dependent Optics

Based on EPAC04 Paper: G. Arduini, F. Zimmermann, C. Carli

$$K_{eff} = \frac{eN_b}{2\sqrt{\pi}\sigma_z(E_b/e)} \text{Im}\{Z_{\perp,eff}\}$$

To 1st order, ΔK perturbation with intensity causes:

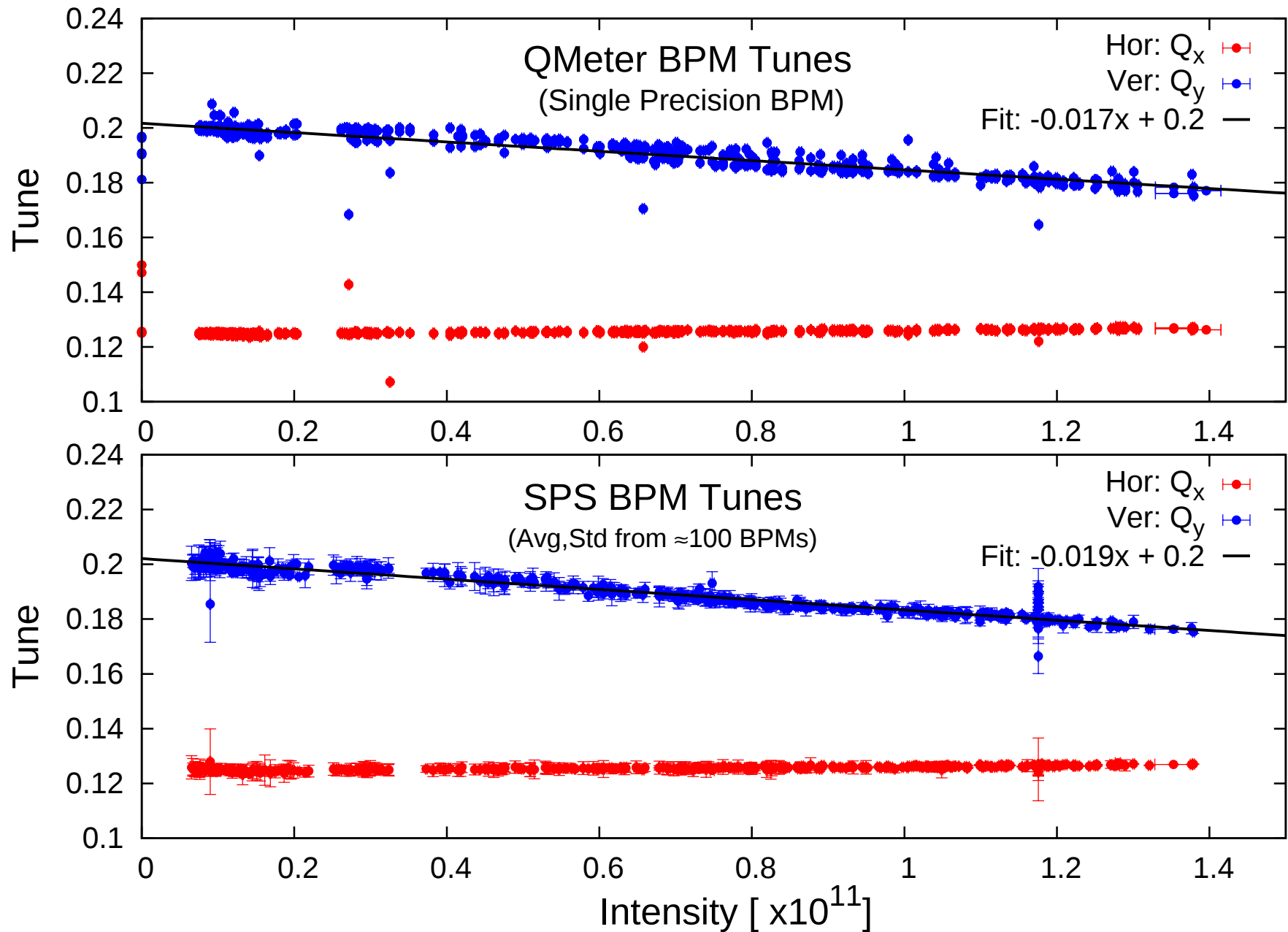
$$\Delta Q = \frac{1}{4\pi} \beta_k \Delta K$$

$$\frac{\Delta\beta(s)}{\beta(s)} = \frac{\beta_k \cos(2|\phi(s) - \phi_k| - 2\pi Q)}{2 \sin(2\pi Q)} \Delta K$$

