

Polarization sessions @ Vienna 11/05

- **Two sessions, one combined with BDIR**

- **Physics: CP violation at the ILC**

 - **Stefan Hesselbach: CP-violation with longitudinally and transversely polarized beams**

- **E166 results**

 - **Ralph Dollan: status about the experiment and preliminary results**

 - **Andreas Schaelicke: implementation of polarization in GEANT 4**

- **Polarimetry and crossing angle**

 - **Peter Schueler: ustream polarimeter update**

Discussion: polarimetry and crossing angle

Status physics since Durham

- POWER report (hep-ph/0507011) sent to Phys. Rept. waiting for the referee report
- New physics issues: new CP-studies with transversely polarized beams

- CP-odd asymmetries and transverse beam polarization

- Asymmetries in neutralino production and decay $\sim \mathcal{P}_{e^-}^T \mathcal{P}_{e^+}^T$

- ⇒ Polarized positrons necessary to measure asymmetries

- $e^+e^- \rightarrow \gamma Z$: asymmetries $\sim \mathcal{P}_{e^-}^T \mathcal{P}_{e^+}^T$ [POWER report, hep-ph/0507011]
(sensitive to CP-violating $\gamma\gamma Z$, $\gamma Z Z$ couplings)

- $e^+e^- \rightarrow t\bar{t}$: asymmetries $\sim \frac{1}{2}(\mathcal{P}_{e^-}^T - \mathcal{P}_{e^+}^T)$ [POWER report, hep-ph/0507011]
(sensitive to new CP-violating (pseudo-)scalar or tensor couplings)

- CP-odd asymmetries and longitudinal beam polarization

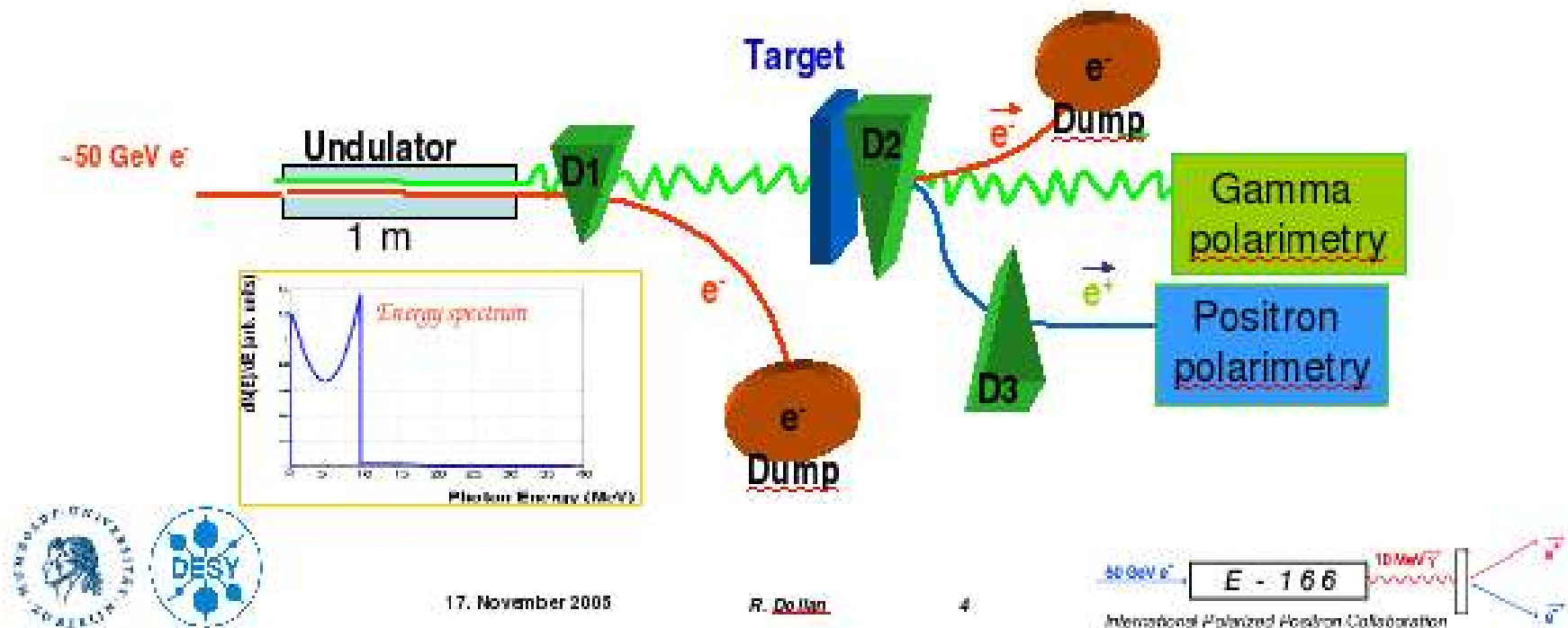
- Positron polarization enhances cross section

- ⇒ For $\mathcal{P}_{e^+} = 60\%$: 30% better measurability of asymmetry possible

- P_T useful; physics will decide how much lumi for this option.

