

REVIEW OF THE SLAC AND LES HOUCHES WORKSHOPS*

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I. Introduction. Polarized Electron Source workshops have been held at varying intervals, beginning in 1983 when Charles Sinclair convened the first at SLAC. Since that time, three workshops were held in conjunction with the International Spin Symposia and two at other occasions. The increasing importance of polarized electron beams at accelerators has stimulated interest in these workshops. Two workshops have been held since the last International Spin Symposium in Nagoya. In 1993, a workshop was held at SLAC, and in 1994 at Les Houches, a polarized electron beam session was held as part of a polarized beam and targets workshop. This report summarizes highlights from the latter two workshops.

History of Polarized Electron Sources Workshops

Year	Place	Convenor
1983	SLAC	C. Sinclair
1988	Minneapolis	C. Sinclair
1990	Bonn	E. Reichert
1992	Nagoya	T. Nakanishi
1993	SLAC	J. Clendenin (SLAC)
		T. Maruyama (SLAC)
		D. Schultz (SLAC)
		M. Leduc (ENS Paris)
1994	Les Houches	E. Steffen (MPI Heidelberg)

The workshops have experienced a growing attendance. These workshops report on progress in all aspects of polarized electron beams and support the polarization progress at labs like SLAC, MIT-Bates, and Mainz, where experiments are running, and at labs such as CEBAF, NIKHEF, and KEK, where future experiments are likely to be run. Interest in polarized electrons for a future linear collider is strong. The frequency of one workshop per year should continue into the future as long as this interest in experiments with polarized electron beams remains strong.

II. The SLAC Workshop on Photocathodes for Polarized Electron Sources for Accelerators (September 8-10, 1993). This workshop was organized by J. Clendenin, T. Maruyama, and D. Schultz, and supported by SLAC. The focus of this workshop was on photocathodes for use in polarized electron sources at accelerators. The reports presented in this workshop have been combined into a proceedings consisting of copies of transparencies from each talk [1]. The workshop contributions can be divided into two categories, accelerators and cathode studies. Listed below are the laboratories and institutions represented, the speakers, and their topics. The workshop had 43 participants representing 22 institutions and laboratories

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Invited talk presented at the 11th International Symposium on Spin Physics and the 8th International Symposium on Polarization Phenomena in Nuclear Physics, Bloomington, Indiana, September 15-22, 1994

Accelerators	Speaker	Subject
Mainz	K. Aulenbacher	MAMI operating experiences
SLAC	S. Ecklund	NLC and Linear Colliders
SLAC	L. Klaisner	SLC experiences
MIT-BATES	M. Farklende	Bates operating experiences
Los Alamos	R. Sheffield	AFEL Accelerator
CEBAF	C. Sinclair	Emittances of GaAs sources
KEK	M. Yoshioka	JLC-ATF source

Cathode Studies

Accelerators	Speaker	Subject
Bielefeld	G. Baum	Strained GaAs
Ferrara	V. Guidi	Timed resolved emission
Ecole Polytechnique	G. Lampel	Layered structures
SLAC	R. Mair	Photoluminescence studies
St. Petersburg	Y. Mamaev	InGaAs, AlGaInAs, GaAsP
SLAC	T. Maruyama	Strained GaAs
SLAC	G. Mulhollan	Low energy test facility
Nagoya	T. Nakanishi	Superlattice structures
Spire Corp.	S. Vernon	MOCVD process
Heidelberg	S. Zwickler	Energy analysis of electrons
Novosibirsk	A. Terekov	InGaAsP on GaAs
SLAC	H. Tang	Charge limits
Mainz	E. Reichert	Thermal studies
ETH Zürich	H. Seigmann	High pulsed laser power studies
NIST	D. Pierce	Studies of surface magnetism
SLAC	G. Mulhollan	Low energy test facility
Stanford	W. Spicer	Theory

Three of the accelerator labs, Mainz, SLAC, and MIT-Bates reported on operational aspects of polarized beams. The remaining laboratory presentations reported on R&D activities aimed at possible future operations. A partial list of accelerator parameters is given below. It should be noted that parameters listed here are a snapshot given at the time of the workshop, and that they may change and can be expected to be different at future times.

