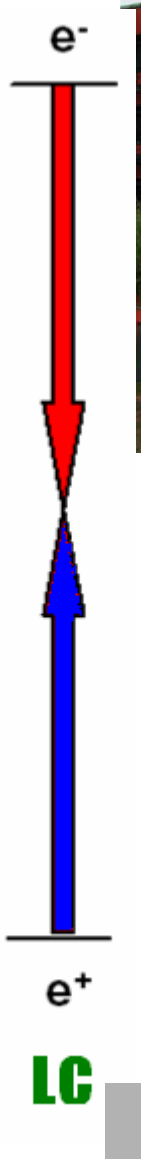
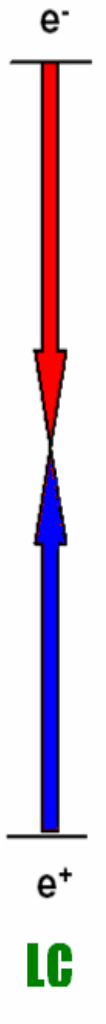


PARTICIPATION IN THE DESIGN AND R&D ACTIVITIES FOR A FUTURE LINEAR COLLIDER:

Accelerator and Detector aspects

FPA2005-02935

Maria del Carmen Alabau,
Javier Resta López
IFIC (Valencia)



Outline

- Scientific project
  - ➢ Main goals
    - ✓ Accelerator Physics
    - ✓ Machine Detector Interface
    - ✓ Detectors

See Indalecio Carbonell's Talk

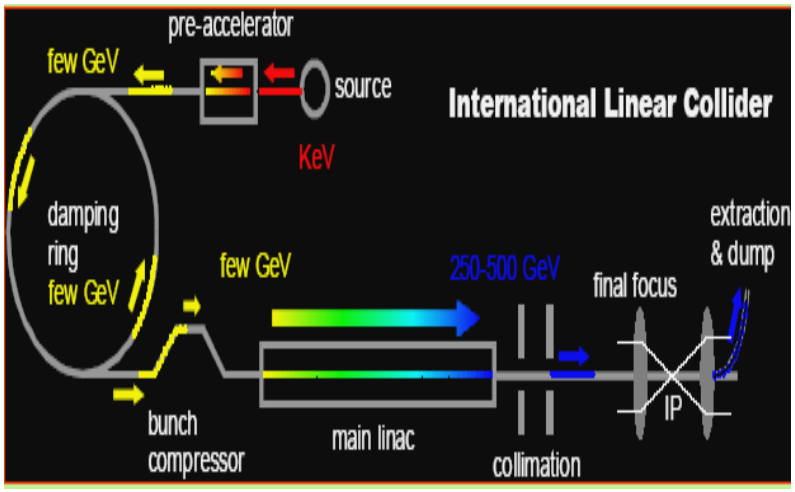
- Personnel & Task

Scientific project:

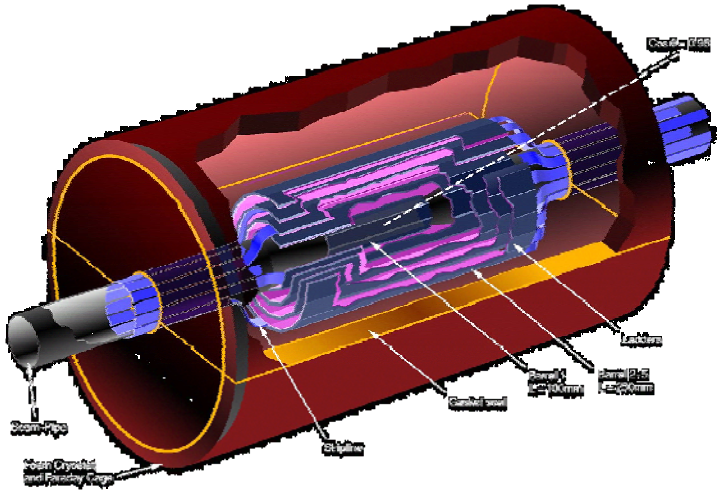
Main Goals

Our project pretends to initiate/consolidate the participation of the IFIC to the ILC effort in both aspects:

Machine



Detector



Machine Detector Interface

Scientific Project: Main Goals

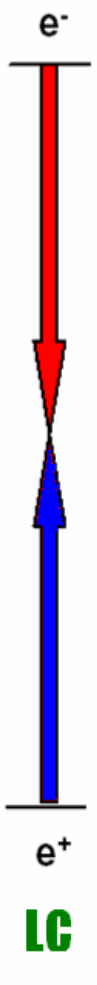
Accelerator aspects

The IFIC participation has already started with:

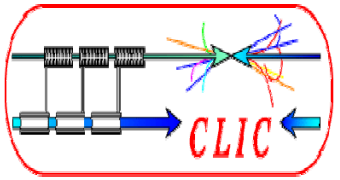
- A feasibility study of a non-linear collimation system for CLIC in 2002 in collaboration with CERN. A doctoral thesis started in the beginning of 2004: ***"Design and Performance Evaluation of a Nonlinear Collimation System for CLIC and LHC"*** (CERN doctoral students program)
- Participation in the European Project CARE in the beginning of 2004
- Participation in the specific design study EUROTeV approved in late 2004

