



30 pC for XFEL

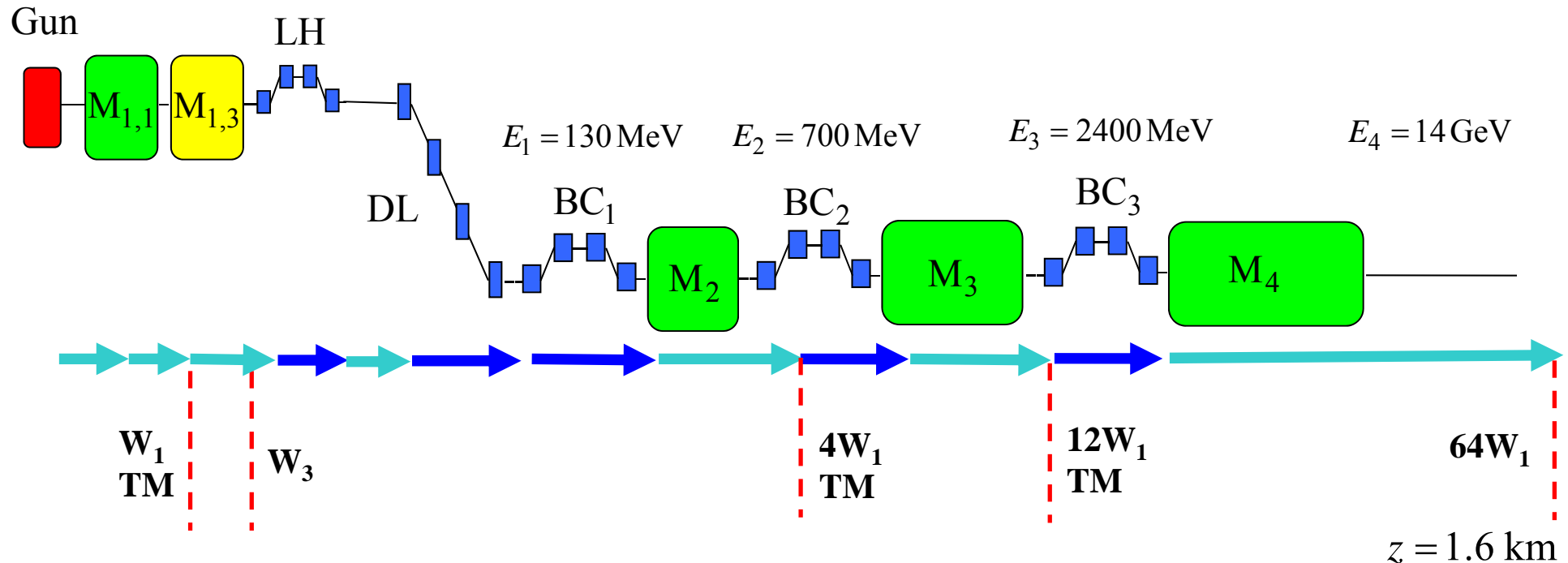
Igor Zagorodnov

3.05.2011

DESY

Beam dynamics simulations for the European XFEL

Full 3D simulation method (200 CPU, ~10 hours)



ASTRA (tracking with **3D space charge**, DESY, K. Flötman)

CSRtrack (tracking through dipoles, DESY, M. Dohlus, T. Limberg)

W1 - TESLA cryomodule wake (TESLA Report 2003-19, DESY, 2003)

W3 - ACC39 wake (TESLA Report 2004-01, DESY, 2004)

TM - transverse matching to the design optics

Choosing of machine parameters

Macro-parameters

Charge Q, nC	Momentum compaction factor in BC ₁ R _{56,1} , [mm]	Compr. in BC ₁ C ₁	Momentum compaction factor in BC ₂ R _{56,2} , [mm]	Compr. in BC ₂ C ₂	Momentum compaction factor in BC ₃ R _{56,3} , [mm]	Total compr. C	First derivative Z', [m ⁻¹]	Second derivative Z'', [m ⁻²]
0.03	-76	4	-50	4	-33	1700	0	300