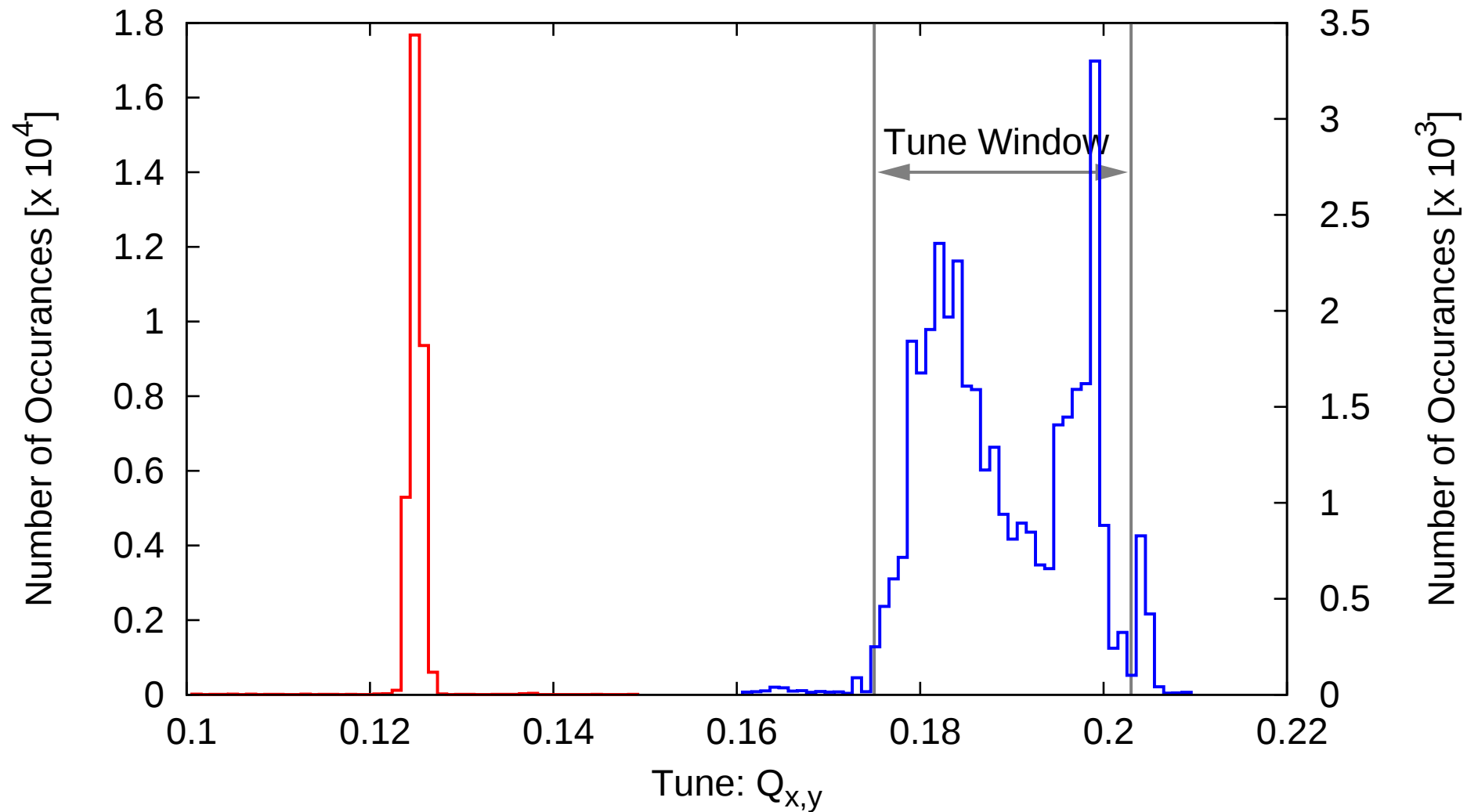
Procedure:

- Measure phase advance between BPM pairs for varying intensities
- Linear fit: $\phi_I = \phi_0 + (\Delta\phi/\Delta N)N_b$
- $\Delta K = R^{-1}\{\Delta\phi/\Delta N_b, Q_x, Q_y\}$, where R is model response matrix

Tune Vs. Intensity (Nov 2, 2007)