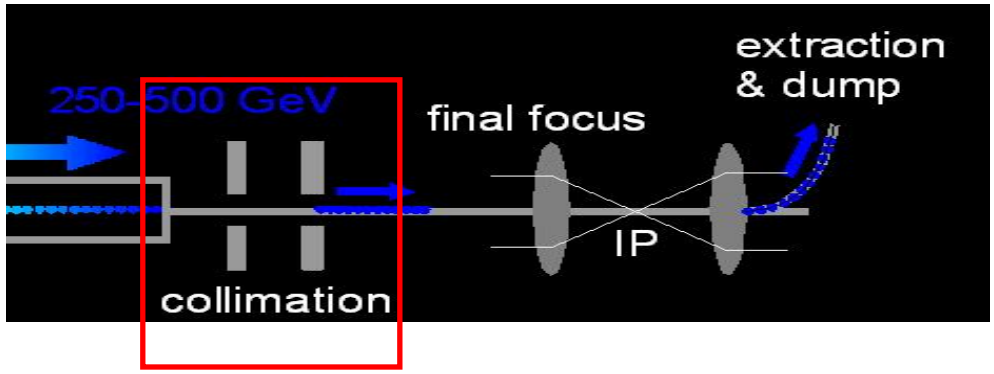
Scientific Project: Main Goals

Accelerator aspects

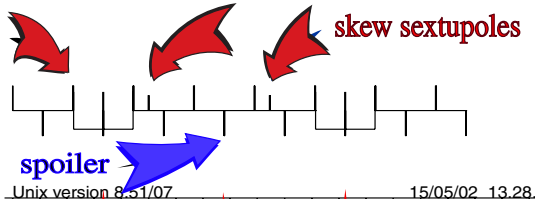


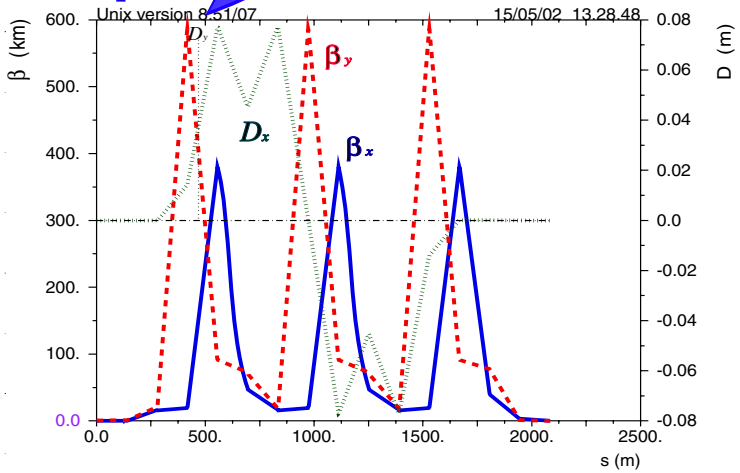
Feasibility of a non-linear collimation system for





- Design Optics
- Non-linear impact on the BDS
- Cleaning efficiency
- Spoiler survival
- Application to other collimation systems (LHC, ILC)

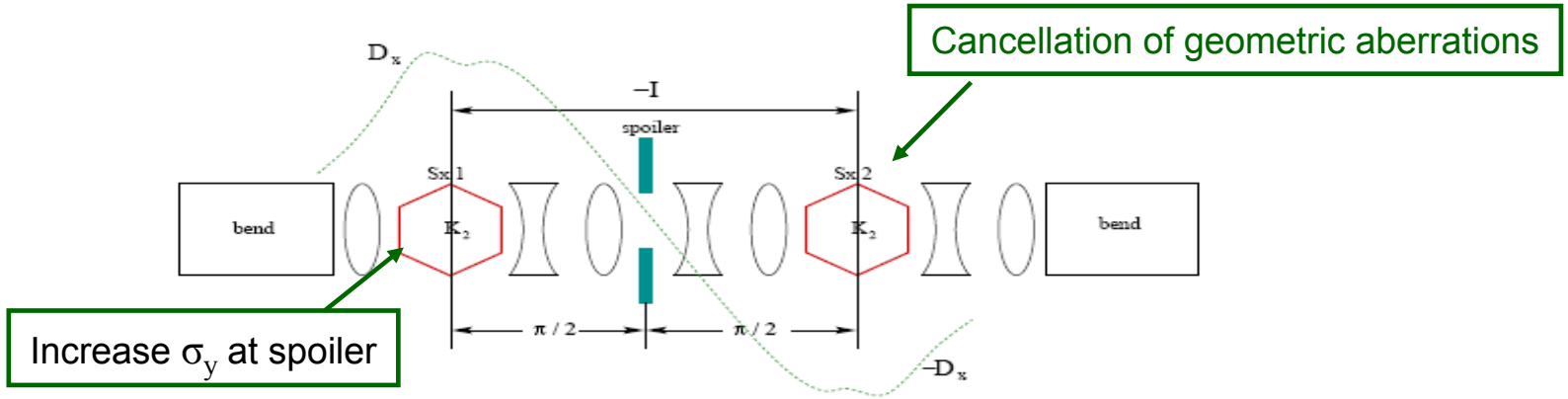




Scientific Project: Main Goals

Accelerator aspects

- Design Optics
  - – Protection in case of mis-steered or errant beams with average energy offset ≥ 1.5 % (energy collimation depth)
  - -- Spoiler survival in case of a full beam impact is required
  - -- Schematic based on a pair of skew sextupoles:

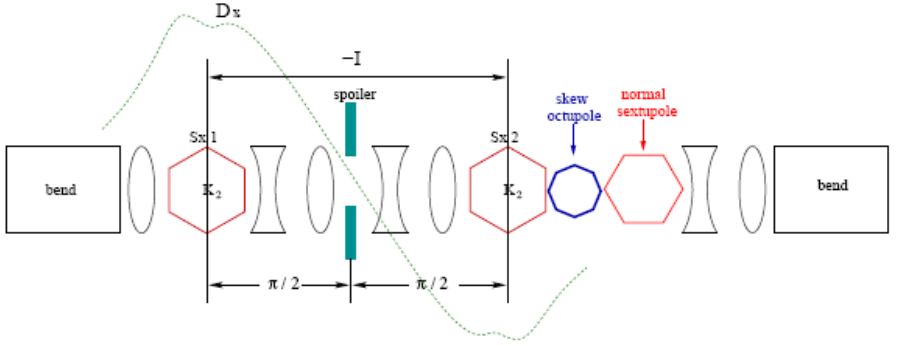


Scientific Project: Main Goals

Accelerator aspects

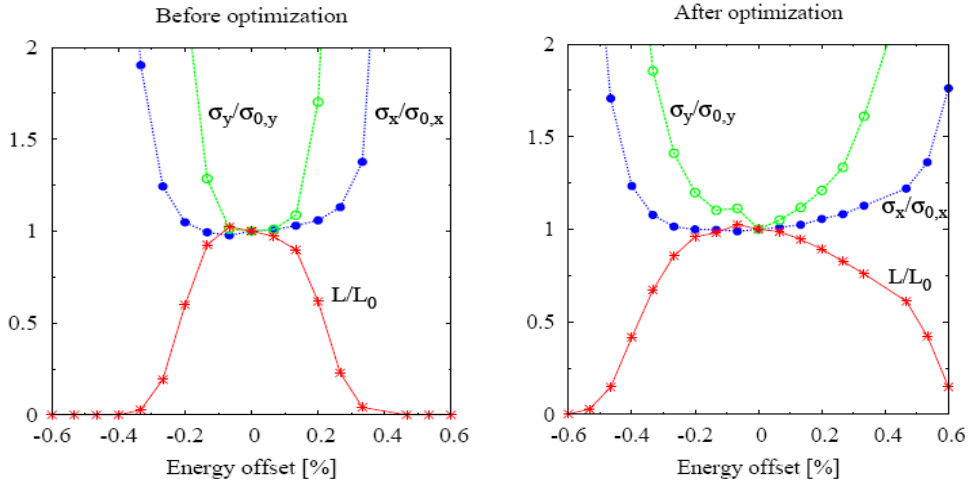
- Non-linear impact on the BDS

- Two additional multipoles for local cancellation of the higher order aberrations (dominant chromatic and geometric aberrations of **second**, **third** and **fourth order**)



- The minimization of aberrations computed by using the code MAPCLASS (R. Tomás, CERN-AB-Note-2006-017)

- Bandwidth studies (normalized luminosity and normalized transverse spot sizes at IP):



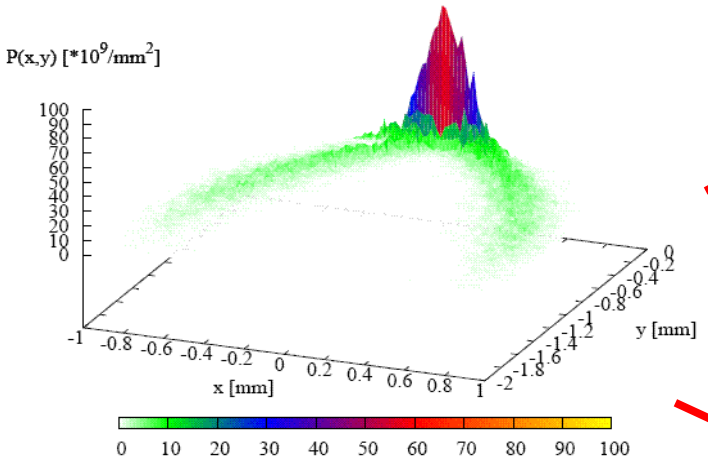
Scientific Project: Main Goals

Accelerator aspects

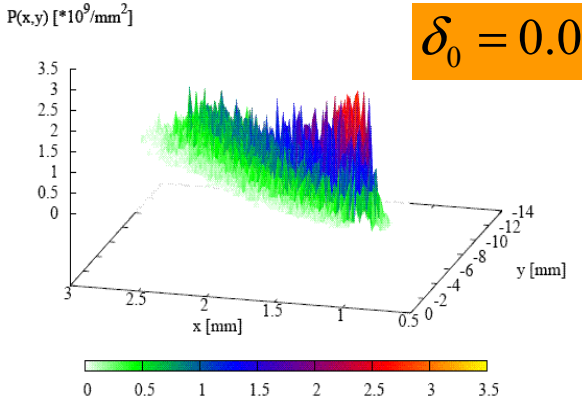
- Spoiler Survival

Transverse beam density at the spoiler

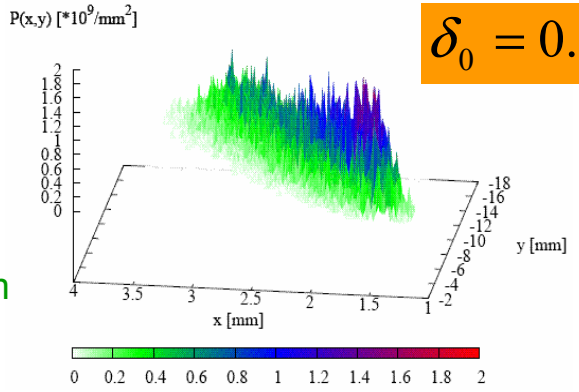
Average energy offset $\delta_0 = 0.0$



$\delta_0 = 0.01$



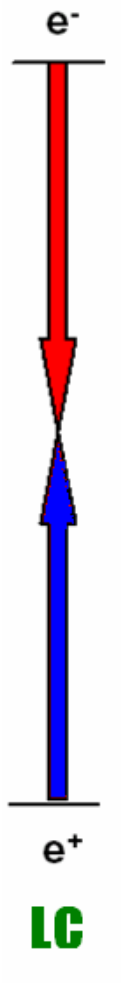
$\delta_0 = 0.013$



Machine protection: the sextupole blows the beam size up and reduces the beam charge density at the spoiler, increasing the probability for spoiler survival in case of beam impact

