Offset and angle studies with Guinea-Pig

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Linear Collider Workshop
ILC 2007

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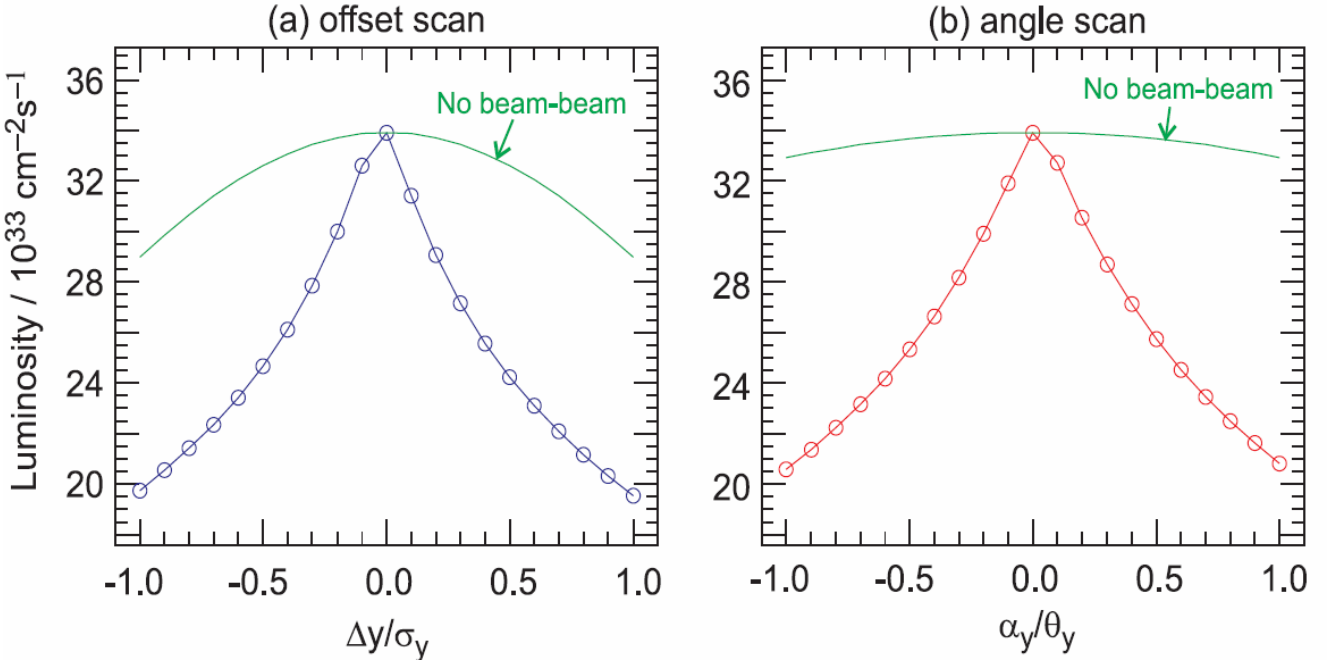
Offset and angle scan from TESLA TDR

Luminosity drops fast with small change of offset and/or angle

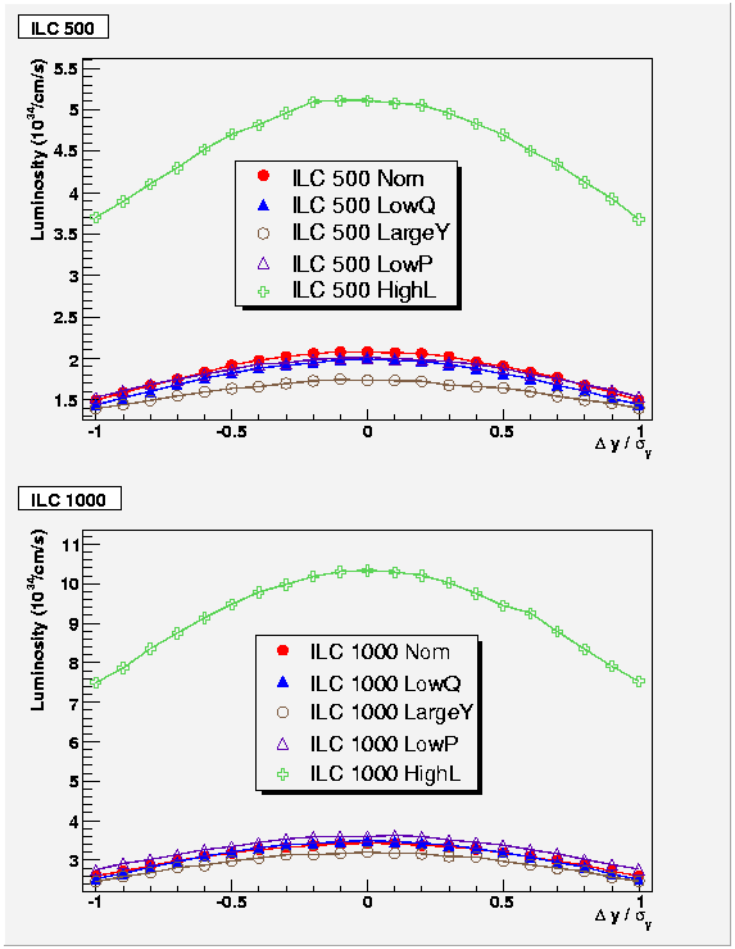


Results from beam-beam simulation with GUINEA-PIG from TESLA TDR

TESLA parameters: σ_y = 5nm , θ_y = 12 μrad

How is the luminosity change for the ILC parameters?

Offset scan with ILC parameter set from 2005



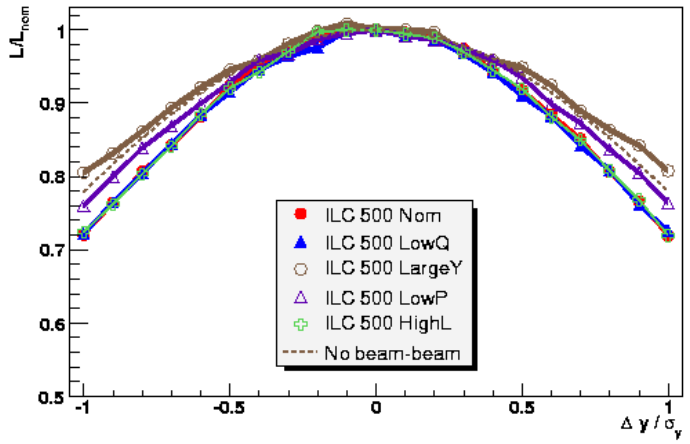
ILC parameters:
ILC 500 NOM: σ_y = 5.7nm
ILC 500 LOW Q: σ_y = 3.5nm
ILC 500 LARGE Y: σ_y = 8.1nm
ILC 500 LOW P: σ_y = 3.8nm
ILC 500 HIGH L: σ_y = 3.5nm

ILC 1000 NOM: σ_y = 3.5nm
ILC 1000 LOW Q: σ_y = 2.5nm
ILC 1000 LARGE Y: σ_y = 7.0nm
ILC 1000 LOW P: σ_y = 2.7nm
ILC 1000 HIGH L: σ_y = 2.5nm

Loss of luminosity falls not so steep, for $\Delta y/\sigma_y = \pm 1$ O(30%)
(TESLA: for $\Delta y/\sigma_y = \pm 1$ O(40%))

