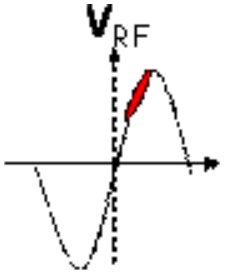
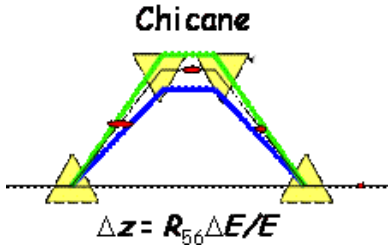
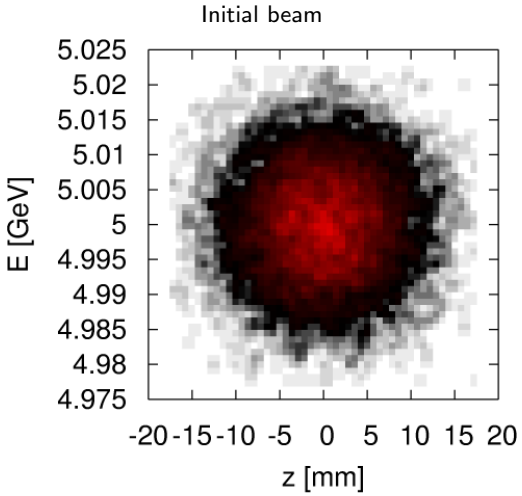
Bunch Compression and DFS

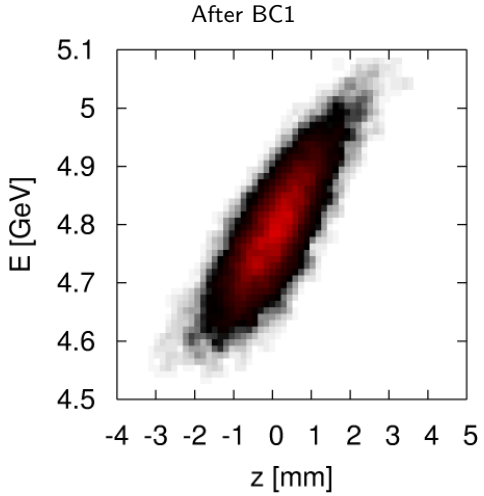
- Off-phase beams get different acceleration, therefore they gain different energy

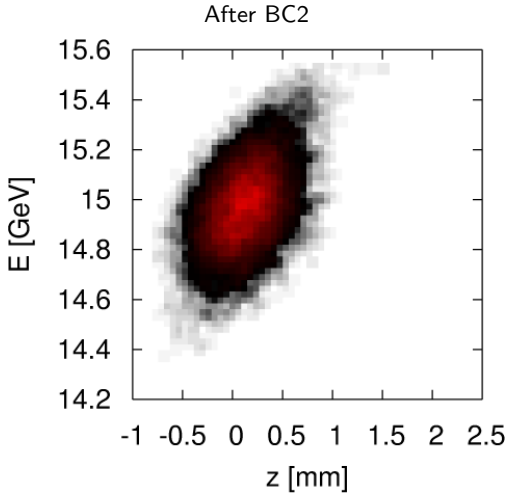
  $\Rightarrow$ they may work as *help beams* for Dispersion Free Steering.











Simulation Parameters

- Misalignment model:
  - $\sigma_{quad} = 300\,\mu\mathrm{m}$ Quadrupole position error
  - $\sigma_{cav} = 300\,\mu\mathrm{m}$ Cavity position error
  - $\sigma'_{cav} = 300\,\mu\mathrm{rad}$ Cavity angle error
  - $\sigma_{BPM} = 200\,\mu\mathrm{m}$ BPM position error
  - $\sigma_{res} = 1 - 10\,\mu\mathrm{m}$ BPM resolution

- Bunch Compressor and Main Linac:
  - Two Stages compression, configuration 300B (6 mm $\rightarrow 300\mu$m bunch length)
  - Six-dimensional tracking
  - ISR emission considered
  - Main Linac, 32 cavities/quadrupole