Parameter	Mainz MAMI	SLAC SLC	MIT- Bates	CEBAF	KEK JLC ATF	Los Alamos AFEL
Pulsed/cw	cw	pulsed	pulsed	cw	pulsed	pulsed
Rate (Hz)		120	600		150	100
Gun type	triode	diode	diode	diode	diode	rf
Voltage (KeV)	100	120	380	100	100	10 ³
Pulse length		2 ns	15 μ s		< 1 ns	< 20 ps
Q/pulse		8 \times 10 ¹⁰	2 \times 10 ¹²		1.5 \times 10 ¹⁰	6 \times 10 ¹⁰
Cathode	GaAsP	strn GaAs	GaAs	GaAs	GaAs	multi-alkali
QE(%)	0.9	0.9	6.5			< 0.1
ϵ (π mm mrad)	0.32	20	0.1	0.6		3
Polarization (%)	40	80	40	—	—	0
QE lifetime (hrs)	20	100–500	200			3
Load lock?	no	yes	no	no	no	no
Laser type	dye	ti-sapp.	ti-sapp.e			

III. The Les Houches Workshop on Polarized Beams and Targets; Sensitive Tools for the Study of Solids, Nuclei, and Particles (June 7-10, 1994). This *Scientific Network on "Polarized Beams and Targets"* workshop was organized under the auspices of the European Community "Human Capital and Mobility." The organizers were Michele Leduc (ENS Paris) and Erhard Steffens (MPI Heidelberg). Sixty three participants representing 36 institutions attended the workshop.

One day-long session was devoted to polarized electron sources and semiconductor photocathodes. Other topics at the workshop included lasers, optical pumping of gas targets, ^3He targets, and selected topics in polarized neutrons and atomic physics.

The talks covering the electron sources and semiconductor photocathodes were combined into one day and summarized in one evening session. Below are listed the presentations from those sessions relating to electron sources and photocathodes.

The talks are summarized in a collection of abstracts available from the organizers [2].

Institution	Speaker	Subject
Palaiseau	G. Lampel	The Physics of the Semiconductor Spin-Polarized Electron Source
ETH Zürich	F. Meier	Emission of Polarized Electrons from Photocathodes using Continuous and Pulsed Light Sources
SLAC	G. Mulhollan	Polarized Electron Beams at SLAC
Mainz	S. Plützer	Photoemission of Spin-Polarized Electrons from Strained $\text{In}_{1-x}\text{Ga}_x\text{As}_{1-y}\text{P}_y$ and $\text{GaAs}_{1-y}\text{P}_y$
Mainz	H. Fischer	XPS Studies of NEA-Cathode Fatigue
Palaiseau	D. M. Campbell	High Polarization and High Yield from Strained GaAs Photoelectric Sources
Orsay	S. Essabaa	Recent Developments and Latest Results of the Orsay Polarized Electron Source

IV. Summary. Gallium arsenide cathodes and layered structures of strained gallium arsenide and gallium arsenide superlattices have been shown to provide high polarization and high currents in photoemission by polarized laser beams. At accelerator facilities with running experiments, these sources have proven to operate with high reliability. Pulsed currents of up to 10 amps in 2 nanoseconds have been used at SLAC for the SLC. Polarizations up to 85% have been achieved for experiments. Mainz has operated photoemission sources with continuous currents, but in some conditions, the cathodes have shown a loss of quantum efficiency at the spot where the laser hits the photocathode when steady currents in excess of $150\ \mu\text{A}$ are drawn. Advances in laser technology, vacuum technology and cathodes materials continue to make the electron source devices better and easier to fabricate and use.

Helium afterglow sources at Rice University and Orsay offer an alternative to photoemission sources for high average currents ($\geq 100\ \mu\text{A}$) with polarization in the range of 60-80%.

1. Proceedings of the Workshop on Photocathodes for Polarized Electron Sources for Accelerators, organized by J. Clendenin et al., SLAC-432 (1993).
2. Abstracts of the Workshop on Polarized Beams and Targets; Sensitive Tools for the Study of Solids, Nuclei, and Particles, organized by M. Leduc (ENS Paris) and E. Steffens (MPI Heidelberg), Les Houches (1994).