Status E166

- Goal: proof of principle for production of (pol.) e^+ via undulator radiation
 - use 50 GeV FFTB beam at SLAC
- We had 2 successful runs:
 - 4 weeks in June: measured γ and e^+ polarization
 - about 5 weeks in September: excellent data --- but not yet final results



Photon Asymmetry -- preliminary

Photon Asymmetries

preliminary

*Photon asymmetries from June data
measured with 2 Detectors:*

01/21/02

Photon Calorimeter : 3.52 % ± 0.15 %

Aerogel Counter : 3.50 % ± 0.40 %

(stat. errors only)

Expected photon asymmetries for 5 MeV eff. threshold:

<u>Beam Energy [GeV]</u>	<u>Aerogel AG2</u>	<u>W-Si Cal. GCAL</u>
46.6	3.54	3.22 %

(G3 Simulation)

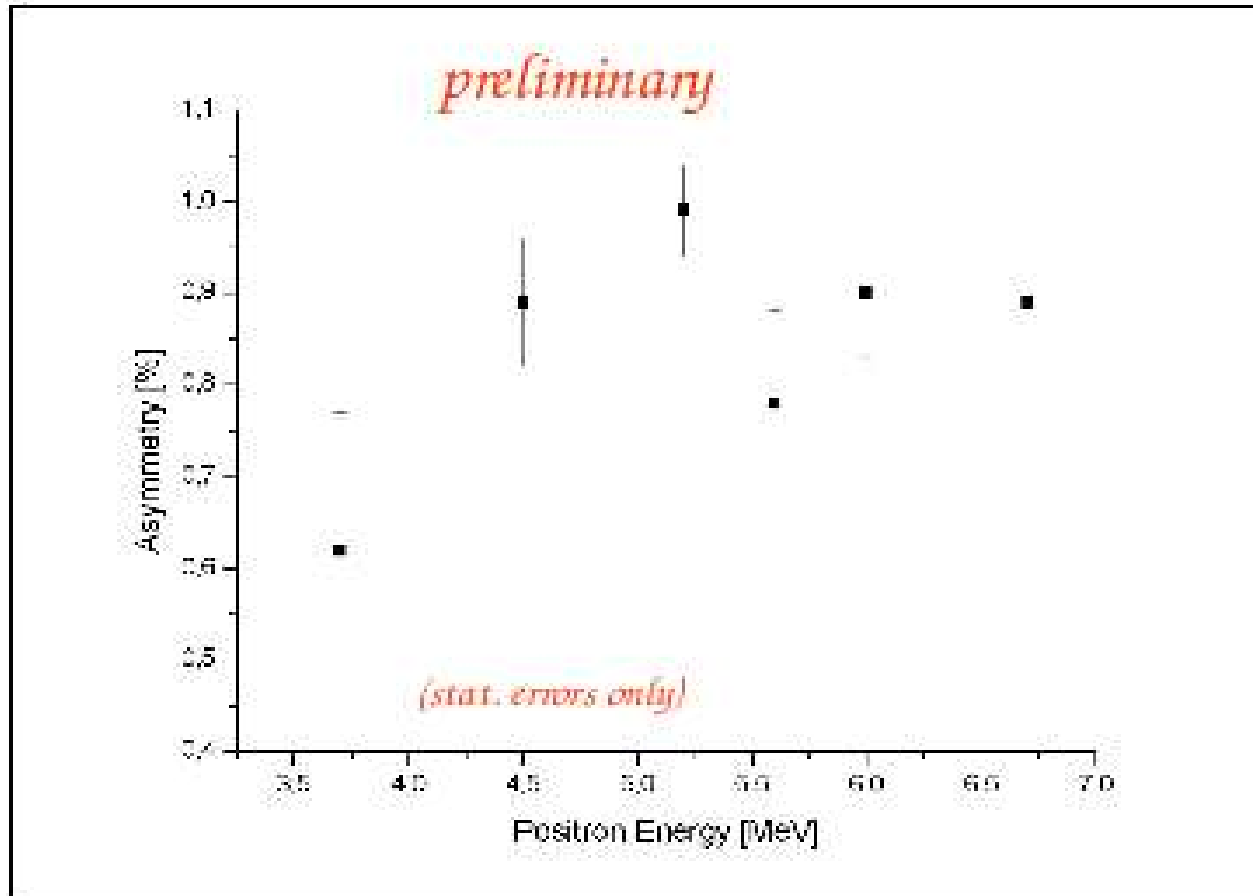
U. G. Sarishev

** Monte Carlo based on the*

calorimeter response function

Preliminary result

Measured positron asymmetry --- E166 collaboration



Final results expected soon!