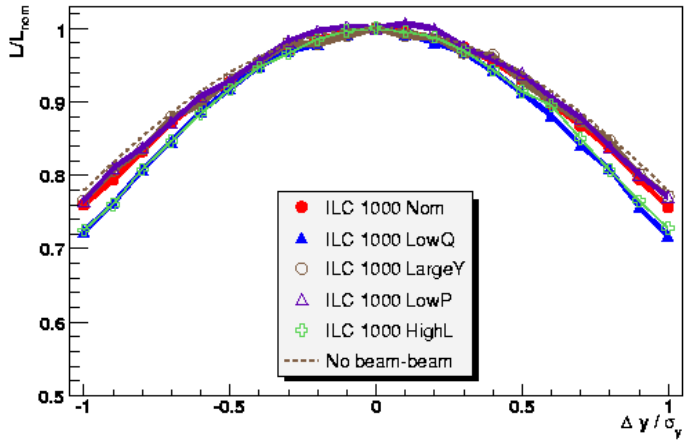
Offset scan with ILC parameters

ILC 500



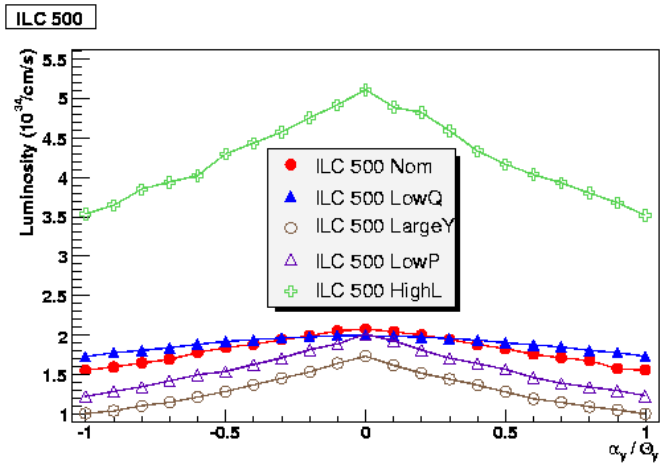
Line for no beam-beam interaction added:
$L/L_{nom}=\exp(1/4 \cdot(\Delta y/\sigma_y)^2)$

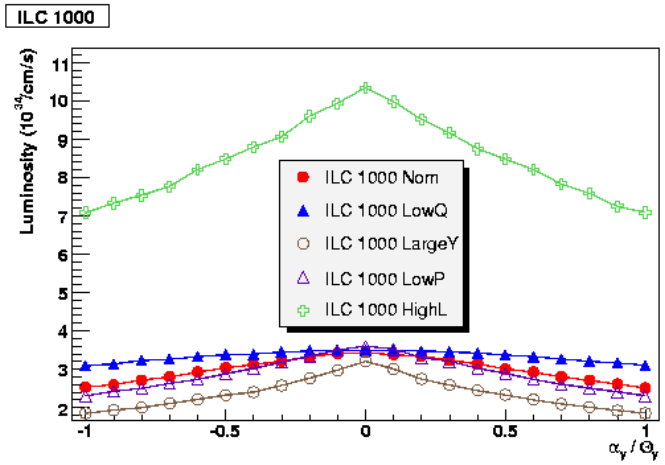
ILC 1000



Loss of luminosity falls not so steep, for $\Delta y/\sigma_y=\pm 1$ O(25%)
(TESLA: for $\Delta y/\sigma_y=\pm 1$ O(40%))

Angle scan with ILC parameters



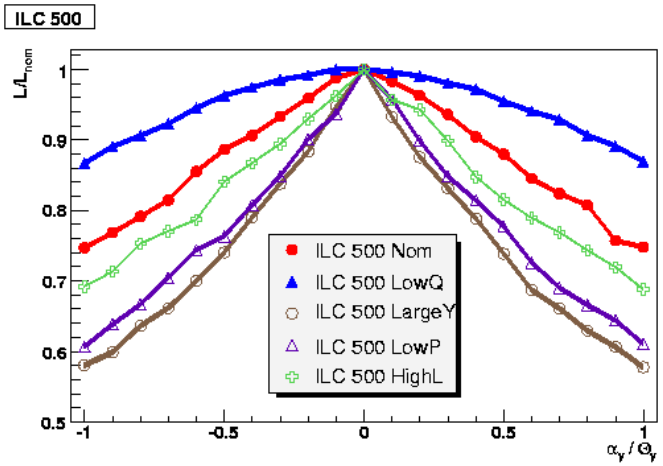


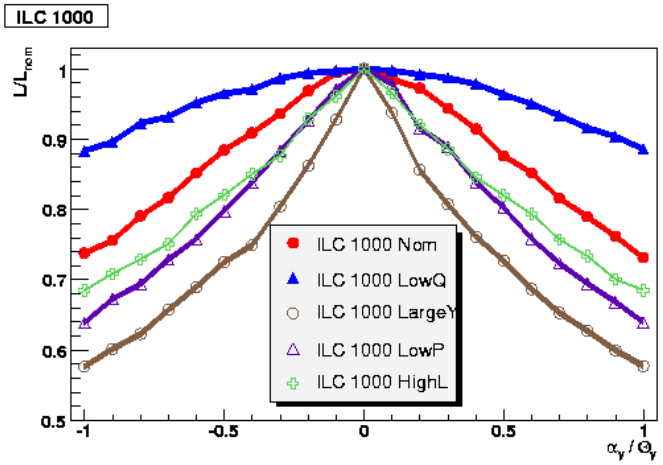
ILC parameters:

ILC 500 NOM: θ_y = 14.3μrad
ILC 500 LOW Q: θ_y = 17.5μrad
ILC 500 LARGE Y: θ_y = 20.2μrad
ILC 500 LOW P: θ_y = 18.9μrad
ILC 500 HIGH L: θ_y = 17.5μrad

ILC 1000 NOM: θ_y = 11.7μrad
ILC 1000 LOW Q: θ_y = 12.4μrad
ILC 1000 LARGE Y: θ_y = 11.7μrad
ILC 1000 LOW P: θ_y = 13.4μrad
ILC 1000 HIGH L: θ_y = 12.4μrad

Angle scan with ILC parameters





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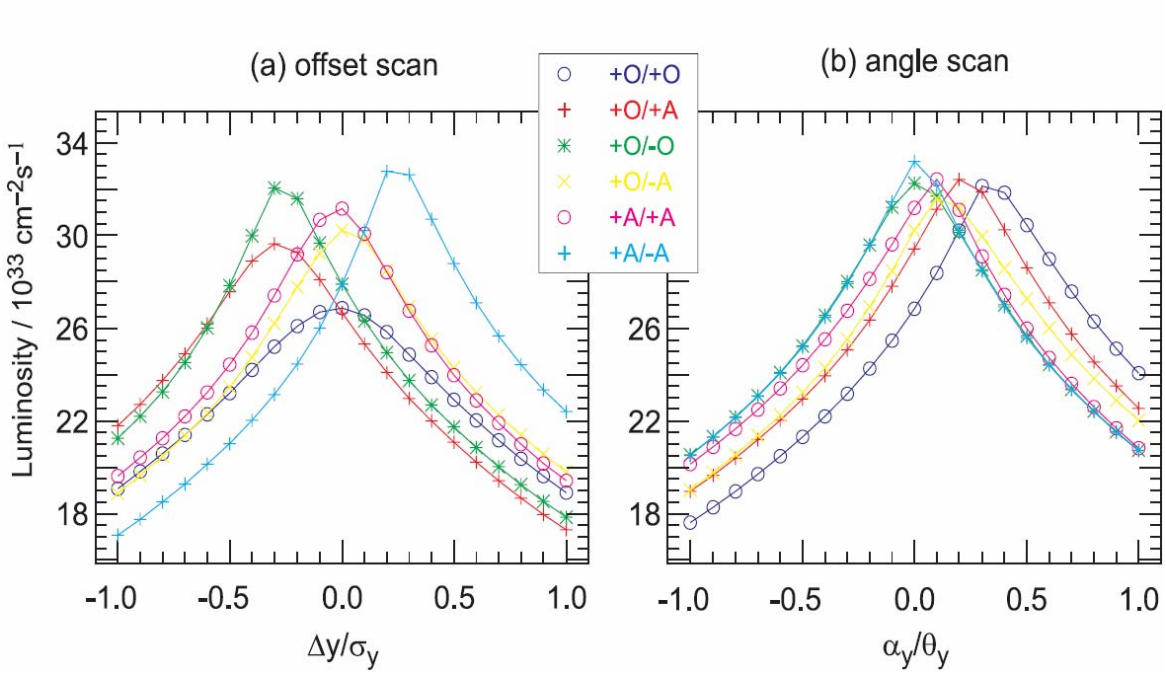
Only 10% loss for LOW Q option,
largest loss of 40% for LARGE Y option!

