

## Polarization Physics at CERN and DESY, May 1988

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This note is a list of recent papers, letters of intent and workshop reports accompanied by comments reflecting conversations with authors, committee members, experts on experimental techniques and accelerator physicists. It provides a base for evaluating what may be the experimental activity in this field in Europe over the next five or ten years.

## 1 - SPIN CONTENT OF NUCLEONS AND SUM RULES

a) Results (CERN-SPS, Experiment EMC-PPT)

- CERN-SPS European Muon Collaboration, polarized proton target (EMC-PPT). Longitudinally polarized muons of 100 to 200 GeV on longitudinally polarized proton target (2 liter volume). Deep inelastic polarized structure function down to  $x \geq 0.02$  (as compared to  $x \geq 0.1$  in the YALE Experiment at SLAC). Raw asymmetry "(parallel-antiparallel)/sum" in new region  $x = 0.02 - 0.10$  is only  $\approx 2\%$  instead of  $\approx 4\%$  expected from extrapolation of YALE data. From the conventional chain of arguments, the authors conclude that the fraction of proton spin carried by valence quarks is smaller than assumed previously, and that the asymmetry on polarized neutron target should be significantly negative.

CERN-EP/87-230, 23-DEC-87 (submitted to Physics Letters).

Critical review of present situation by Close and Roberts ("....no clear conclusion....."). Much discussion about experiment and interpretation of data (Seminar by E. Leader). General consensus that deep inelastic polarized lepton scattering on polarized *neutrons* is urgently needed to clarify the situation. Close and Roberts emphasize advantage of *isoscalar* polarized nucleon target for determining fraction of nucleon spin carried by valence quarks. (ND<sub>3</sub> or, better, <sup>6</sup>LiD).

Phys.Rev.Letters 60(1988)1471.

*b) Projects (following the surprise created by the EMC-PPT result)*

- CERN-SPS (EMC-PNT): Repeat EMC-PPT with same beam and improved apparatus on polarized neutron- (and proton) targets.

Letter of Intent CERN/SPS 88-11, SPSC/I169 20-APR-88, spokesman V.W.Hughes, contactman D.v.Harrach. Submitted to SPS Committee, next session early JUL-88.

- DESY-HERA (EUR/USA). Internal polarized gas target in circulating longitudinally polarized electron beam. In East Hall where first pair of spin rotators will be installed. Some modification of layout is needed in order not to interfere with the proton beam, for compatibility with H1 and ZEUS. Polarized Proton, <sup>3</sup>He (and Deuteron) gas jet accumulated in storage cell. No dilution of raw asymmetry due to unpolarized nucleons present in high density targets needed for extracted beam (single pass) experiments like YALE-SLAC, EMC-PPT or EMC-PNT.

Memorandum of Intent PRC 88/2 D.Allasia et al., Germany-Netherlands-Sweden-USA(Wisconsin).

- DESY-HERA (USA). Same technique, same goals as the preceding (and astrophysical implication of proton spin structure).

Letter of Intent PRC 88/1 Caltech-Argonne, spokesperson R.G.Milner.

The DESY Physics Research Committee suggests that the two collaborations submit a common proposal.

At CERN-SPS, the UA6 group proposes to replace in 1990 the present unpolarized gas cluster target by a polarized gas jet target. "The applicability to LEP in the near future is a distinct possibility". Some of the co-authors are considering using this target for deep inelastic scattering of the LEP polarized electron beam, similarly to the projects for DESY but at higher energies.

Letter of Intent CERN/SPSC/88-9, SPSC/I168 of 16-APR-88, CERN-Italy-Switzerland-USA(Michigan, Rockefeller)

## 2 - ELECTROWEAK PHYSICS

(Precision tests of the Standard Model (S.M.) and search for new gauge bosons.)

### a) Projects

- CERN-LEP. Polarization Physics has gained momentum in 1987, in part due to impact of SLC polarized electron beam program ("...SLC can polarize only electrons..."). At LEP, transverse spin program, longitudinal spin program with spin rotators ("...Polarization considerably sharpens the precision tests of the S.M. ...."). Transverse polarimeter is scheduled for 1990. Proposal to build

special wigglers for improved polarization build-up time at Z resonance energy, submitted in MAY-88.

