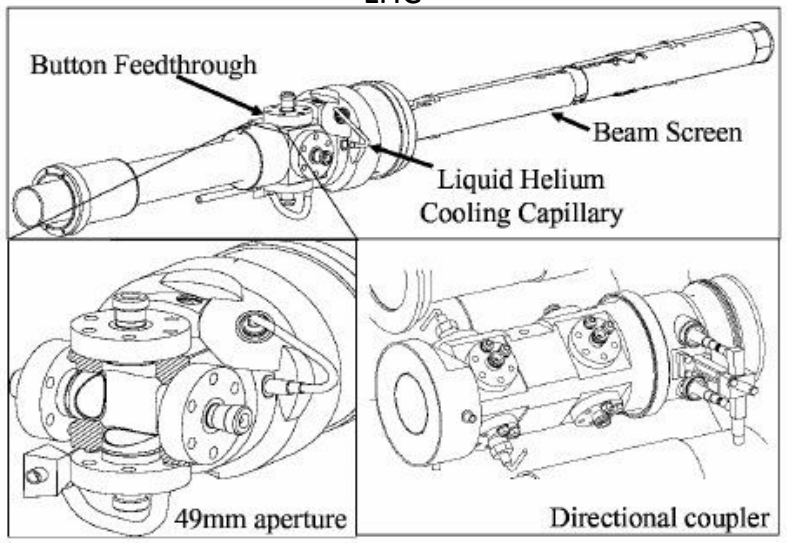
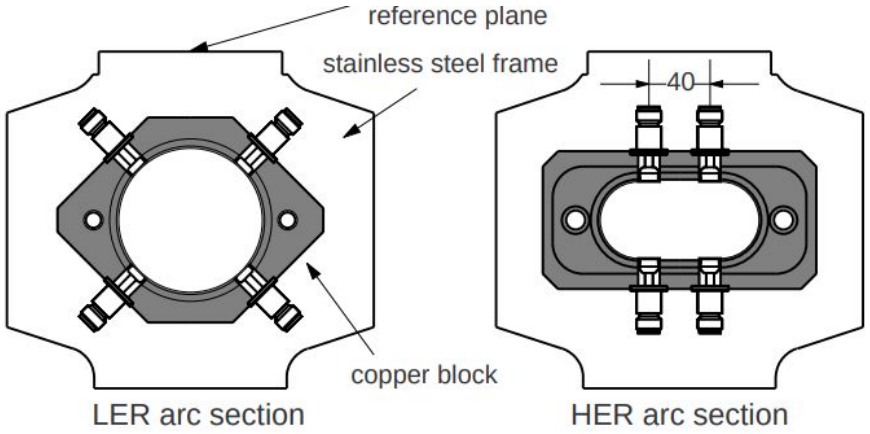
Turn-by-turn Beam Position Measurement precision (noise) in various accelerators