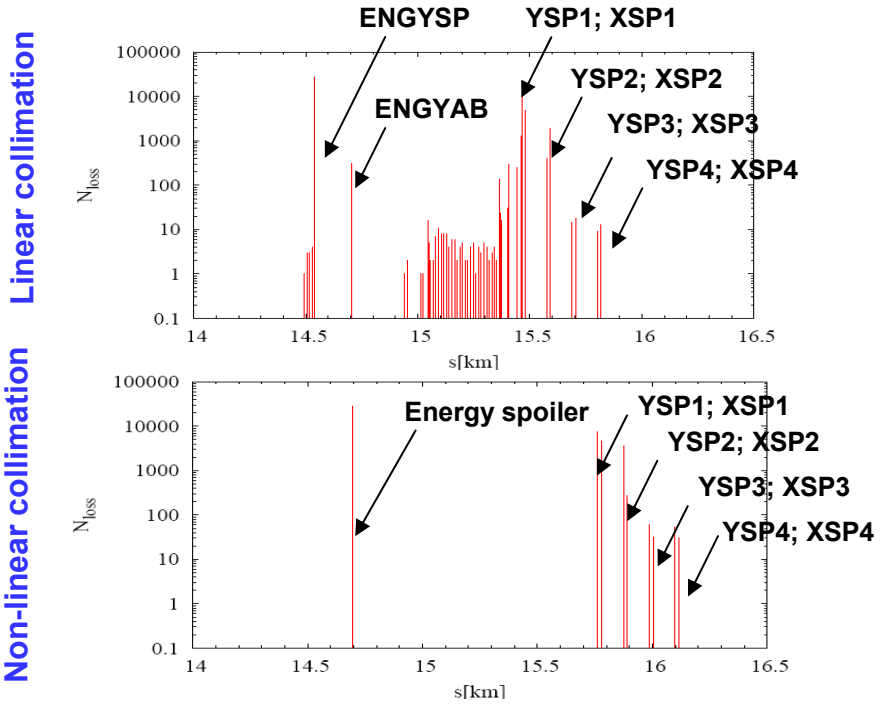
Scientific Project: Main Goals

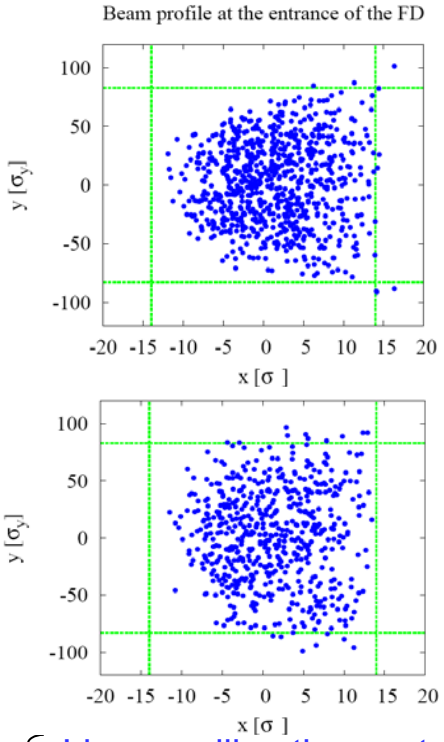
Accelerator aspects



- Cleaning efficiency

Tracking sample by using the code Placet with an input gaussian halo of 5x10^4 macroparticles: 12.5σ_x, 100σ_y (a 25% increase over collimation depth:10σ_x and 80σ_y) and 4% full width energy spread (energy collimation depth: ± 1.5%)





Aperture final doublet: 14σ_x and 83σ_y

Cleaning efficiency: $\frac{\text{\# outside collimation depth at FD}}{\text{\# total initial halo}}$

- Linear collimation system ≈ 5.x10^{-4}
- Nonlinear collimation system ≈ 5.5x10^{-4}

Scientific Project: Main Goals
Machine Detector Interface

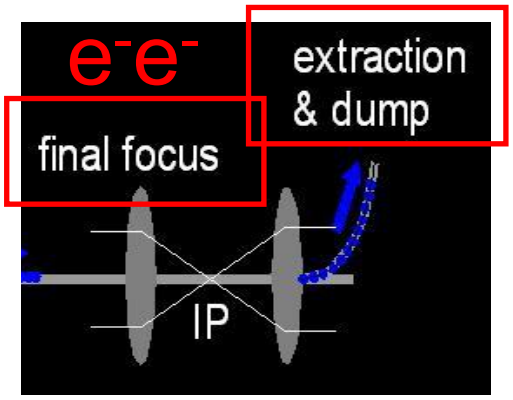
Optimization of the e^-e^- mode of operation at the ILC

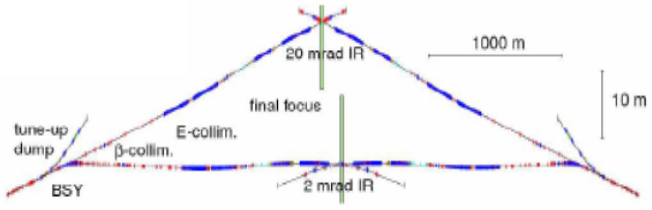
- **Beam parameters optimization and performance study taking into account the beam-based feedback requirements**
- **Optics studies for the Final Focus and Extraction Line for both large and small crossing angle geometries**

Design study of the disrupted and energy degraded beam after the IP. Impact in the tracking performance.

