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Energy test beam and gradient test beam

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Gradient test beam

ΔE and Δg

Undulator limit

Dispersion Free Steering Test Beam Options

Peder Eliasson
presented by Andrea Latina

CERN

8-11 January 2007

Introduction

General remarks

- Standard ILC misalignments used (including quad roll)
- Quad roll is not corrected, which sets a lower limit for emittance growth at roughly 1.7nm.
- Bpm resolution assumed to be $1\mu m$
- All results are averages over 50 seeds (except last plot which is an average of 200 seeds).

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Energy and gradient weights (one test beam each)

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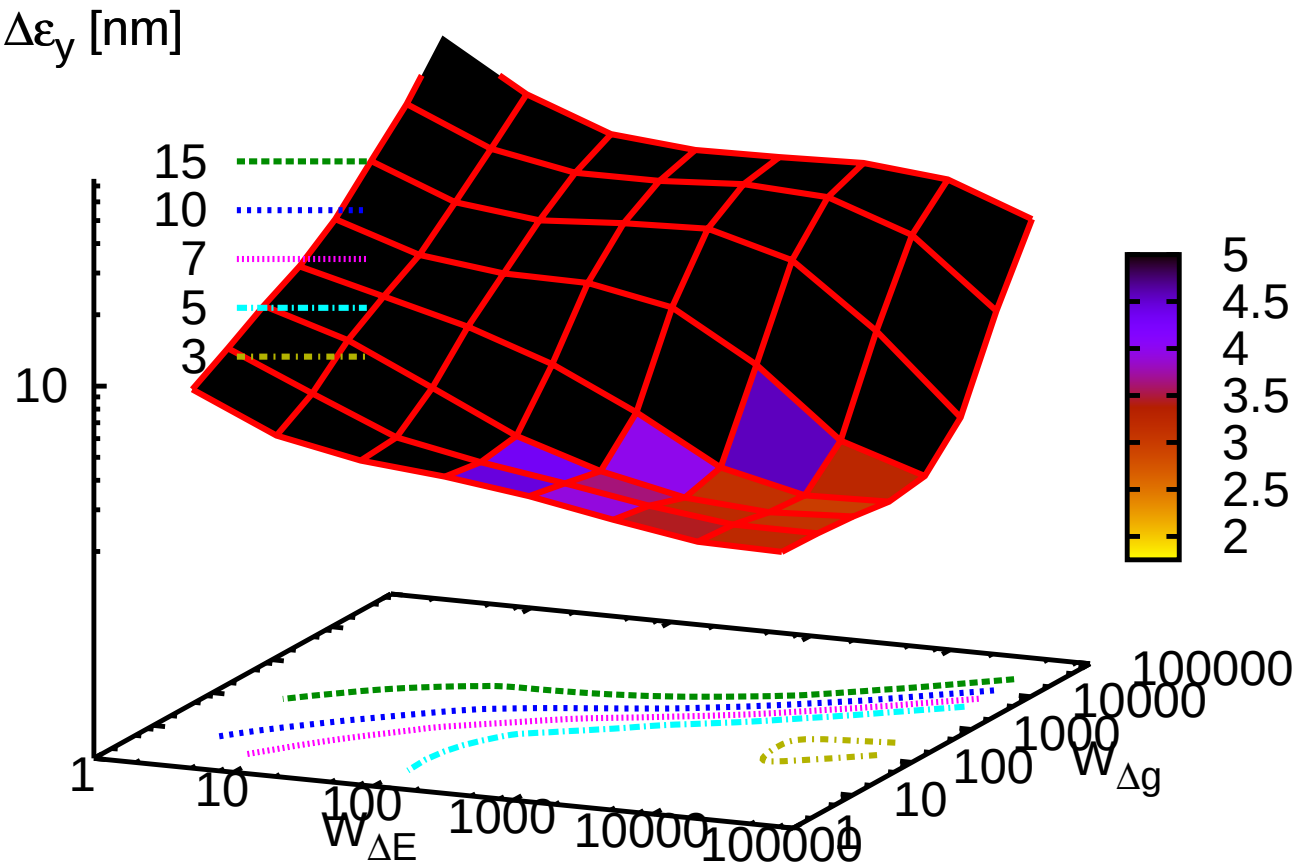
Dispersion Free Steering (black means $\Delta\epsilon > 5nm$)
$\Delta E = \Delta g = 0.2$
Optimum: $w_\Delta E$=12800, $w_\Delta g$=200



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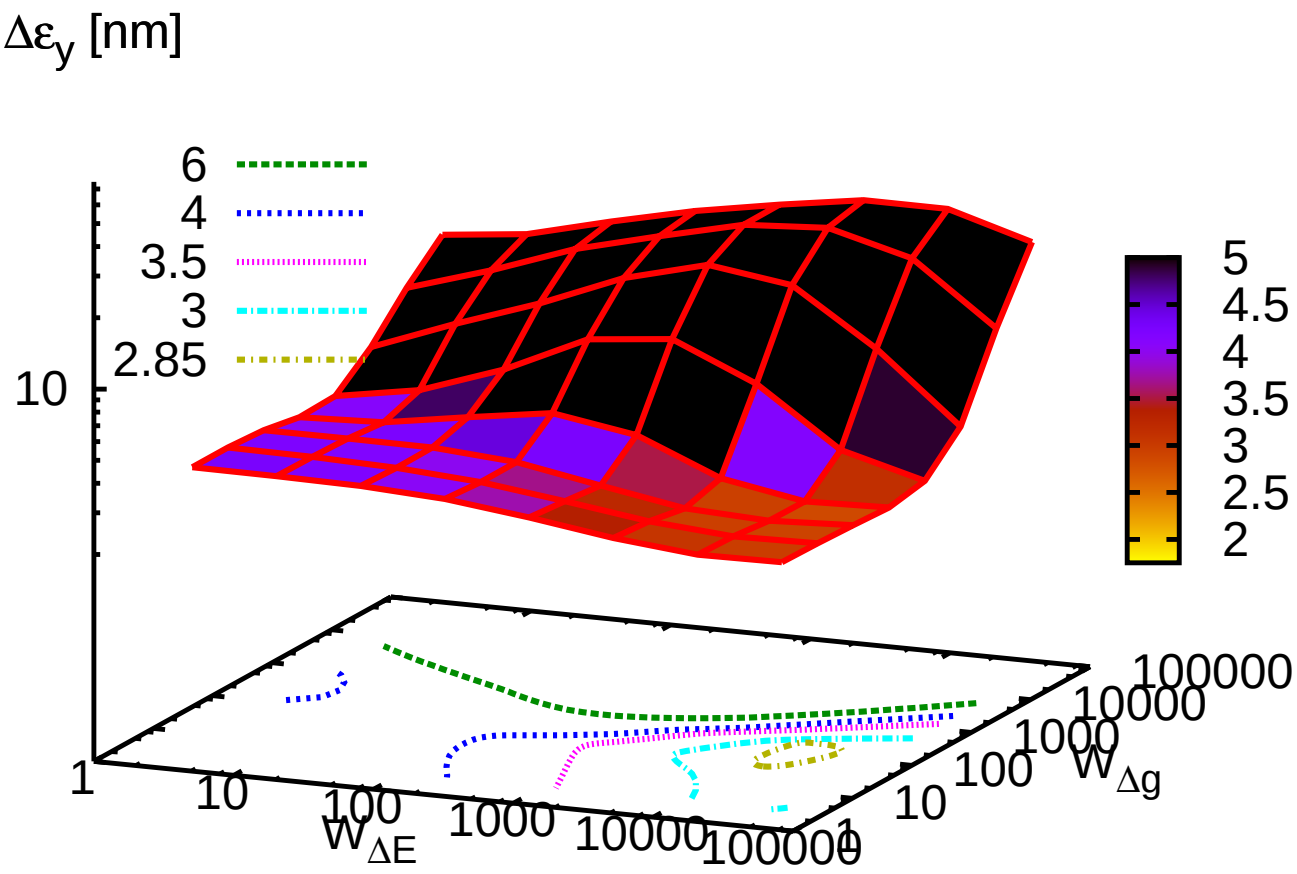
Dispersion Free Steering and dispersion bumps
$\Delta E = \Delta g = 0.2$
Optimum: $w_\Delta E$=12800, $w\Delta g$=200



