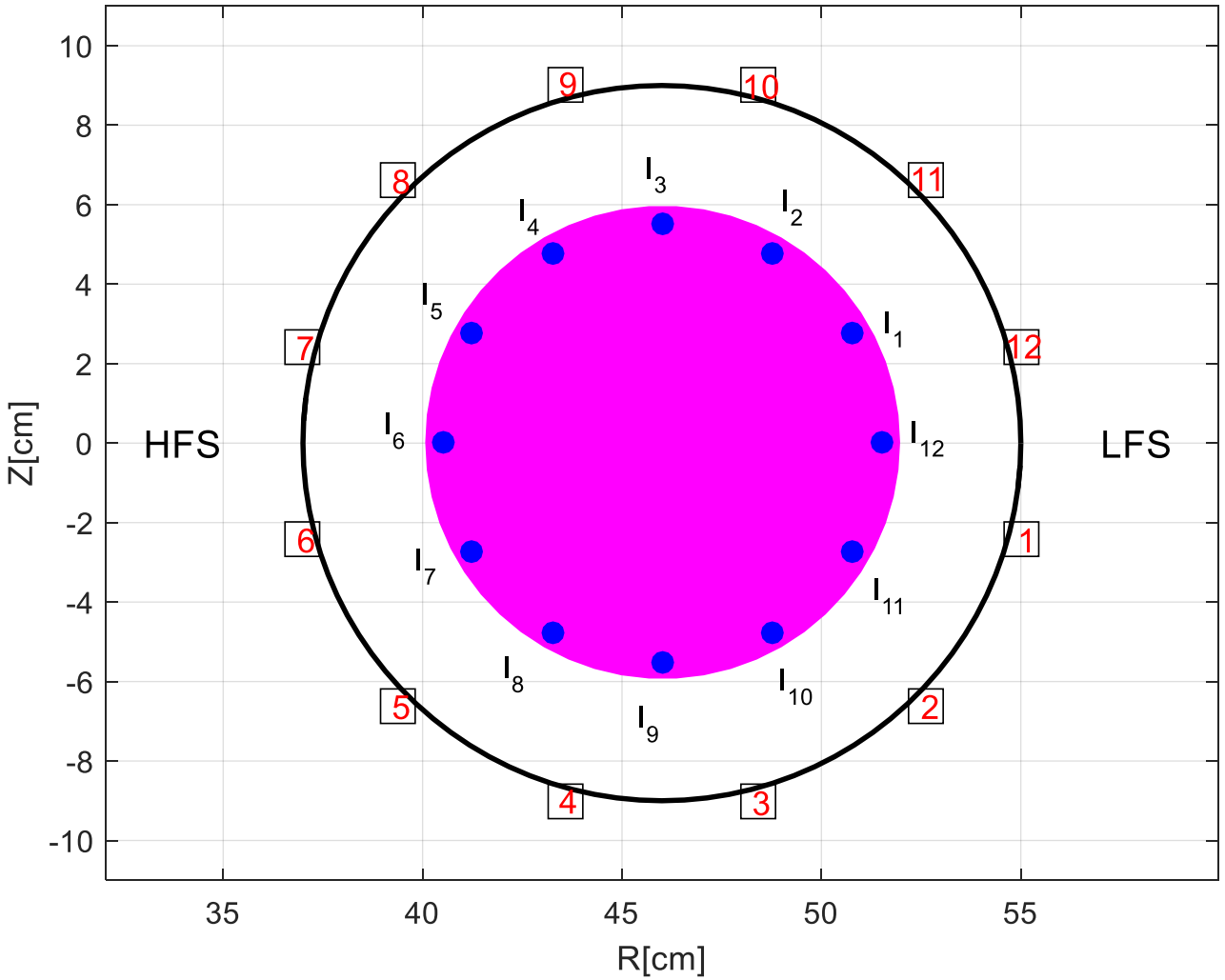
ISTTOK Centroid Position Reconstruction

Multi-filamentary Model



$$i_{p,f} = M_{fp}^{\dagger} f_p$$

M_{fp} Matrix whose *ij*-element gives the contribution to the measurement *i* of a unitary current in the filament *j*

f_p Represents the measurement vector where the contribution given by the poloidal field coils has been subtracted