ESRF BPM

LHC

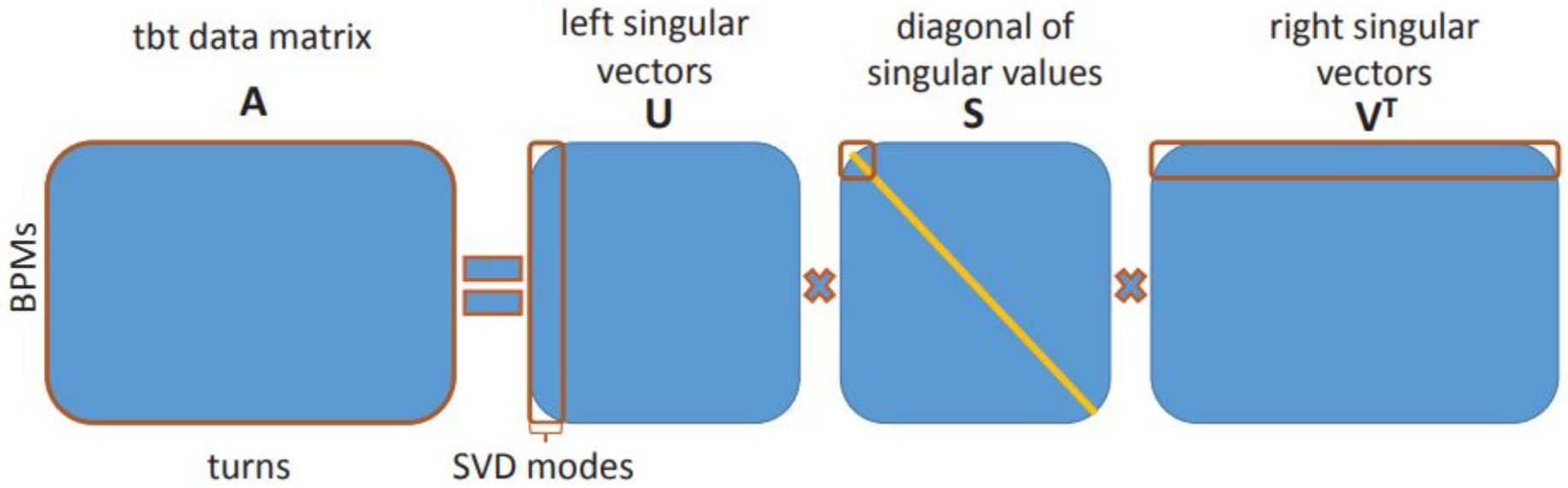


SuperKEKB



M. Hofer, A. Huschauer, J. Keintzel, M. Le Garrec, E.H. Maclean, L. Malina, T. Persson, R. Tomas and A. Wegscheider.

Singular Value Decomposition of Turn-by-turn BPM data



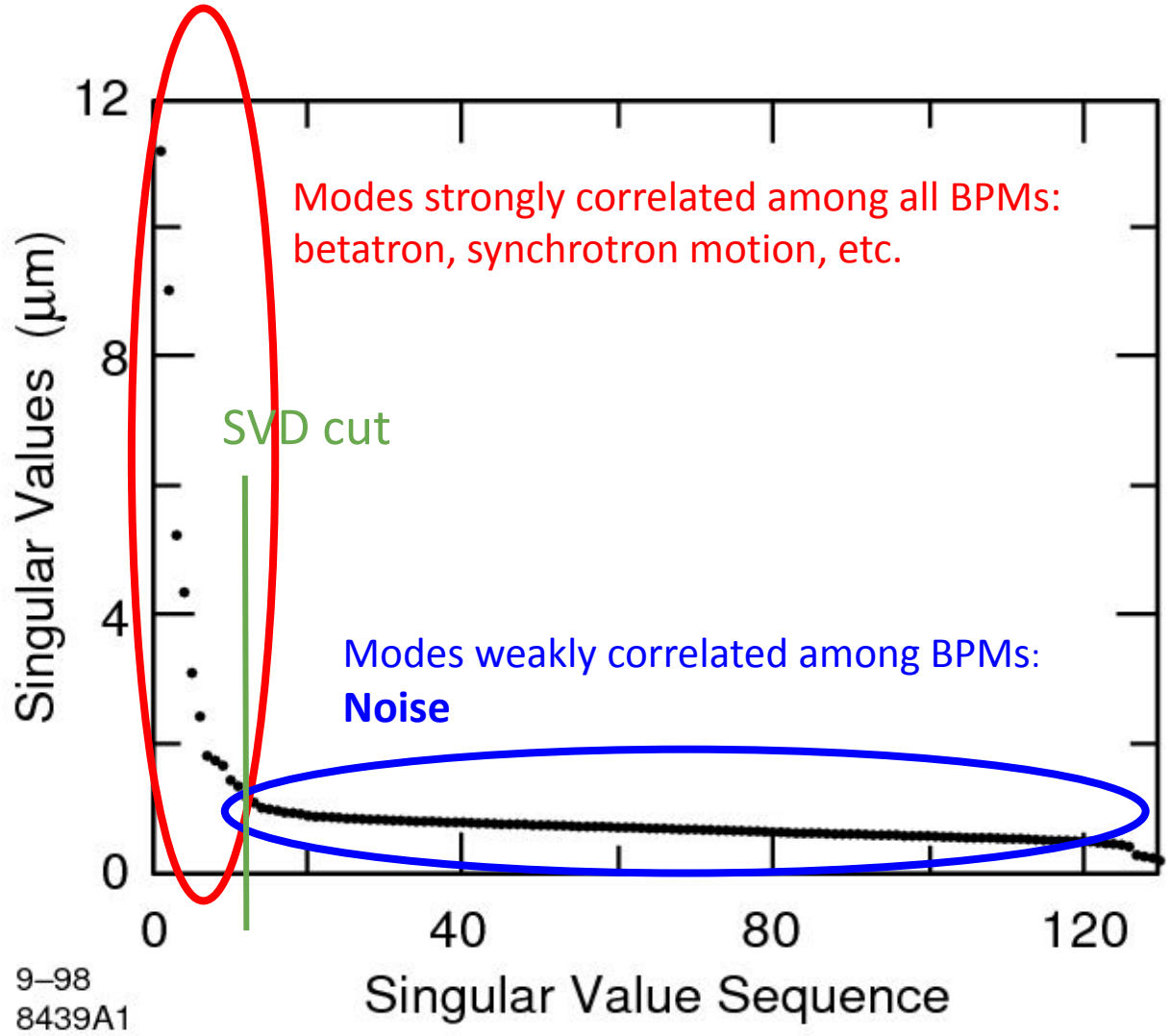
U and **V** are unitary matrices and their columns are orthonormal.

S is a diagonal matrix containing the singular values in descending order.

Singular Values and measurement Noise

The contribution from the weak singular modes to the signal is interpreted as the measurement Noise.

There is some arbitrariness in the choice of the SVD cut



BPM noise as measured from SVD analysis of Turn-by-Turn data

Machine	Noise in TbT measurements [µm]	Bunch intensity [10^{10}cpb]	Number of bunches	Bunch length [mm]	BPM/beam screen diameter [mm]
ESRF	10	0.04	330		79 x 33
ALBA	14	0.1	45	6	72 x 28
PETRA	22	23	1-5	13.2	octants: 80x40, 80x38; straight sections: 94 undulators: 66x11, 57x7; wigglers: 120x30, 60x26
LHC	100	1	1	70	49
SKEKB LER/HER*	200 / 125	6	1		LER 94 / HER 104 x 50
PS	200	10	1		166 x 80
PSB	30	30	1		140
IOTA (similar to ATF2 BPM design)	100	0.067	1		47.5

*In SKEKB with 8mA (multibunch) a BPM noise of about 50 µm was observed