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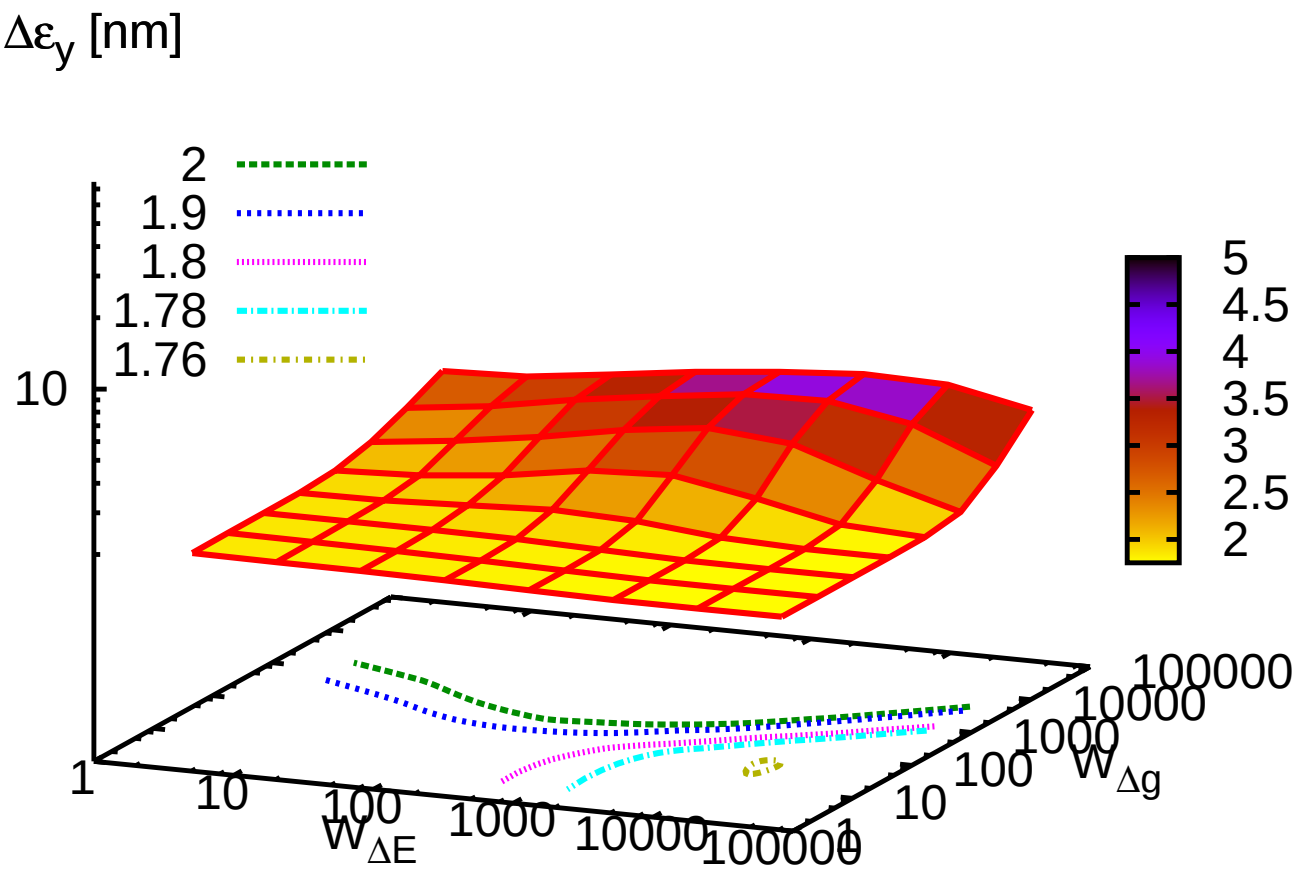
Dispersion Free Steering and dispersion and wakefield bumps
$\Delta E = \Delta g = 0.2$
Optimum: $w_\Delta E$=12800, $w_\Delta g$=50



Energy and gradient weights (one test beam each)

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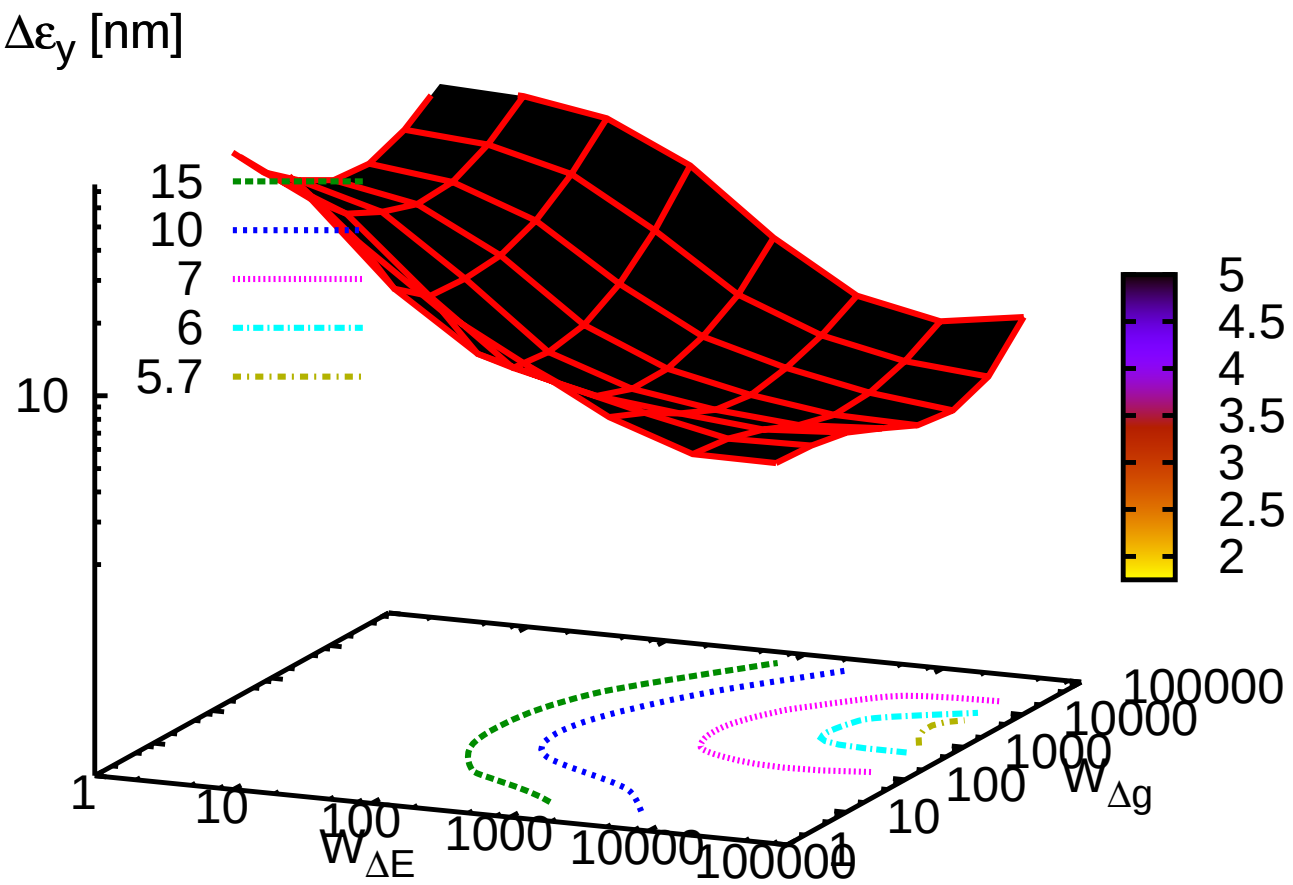
Dispersion Free Steering

$\Delta E = \Delta g = 0.01$

Optimum: $w_\Delta E$=51200, $w_\Delta g$=3200



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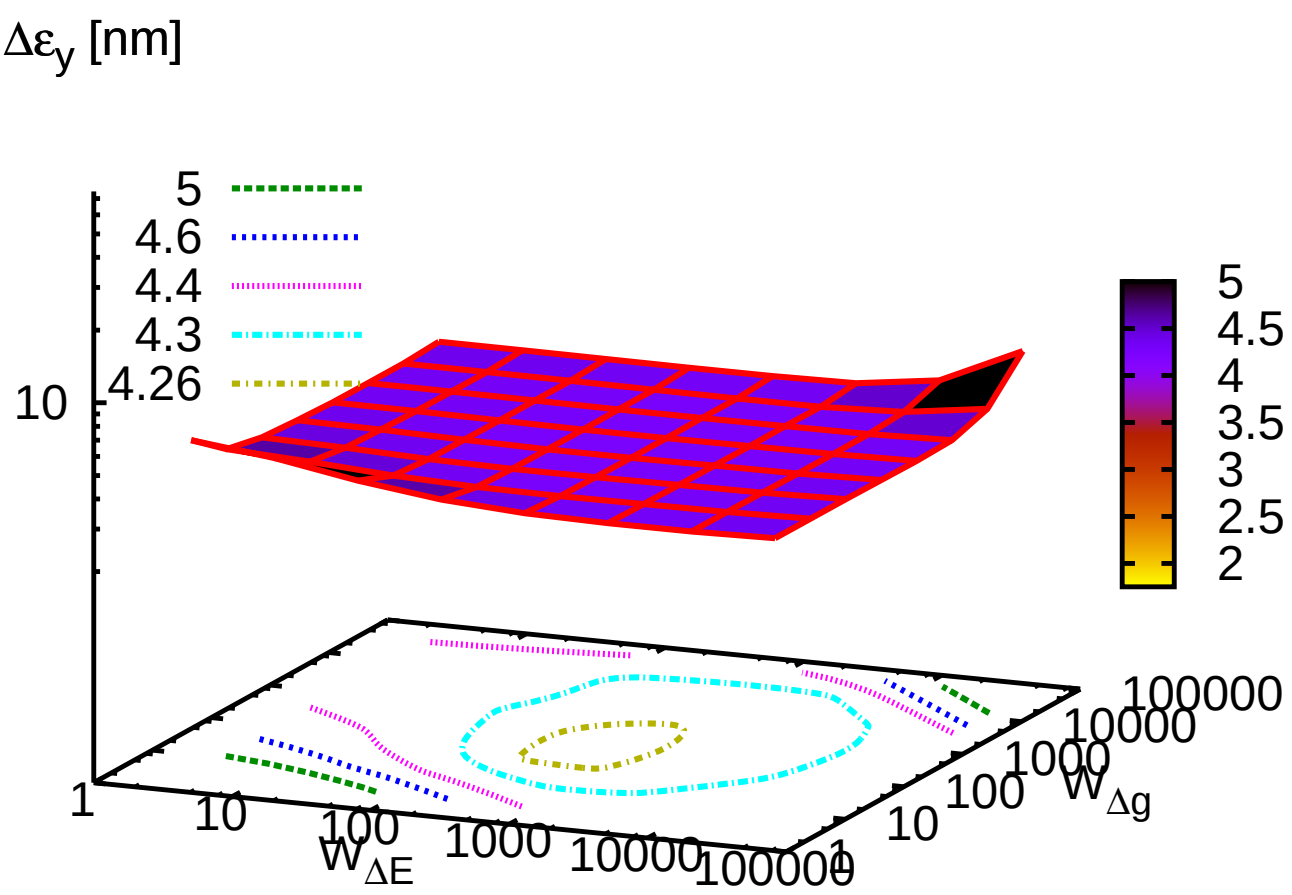
$\Delta E = \Delta g = 0.01$