Next step: include 'banana effect'

Banana effect: internal bunch deformations,
induced by single-bunch wakefields in the linac.

TESLA TDR: single bunch correlated emittance growth
expected to be 6% in average.



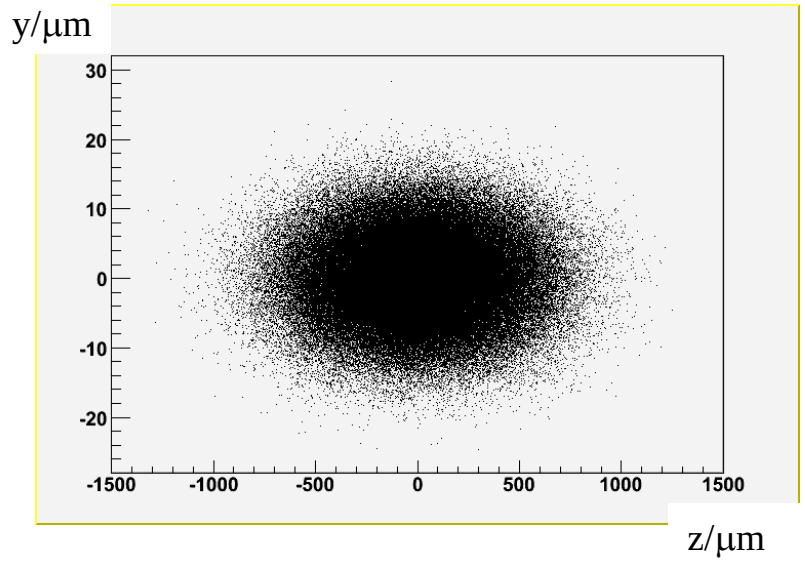
Results from beam-beam simulation with GUINEA-PIG from TESLA TDR

Next step: include 'banana effect'

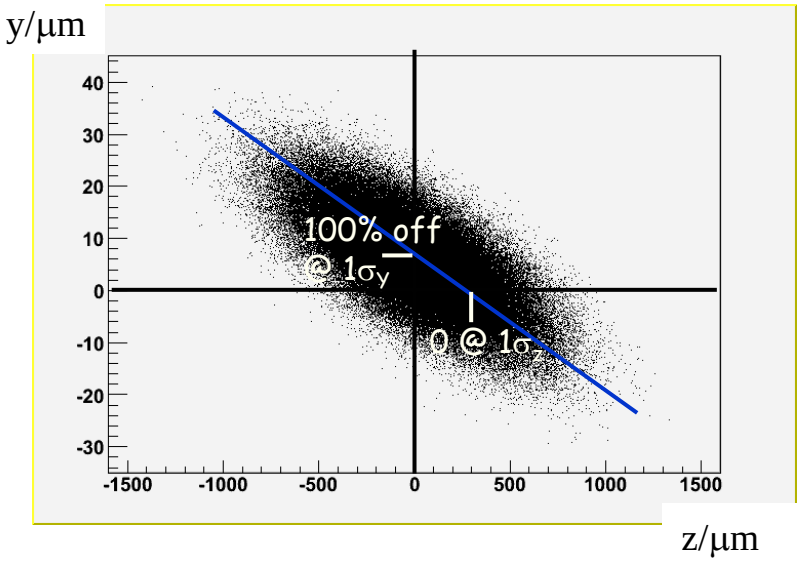
For these plots a 'banana shape' beam needs to be feeded into Guinea-Pig

- Simulated 'banana' from MERLIN not yet available.
- Idea: just generate beam with ILC parameters
  and change it linearly by average of **6%** (number from TESLA TDR)