"Physics with Polarized Beams in LEP", ALEPH 87-17, NOTE 87-5 by The ALEPH Polarization Working Group, 27-APR-87.

"Workshop on Polarization in LEP", 9/11-NOV-87, Proceedings edited by CERN-EP Division.

"Dedicated Wigglers for Polarization" LEP-Note 606, 03-MAY-88.

- DESY-HERA. Importance of experiments with longitudinal electron polarization at intersection had always been emphasized throughout the history of HERA project ("...Stringent and precise test of the S.M. (1983)....", "...Use of polarization in search for new gauge bosons (1988)...."). Proton beam polarization is considered too difficult to realize. Thus, no discussion of possibility to measure polarized nucleon structure functions in very high energy deep inelastic polarized electron-proton scattering with colliding beams.

Workshop "Experimentation at HERA", NIKHEF Amsterdam, 9/11-JUN-83.

No recent documents on polarization physics from H1 or ZEUS groups. A first pair of spin rotators is under construction and will be installed in the East Hall for testing on the ring in about one year from now. Plans are to build subsequently two more pairs for North- and South Halls (H1 and ZEUS experiments).

### 3 - STRONG INTERACTIONS (CERN)

#### a) Results

- CERN-ISR. Results on polarization of inclusively produced hyperons, presented at Fermilab in 1987 by P. Schlein.
- CERN-LEAR. (1) Antiproton scattering on polarized proton target (Exp. PS-172) is completed : Analyzing power of elastic scattering, interpreted by diffraction scattering plus spin-orbit at edge of diffraction profile. (2) Polarization in small angle antiproton-carbon elastic scattering by double scattering method. The  $p\bar{p}$ -c analyzing power is too small to be useful for carbon plate polarimeter. (3) Polarization measurement of  $\Lambda$ - $\bar{\Lambda}$  pairs produced in unpolarized antiproton-proton collisions.

#### b) Experiments in progress and projects (CERN-LEAR)

- A second (frozen spin) polarized target, in SPES II spectrometer.
- Internal polarized gas storage cell used (1) as target and (2) as Spin Filter for progressively polarizing the circulating antiproton beam.
- Spin Splitter for spatially separating antiproton transverse spin states in the circulating beam by cumulative Stern-Gerlach effect in quadrupole field gradients.
- Proposal to polarize the circulating antiproton beam by antihydrogen formation and optical pumping with circularly polarized laser beam.

"Proceedings of the Fourth LEAR Workshop, 6/13-SEP-87". (About 1/3 of the contributions on "Nucleon-Antinucleon Scattering" are on polarization physics)

c) Projects (CERN-SPS)

- Proposal to replace for 1990 the present unpolarized gas cluster target (UA6) by a polarized gas jet target (see above).

Letter of Intent CERN/SPS/88-9, SPSC/I168 of 16-APR-88, CERN-Italy-Switzerland-USA (Michigan,Rockefeller).

## 4 - SUMMARY

- At CERN, much progress in 1987 towards *polarized beams in LEP* triggered by detailed theoretical investigation on the role of spin dependent observables in electroweak physics, and by competition from SLC.
- In 1988 at CERN and DESY, several Letters of Intent for *new experiments on spin content of nucleons in terms of partons*, following announcement of the EMC results for deep inelastic polarized structure function at small x.
- The two intermediate energy hadron machines in Europe, LNS-Saclay and PSI-Villigen (and the Bonn Electron-Synchrotron) are engaged in *long term experimental programs with polarized beams and/or polarized targets*, in the construction of new polarized targets and in the development of new target materials.
- Technical developments : (1) Work on projects for *internal polarized gas targets* in HERA, SPS and LEAR circulating beams. (2) Recent progress with  ${}^6\text{LiD}$  as *polarized neutron- or isoscalar nucleon target* in external beams.