SVD – Singular Value Decomposition for matrix pseudo-inversion

•Pironti A., *Magnetic Control of Tokamak Plasmas*, 2nd ed. Springer, 2016

$$M_{fp}^{\dagger} = 10^{-6} \times \begin{bmatrix} 0.558 & -0.423 & 0.263 & -0.117 & 0.019 & 0.065 & -0.147 & 0.270 & -0.446 & 0.699 & -0.612 & -0.195 \\ -0.351 & 0.233 & -0.094 & -0.007 & 0.092 & -0.164 & 0.264 & -0.409 & 0.645 & -0.649 & -0.019 & 0.413 \\ 0.207 & -0.075 & -0.031 & 0.121 & -0.187 & 0.268 & -0.377 & 0.565 & -0.580 & 0.033 & 0.321 & -0.293 \\ -0.086 & -0.033 & 0.141 & -0.211 & 0.283 & -0.359 & 0.491 & -0.465 & -0.012 & 0.305 & -0.282 & 0.214 \\ 0.005 & 0.130 & -0.220 & 0.294 & -0.350 & 0.433 & -0.340 & -0.106 & 0.337 & -0.306 & 0.252 & -0.136 \\ 0.075 & -0.193 & 0.286 & -0.334 & 0.383 & -0.220 & -0.220 & 0.383 & -0.334 & 0.286 & -0.193 & 0.075 \\ -0.136 & 0.252 & -0.306 & 0.337 & -0.106 & -0.340 & 0.433 & -0.350 & 0.294 & -0.220 & 0.130 & 0.005 \\ 0.214 & -0.282 & 0.305 & -0.012 & -0.465 & 0.491 & -0.359 & 0.283 & -0.211 & 0.141 & -0.033 & -0.086 \\ -0.293 & 0.321 & 0.033 & -0.580 & 0.565 & -0.377 & 0.268 & -0.187 & 0.121 & -0.031 & -0.075 & 0.207 \\ 0.413 & -0.019 & -0.649 & 0.645 & -0.409 & 0.264 & -0.164 & 0.092 & -0.007 & -0.094 & 0.233 & -0.351 \\ -0.195 & -0.612 & 0.699 & -0.446 & 0.270 & -0.147 & 0.065 & 0.019 & -0.117 & 0.263 & -0.423 & 0.558 \\ -0.437 & 0.675 & -0.458 & 0.275 & -0.134 & 0.042 & 0.042 & -0.134 & 0.275 & -0.458 & 0.675 & -0.437 \end{bmatrix}$$

$$A = USV^* = [U_1 U_2] \begin{bmatrix} S_1 & 0 \\ 0 & 0 \end{bmatrix} [V_1 V_2]^*$$

$$A = U_1 S_1 V_1^*$$

$$A^{\dagger} = V_1 S_1^{-1} U_1^*$$

$$z_0 = \frac{\sum_{k=1}^{\mu} i_{p,f_k} z_{p,f_k}}{\sum_{k=1}^{\mu} i_{p,f_k}} \qquad r_0 = \sqrt{\frac{\sum_{k=1}^{\mu} i_{p,f_k} r_{p,f_k}^2}{\sum_{k=1}^{\mu} i_{p,f_k}}}$$

Where $\left(r_{p,f_k}, z_{p,f_k}\right)$ and i_{p,f_k} are the position and the current of the filament $k, k = 1,2, \dots, \mu$, respectively.

•Pironti A., *Magnetic Control of Tokamak Plasmas*, 2nd ed. Springer, 2016

Signals List SDAS

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R0='MARTE_NODE_IVO3.DataCollection.Channel_083'
z0='MARTE_NODE_IVO3.DataCollection.Channel_084’

R0_uncorr='MARTE_NODE_IVO3.DataCollection.Channel_226'
z0_uncorr='MARTE_NODE_IVO3.DataCollection.Channel_227'


sumIfil='MARTE_NODE_IVO3.DataCollection.Channel_230';

RMSE_mirnv='MARTE_NODE_IVO3.DataCollection.Channel_229';