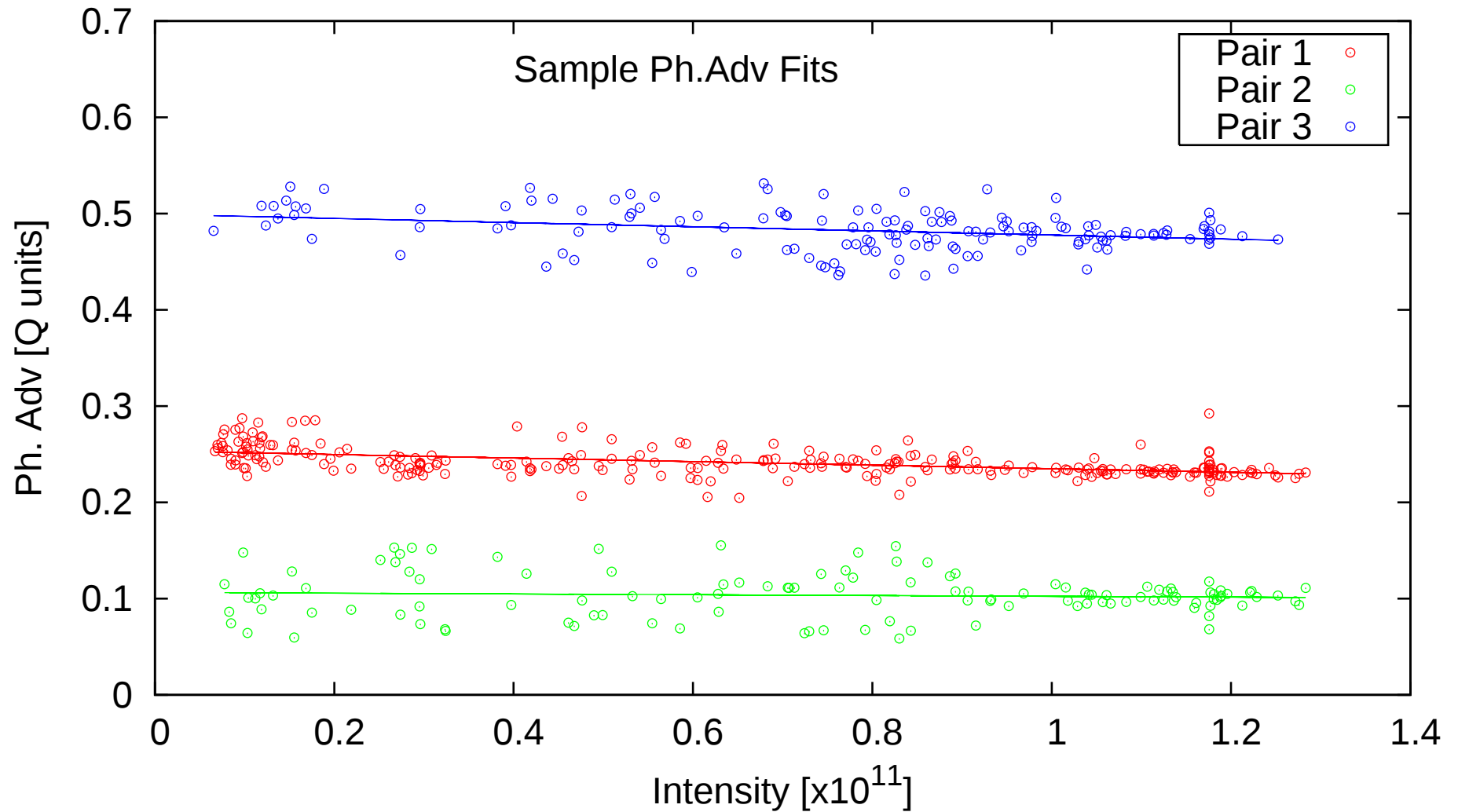


Data Selection



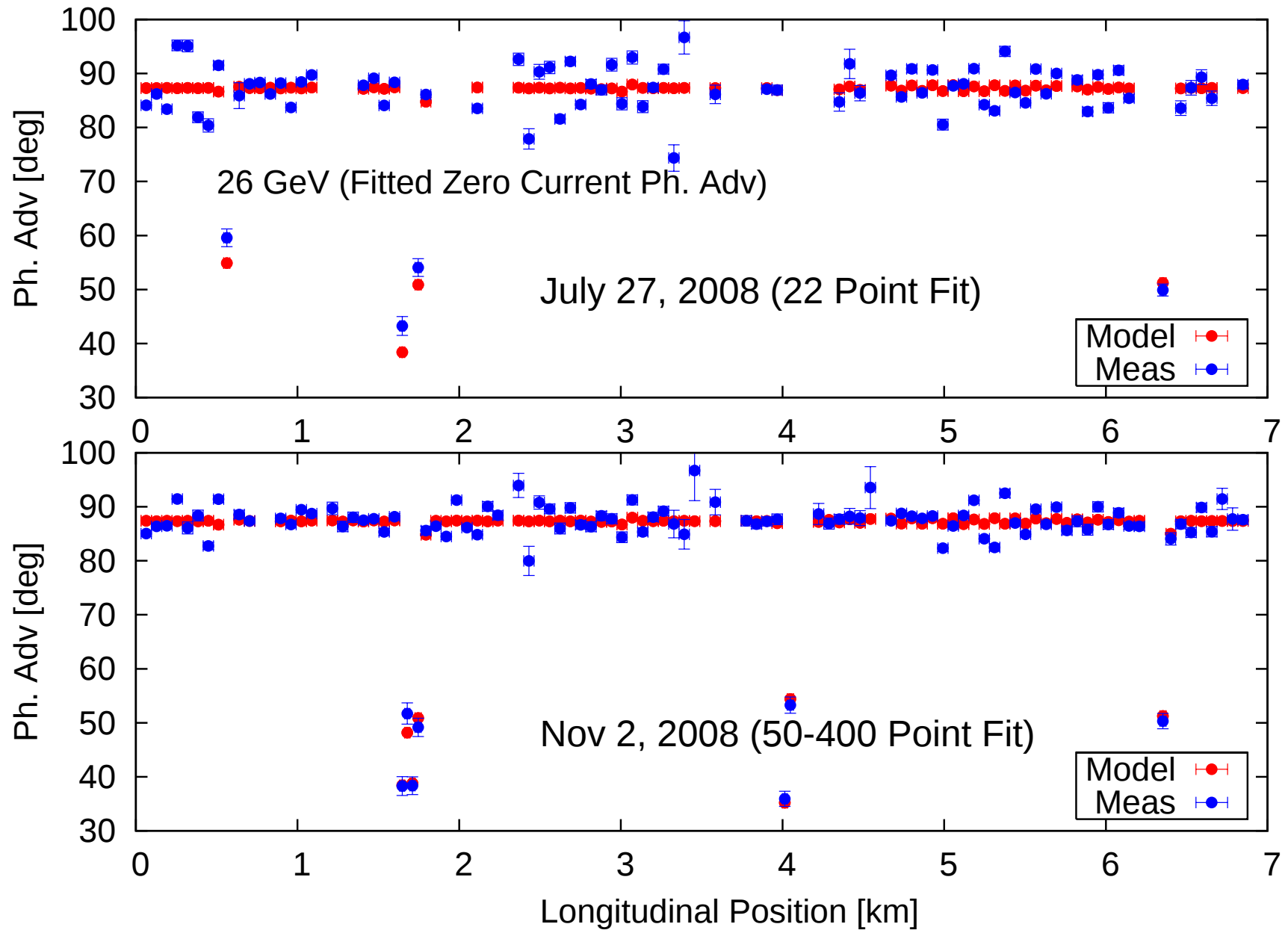
- Histogram of tunes from all BPMs (~ 100), all files (~ 410)
- Tune window & ph. adv of the (meas-model) used as selection criteria

Sample Fits (Nov 2 Data)

