

Beam Delivery & Interaction Region (ex-MDI)



- **LC design & operation : new challenges !**
 - ➔ involve of HEP community attractive and natural
→ **SLAC model**
- **special needs for some physics topics :**
energy calibration – polarization – correlations – backgrounds

Goals for 2004-2005

→ inputs for technology choice (end-2004)

→ prepare strong European team for GLC

(2006...)

- Realistic beams & backgrounds → detector & other components
- Physics consequence from BDIR differences in cold & warm options
- Update BDIR layouts & studies with new $l^* = 4-5$ m optics, with and without crossing angle
- Good & bad from head-on and crossing angle geometries
- BD design to ensure physics goals : layout, background, monitoring...
- Planning and R&D for polarimetry, energy calibration, diagnostics and luminosity measurements
- Requirements for $\gamma\gamma$, $e\gamma$ and GigaZ options with corresponding working groups

Connections

- FP6/Esgard/Care/Elan/WP5 Beam Dynamics (D. Schulte)
..... /WP6 Instrumentation (S. Smith)
Kick-off meeting CERN November 19-21 <http://esgard.lal.in2p3.fr/>
- FP6/Esgard/Design Study on LC (*recommend : prepare just ONE !*)
- UK/PPARC/Design Study/LC Beam Delivery : 2004-2006
- FP6/Marie Curie/RTN ? → *next call for bids in 2005*
- BDIR / IRBI activity in US & Asia → *pre-meeting Paris 04/2004*
- “*R&D for the TESLA detector instr. in the very forward region*”

Organization { Project-driven Web-based

- Projects → documentation (ideally via link to web-page)
→ contact-person for BDIR group
- Collect slides and short summaries → minutes of meetings
- Encourage write-ups
- Tools : availability of software, data files, drawings...
- Intermediate meetings (or phone conf.) for some topics
- Participant and mailing lists & discussion forum

Projects (discussed Friday 8:30 am)

1. New optics $l^*=4-5m$, *local chromatic correction, X-angle*
2. Halo collimation $50 \sigma_x$ & $10 \sigma_y$ for dp/p $-3(5)\%$ to $+0.5\%$
3. Mask design and detector relevant beam \rightarrow backgrounds
4. Final doublet supports *alignment, stability, adjustment*
5. Beamstrahlung pairs *uncertainty in $\sim 10^{-3}$ tail* \rightarrow *VD-1*
6. Crossing angle or not ? *global analysis & risk assessment*

Projects (discussed Friday 8:30 am)

1. Energy calibration – 3 *measure spin precession instead of magnetic fields* → harder bends → less precise BPM
10. Energy calibration – 4 *Bhabha energies in LAT&LCAL*
11. Energy calibration – 5 *$ee \rightarrow (Z \rightarrow \mu\mu) \gamma$*
12. Energy calibration – 6 *Bhabha acolinearity*
13. Energy spread *spent-beam profile @ high dispersion / β*
14. Luminosity – 1 *measure σ_{Bhabha} in LAT (+hermeticity)*
15. Luminosity – 2 *monitor pairs in LCAL*

Projects (discussed Friday 8:30 am)

1. Beam monitor – 1 *Comptons off focussed laser beam*
2. Beam monitor – 2 *emission off thin (carbon ?) wire*
3. Beam monitor – 3 *“Shintake” laser interferometry*
4. Beam monitor – 4 *RF & dispersion $\sigma_z \rightarrow \sigma_x$*
5. BPMs *stripline & cavity (spectrometer $\rightarrow 0.1\mu\text{m}$)*
6. Bremstrahlung *tuning @ low intensity & large offsets ?*
7. Polarimetry – 1 *Compton process before & after*

Tasks Goals Status Contact Links (doc.)