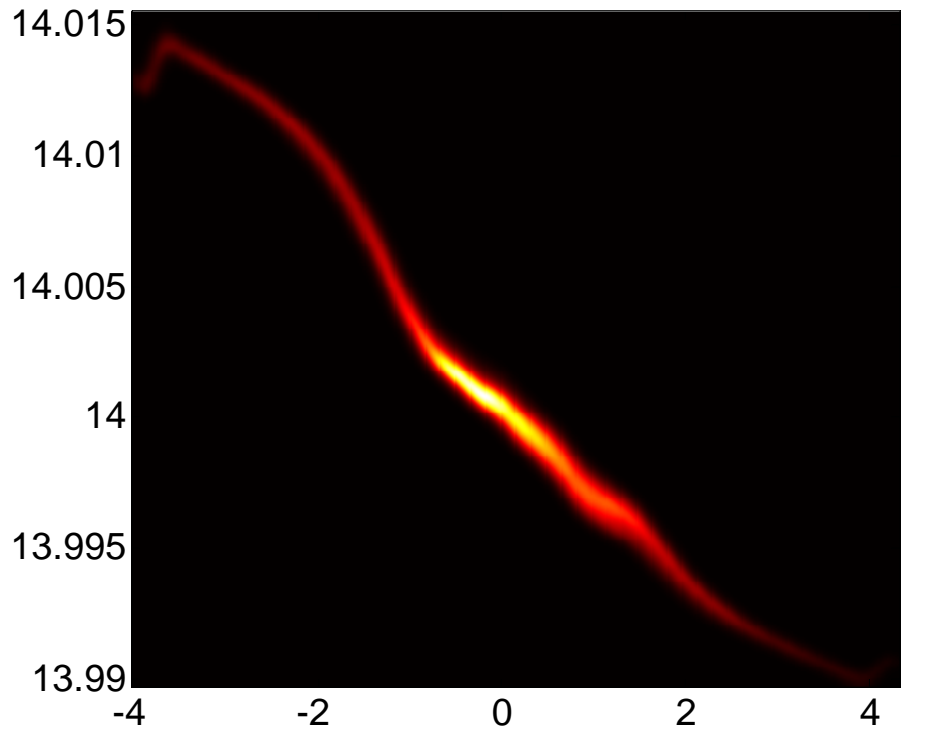
$$E_1 = 130 \text{ MeV} \quad E_2 = 700 \text{ MeV} \quad E_3 = 2400 \text{ MeV}$$

I. Zagorodnov, M. Dohlus, *A Semi-Analytical Modelling of Multistage Bunch Compression with Collective Effects*, Physical Review STAB 14 (2011), 014403.

XFEL beam dynamic simulations for different charges (full)