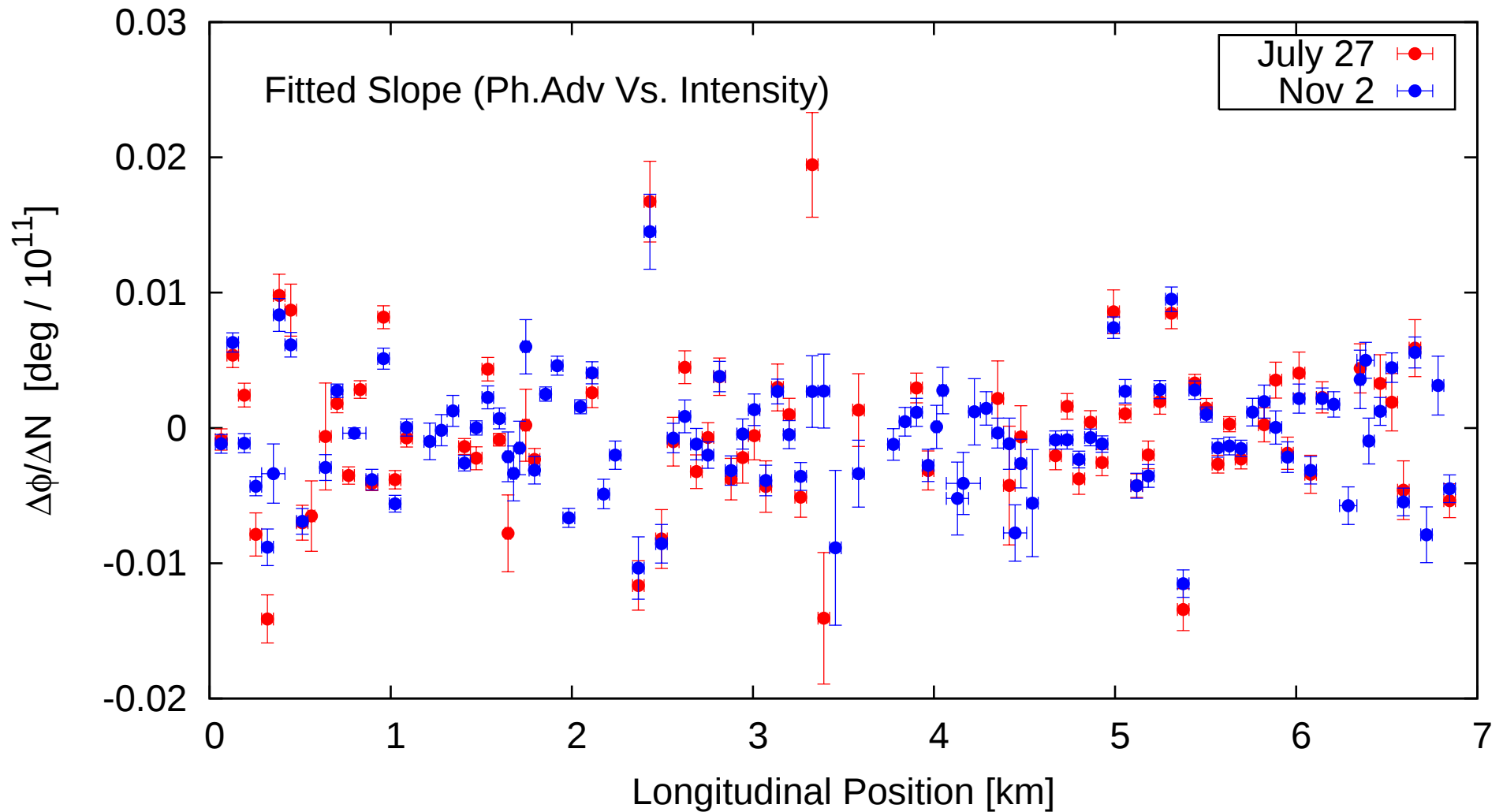


- Only fit BPMs passing selection criteria (lot of statistics)
- Spread is ph. adv is large (BPM gains ?)