TASK	GOALS	STATUS	CONTACT	LINKS (Prelim.)
FFS optics Focus spot size at IP down to 550 and 5 nm Local chromatic correction with $1^* \sim 5$ m	Achromatic over $dp/p = \pm 0.5\%$ Solutions with and without X-angle Acceptable halo	$1^* = 5$ m design for head-on coll. Needs more study Solution with X- angle needed	Deepa Angal- Kalinin (Daresbury)	PAC paper from Olivier Napoly and Jacques Payet MAD deck with head-on solution
Halo collimation No direct synchrotron radiation from final doublets to hit inner masks	Remove beam particles beyond 48 σ_x and 9 σ_y with dp/p from -3% to $+0.5\%$	TDR design needs improving Study needed with X-angle	Deepa Angal- Kalinin (Daresbury)	PAC paper from Olivier Napoly and Jacques Payet MAD deck with head-on solution
Mask design and detector relevant beam induced backgrounds Mask for back-scattered secondaries from pairs Bhabha monitor (LAT)	Aim for levels as with TDR design (tab. 7.1.6 of TDR) Realistic background and LAT in detector simulation	TDR design being updated with $1^* = 5$ m (head-on) Solution with X- angle needed	Karsten Büsser (DESY)	New layout drawing with $1^* = 5$ m for head-on sol. Table 7.1.6 in TDR
Final doublet supports Adequate mechanical stability Alignment and in situ adjustments (\rightarrow with and without crossing angle) (\rightarrow cold option only ?)	Relative vertical motion of two final doublets. It. ~ 0.5 nm in $\tau \sim (170 \text{ kHz})^{-1} \sim$ 6 μ s or better... From ATL model: 0.03 nm vibration; care not to amplify		Norbert Meyers Klaus Sinram (DESY)	
Beamstrahlung Pairs Estimate uncertainty in rate reaching VLayer-1 (it corresponds to a \sim 10^3 tail...)	GinseaPig+Brüms calculations with present parameters Theory uncertainty from the treatment	TDR computations Further checks by Damien Grandjean	Philip Bambade (Orsay) (theory support)	Slides from talk at Prague by Damien Grandjean
Crossing angle or not Recommendation from global analysis of both cases, considering all aspects (cold option) Risk assessment	• Physics reach (mainly at low Pt) • IP beam tuning, • Extraction of spent beam and beamstr., • Electrostatic sep., • Optics constraints, • Crab-cross. cavity, • Super-conductive mini quadrupole, • IR design, • Spent beam diag.	TDR design with head-on collisions Variant with a very small vertical angle (Brinkman)	Philip Bambade (Orsay) WG to evaluate consequences on the physics reach led by Achim Stahl (DESY-Zeuthen)	Slides from dedicated Jan. 03 and talks at subsequent ECFA and TESLA meetings
Energy calibration -1 Upstream spectrometer through measurements of a reference bending magnet and of beam trajectories before and after	Relative precision of a few 10^{-4} - $5 \cdot 10^{-5}$ for top and W masses Absolute precision in 10^{-2} - 10^{-3} to improve M_Z measurement Need information on each bunch ? (No...)	Technical design exists plan report Spring 2004 Integration in BDS and design of Cavity-BPM with 0.1μ m resolution May reach $5 \cdot 10^{-3}$	Jürgen Schreiber (DESY)	Document with proposal and subsequent reports at ECFA meetings

TASK	GOALS	STATUS	CONTACT	LINKS (Prelim.)
Energy calibration -2 Downstream spectro- meter based on measuring a reference bend and the synchrotron radiation from smaller bends in orthogonal direction before and after (SLC)	Same as upstream spectrometer Measure energy spread (and tails) from beam-beam interaction Check feasibility with and without crossing angle	Not yet considered Our US colleagues have proposed one based on the SLC experience	Valery Telnov (BINP)	Paper and slides by Valery Telnov
Energy calibration -3 Measurement of spin precession through existing bends to extract the total field Reduce requirements on BPMs with larger bend angles and drifts (needs polarisation...)	Same as upstream spectrometer Feasibility of precise position measurements at large distances for absolute calibration ? Combined with polarimetry both up- and downstream ?	Proposal by Valery Telnov	Valery Telnov (BINP) (practical setup)	
Energy calibration -4 Infer CMS energy from measurements of Bhabha energies and angles in LAT and LCAL calorimeters	Evaluate precision on $\langle E_{CMS} \rangle$, on core width and on event fraction in lower tail	Good reconstruction of the shape of the energy distribution below its maximum demonstrated	Freddy Poirier (London RH)	Description in slides shown in Amsterdam, PhD thesis
Energy calibration -5 CMS energy from measurements of				
Energy calibration -6 CMS energy from the acolinearity in Bhabha events		Under study	Stewart Boogert (London UCL)	
Energy spread Track relative changes in energy distribution by measuring the spent beam	Use existing bends and plan mechanical or laser wires for beam size measurements	Initial study by Nick Walker		Slides shown in Amsterdam
Measure luminosity -1 Use LAT to measure Bhabha cross-section Hermetic calorimetry (83.8 to 27.5 mrad)	Accuracy for absolute measurement ? Energy resolution : $\sim 10\%$ stochastic $\sim 1\%$ constant	Under study	x.y.	WEB-page of the collaboration on R&D for the TESLA detector instr. of the very forward region
Measure luminosity -2 Use LCAL to measure pairs and track fast luminosity changes Hermetic calorimetry (30 to 5.4 mrad)	Relative accuracy 1 % in 30-50 ns \rightarrow input to luminosity feedback loop	Under study	x.y.	WEB-page of the collaboration on R&D for the TESLA detector instr. of the very forward region
Optimise luminosity Use beam-beam deflections, pairs and BDS trajectory meas.	Fast + slow feedback to keep steering and optical tuning on the relevant time-scales	Trajectory feedback simulation at IP with "realistic" beams by Glen White	Glen White (London QM) (x,y? A.S. pairs)	Slides and WEB-page from Glen White
TASK	GOALS	STATUS	CONTACT	LINKS (Prelim.)