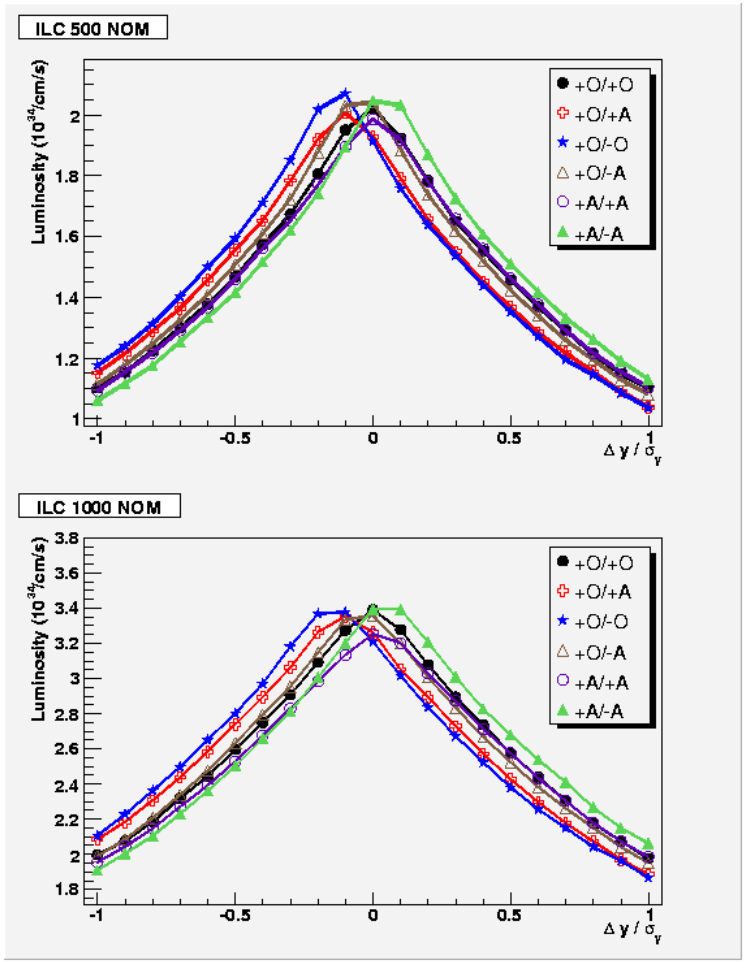
Examples: Beam for ILC-NOM-500

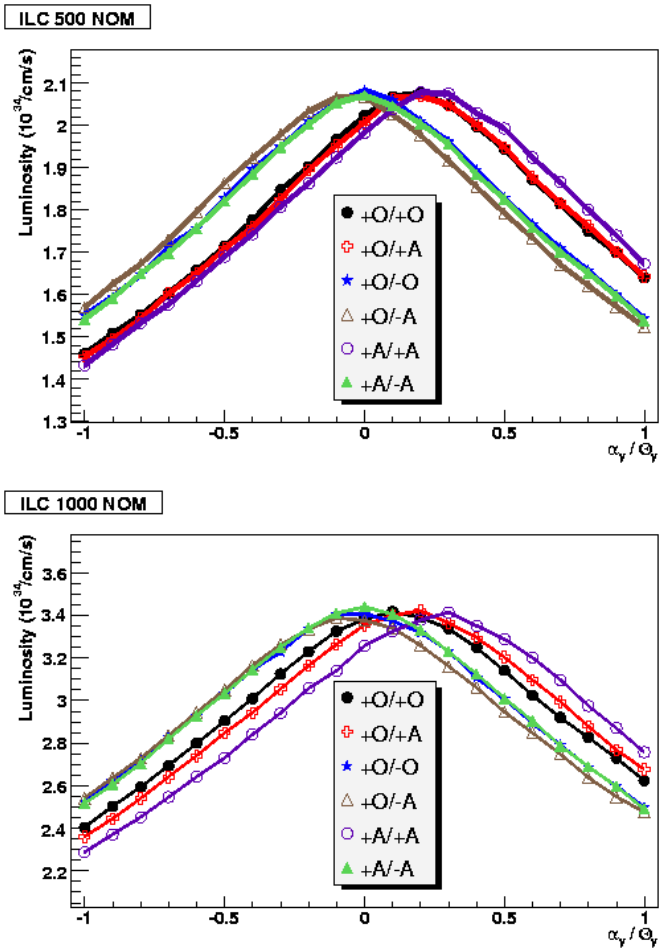


Beam for ILC-NOM-500 with **100%** correlated emittance growth (to make the effect visible)



Offset scan followed by angle scan for best offset value





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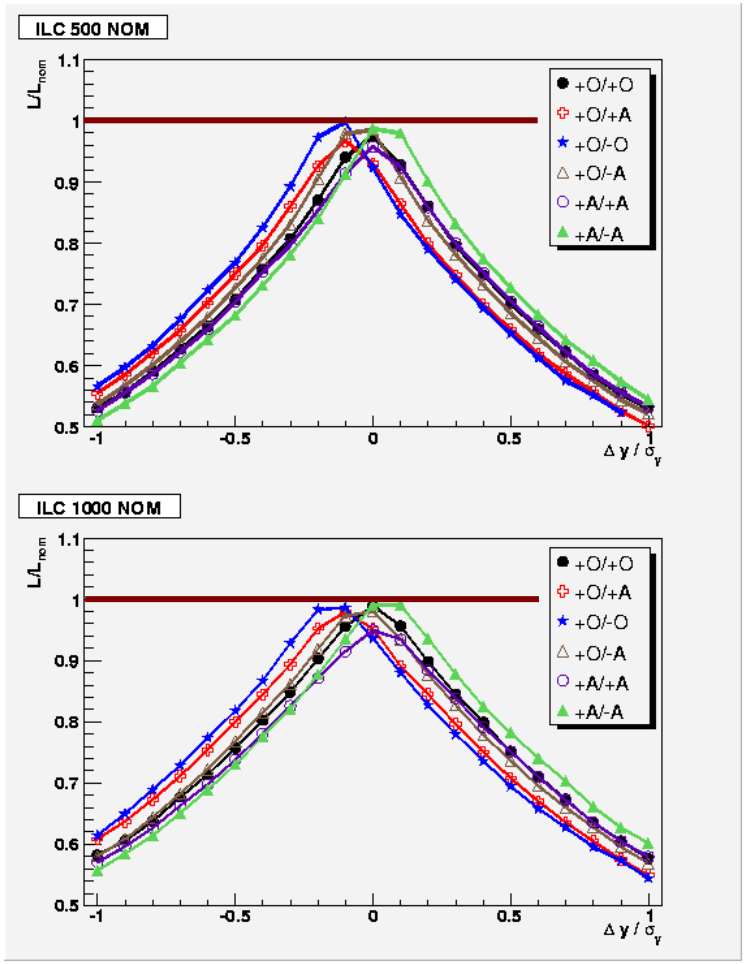

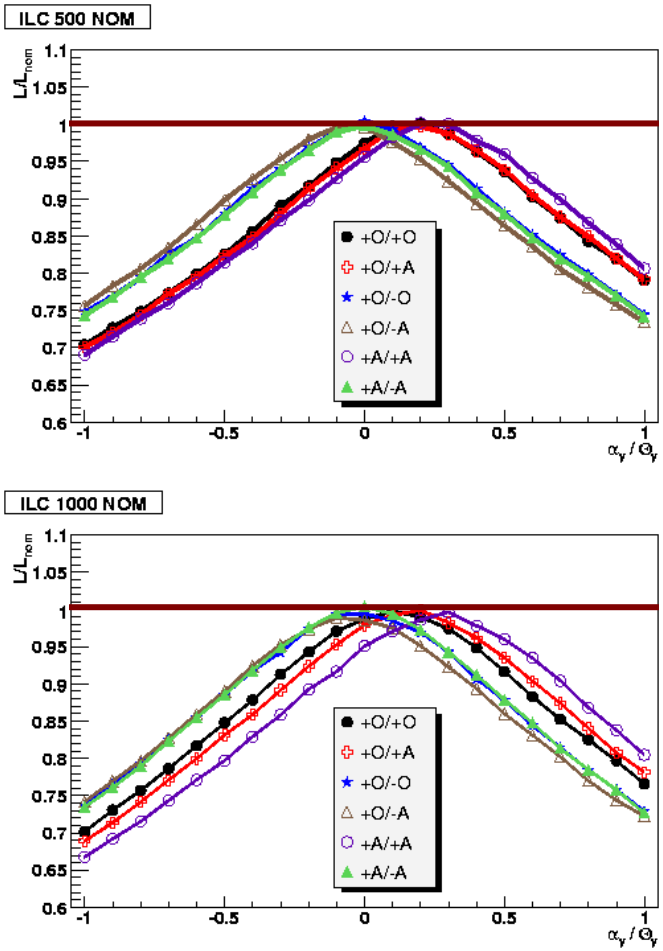

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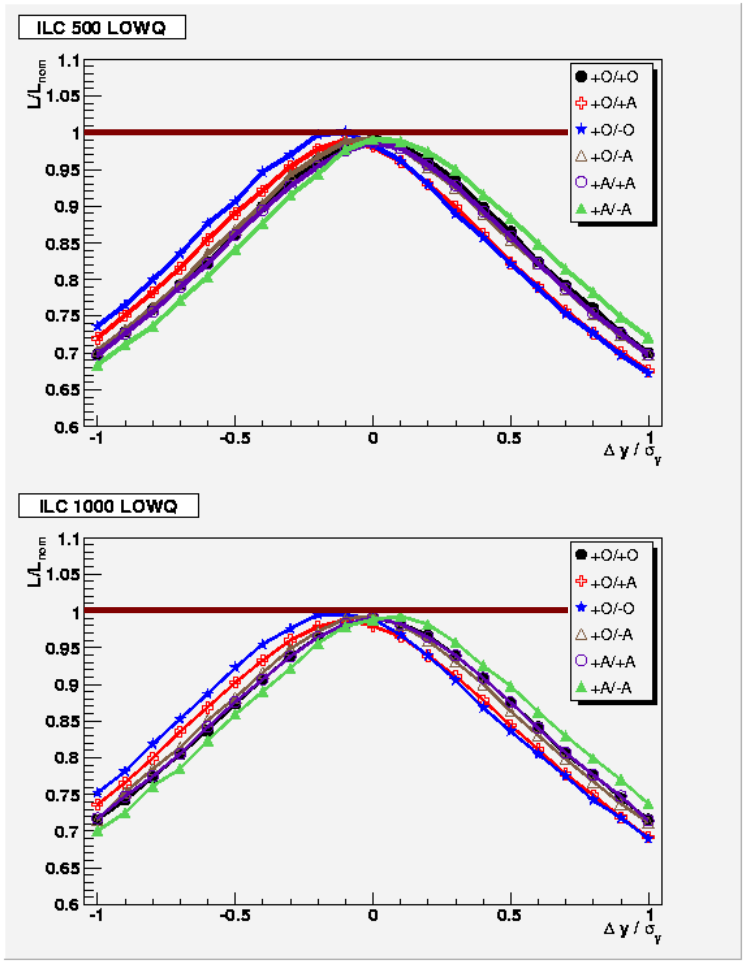