Optimum: $w_\Delta E$=800, $w_\Delta g$=200



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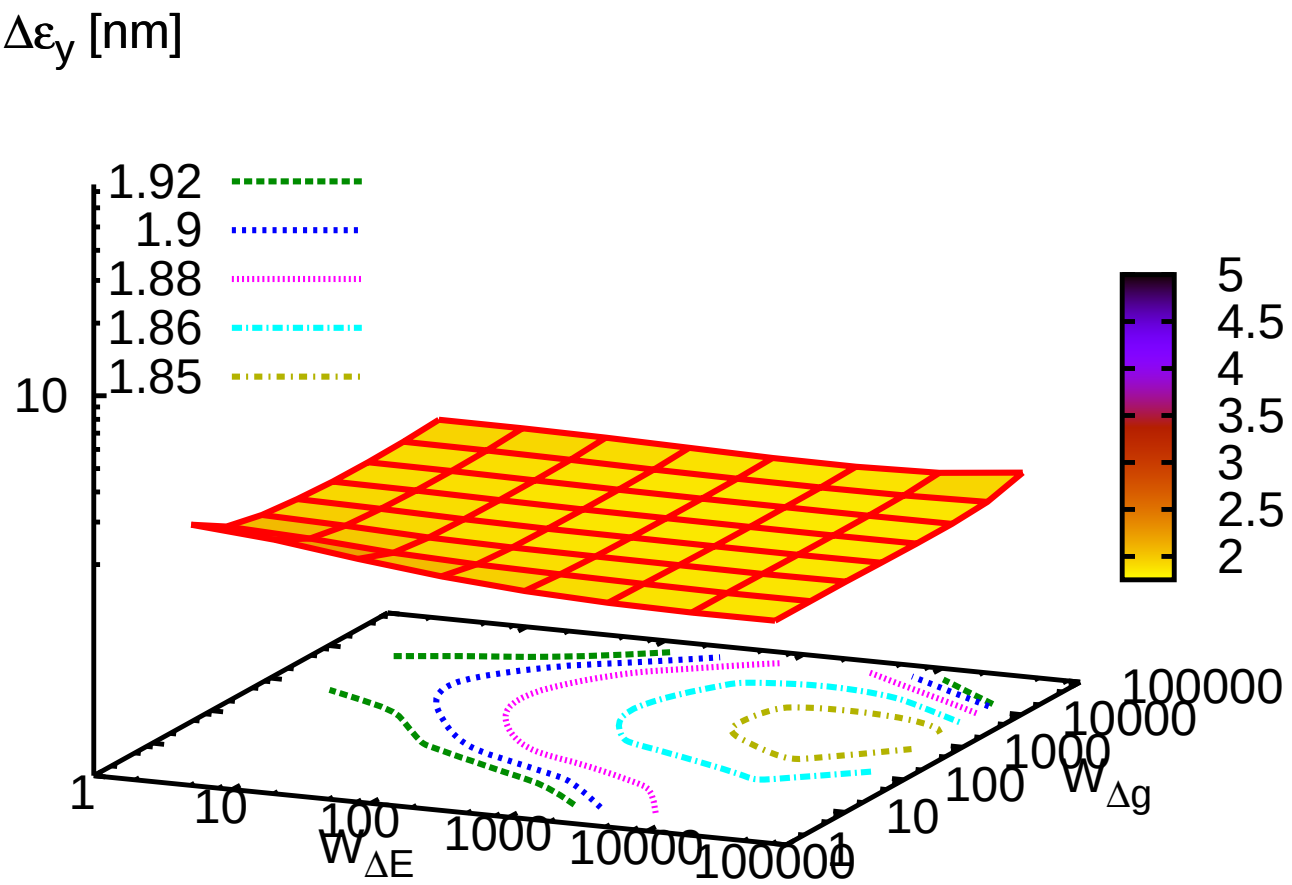
$\Delta E = \Delta g = 0.01$

Optimum: $w_\Delta E$=12800, $w_\Delta g$=800



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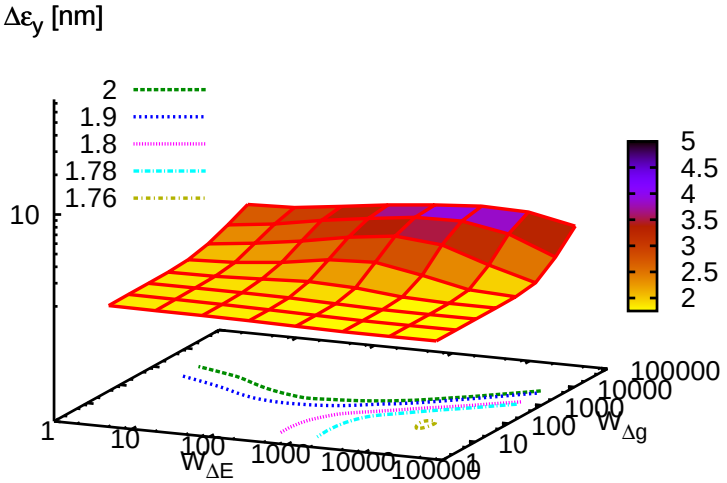
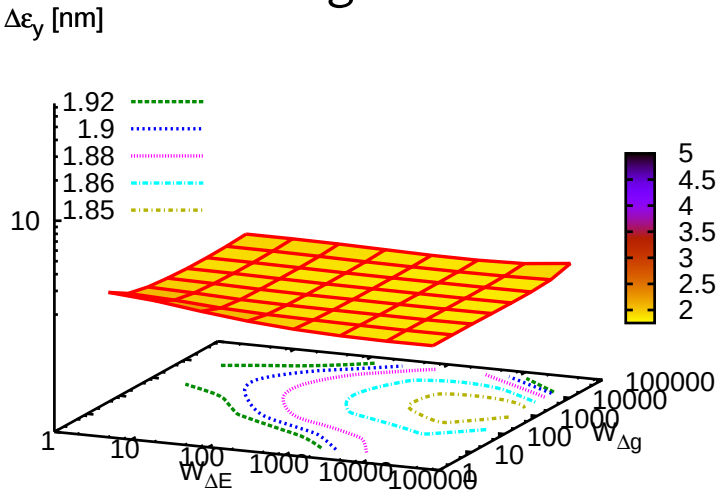
$\Delta E = \Delta g = 0.2$



$\Delta E = \Delta g = 0.01$



- Optimal emittance better for $\Delta = 0.2$.
- But the optimum is much flatter for $\Delta = 0.01$.
- In general smaller energy and gradient difference allows higher weight.

Energy and gradient weights (one test beam each)

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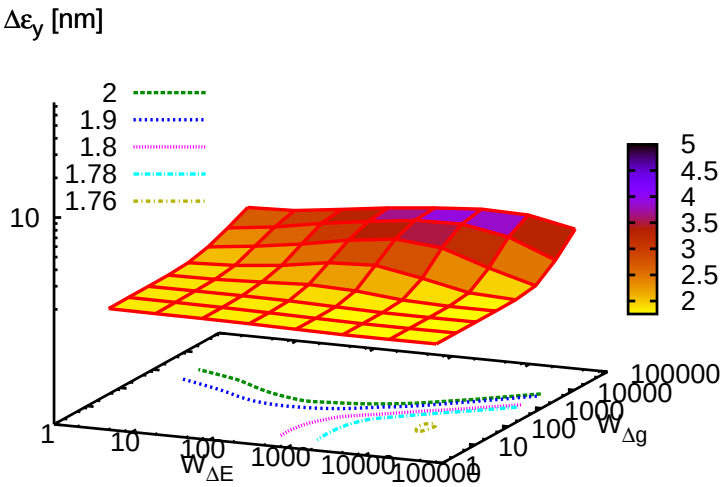
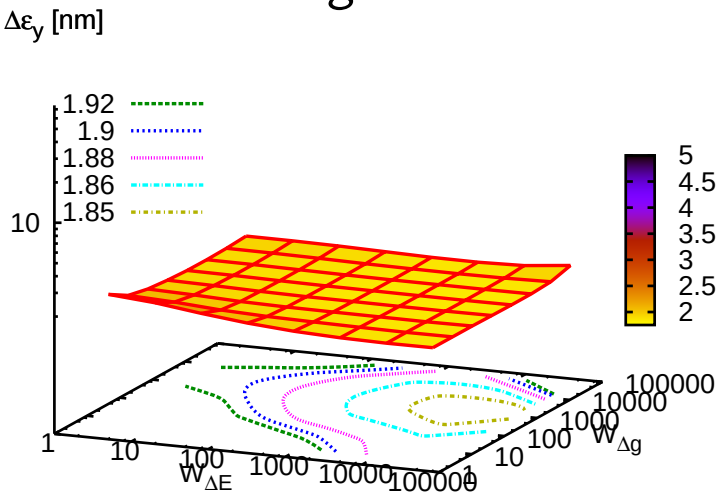
$\Delta E = \Delta g = 0.2$



$\Delta E = \Delta g = 0.01$



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Energy and gradient weights (one test beam each)