SPS Zero Current Ph. Adv

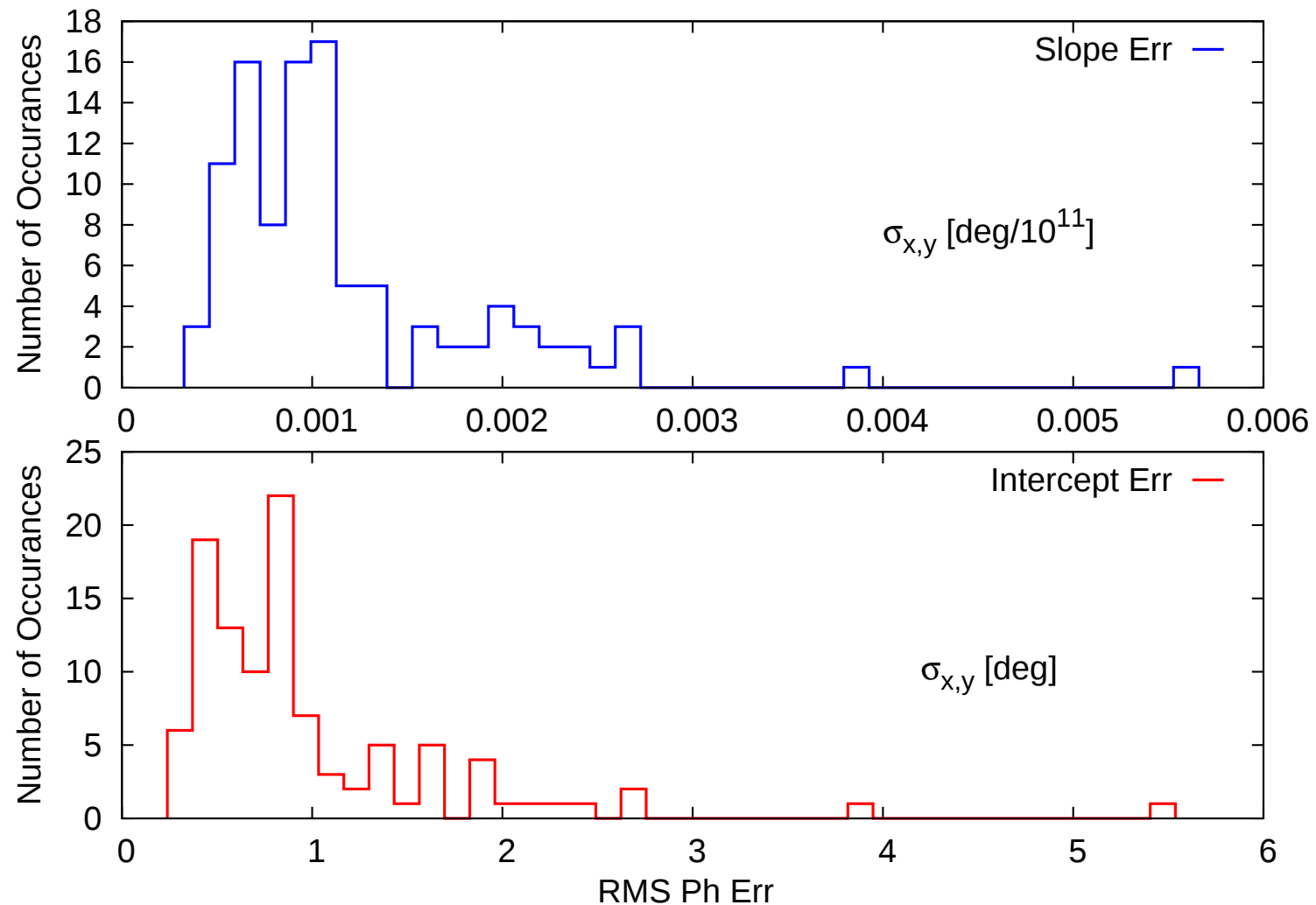


Fitted Slope $\Delta\phi/\Delta N$



- Similar slopes for 2 exps: Nov 2 (400 data sets) & July 27 (22 data sets)