Q=30 pC

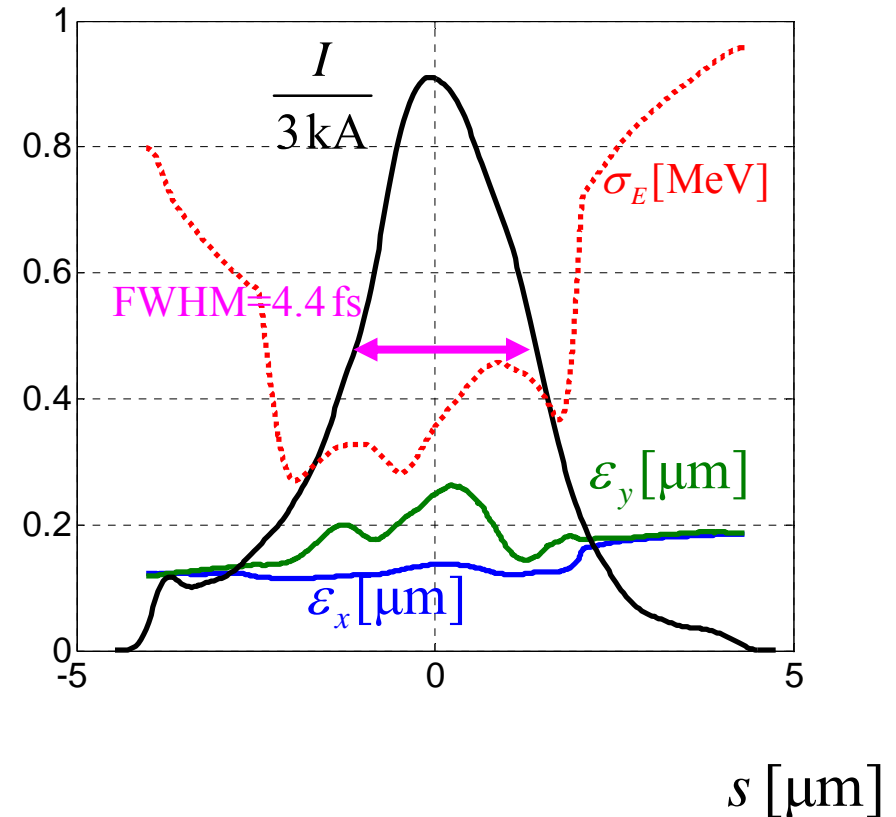
E [MeV] Phase space



s [μm]

bunch head

Current, emittance, energy spread

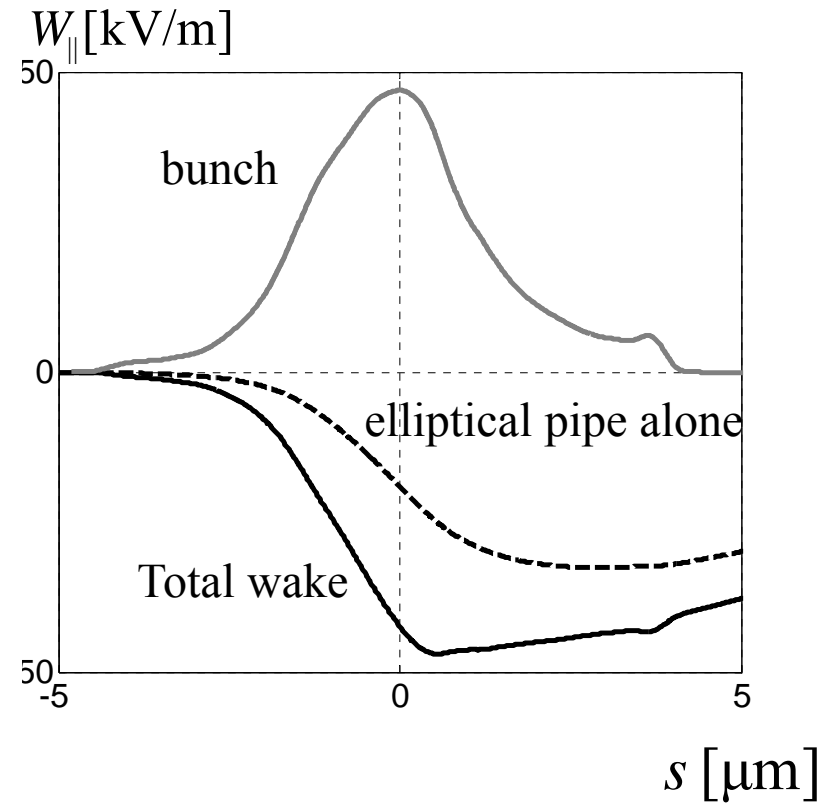
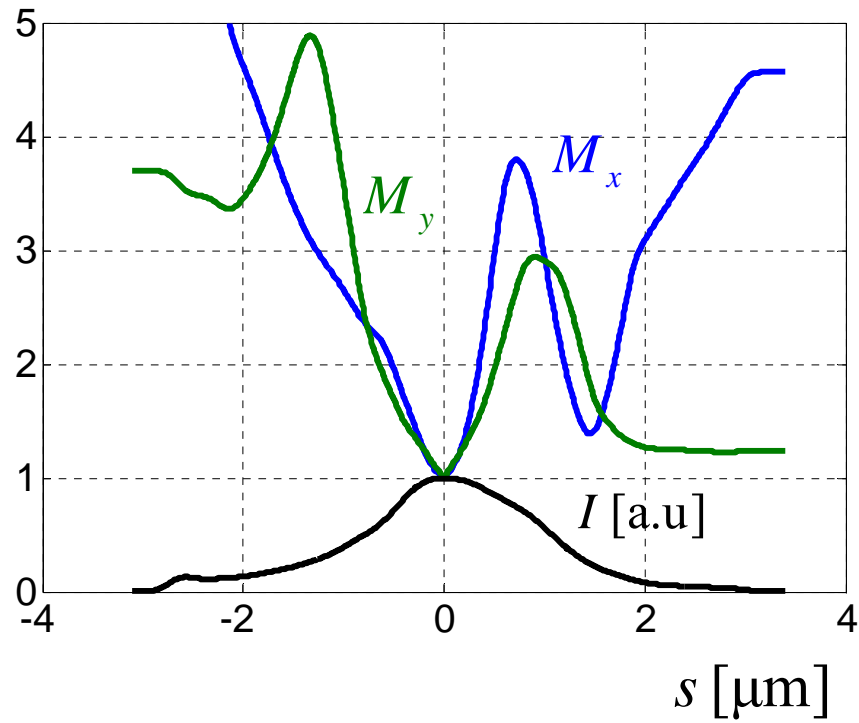