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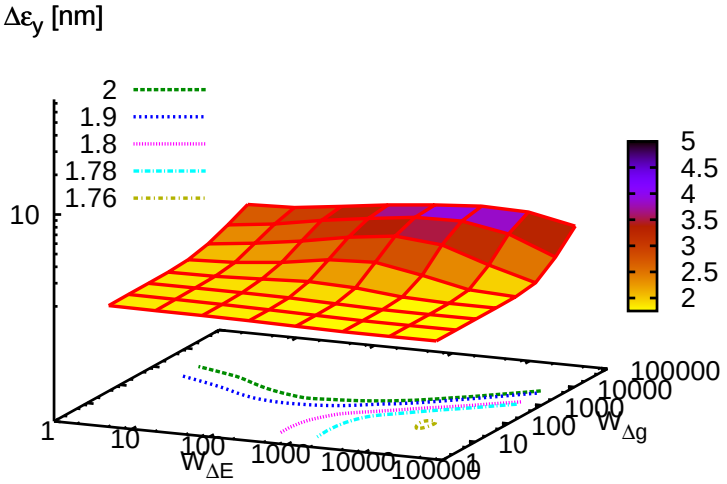
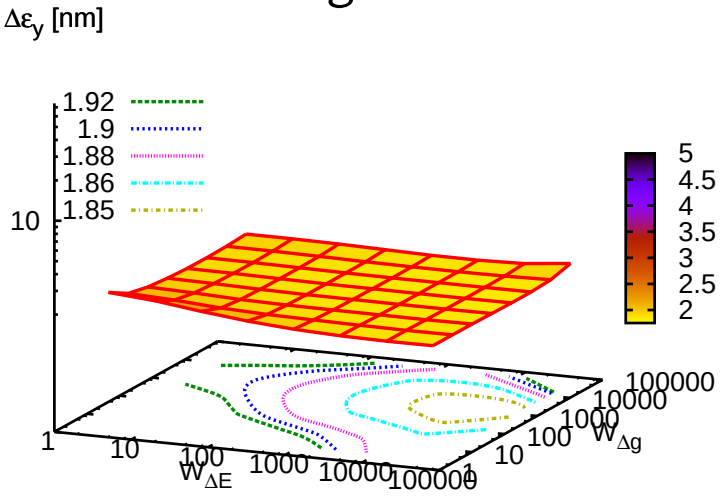
$\Delta E = \Delta g = 0.2$



$\Delta E = \Delta g = 0.01$



- Optimal emittance better for $\Delta = 0.2$.
- But the optimum is much flatter for $\Delta = 0.01$.
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Weight on energy modified test beam

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Peder Eliasson *presented by* Andrea Latina

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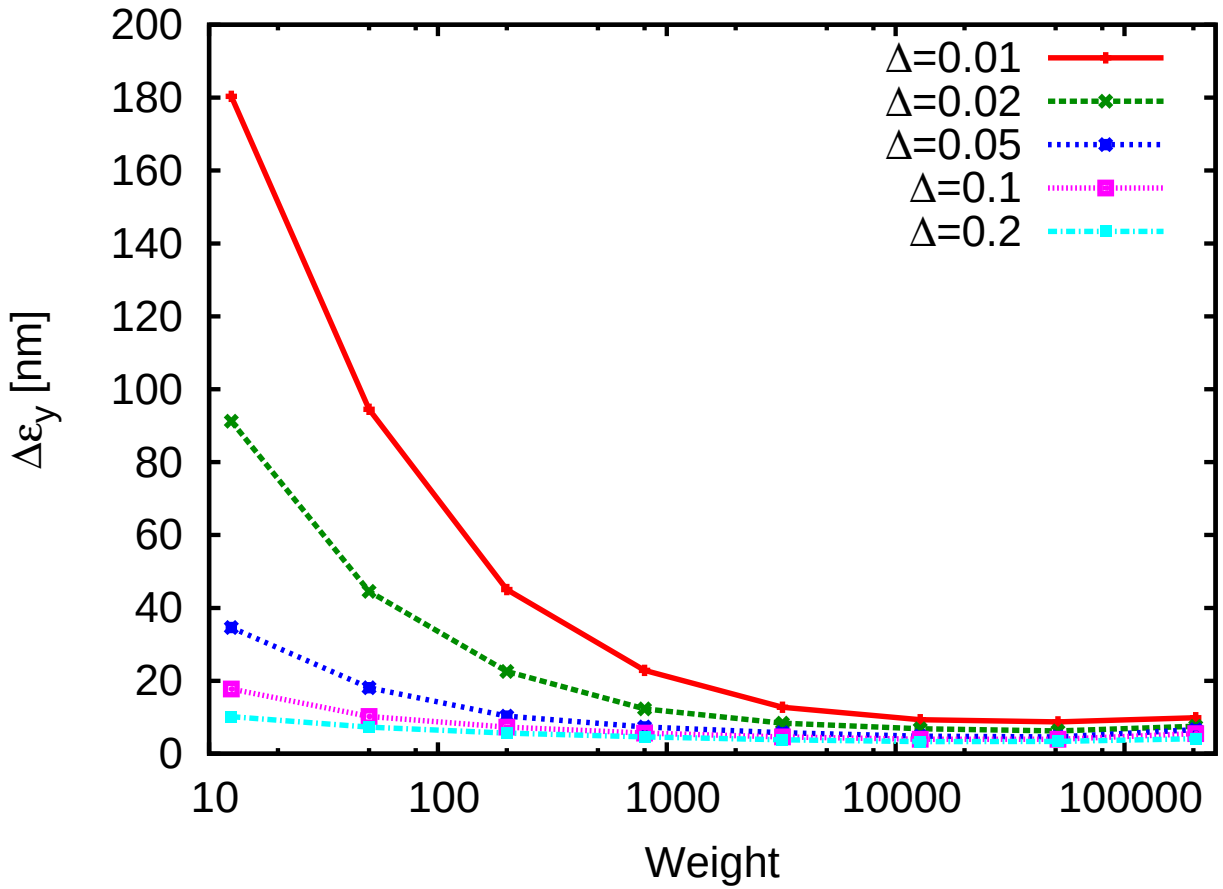
Gradient test beam

ΔE and Δg

Undulator limit

Dispersion Free Steering
Optimum weight ($\Delta \geq 0.1$): 12800
Optimum weight ($\Delta \leq 0.05$): 51200



Weight on energy modified test beam

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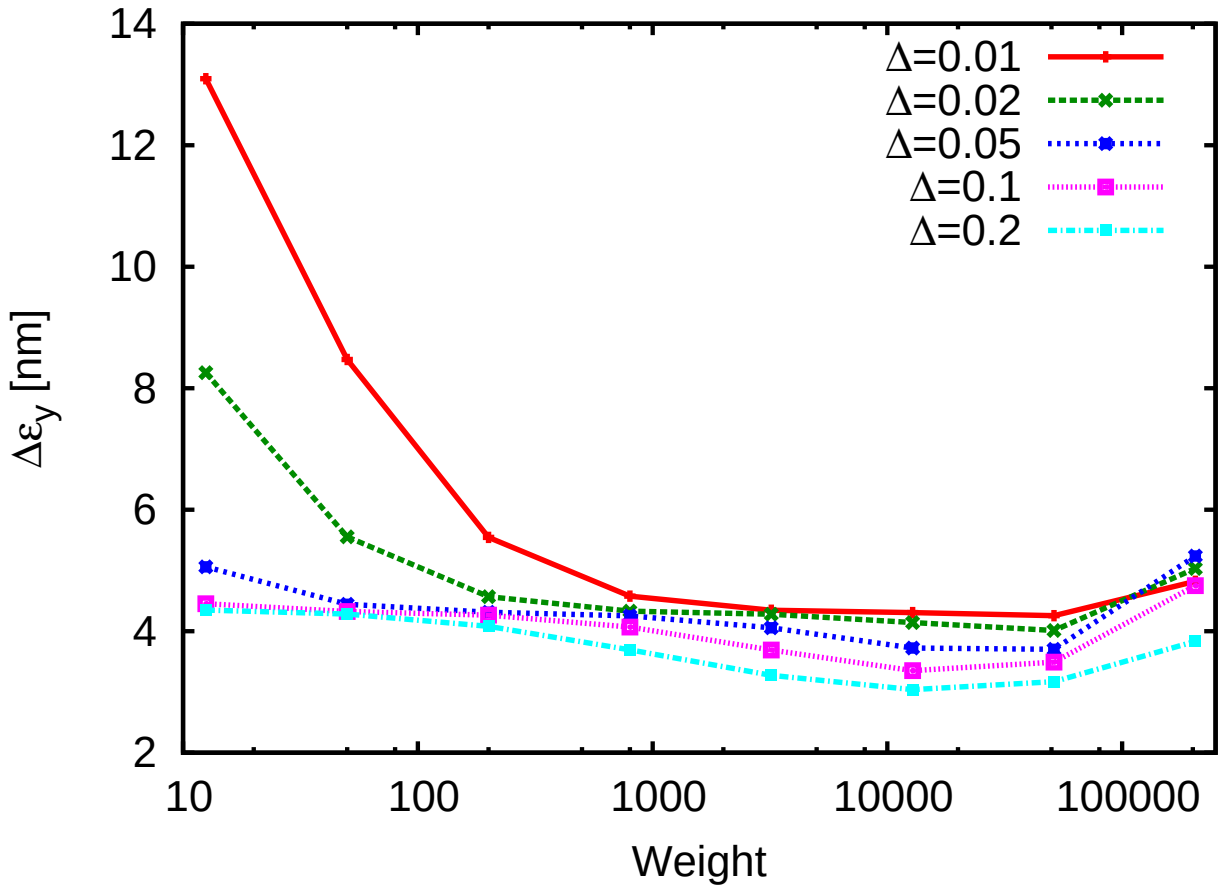
Undulator limit

Dispersion Free Steering and dispersion bumps
Optimum weight ($\Delta \geq 0.1$): 12800
Optimum weight ($\Delta \leq 0.05$): 51200