Beam monitor -1 Measure Comptons photons off focussed laser beam	Beam profile measurement with 4-5 μ m resolution		Grahame Blair (London)	
Beam monitor -2 Measure photon and secondary emission off thin (carbon ?) wire	Beam profile measurement with 4-5 μ m resolution		Grahame Blair (London) ?	
Beam monitor -3 "Shintake" laser interferometry	Beam profile measurement with 0.05 (?) μ m resolution Space in IR : useful if 0.8 m from IP ?	Demonstrated at the FFTB (SLAC)	Grahame Blair (London) ?	
Beam monitor -4 Use RF cavity and dispersion from bend to extract bunch length from transverse size	Precision ?			
Beam monitor -5 Beam position monitors (stripline and cavity)	Precision $\sim 0.1 \mu$ m			
Beam monitor -6 Exploit brenstrahlung dependence on beam size for low intensity tuning, include at large vertical offsets	Explore feasibility	Observation at VEPP4 and HERA Proposal by Baier and Katkov	Philip Bambade (Orsay)	Papers by Baier and Katkov
Polarimetry -1 Exploit Compton process in setups both before and after the IP	Relative precision of $\sim 0.5\%$ (averaging at least 30 bunches) Compare result before and after to probe depolarising effects Need information on each bunch ? (No...) Combine with Telnov energy measurement	Design available and location planned for the upstream setup Downstream: setup to be considered	K. Schüller (DESY)	Papers and talks by K. Schüller
Polarimetry -2 Analyse ee \rightarrow WW and ee \rightarrow Wev processes	Absolute precision ? averaging over ? Worries without e+ pol.	Early study by Klaus Möing and later by François Richard		Slides from François Richard
Alignment and active mechanical stabilisation Relative vertical location of IP doublets	Specify needs for the cold and warm options			
Positron polarisation -1 E 166				
Positron polarisation -2				

Thursday, November 13th, 15:15-16:45

Neutron background simulated with GEANT4

Peter Wienemann

15'+5'

Extracting beam parameters from LCAL energy distributions

Wolfgang Lohmann

15'+5'

Simulations with realistic beams

Wolfgang Lohmann

15'+5'

Mask designs update

Karsten Büßer

10'+5'

Beam profile monitor

Hitoshi Yamamoto

15'+5'

Thursday, November 13th, 17:10-19:00

Report from the satellite meeting on beam instrumentation

David Miller

15'+5'

Report from the US beam instrumentation efforts

Eric Torrence

15'+5'

Beam spectrometer

Heinz-Jürgen Schreiber

20'+5'

Laser wire studies

Grahame Blair

15'+5'

Friday, November 14th, 8:30-10:15

Discussion session BDIR goals and projects in 2004-2005 (* joint session with Polarization group)

Philip Bambade,
LAL/Orsay

ECFA LC Study, Montpellier

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Friday, November 14th, 14:00-15:45

13/11/2003

Conclusion

- Reshaping and extending BDIR activity
- Program ambitious, varied, innovative...
- Connections
- Prepare relevant European participation to GLC

→ please join us !

→ feedback, ideas...