mirnv_SVD_recon1='MARTE_NODE_IVO3.DataCollection.Channel_231';
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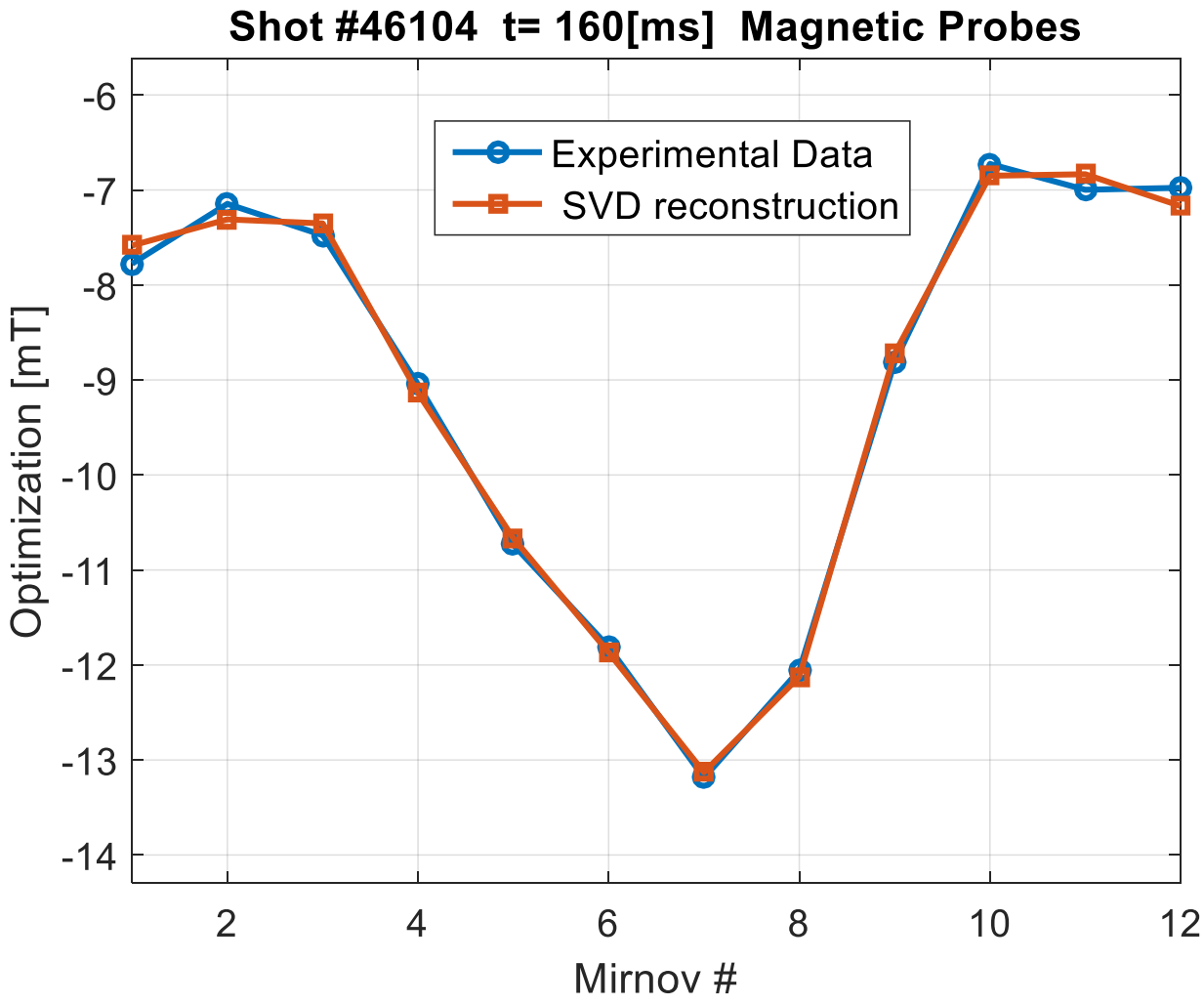
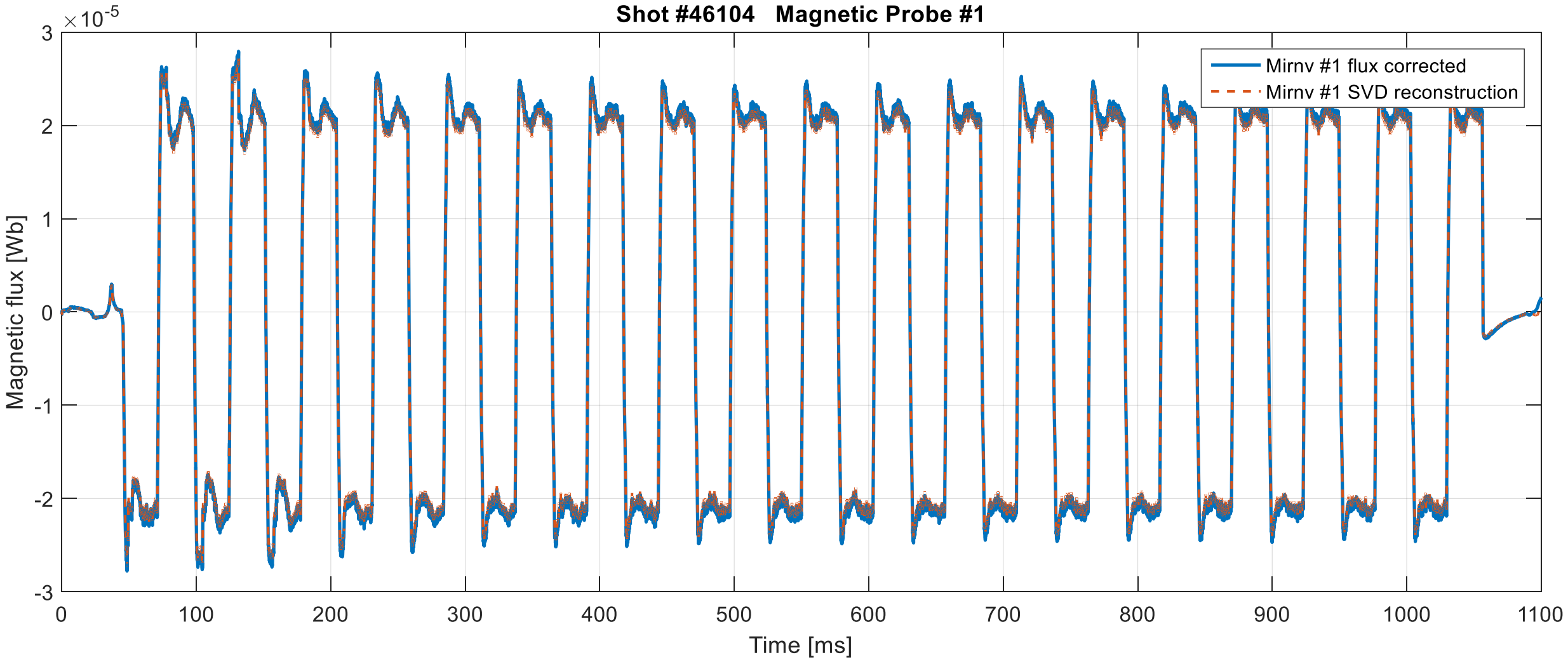
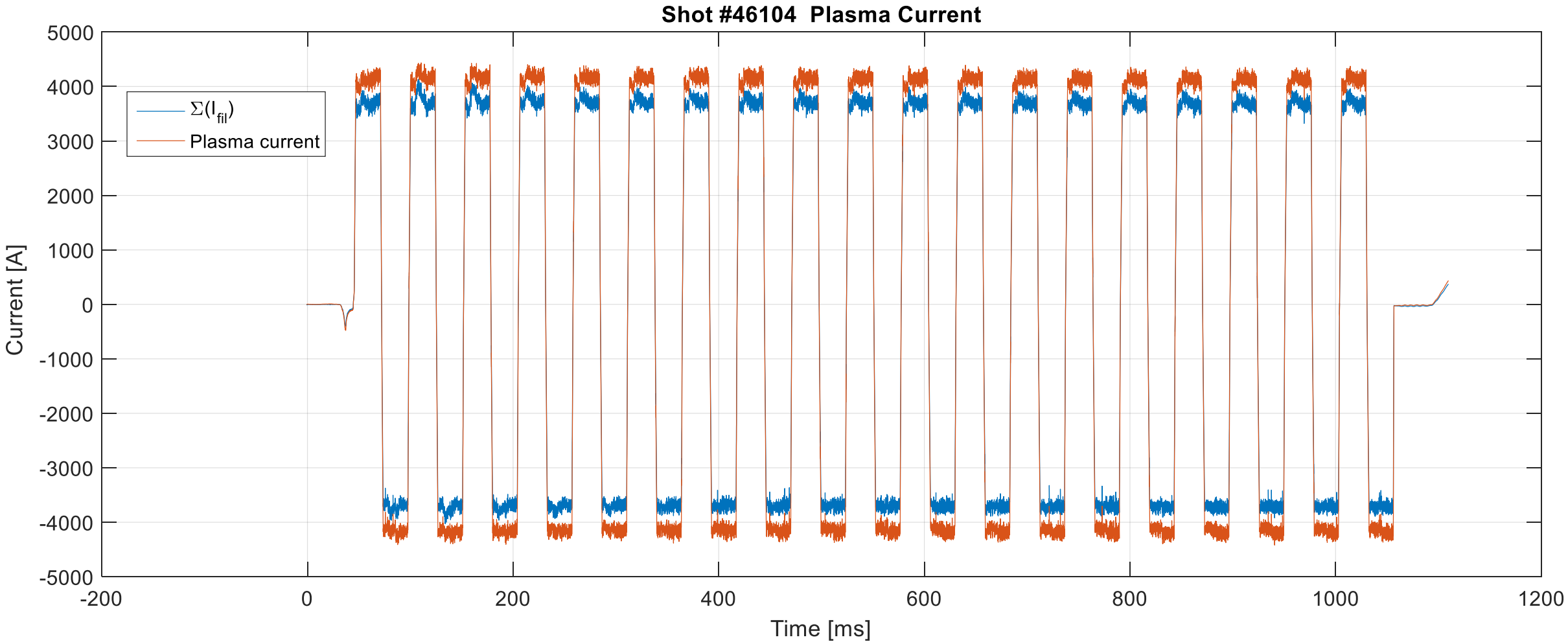
Results


Shot #46104 t= 160[ms] Magnetic Probes
Experimental Data
SVD reconstruction
Optimization [mT]
-6
-7
-8
-9
-10
-11
-12
-13
-14
2
4
6
8
10
12
Mirnov #

Results (Channel 202 and 231)



Results (Channel 85 and 230)



Results (Channel 85 ,83 and 84)

Shot # 46104