Weight on energy modified test beam

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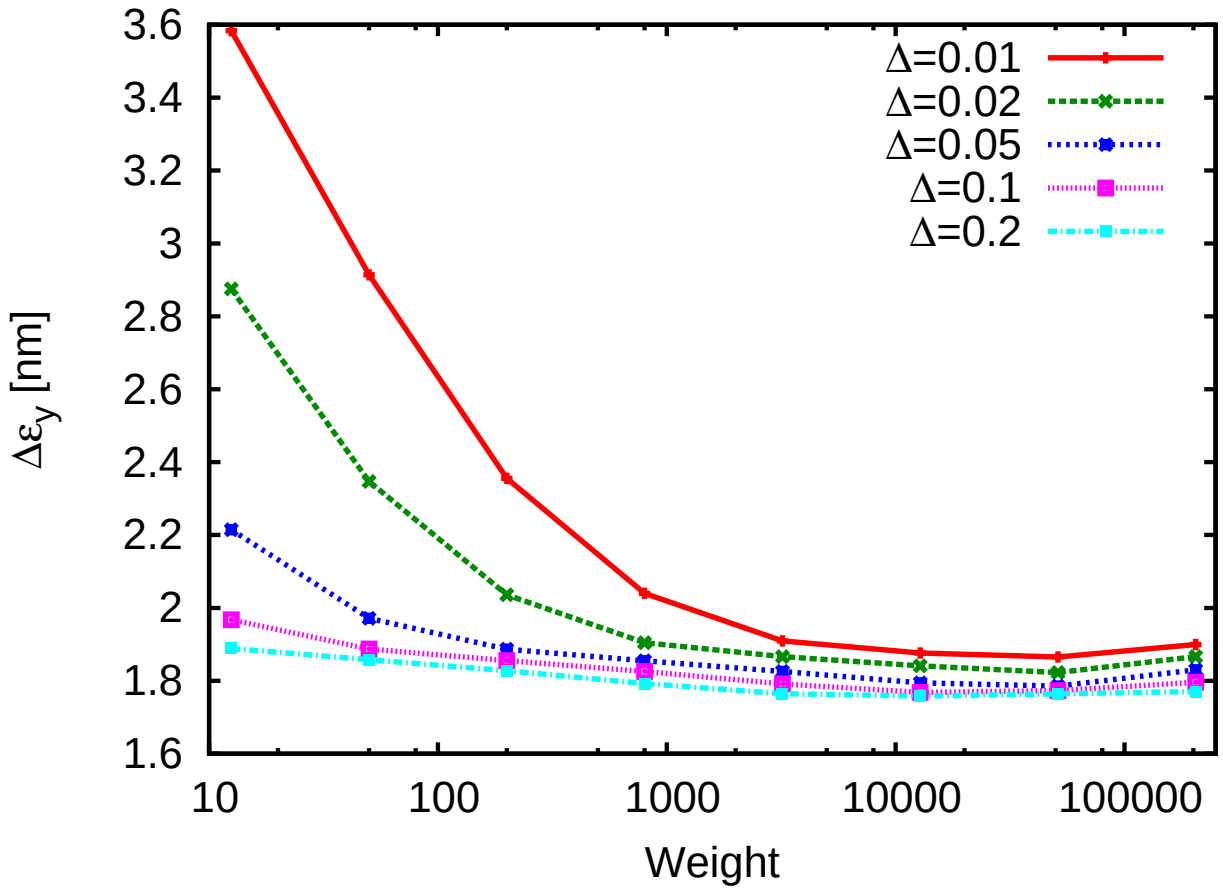
Undulator limit

Dispersion Free Steering and dispersion and wakefield bumps
Optimum weight ($\Delta \geq 0.1$): 12800
Optimum weight ($\Delta \leq 0.05$): 51200



Weight on gradient modified test beam

Dispersion Free Steering Test Beam Options

Peder Eliasson *presented by* Andrea Latina

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Energy test beam and gradient test beam

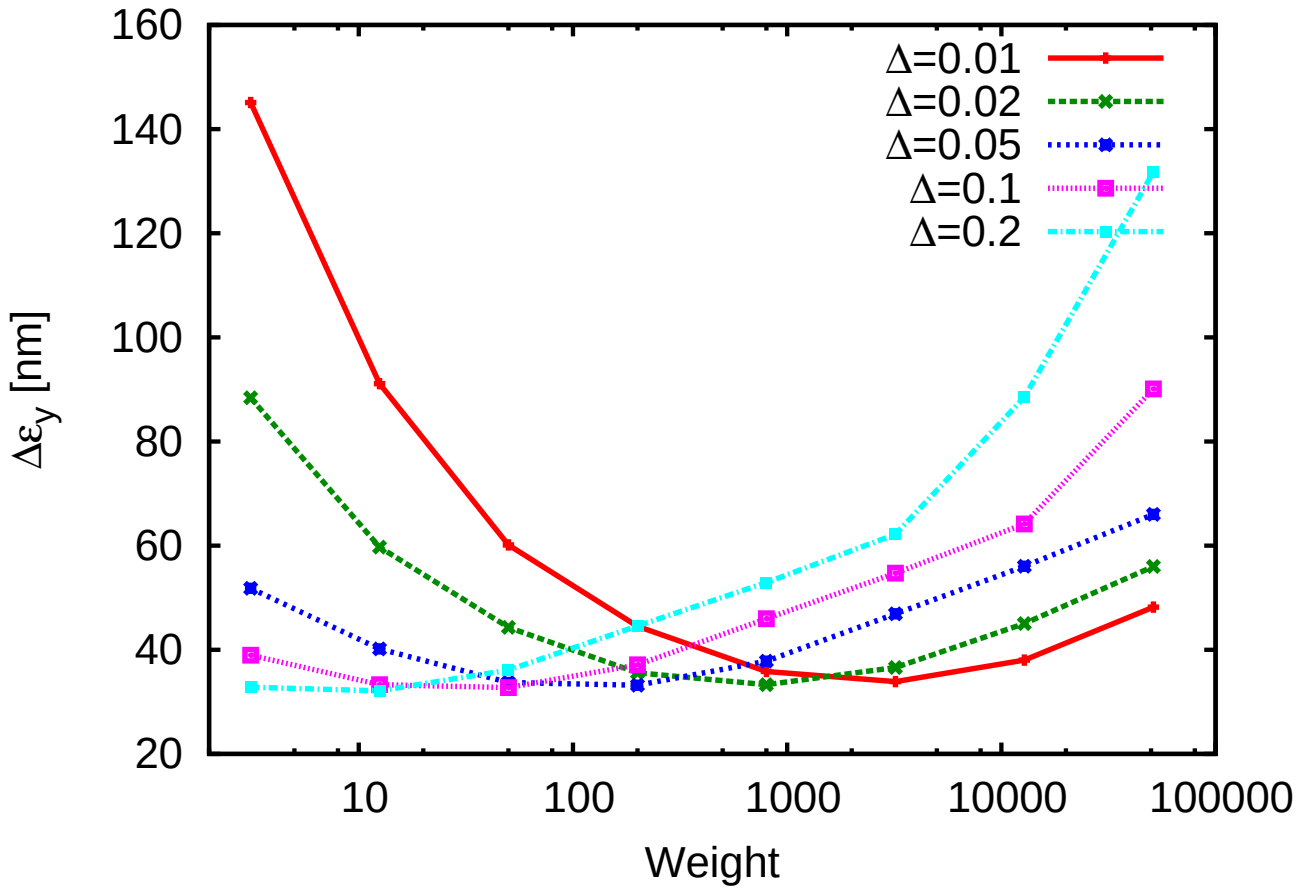
Energy test beam

Gradient test beam

ΔE and Δg

Undulator limit

Difficult to reach acceptable emittance growth using only Dispersion Free Steering with a gradient test beam.
Lower Δ leads to higher optimum weight.



Weight on gradient modified test beam

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Energy test beam and gradient test beam

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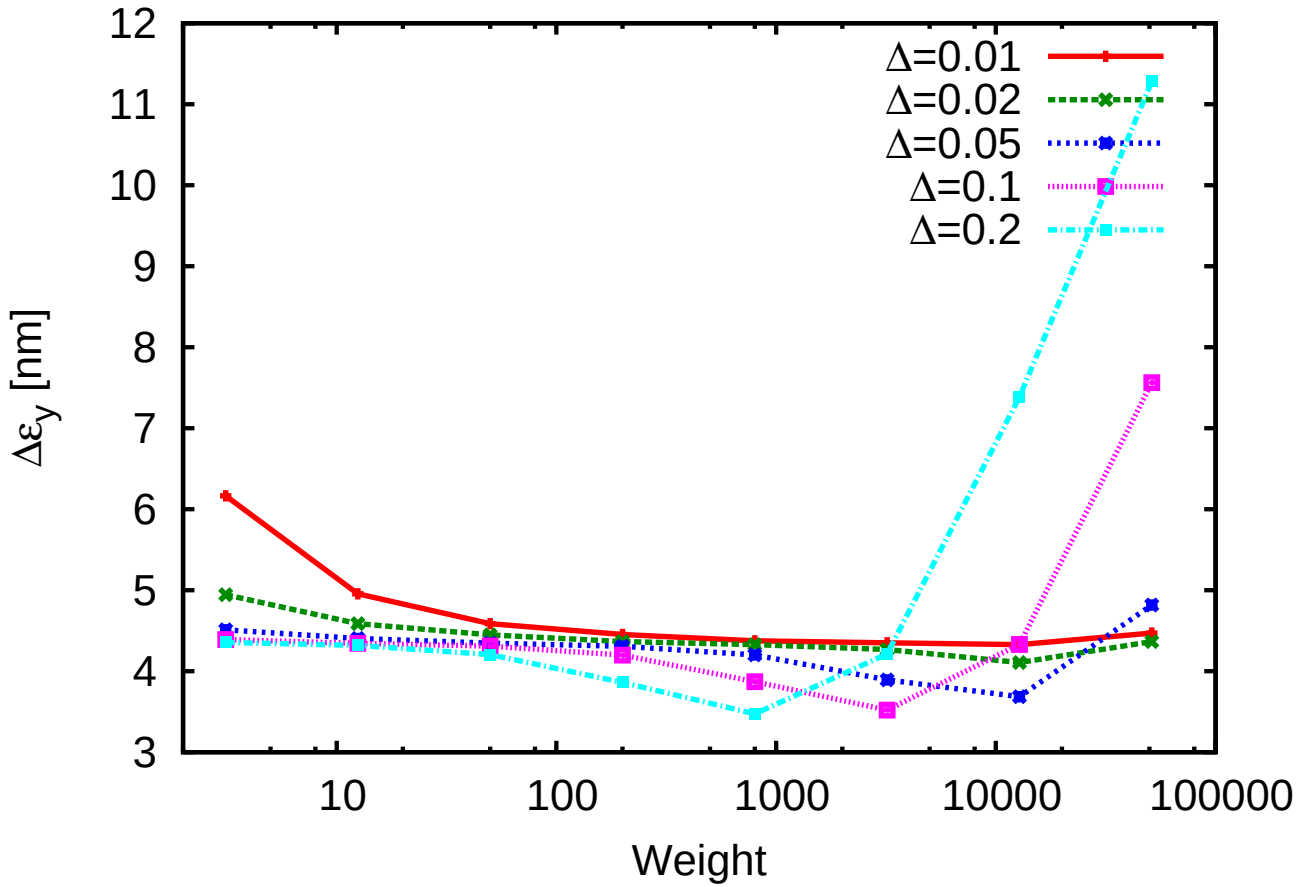
ΔE and Δg