$$\mathcal{E}_x^{proj} = 0.16 [\mu\text{m}]$$

$$\mathcal{E}_y^{proj} = 0.58 [\mu\text{m}]$$

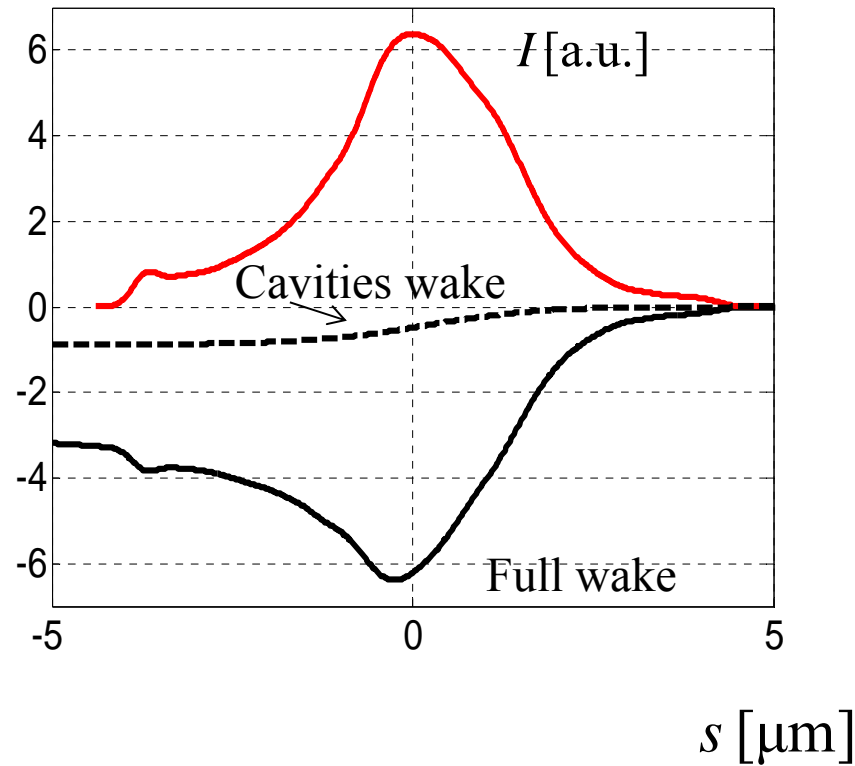
We have removed 6% of bad particles in the analysis (Q = 28 pC!)

Mismatch and undulator wake.



Accelerator wakes. $Q=250$ pC

W_{\parallel} [MV]



$$\frac{E - E_0}{E_0 \rho}$$

$$\rho = 5.3e-4$$