- Relative error appears similar, not too much gain from statistics

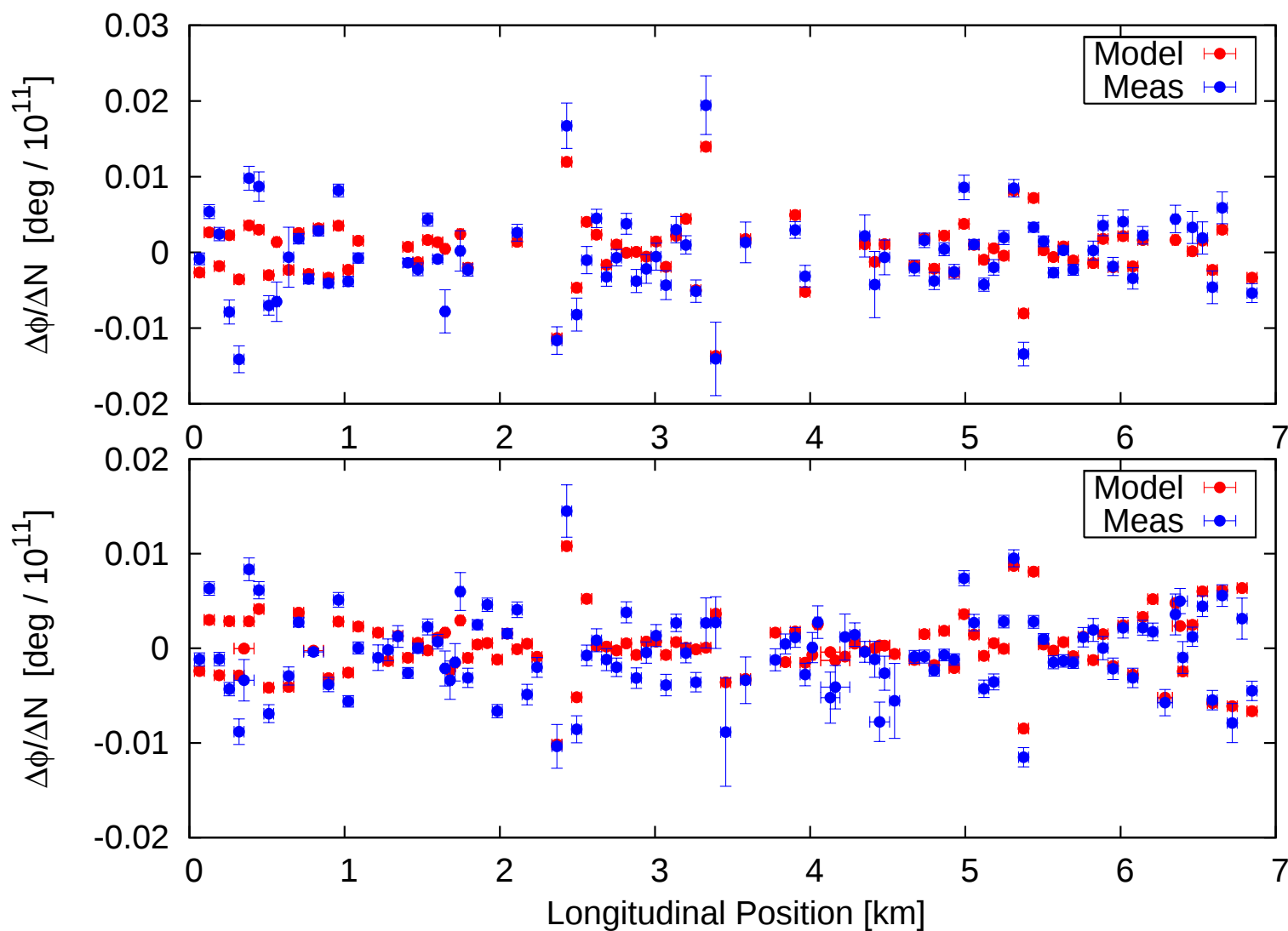
BPM Phase Err (Nov 2 Data)