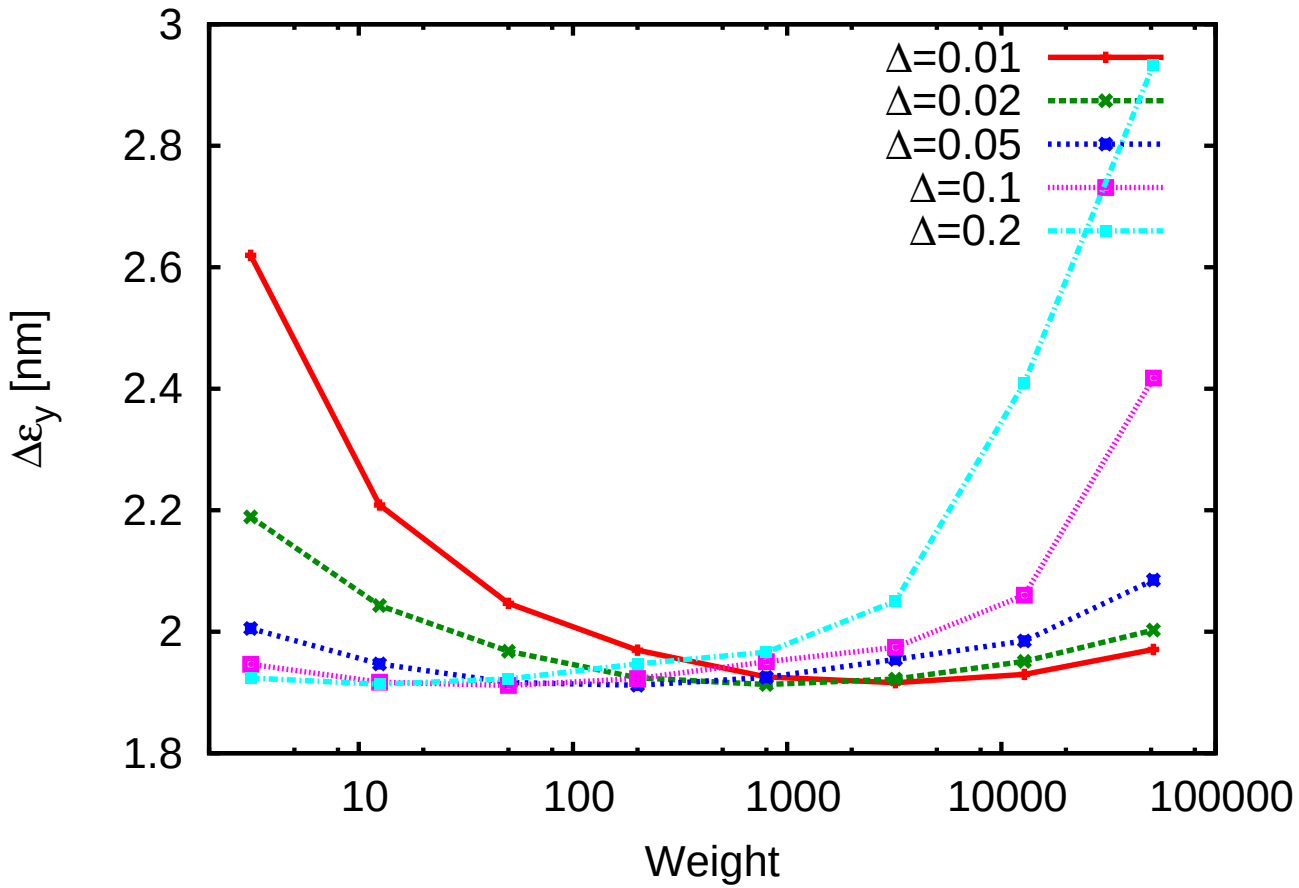
Undulator limit

With dispersion bumps acceptable emittance growth can be acheieved. Relatively high optimum weights (even for $\Delta = 0.2$).



Weight on gradient modified test beam

With dispersion and wakefield bumps very low emittance can be achieved even without energy modified test beams.



One test beam with ΔE and Δg

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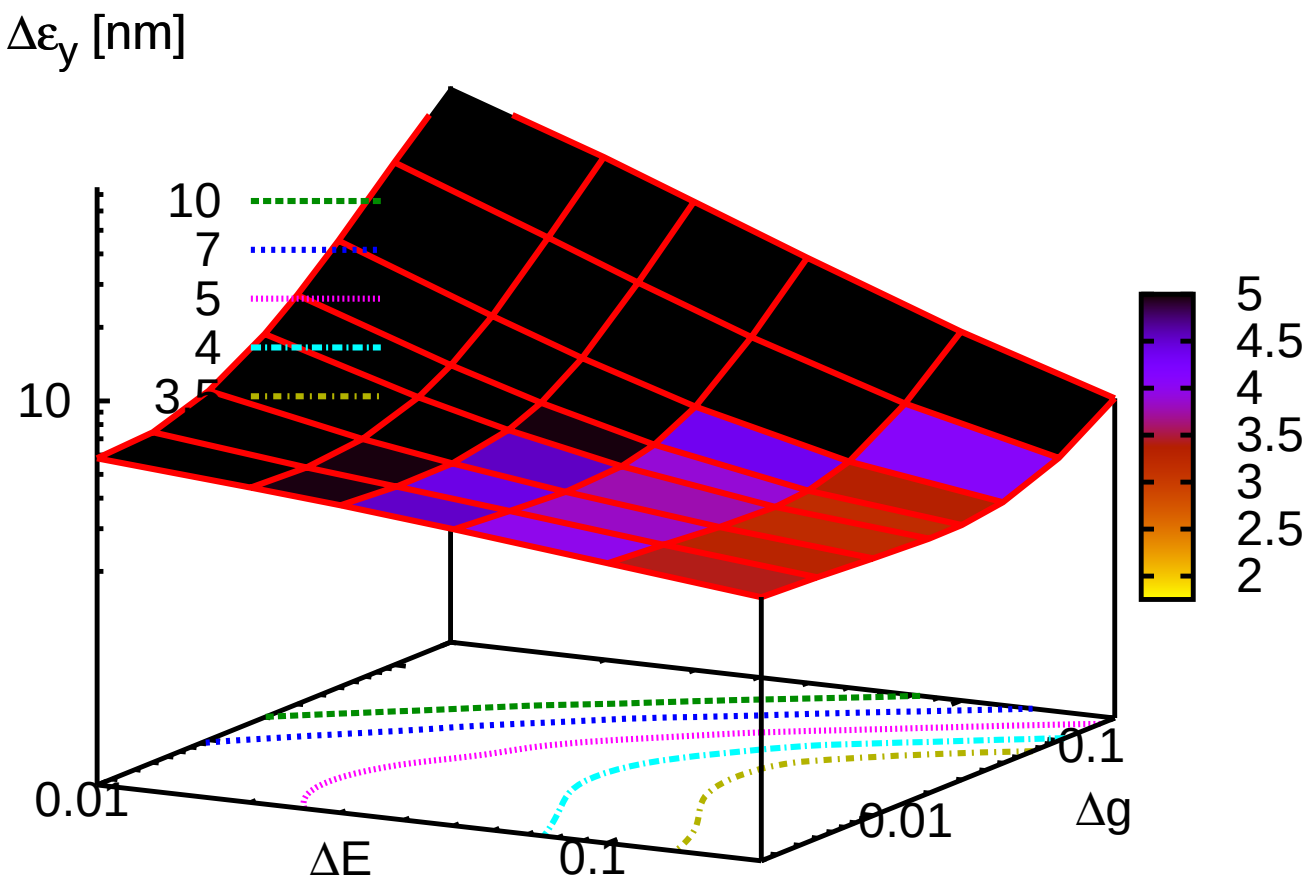
Energy test beam

Gradient test beam

ΔE and Δg

Undulator limit

Dispersion Free Steering
Weight = 12800
Optimum: $\Delta E = 0.2$, $\Delta g = 0.02$)