Polarization at Geant4

- **Geant4: toolkit for simulation of the passage of particles through matter**

- important for target studies and for polarimetry

- needed for ILC as well as E166

- aim for a complete treatment of polarization

- **Careful test of all routines has been made / will be continued**

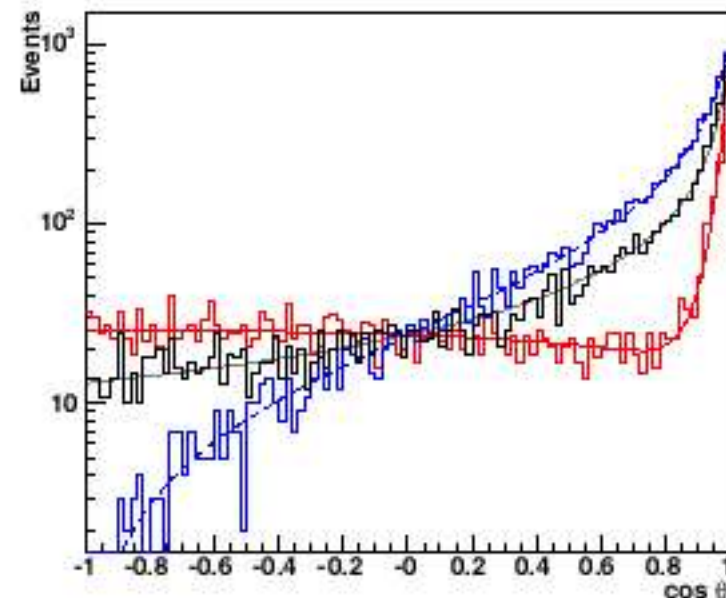
- **Application to physics studies**

- analysis of E166 data

- study of ILC polarimetry

- **planned: finished next spring**

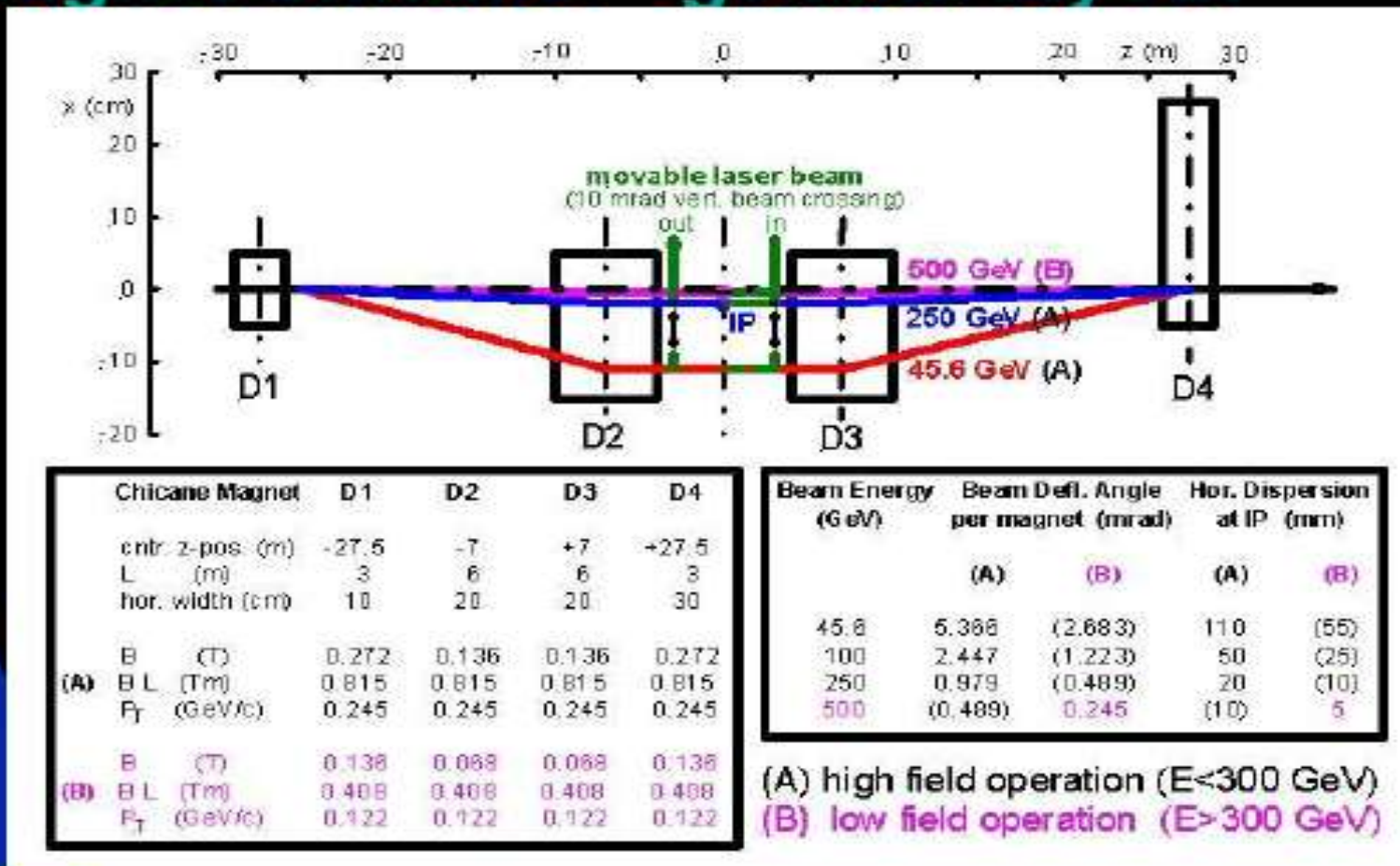
Compton scattering – Asymmetry



$$\begin{aligned} P_\gamma \cdot P_e &= +1 \\ P_\gamma \cdot P_e &= -1 \\ P_\gamma \cdot P_e &= 0 \end{aligned}$$

Upstream polarimeter with chicane

4-Magnet Chicane: general layout



2 operating regimes depending on beam energy

Upstream Polarimeter Update

summary & conclusion

- **we have extended our upstream polarimeter study and adopted the chicane spectrometer design**
- **chicane simplifies laser requirements:
single green wavelength will accommodate all beam energies**
- **all essential results from earlier TESLA study remain valid**
- **detailed engineering still to be done**

Discussion session: Xing angle vs polarimetry