- Dispersion Free Steering:
  - $\Phi_0 = 0$, nominal beam
  - $\Phi_{1,2} = \pm\Delta\Phi$, help beams
  - $\omega_{1,i} = 1$, orbit correction
  - $\omega_{2,k} = 1000 - 10000$
  - $\sigma_{res} = 1 - 5\,\mu\mathrm{m}$ BPM resolution

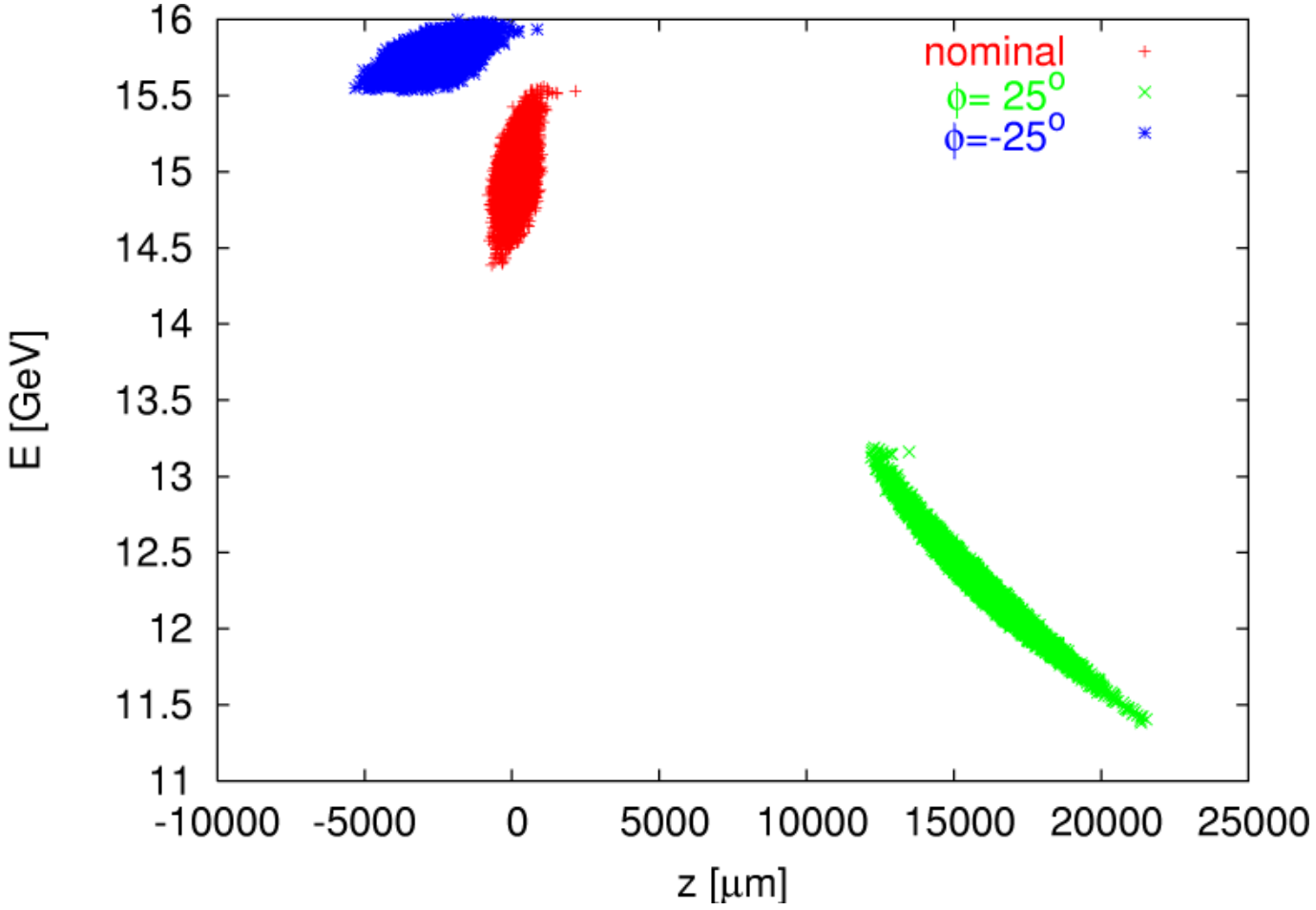
- Algorithm:
  - 1. One-to-One Correction
  - 2. Dispersion Free Steering
  - 4. Emittance Tuning Bumps