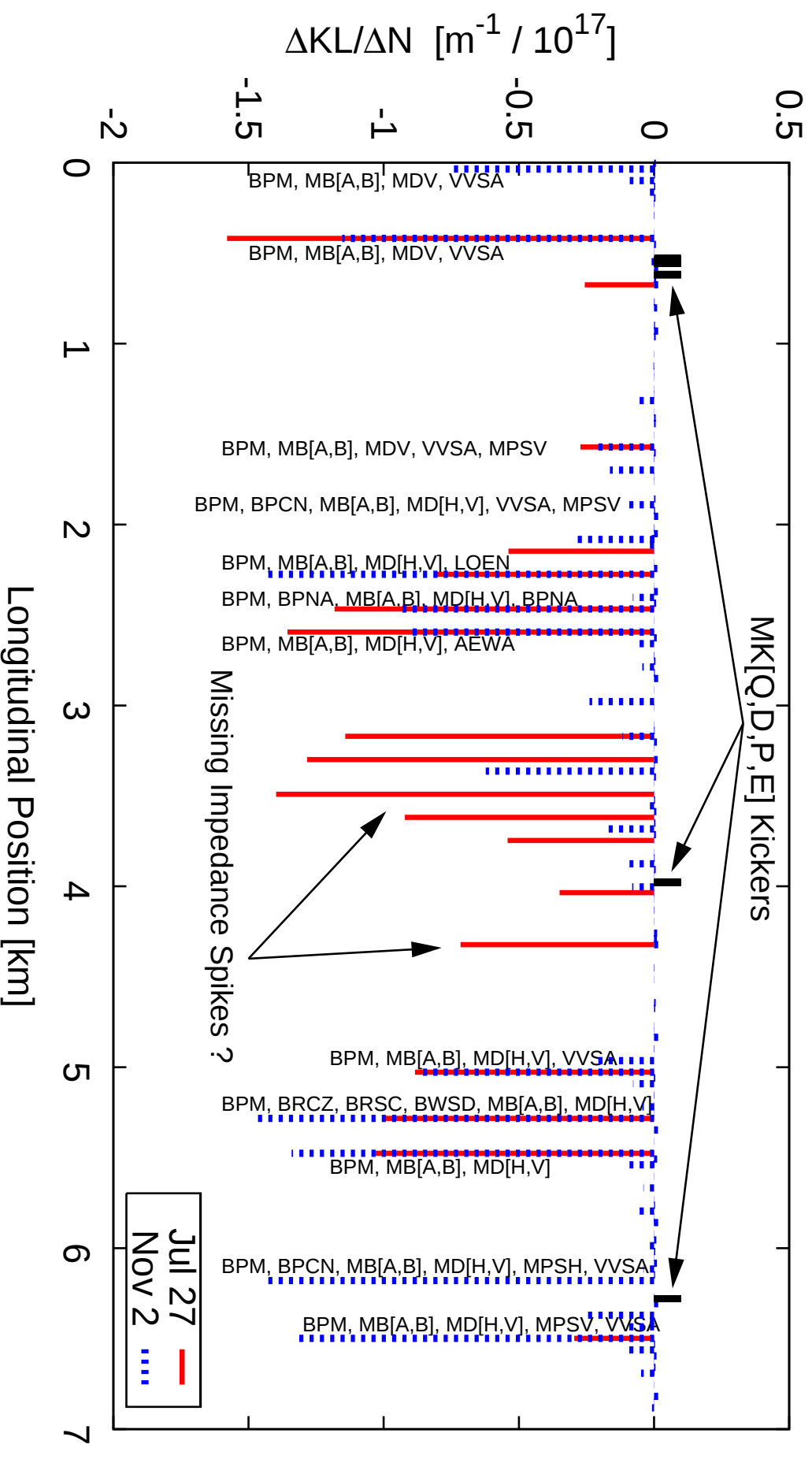
- Error in phase adv < 1 deg (a bit high)
- Error in slope is 1 order of magnitude smaller than slope