- **Crossing angle has implications for upstream as well as downstream polarimeter (DID and Anti-DID)**
- **not final conclusions yet**
- **still quantitative studies under work**
- **discussion still ongoing**

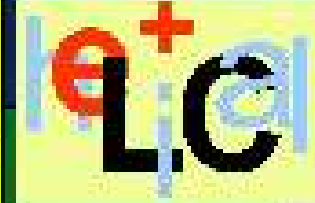
Helical Collaboration Status

I.R. Bailey, P. Cooke, J.B. Dainton, T. Greenshaw, L.I. Malysheva (University of Liverpool)
D.P. Barber (DESY)

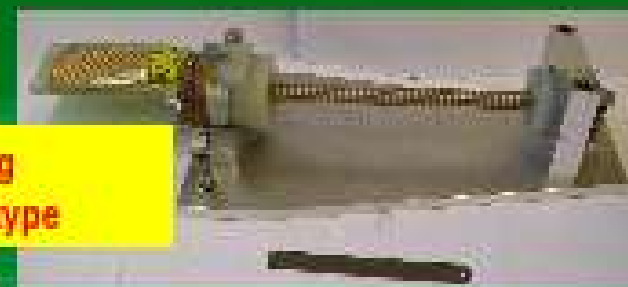
G.A. Moorgat-Pick (University of Durham / CERN)

J.A. Clarke, O.B. Malyshev, R.J. Reid, D.J. Scott, B. Todd (CCLRC ASTeC Daresbury Laboratory)

E. Baynham, T. Bradshaw, A. Brumfit, S. Carr, Y. Ivanyushenkov, J. Rochford
(CCLRC Rutherford Appleton Laboratory)



- Part of both the UK-based LC-ABD initiative and EUROTeV. Collaborates with Cornell University.
- Mandated to design a helical undulator as part of a spin-polarised positron source for the ILC.
- Short (30cm) superconducting and permanent magnet prototypes have been constructed at RAL/ Daresbury/ Liverpool.
- First measurements of field quality completed. Additional DAQ systems under construction.
- Decision made to construct and test long (4m) superconducting undulator module.
- Decision endorsed by international LC-ABD review panel (October 2005).