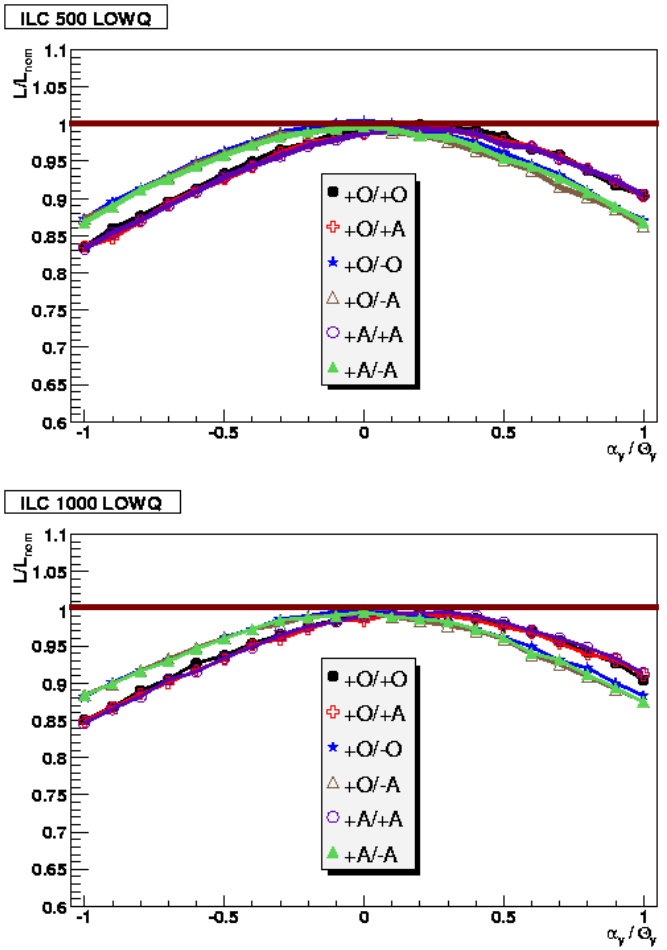

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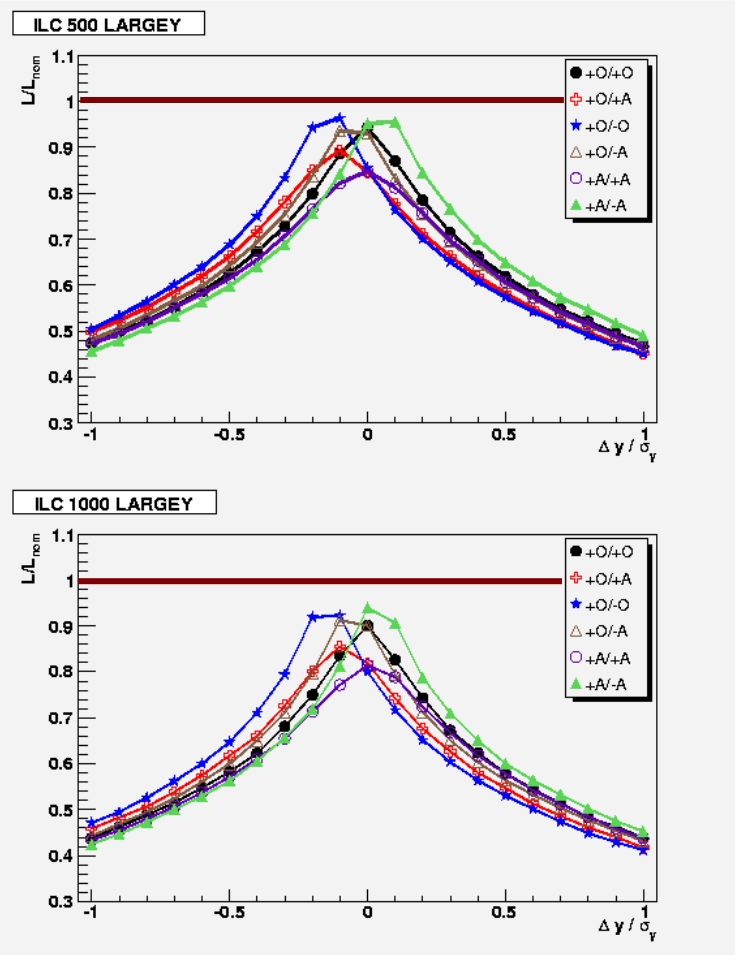