Simulation Procedure

- Tracking (PLACET):
  - full 6^{th}-dimensional tracking in BC1 and BC2 (ISR considered)
  - Phase delay introduced in BC2
  - Tracking through the ML and optimization

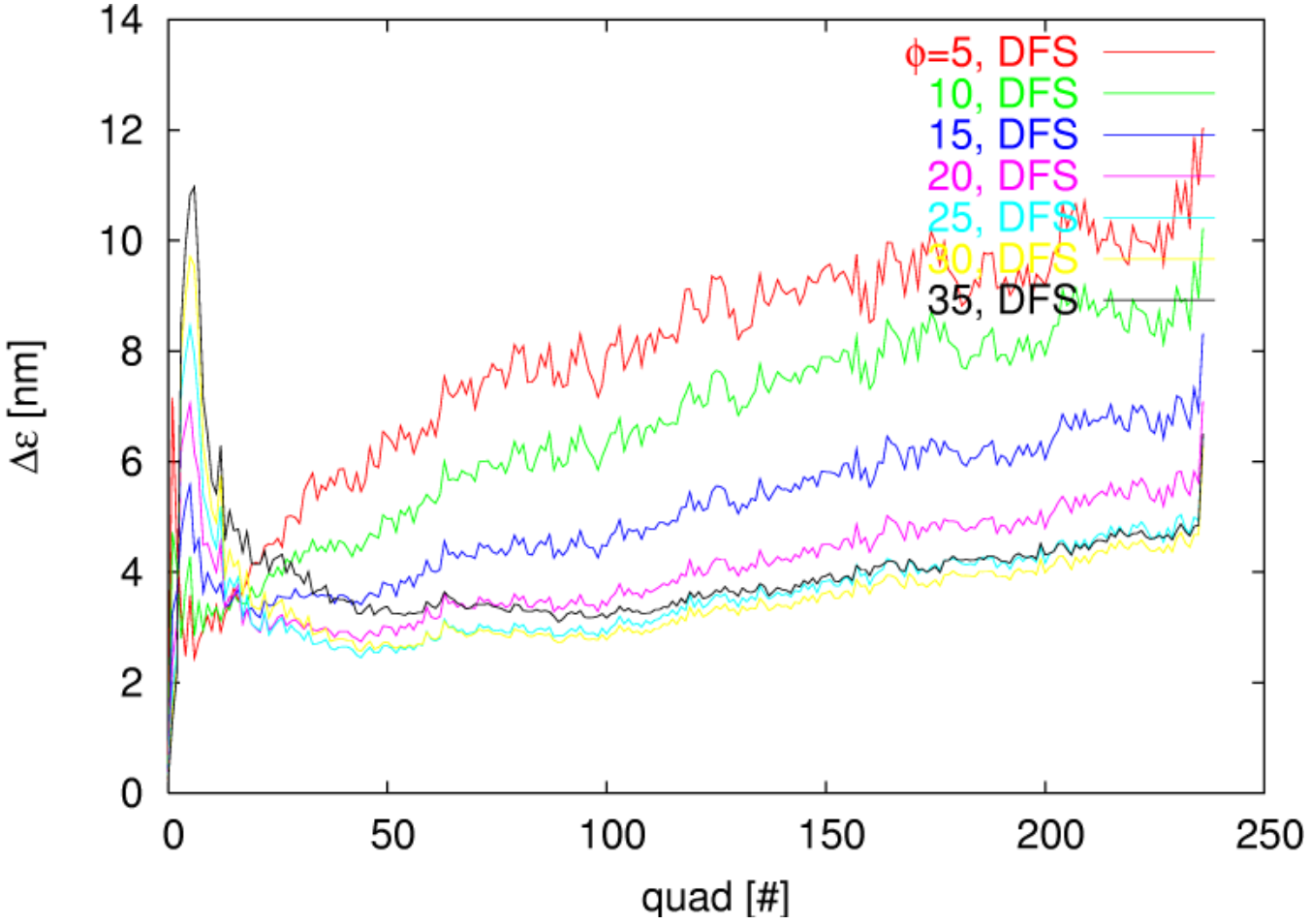
- Emittance Growth reduction:
  - Scan for the phase that gives the best results
  - Reduction of the emittance growth:
    - 1. One-to-One Correction
    - 2. Dispersion Free Steering
    - 3. Emittance Tuning Bumps Optimization