One test beam with ΔE and Δg

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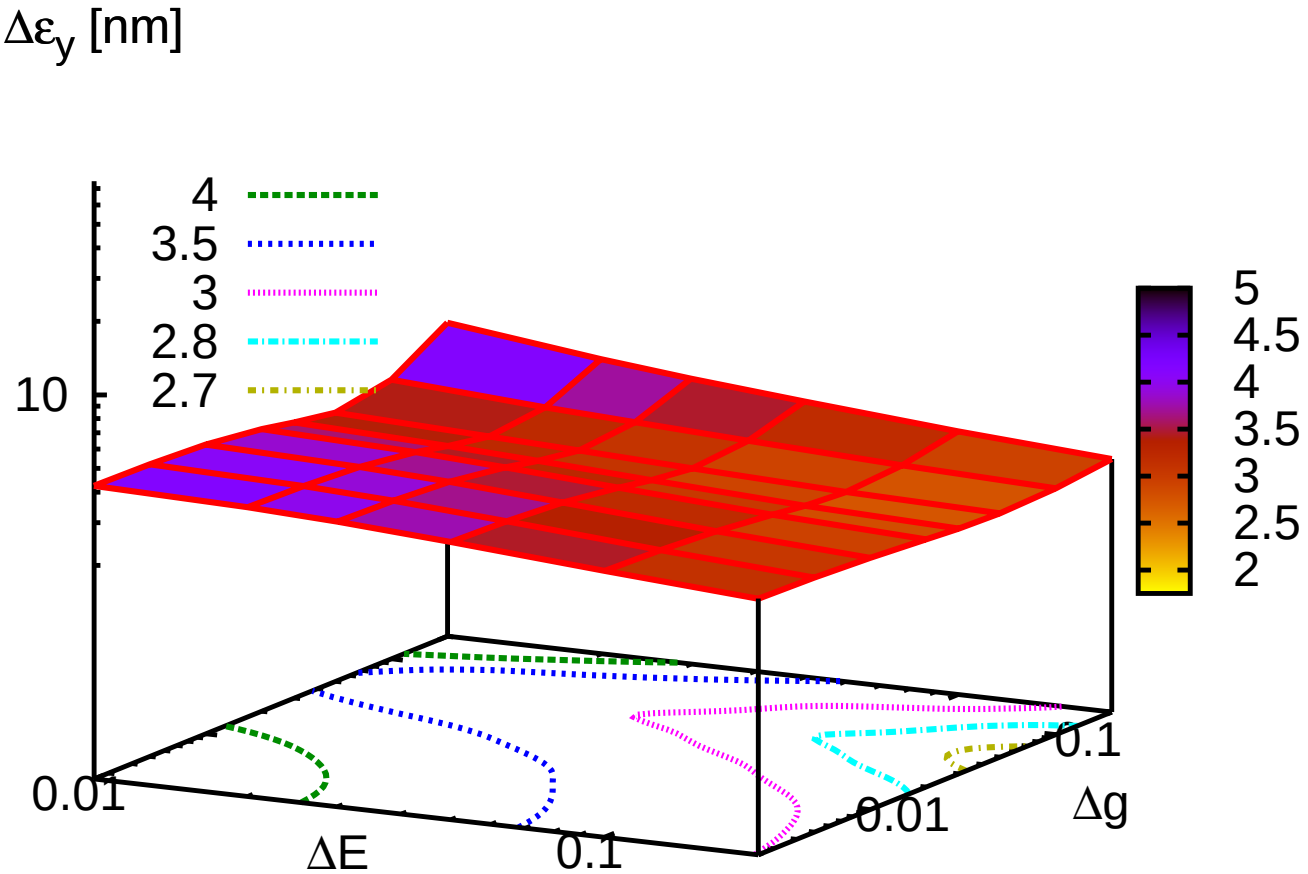
Dispersion Free Steering and dispersion bumps
Weight $= 12800$
Optimum: $\Delta E = 0.2$, $\Delta g = 0.05$)



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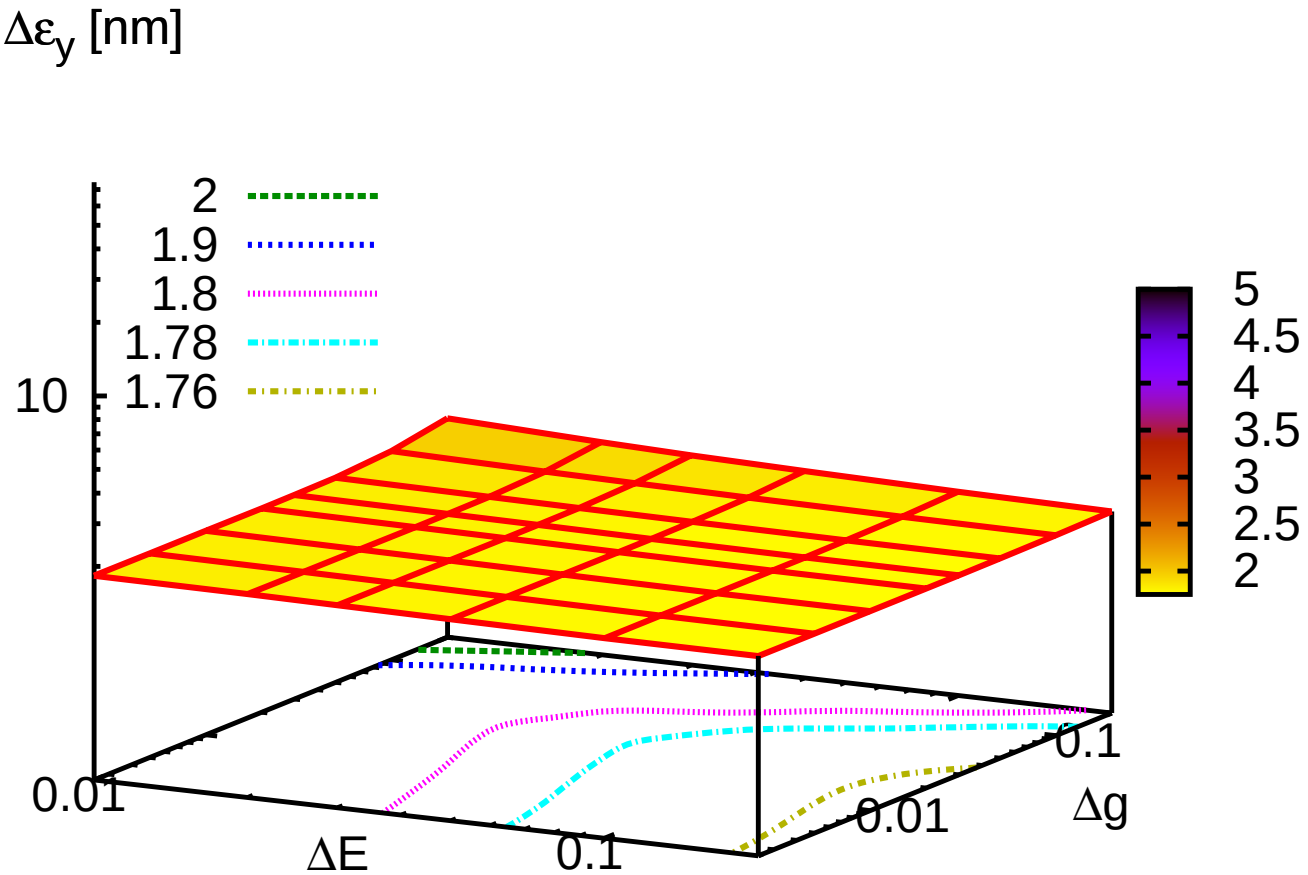
Dispersion Free Steering and dispersion and wakefield bumps
Weight $= 12800$
Optimum: $\Delta E = 0.2$, $\Delta g = 0.01$)



Energy deviation at undulator

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Peder Eliasson *presented by* Andrea Latina

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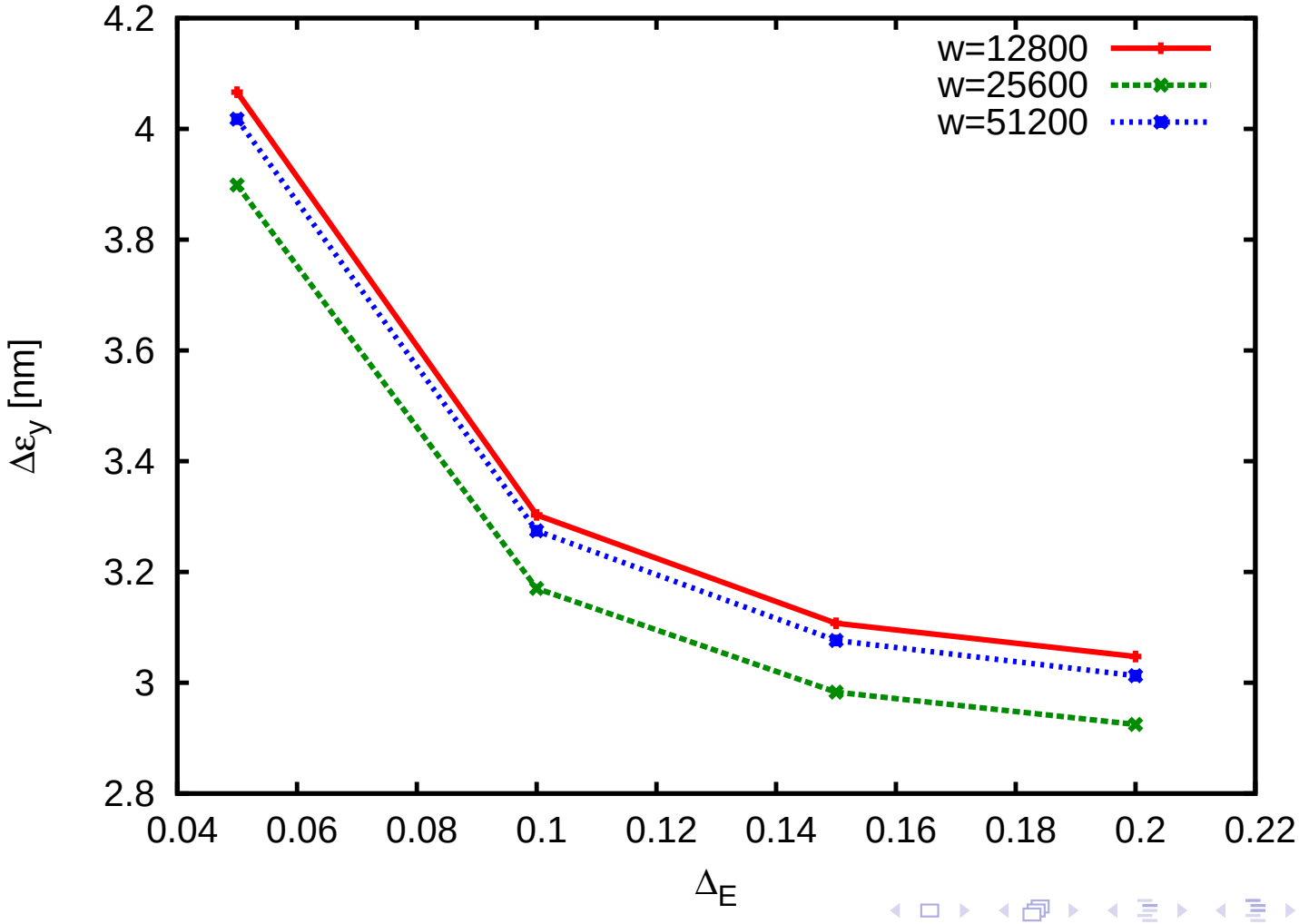
ΔE and Δg

Undulator limit

Dispersion Free Steering
ΔE varied and Δg adjusted to avoid more than 2% energy deviation at undulator (at 150GeV).