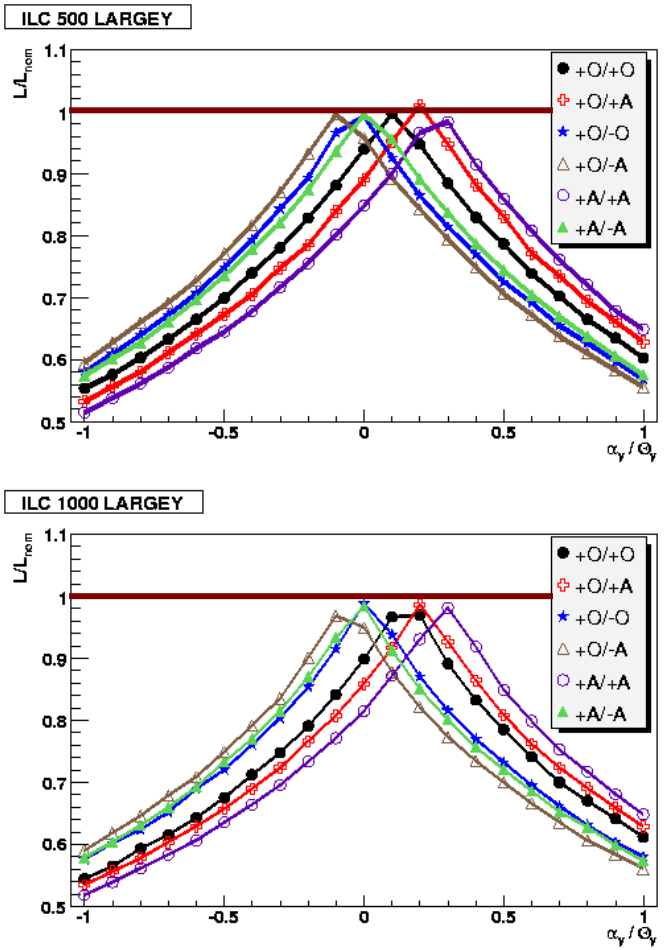

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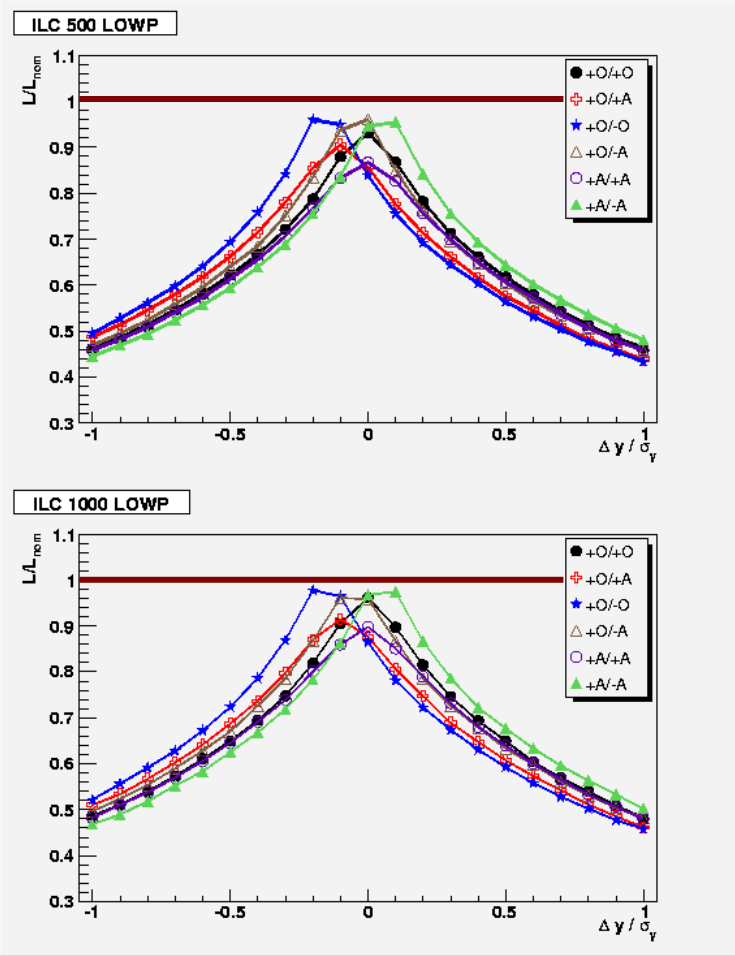

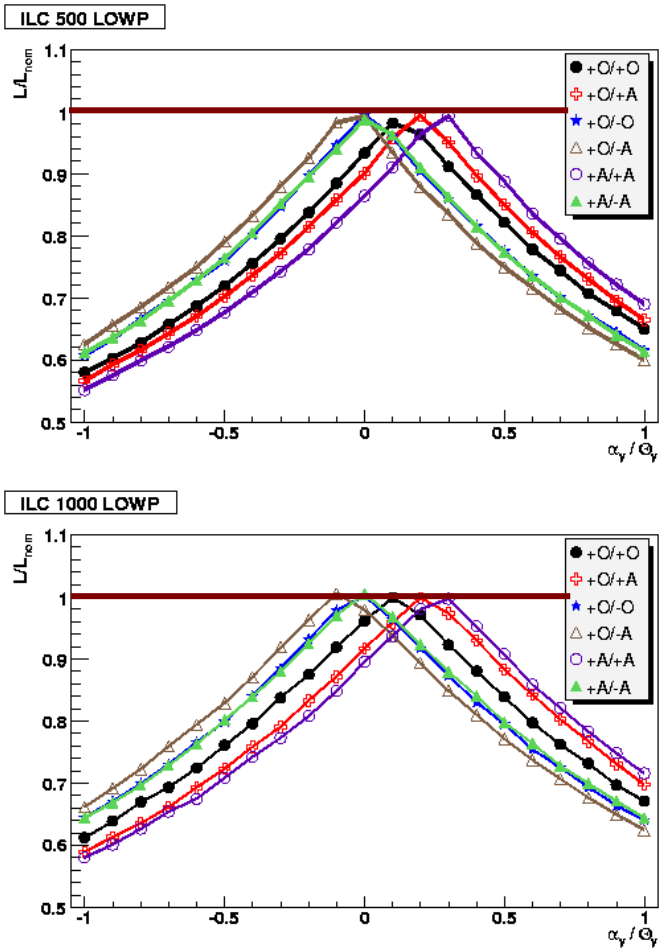

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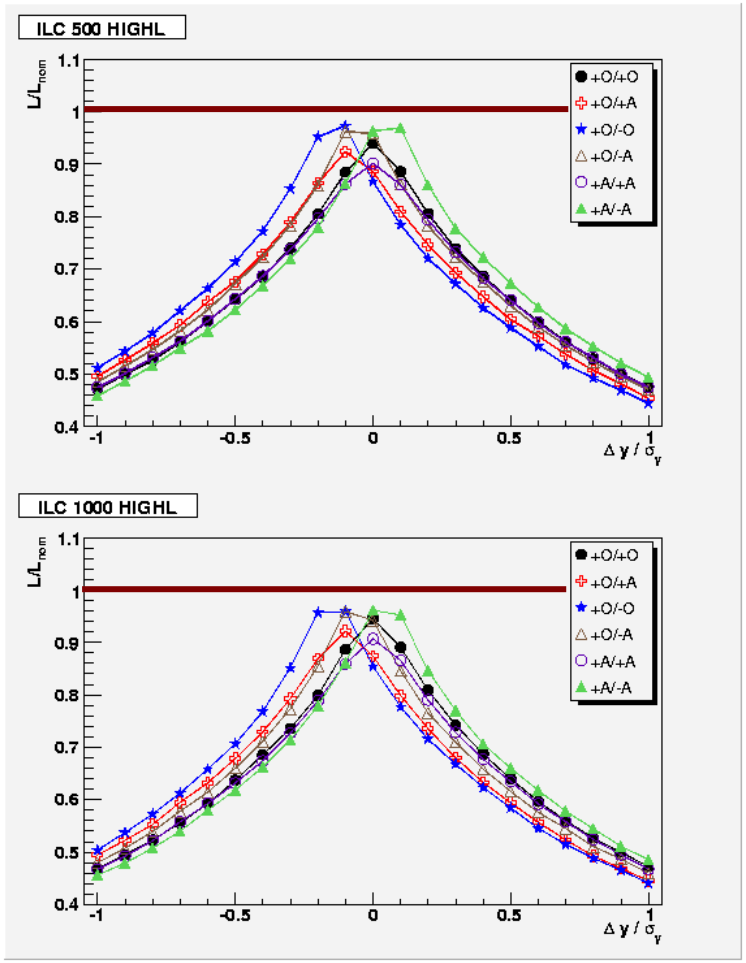
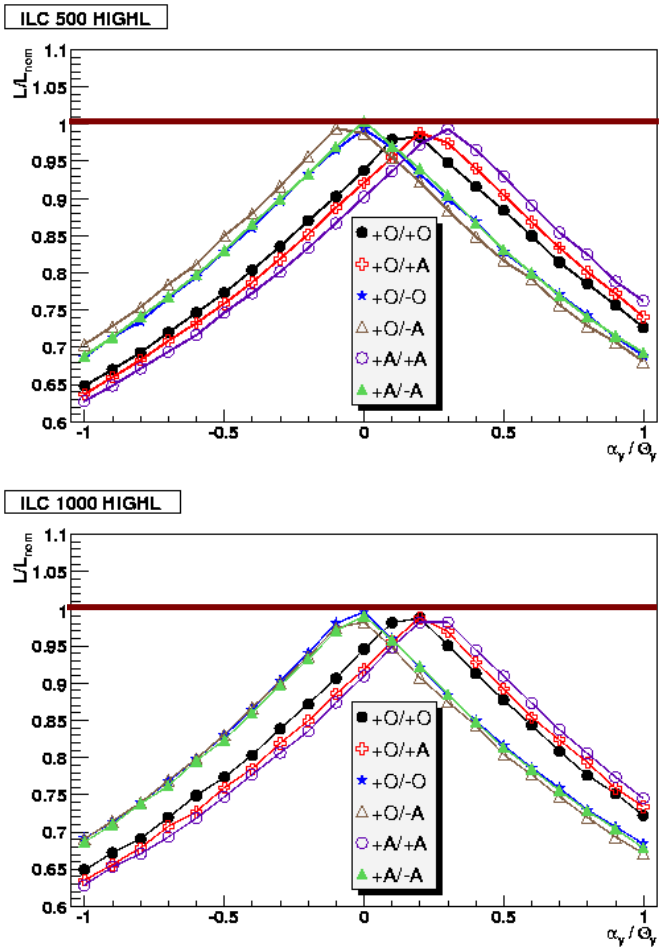