Simulations based on realistic beam conditions including the halo:

- **identify and estimate losses in the spent beam transport line**
- **study of installation of relevant post-IP beam diagnostic (luminosity, energy and energy spread and polarisation monitors)**





Collaboration:

LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

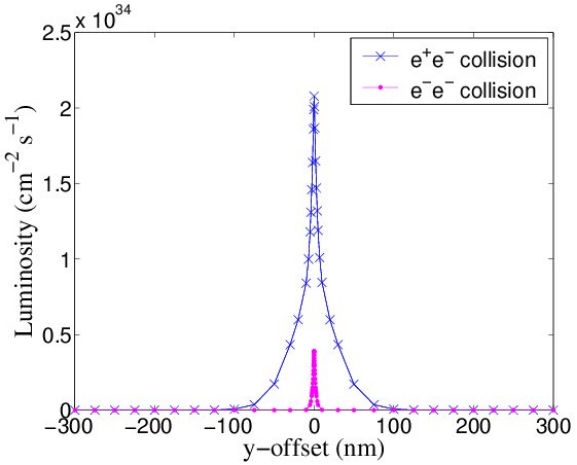
A doctoral thesis started in the beginning of 2005: ***"Design and Performance Evaluation of the MDI system for the ILC"*** (EU doctoral students program)

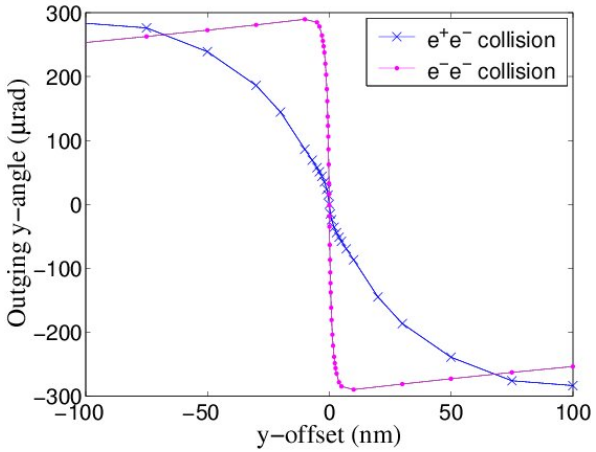
Scientific Project: Main Goals
Machine Detector Interface

Optimization of the e^-e^- mode of operation at the ILC

– e^-e^- luminosity is ~20% of the e^+e^- luminosity and drops rapidly with the vertical offset

– e^-e^- shows sharper deflection curves (different performace for feedback?)



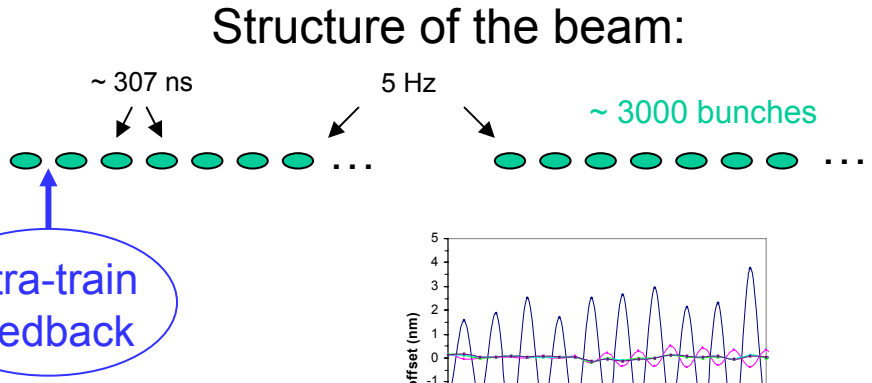


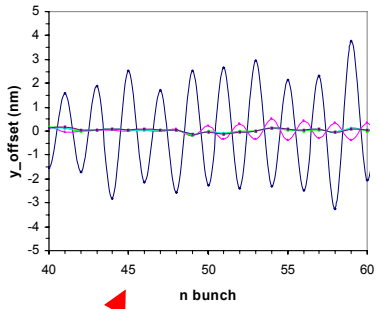
[M.Alabau, R.Appleby O.Dadoun, P.Bambade and A.Faus-Golfe, "Optimization of the e-e- Option for the ILC" EPAC'06]

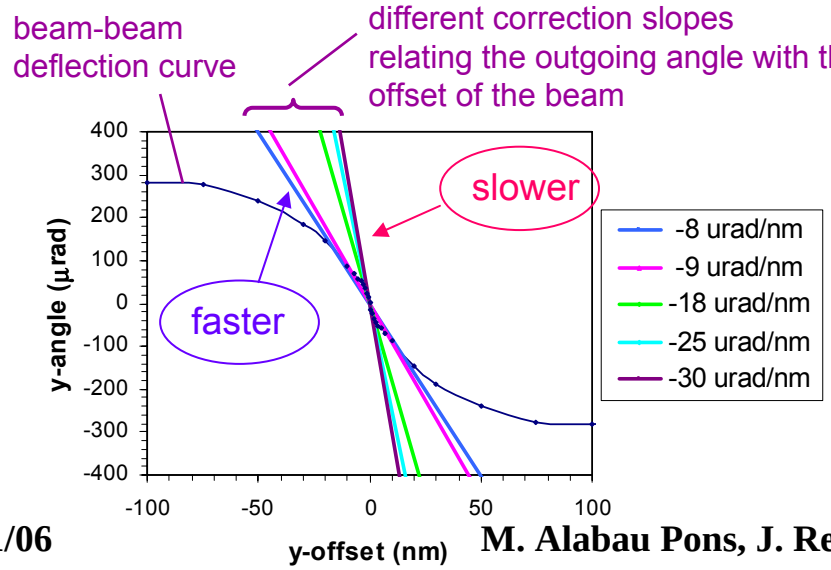
Scientific Project: Main Goals
Machine Detector Interface

