Longitudinal Beam Dynamics Studies

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longitudinal phase space tool: rf_tweak4_csr

characterization of FLASH

“virtual” initial distribution

LOLA: experiment & theory

required shifts

longitudinal phase space tool: rf_tweak4_csr

reads machine parameters (rf before bc2)

keeps & controls working point before bc2 (E, E', E'', E''')

predicts compression / phase space distribution

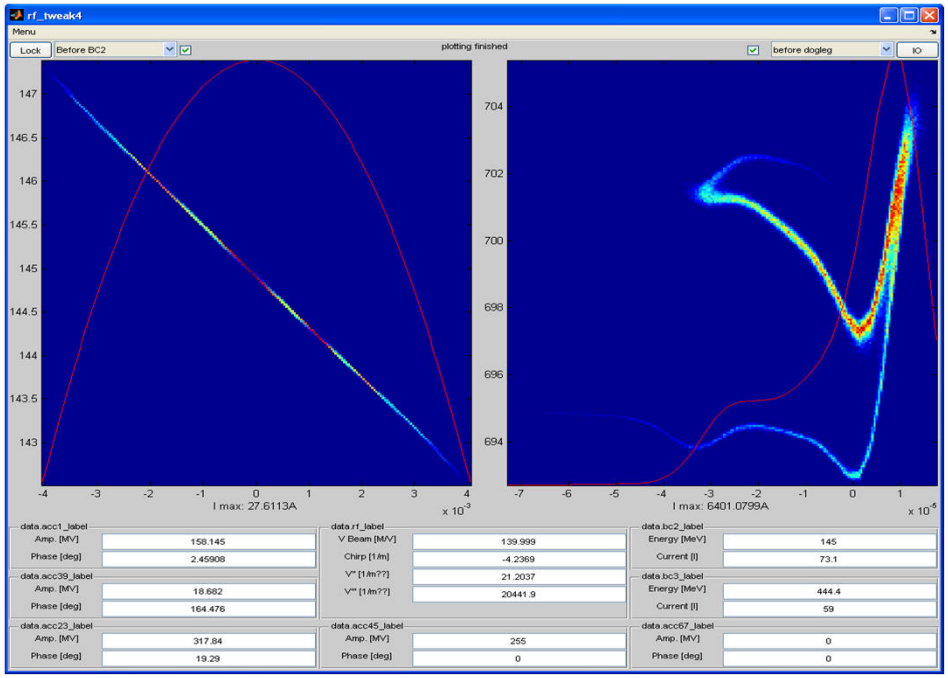
need knowledge of "virtual" 1D distribution

without self effects $\mathrm{E}(s) \rightarrow C(s)$

without self effects $\mathrm{E}_i, q_i, s_i, \quad i = 1 \cdots \sim 10^6$ from Astra or 1D particle generator

cavity wakes, SC wakes; need few seconds

cavity, SC & CSR, 1E6 particles ~ one minute



characterization of FLASH

gun → initial (virtual) 1D phase space distribution
rf (after gun): amplitudes and phases
self effects: known & considered wakes (cavity, SC, CSR)
known but not considered (complete imp. data base)
unknown wakes
compressors: r56
LOLA measurement
calibration
coupling/de-coupling with/from other phase space dim.
velocity effects

“virtual” initial distribution

it is:

longitudinal phase space before BC2

minus nominal rf-field of ACC1 and ACC13

“virtual” initial distribution

depends on gun parameters and systematic error of rf settings
sensitive on E, but insensitive on the other knobs (E’, E’’, E’’’)

reconstruction:

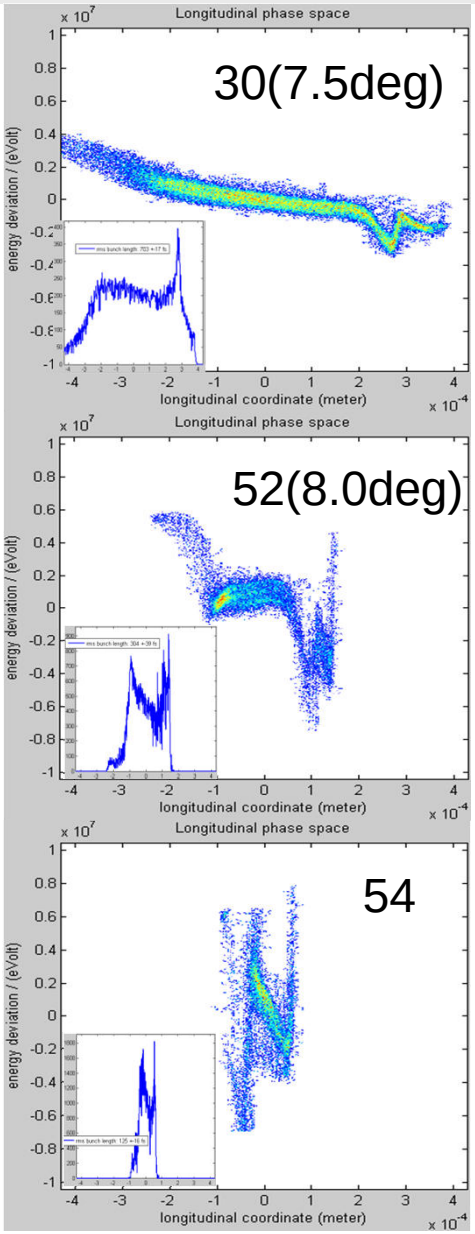
without self effects: low bunch charge, weak compression

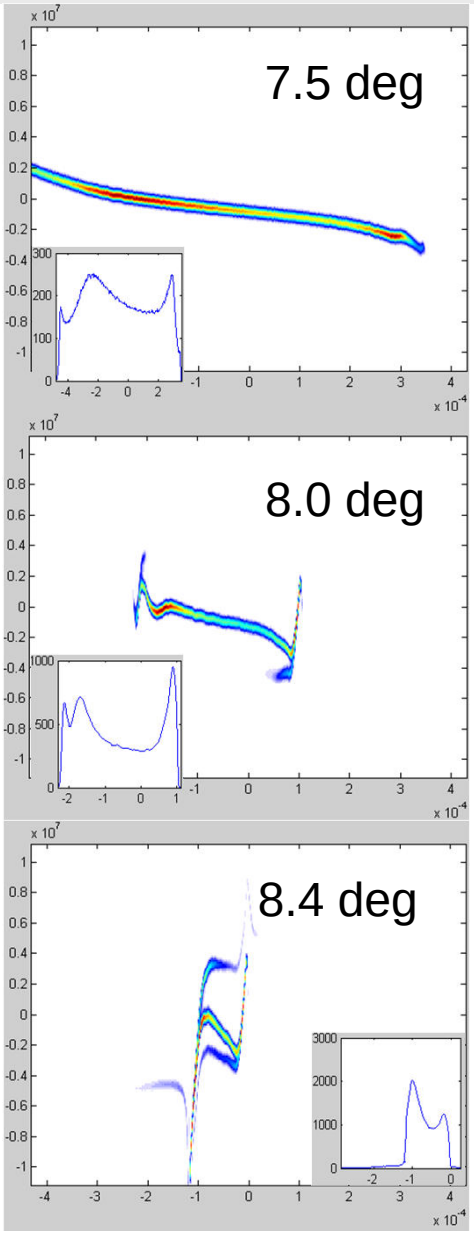
time-energy-method: take longitudinal phase space from LOLA
track back
needs knowledge of all parameters

time-time-method: take longitudinal profile for two different rf settings
unique initial distribution
needs many parameters but not LOLA energy scale!

simplify setup: one-BC-mode

LOLA: experiment & theory





required shifts

phase control with BAMS
single bunch operation
energy 700MeV
LOLA measurement (some measurements on both slopes)
no SASE
all measurements with Q = 0.25 nC **and** 1 nC

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2 shifts: BC3 off, RF between BCs on crest
weak compression (C=1…3); use rf-tweak;
→ characterization of “virtual” initial distribution
all measurements on same LOLA working point
strong compression (C=3…)
→ both slopes, chirped & un-chirped

sensitivity of LOLA measurement on transverse steering
strong compression with weak / strong streak
steering before LOLA, … upstream

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2 shifts: pseudo 1-BC operation, BCs nominal but RF between BCs on crest
measurements as before

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2 shifts: effect of gun parameters on long. profile (“virtual” initial distr.)

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2 shifts: automatisation of LOLA