Conclusion

- Offset scan has similar effect for all parameter sets
- Angle scan has smallest effect on LOWQ and largest effect on LARGEY parameter sets.

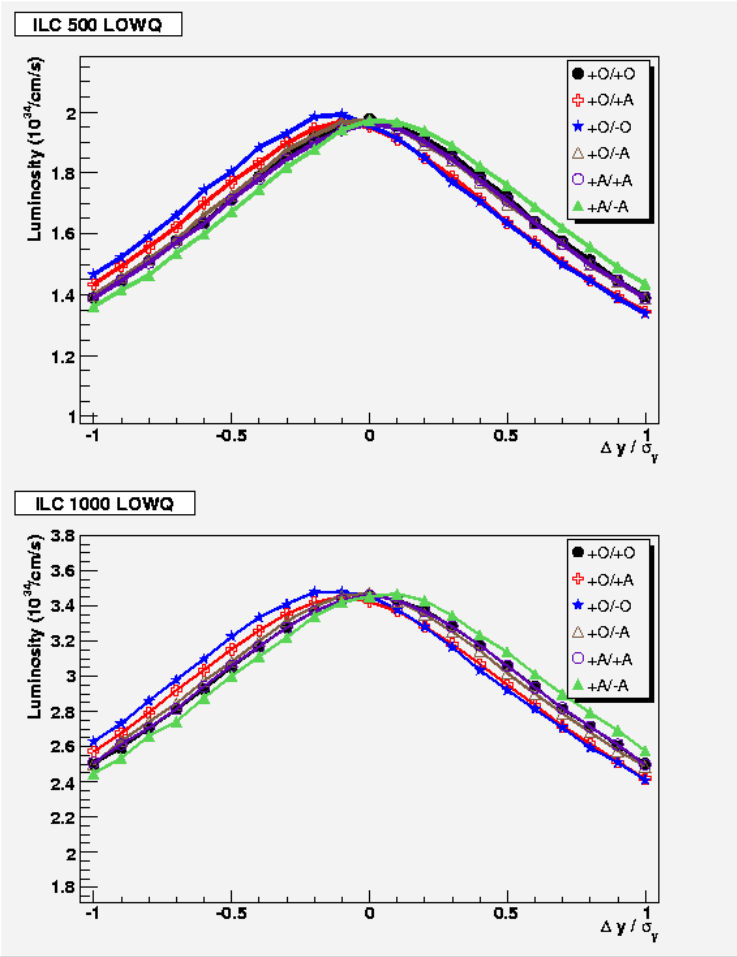
- Effect of wake fields causing banana deformation in beams is less pronounced for the ILC parameters than for the TESLA parameters (so far just tested with linear correlated emittance growth)

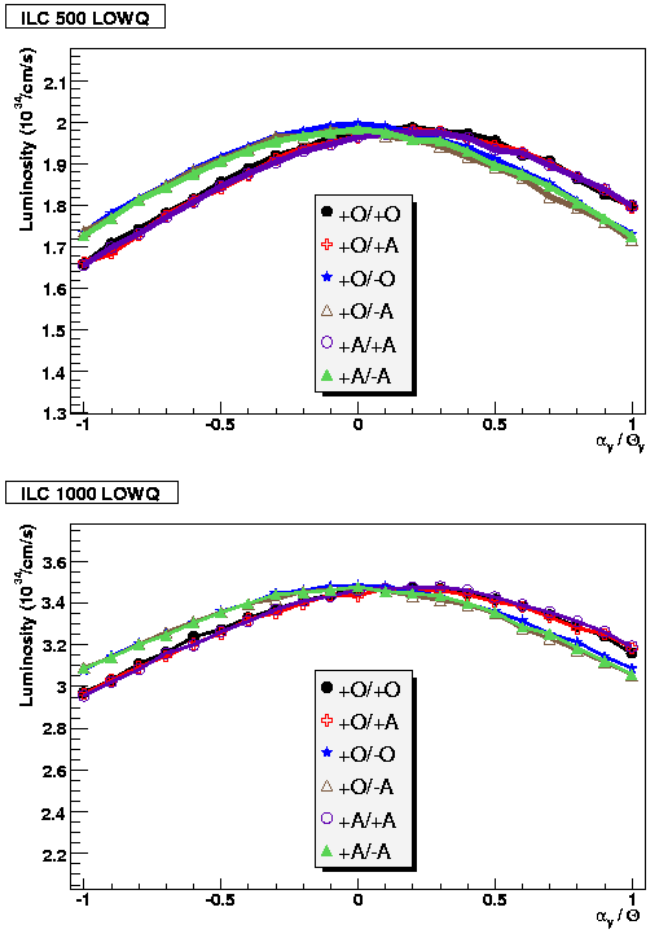
- Possibility to get 100% luminosity for all parameter sets when performing an offset scan followed by an angle scan

- TO DO:
  Feed more realistic banana beam (e.g. output from Merlin when available) into Guinea-Pig

BACKUP transparencies

Offset scan followed by angle scan for best offset value





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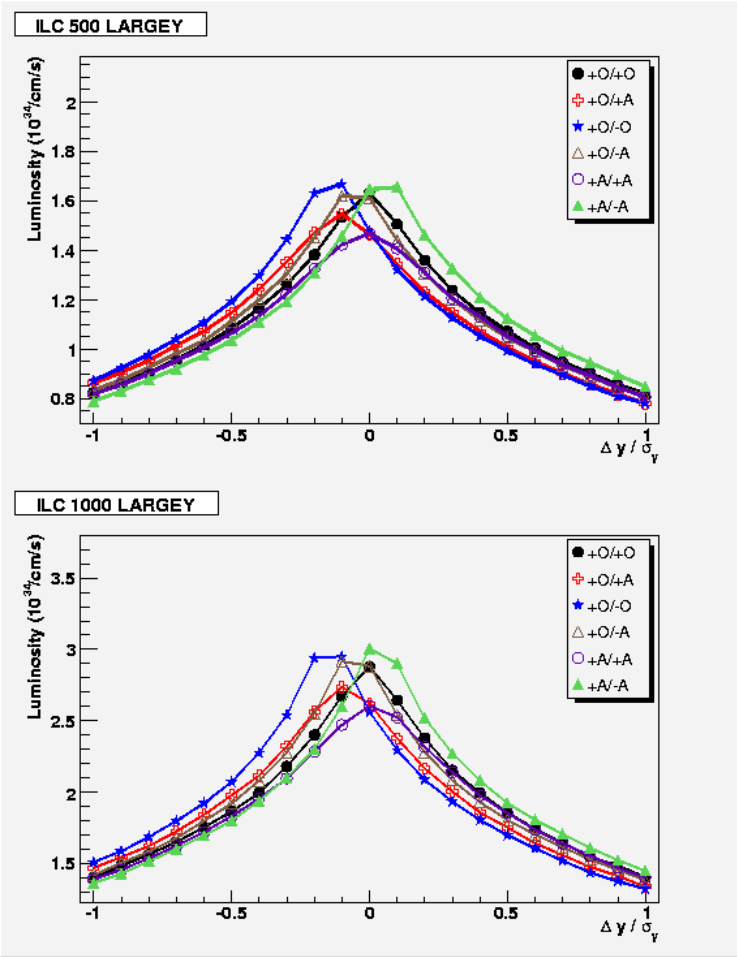