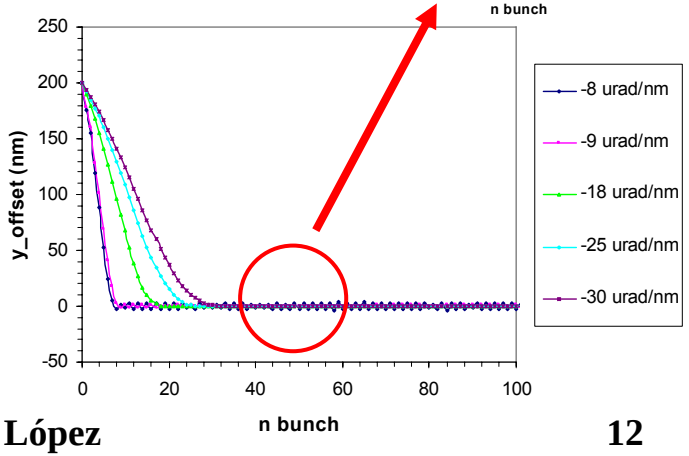
- Beam parameters optimization for e^-e^- mode operation at the ILC

- a simplified simulation of the **beam-based feedback** has been carried out for different initial train offsets and different jitters bunch-to-bunch









Scientific Project: Main Goals
Machine Detector Interface

- Beam parameters optimization for e^-e^- mode operation at the ILC
  - – Simplified simulation of the beam-based feedback system
    - Average train luminosity almost independent of the initial offset
    - e^-e^- luminosity loss a factor 2 greater for the same assumption on jitter → because the **greater sensitivity** to vertical offsets

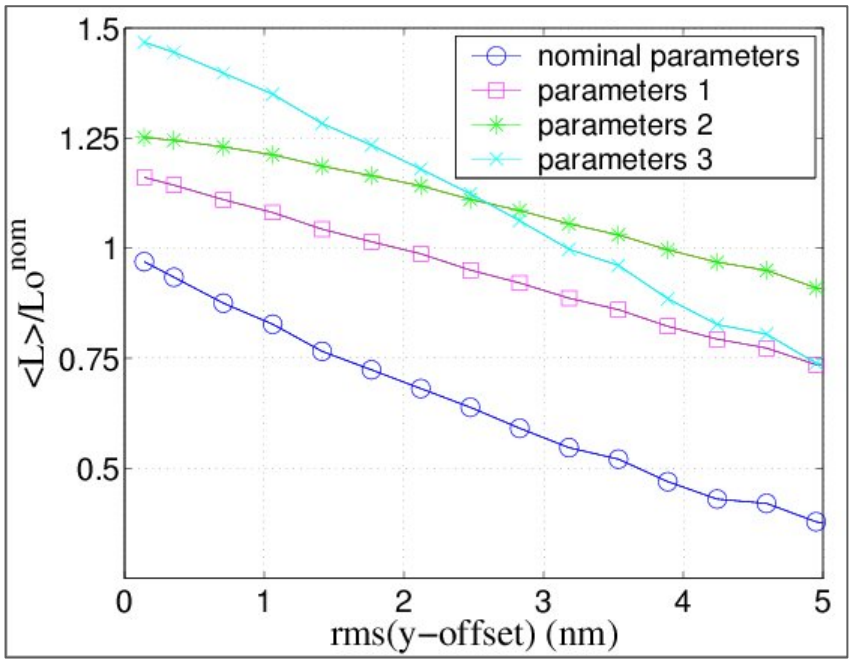
Sets of alternative beam parameters for the e^-e^- option with smaller disruption has been derived by varying the beam sizes, in order to maximize the luminosity

(while limiting beamstrahlung energy loss to 5%)

	nom.	set 1	set 2	set 3	low P
N/N_o	1	1	1	1	0.5
σ_z^*/σ_{zo}^*	1	0.7	0.5	0.5	0.5
σ_x^*/σ_{xo}^*	1	0.7	0.8	0.9	0.7
σ_y^*/σ_{yo}^*	1	1.5	1.5	1	0.6
$\epsilon_x^*(\mu m)$	10	10	10	10	9.6
$\epsilon_y^*(\mu m)$	0.04	0.04	0.04	0.04	0.03
$\beta_x^*(mm)$	21.0	10.3	13.4	17.0	10.0
$\beta_y^*(mm)$	0.4	0.9	0.9	0.4	0.2
$L\ (\times 10^{33})$ $(cm^{-2}s^{-1})$	3.9	4.6	4.9	5.8	3.0
$\delta_B\ (\%)$	2.24	4.9	5.0	4.3	2.2

Scientific Project: Main Goals
Machine Detector Interface

- Simplified feedback simulation
  - Feedback simulation for different jitter bunch-to-bunch with the alternative parameters



Average train luminosity versus r.m.s. vertical offset difference between the beams