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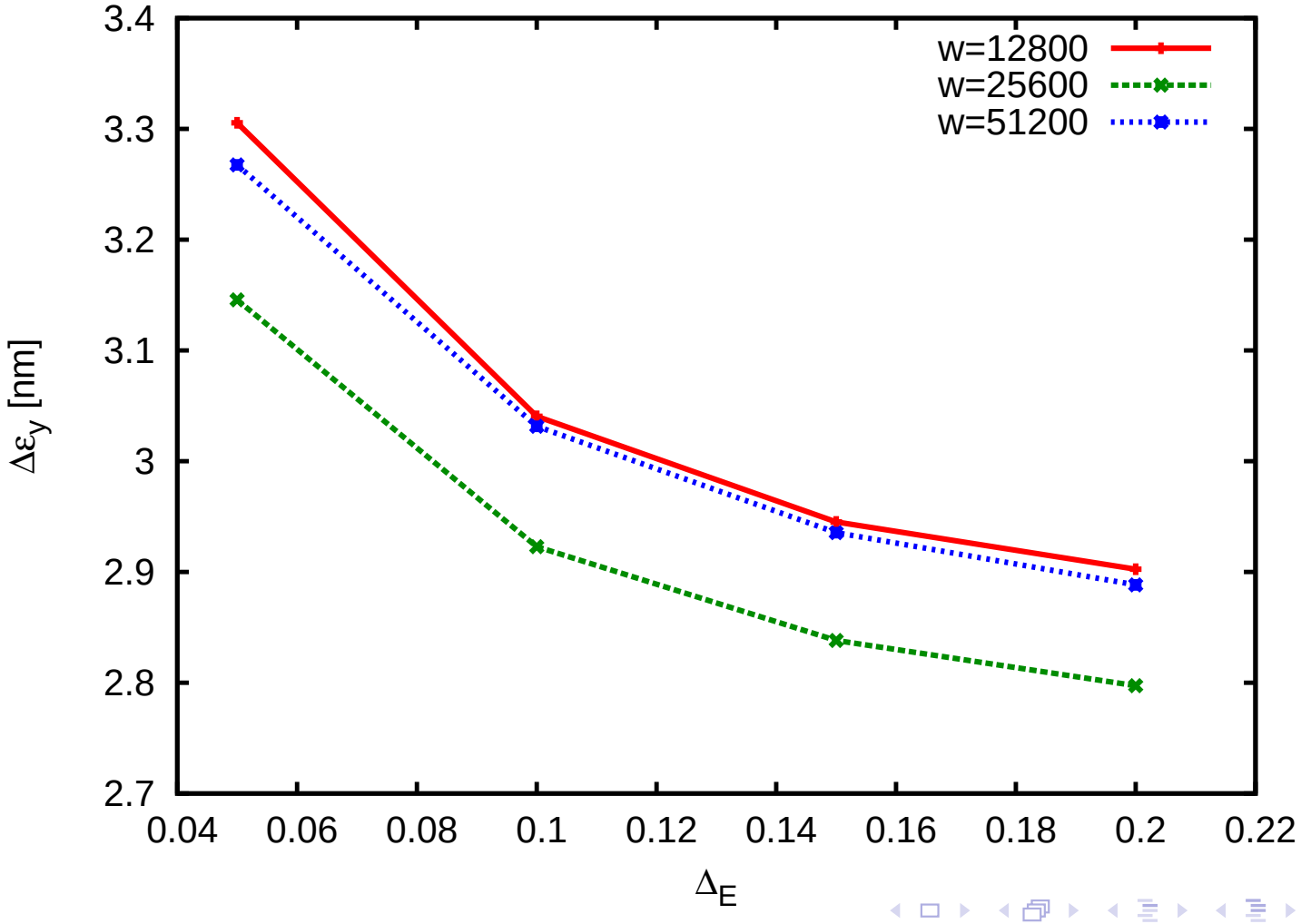

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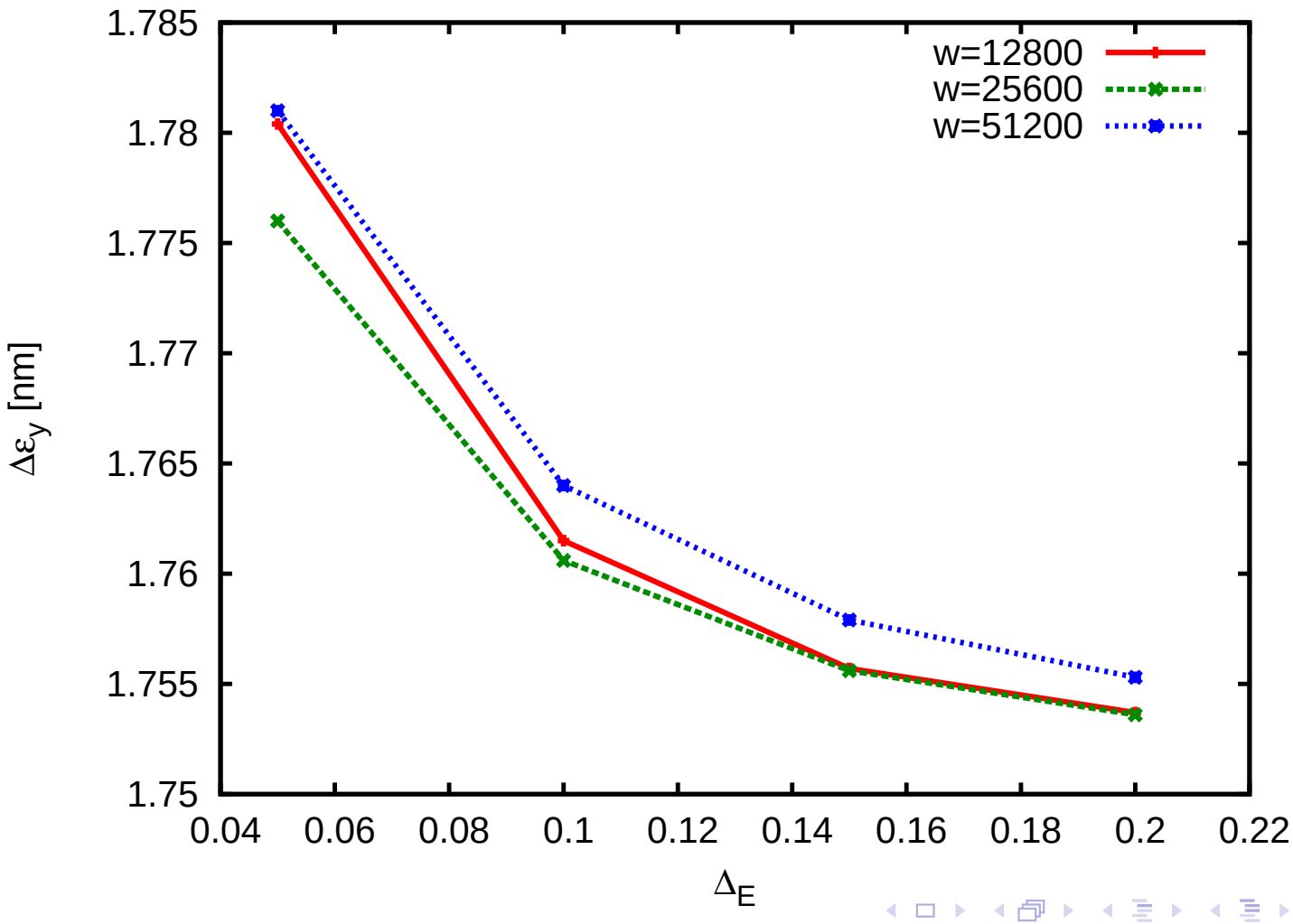

Energy deviation at undulator

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Energy test beam and gradient test beam

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Gradient test beam

ΔE and Δg

Undulator limit

- Optimum weight is 25600.
- The higher the energy difference the better.
- However, $\Delta E > 0.2$ leads to larger energy deviations than 2% at undulator.
- Besides, if the bunch compressor is used to produce the energy difference already 10% is at the limit of what can be achieved without to strong non-linearities.

Energy deviation at undulator

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Energy deviation at undulator

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Undulator limit

- Very good results can be obtained using $\Delta E = 0.1$ and $\Delta g \approx 0.01$ (energy difference at undulator stays just below 2%).
- Dispersion Free Steering removes almost all dispersion and there is nothing to be gained by using dispersion bumps. Wakefield bumps on the other hand strongly enhance the emittance.