Phase Portraits: Nominal Beam + Test Beams



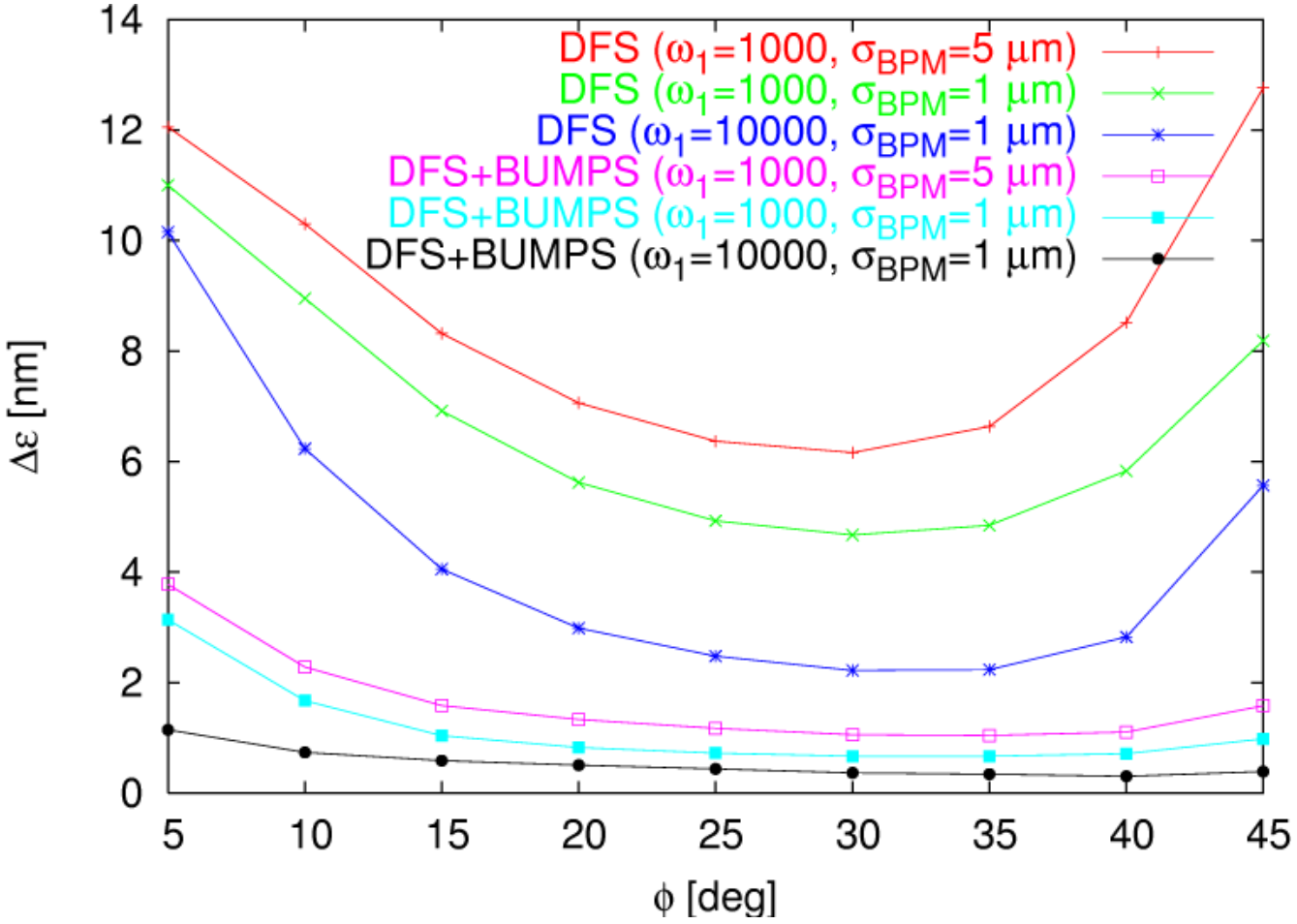
(average of 100 machines)