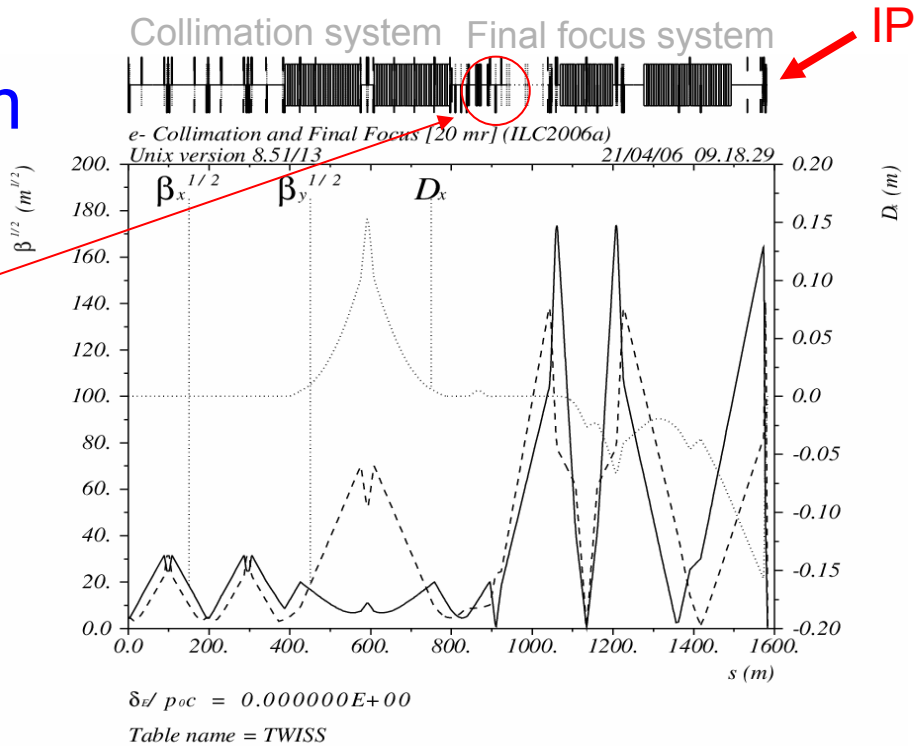
The alternative parameters have increased luminosity compared to the obtained for the nominal case for e-e-

Scientific Project: Main Goals
Machine Detector Interface

- Optics studies for the e^-e^- mode of operation at the ILC
  - –Optics studies for the **20 mrad** crossing angle geometries for the different sets of alternative parameters

Final Focus System

Obtaining new beta functions at the IP using only quadrupoles upstream of chromatic correction section to keep the same geometry, and refitting of the sextupoles



Scientific Project: Main Goals
Machine Detector Interface

- Optics studies for the e^-e^- mode of operation at the ILC
  - **20 mrad** crossing angle geometry

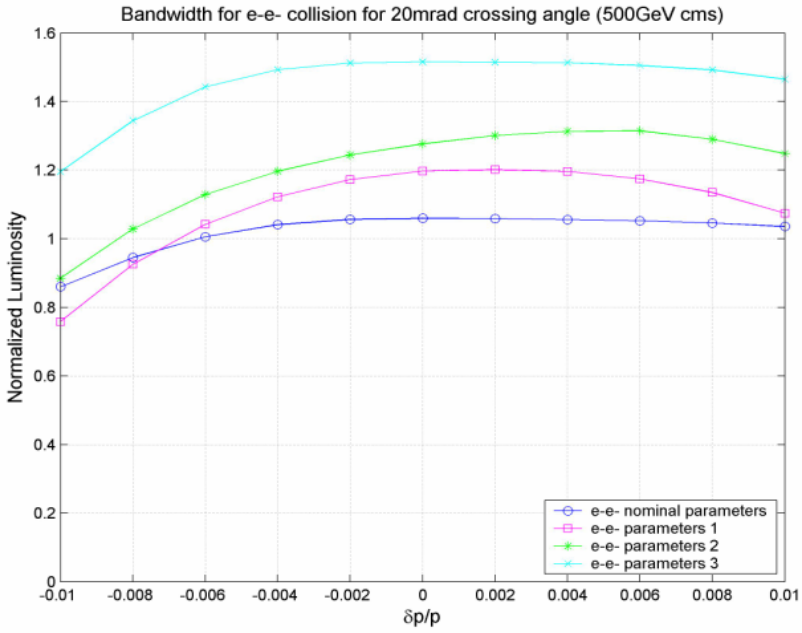
Final Focus System

Higher order optical aberrations contribute to the beam size at the IP.

To estimate the luminosity, complete tracking simulations are used.

parameters 3 have higher luminosity but higher sensitivity to the offsets than parameters 2

