EuCARD-2

Enhanced European Coordination for Accelerator Research & Development

Milestone Report

1st XPOL Topical Workshop

04 April 2014

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MILESTONE REPORT

1ST XPOL TOPICAL WORKSHOP: SPIN OPTIMIZATION AT LEPTON ACCELERATORS

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Abstract:

The XPOL workshop, organized from 12-13 February 2014 at Mainz University, was devoted to the subject of "spin optimization" at lepton accelerators. This theme comprises spin generation, spin transport and the accurate measurement of all components of the spin vector.

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Delivery Slip

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TABLE OF CONTENTS

1. WORKSHOP SUMMARY

The "spin optimization workshop" addressed the question how to provide the best experimental conditions for exploiting the physics potential of polarized lepton beams. This actually amounts to a complex of questions which we summarize by the name "extreme polarization". In total the workshop featured 15 talks and it was attended by 25 participants from eight different institutions. The contributions can be grouped into four different subtopics. In the following we summarize the contents of each of these subtopics and indicate the affiliation of the respective speakers. The individual slides from all the talks can be found at the workshop indico web site

https://indico.mitp.uni-mainz.de/conferenceDisplay.py?ovw=True&confId=18

***High–precision beam polarimetry**: Measuring scattering asymmetries allows one to extract fundamental, spin dependent quantities, in particular for electroweak processes. A specific example is the measurement of the electro-weak mixing angle Θ_W, which is a cornerstone of the standard model. This is of particular importance in the new collider projects, no matter if they are circular (FCC) or linear (ILC). Talks from DESY-HH, U-Hamburg, and JGU summarized ongoing experimental and theoretical studies with accuracy objectives ranging from 0.3% at low energies (double scattering and Möller polarimetry with completely polarized hydrogen gas) to 0.25% (luminosity averaged polarization at ILC determined using Laser-Compton scattering) or even 0.1% if the W-pair production asymmetry is analysed.*

***Polarized positron sources:** For several electroweak reaction channels, polarized positrons allow increasing the effective luminosity, since only one type of helicity couples to the reaction. Whereas polarized e+ generation is comparatively easy in circular machines due to the Sokolov-Ternov effect, constructing an intense source of polarized e^+ for the ILC is challenging. The preferred method (U-Hamburg, DESY-ZT) is production via circular polarized gamma rays, generated by synchrotron radiation from a high-energy (>100 GeV) electron beam passing through a long helical undulator. The phase space density is then increased in a damping ring, which in turn raises new issues concerning spin depolarization – see below.*

***Radiative processes**: Polarization measurement is hampered by theoretical uncertainties caused by radiative background processes. The pertinent experimental (U-Heidelberg, U-Mainz) as well as theoretical studies (TU-Munich) on polarized positron sources were presented. Radiative processes being the basic ingredient for polarized e+ production, our ignorance of several of the polarization dependent cross sections at intermediate relativistic energies (γ~10) may limit the predictability of e+ sources.*

***Spin stability/depolarization in very high energy machines**: In high energy machines the coherence of the spin-ensemble is threatened by resonances. This subject was addressed by participants from BNL and U-Liverpool. Very high energy circular machines must be designed from the beginning with appropriate "spin-infrastructure" in order to enable spin-*

polarized experiments. Even in linear machines (DESY-HH) the transfer from polarimeter to the IP causes some concern.

Spin specific hard- and software. *Spin physics requires dedicated spin-tracking software (U-Bonn) and also sophisticated experimental techniques for reducing systematic errors in the determination of the analysing power of spin-specific processes (U-Mainz). For very high energy polarimeters detector energy calibration is of utmost importance. Polarized positrons, on the other hand, require very careful design of photon collimators, posing extreme demands with regard to thermal stress and adjustment accuracy.*

2. BASIC DETAILS ABOUT THE WORKSHOP

Type of activity	Workshop
Title	Spin Optimization at Lepton Accelerators
Date	12-13 February 2014
Place	Johannes-Gutenberg University Mainz
Type of audience	Scientific community, Industry
Size of audience	25
Scope of the workshop	International
Link	https://indico.mitp.uni-mainz.de/conferenceDisplay.py?ovw=True&confId=18
Partners involved	JGU, DESY

3. MAJOR OUTCOMES / RELATION TO OTHER EUCARD-2 WORK

Spin optimization deals with long standing problems, which require persistent scientific and technological investigations. In spite of the unclear situation concerning the realization of large scale machines such as the ILC considerable progress has been achieved. During recent years university groups have entered the field, either to promote their own medium scale projects or to contribute with fundamental research and/or R&D. It is well known that large scale facilities with “extreme beams” can only exploit their physics potential to the maximum extent if “optimized polarization” is available. This issue appears to be at hand, at least for several of the presently pursued schemes for extreme beams. The workshop has clarified many of the milestones accomplished, and has helped to define the road ahead in order to overcome the outstanding open questions, e.g. achieving maximum polarization in large circular machines and realizing highest-intensity polarized positron sources for linear accelerators.

ANNEX: GLOSSARY

Acronym	Definition
JGU	Johannes-Gutenberg Universität Mainz
DESY-HH	Deutsches Elektronen Synchrotron, Location Hamburg
DESY-ZT	Deutsches Elektronen Synchrotron, Location Zeuthen
BNL	Brookhaven National Laboratory
FCC	Future Circular Collider
ILC	International Linear Collider
e+	Positron
IP	Interaction Point
U	University (U-Bonn, U-Hamburg, U-Liverpool)
TU	Technische Universität (TU-München)
γ	Relativistic Lorentz factor
Θ_W	Electroweak mixing angle