Emittance Growth along the machine for different ϕ



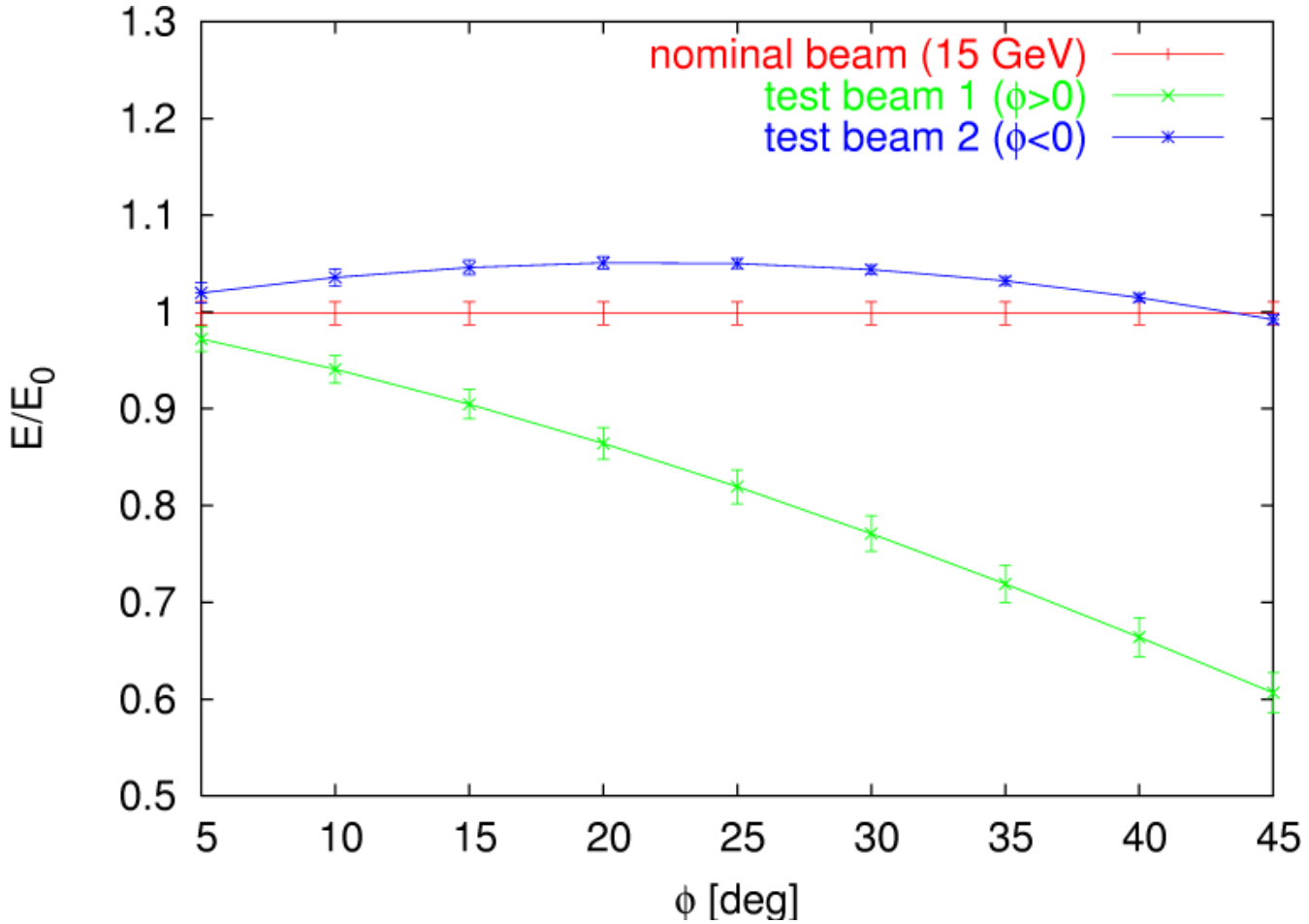
($\omega_1 = 1000$, average of 100 machines)