Optical bandwidth

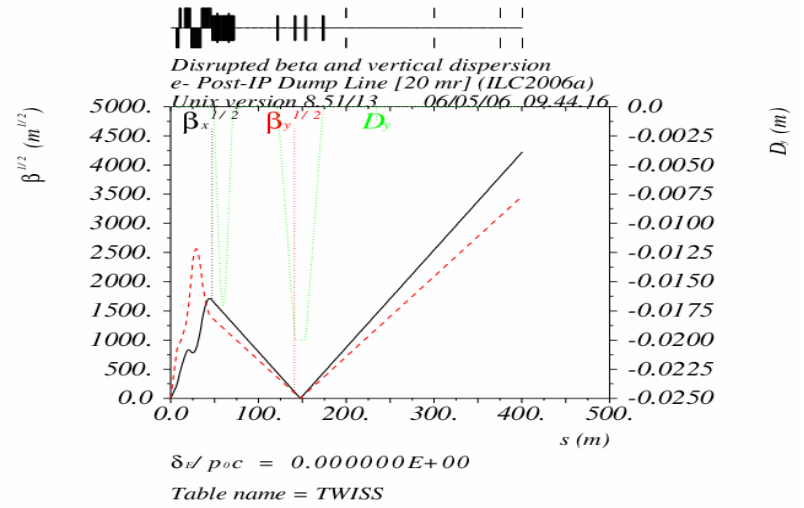


Scientific Project: Main Goals
Machine Detector Interface

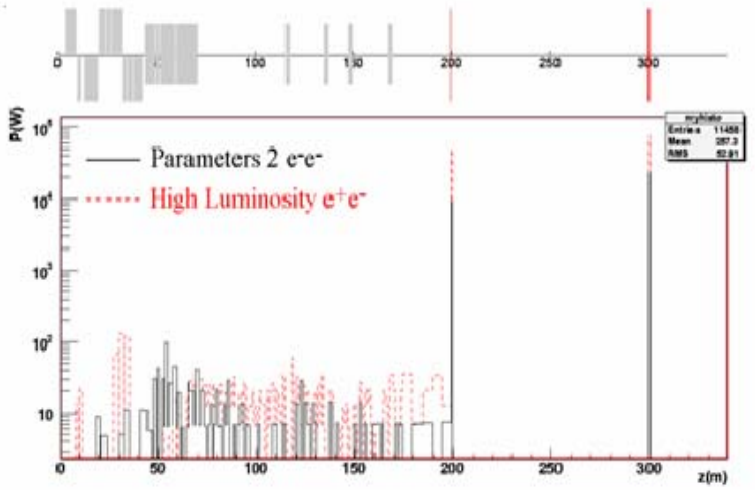
- Optics studies for the e^-e^- mode operation at the ILC
  - **20 mrad** crossing angle geometry

Extraction Line

ß-functions for the disrupted outgoing beam for the parameters set 2



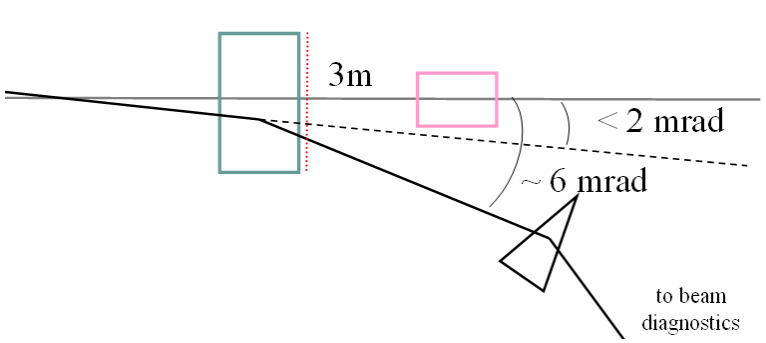
Tracking simulation with BDSIM to obtain the power losses along the extraction line. Losses acceptable compared with the e+e- high luminosity parameters

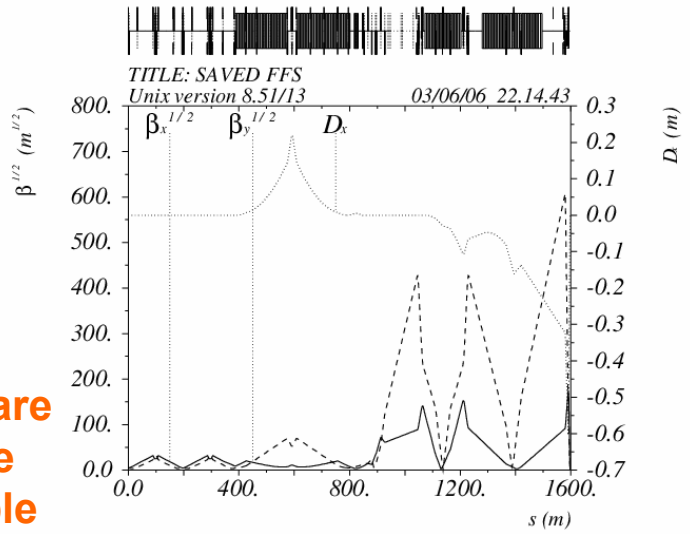


Scientific Project: Main Goals
Machine Detector Interface

- Optics studies for the e^-e^- mode operation at the ILC
  - **2 mrad** crossing angle geometry

In the 2 mrad crossing angle geometry the spent beam is transported off-axis through the last defocusing quadrupole of the final focus. The kick produced by this quadrupole is used to extract the beam, which makes the extraction very difficult for the e^-e^- mode of operation. Going to rounder beams is needed, which decreases the luminosity significantlv.





Improvements with half the bunch length are also being investigated, with for example $ß_{x/y}$=10/3 mm. In this case, more acceptable overall performance is expected.

$L=3.7\times10^{33}\ cm^{-2}s^{-1}$

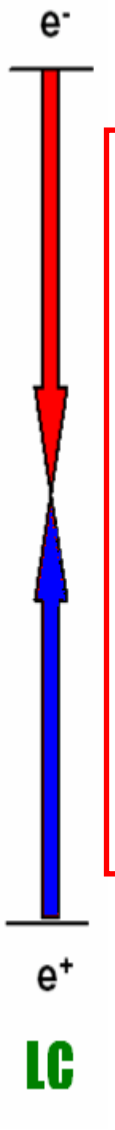
Scientific Project: Main Goals
Machine Detector Interface

• Collaboration in the design of an interaction region with Head-On collisions for the ILC (CEA/DSM/DAPNIA (Saclay), CCLRC/DL/ASTeC (Daresbury), LAL (Orsay), SLAC (Menlo Park), UMAN (Manchester)).

[J.Payet et al, "Design of an Interaction Region with Head-On Collisions for the ILC" EPAC'06]

• Collaboration starting in 2007 with CERN in the ATF2 project (KEK, Japan) for the beam-based tuning and performance simulations.

Personnel & Tasks



TASK	PERSONNEL
Feasibility of a non-linear collimation system Particle tracking along BDS	A. Faus-Golfe J. Resta Lopez
Machine Detector Interface	A. Faus-Golfe J. Fuster Verdú C. Alabau Pons
R&D on Si Detectors Participation on the design of tracking system	C. Lacasta Llacer J. Fuster Verdú M. Vos I. Carbonell P. Modesto