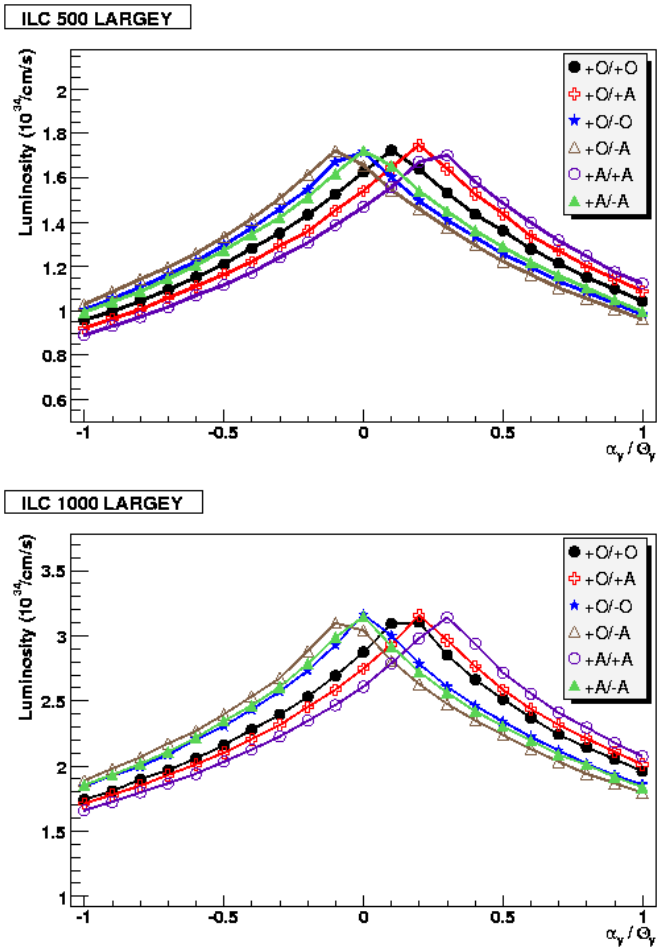

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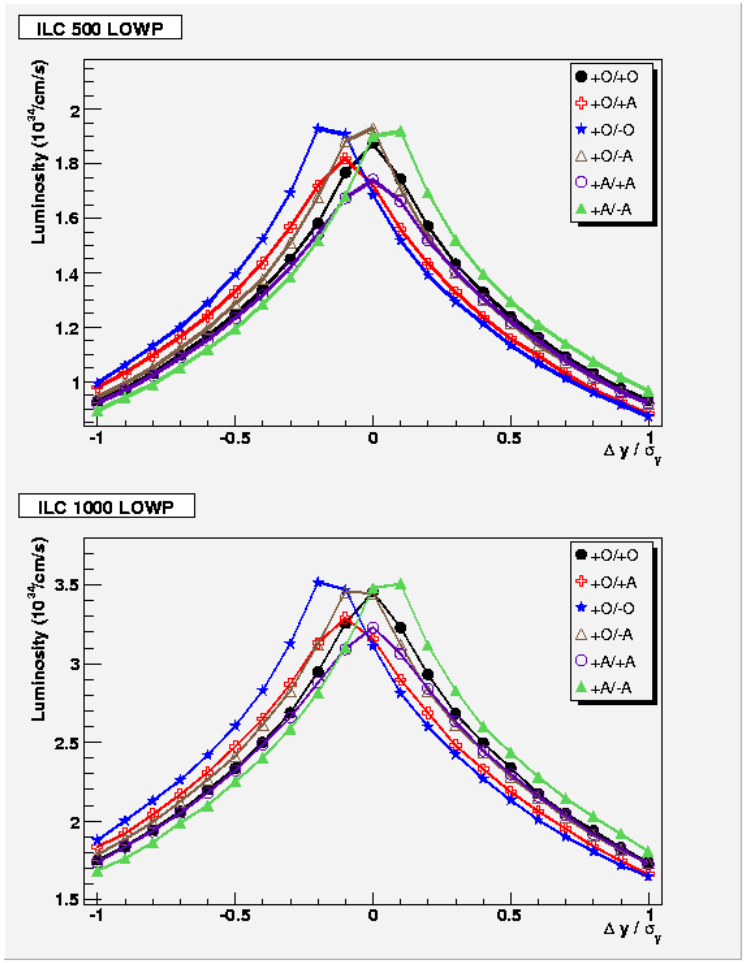

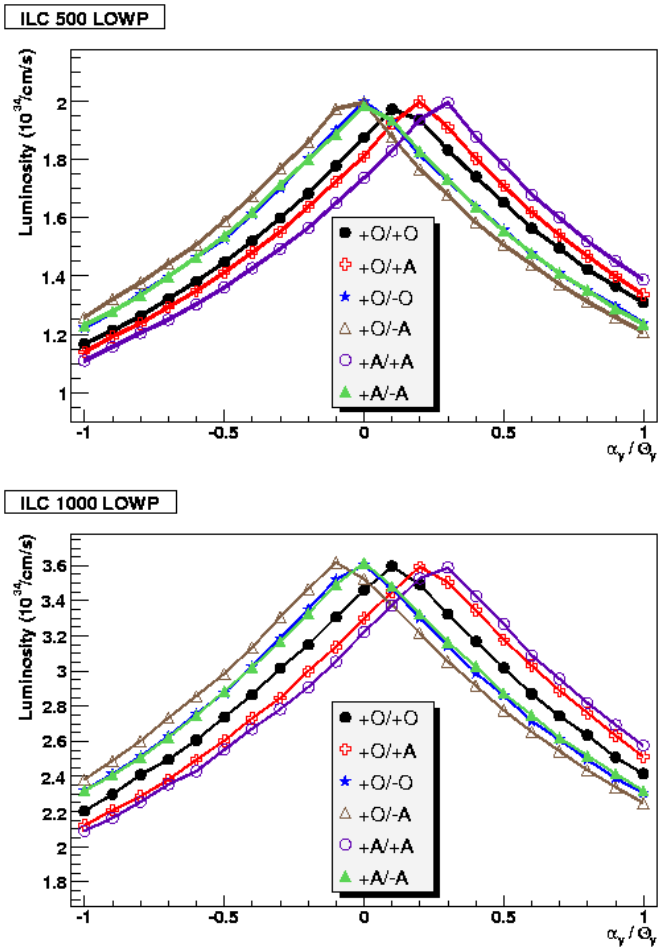

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