Emittance Growth as a function of ϕ



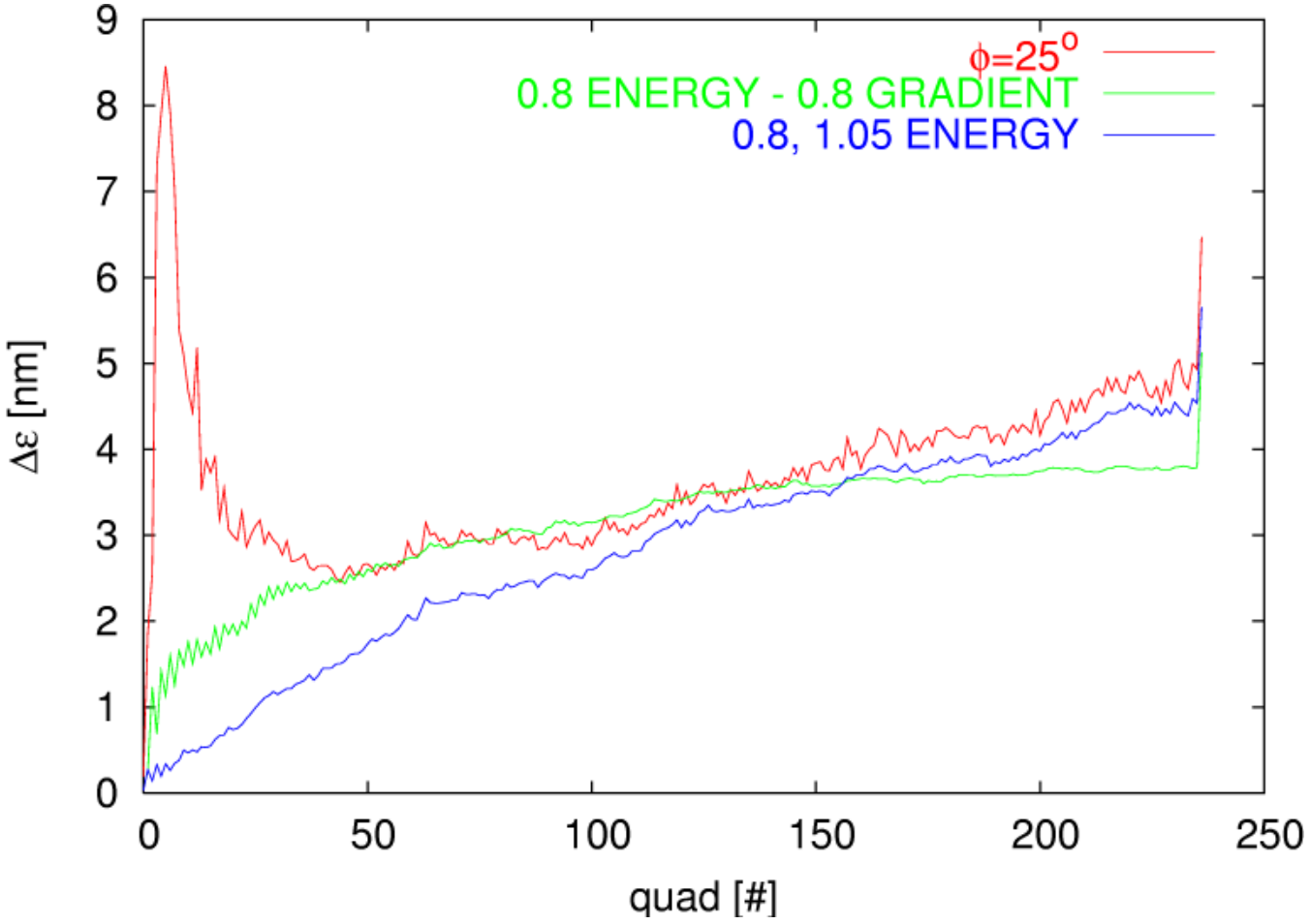
(average of 100 machines)

Energy of the Test Beams as a function of ϕ



(average of 100 machines)

Comparison with previous simulations



(average of 100 machines)