Superconducting undulator prototype



Permanent magnet undulator prototype

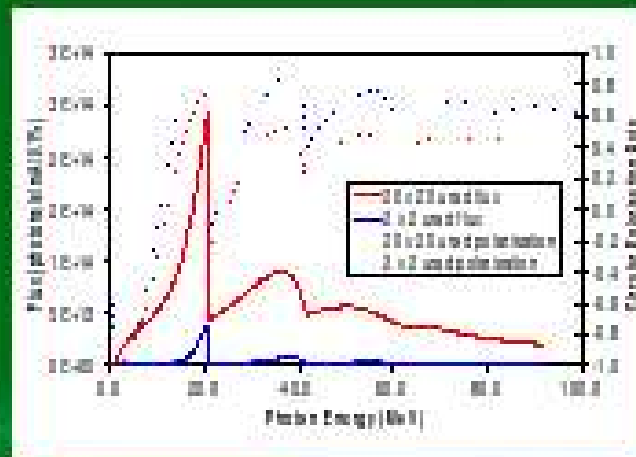


Preliminary design of long superconducting undulator prototype

Helical Collaboration Status (2)

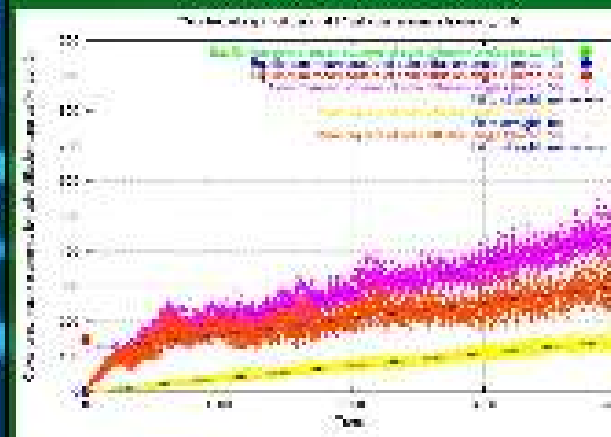
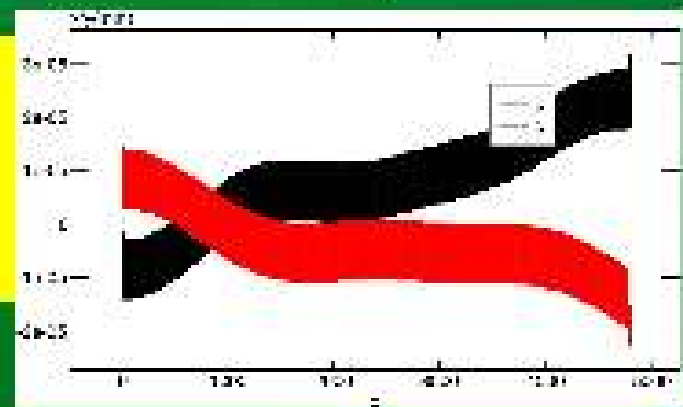


- Developing reliable software tools that allow the machine to be optimised for spin polarisation as well as luminosity. Aiming to carry out full cradle-to-grave simulations.
- Currently carrying out simulations of positron source and depolarisation effects in damping rings and during bunch-bunch interactions.
- Damping ring simulations recently presented at CERN ILC damping ring workshop.
- Will soon extend simulations to cover BDS, main linac, etc.
- Will address key questions such as impact of tunnel curvature, positions of polarimeters, etc.
- In process of recruiting new staff and actively seeking new collaborators.



Energy spectrum and circular polarisation of photons from helical undulator.

Trajectories of electrons through helical undulator.



Example of SLICKTRACK simulation showing depolarisation of electrons in a ring.

Conclusions

- **Very active field**
- **promising results from helical undulator at E166**
- **much work on prototypes for ILC helical undulator at RAL and Daresbury**
- **Completion of polarization in Geant4 close to finish**
- **Chicane design for upstream polarimeter under study**