Matched Model to Slope $\Delta\phi/\Delta N$

Constraint: $\Delta K < 0$ SVD (6 Iter) $\rightarrow$ Simplex (18 Quads) $\rightarrow$ SVD (6 Iter)

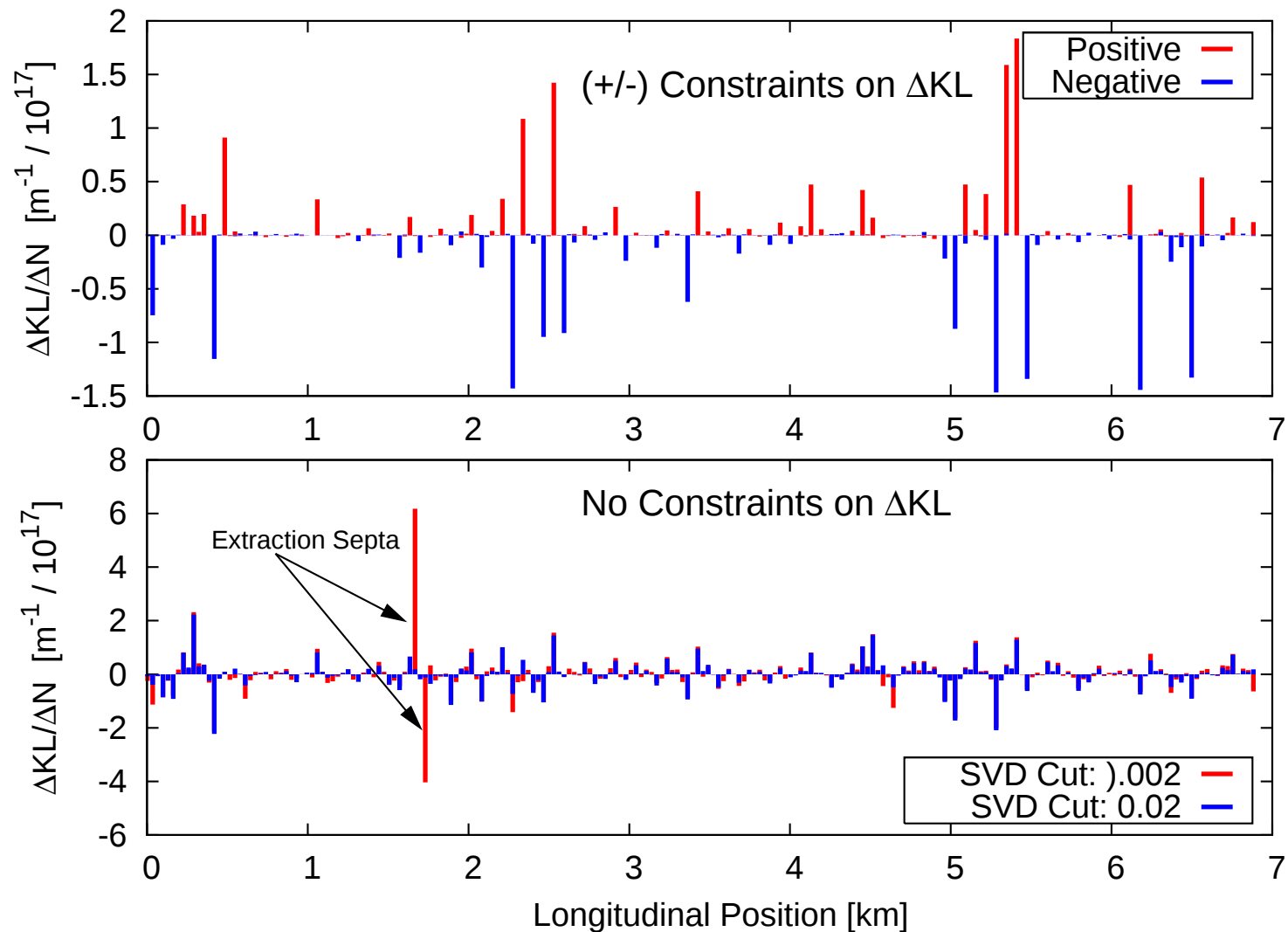


Estimated Impedance Distribution



- Most sources similar for July 27 & Nov 2, some missing near 3-5 km
- Sources near 2.5 km & 5.5 km ?? (Also seen by FZ/GA in 2004)

Estimated Impedance Distribution



- Main difference ($\pm$) constraints: 4-5 km, [else remarkably similar](#)
- No constraint yield big spike at 1.8 km & similar behavior with constraints