HYPERON RADIATIVE DECAYS

(experiment E761)

N. F. Bondar, A. S. Denisov, A. V. Dobrovolsky, V. L. Golovtsov, V. T. Grachev,
A. V. Khanzadeev, A. G. Krivshich, N. P. Kuropatkin, V. M. Samsonov,
N. K. Terentyev, I. I. Tkatch, L. N. Uvarov, A. A. Vorobyov
R. Carrigan, P. S. Cooper, H. Gottschalk, J. Lach, A. Morelos*
Li Yunshan, Tang Fukun, Lang Fengfei, Li Chengze,
Shi Huanzhang, Zhao Wenheng, Dai Li-Shen**
P. A. Goritchev, M. A. Kubantsev***
E. McCliment, C. Newsom, T. Dubbs****
C. Escobar, P. Gouffon, J. Mahon*****
M. Foucher ******
A. M. Endler, M. P. Maia *******
D. Chen, I. J. Kim, C. R. Sun, F. Sun********
V. J. Smith*********

* Fermilab, Batavia, Illinois, USA
** Institute of High Energy Physics, Beijing, PRC
*** Institute of Theoretical and Experimental Physics, Moscow, USSR
**** University of Iowa, Iowa City, Iowa, USA
***** University of Sao Paulo, Brazil
****** Yale University, New Haven, Connecticut, USA
******* Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil
******** State University of New York-Albany, Albany, USA
********* H. H. Wills Physics Laboratory, University of Bristol, United Kingdom

The main goal of this experiment [1] is to measure the radiative decay asymmetries of polarized hyperons for reactions $\Sigma^+ \to p\gamma$ and $\Xi^- \to \Sigma^-\gamma$. The large asymmetry as observed in the previous $\Sigma^+ \to p\gamma$ experiments ($\alpha_\gamma = -0.72 \pm 0.29$ [2], $\alpha_\gamma = -0.86 \pm 0.15$ [3]) constitutes a major puzzle in hyperon physics. Indeed, exact SU(3) symmetry predicts zero for α_γ in the $\Sigma^+ \to p\gamma$ decay. Many theoretical models failed to describe simultaneously the observed branching ratios and asymmetry parameters. Only recently, the LNPI theoreticians have found a possibility to reproduce the $\Sigma^+ \to p\gamma$ experimental data in the framework of the QCD sum rules [3]. Unfortunately, this method requires calculations of many diagrammes causing some doubt in the reliability of the result. On the other hand, the reliability of the experiments [2, 3] is also not so evident because of the very small statistics in these experiments (107 events in [2] and 191 events in [3]). Up to now, the reaction $\Xi^- \to \Sigma^-\gamma$ has been registered (11 events), but the asymmetry was not measured.

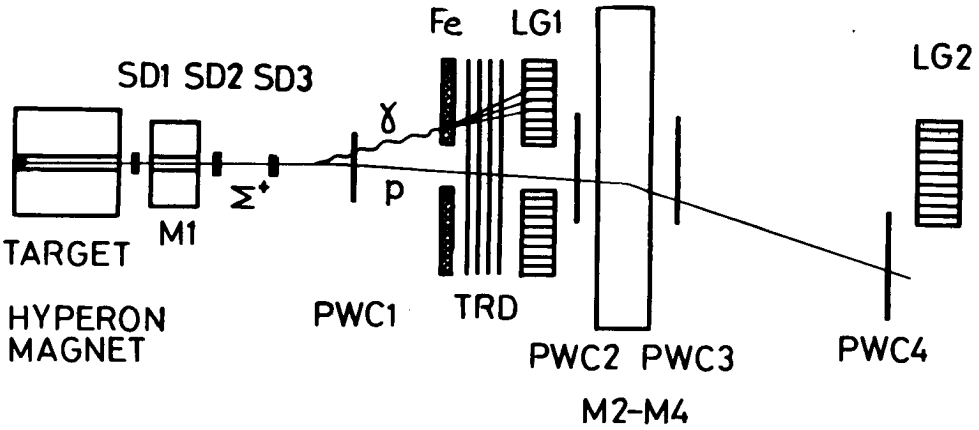

Fig. Setup of experiment E761 in charged hyperon beam at Fermilab. Shown are magnets (M1 — M4), microstrip detectors (SD1 — SD3), proportional chambers (PWC1 — PWC4), transition radiation detector (TRD) and electromagnetic calorimeters (LG1, LG2)

The E761 expects to provide high statistical measurements of the $\Sigma^+ \to p\gamma$ decay at the rate of 25000 reconstructable events per week. The expected rate for $\Xi^- \to \Sigma^- \gamma$ is 300 events per week. The high intensity polarized charged hyperon beam at Fermilab will be used in this experiment. The momentum of the beam particles is 350 GeV/c, the polarization of the Σ^+ hyperons is about 20%, and that of the Ξ^- hyperons is about 10%.

The experimental setup is shown in the figure. The layout consists of two magnetic spectrometers instrumented with Si-strip detectors and MWPCs, two electromagnetic calorimeters to measure the energy of the γ's and a TRD to measure accurately the position of the γ's. This setup is designed to provide clean separation of the $\Sigma^+ \to p\gamma$ decays from the background reaction $\Sigma^+ \to p\pi^\circ$ which is 500 times more prolific.

By the end of 1989, all the experimental equipment was ready and installed in the experimental area at FNAL. Many essential parts of the equipment have been produced at LNPI such as all the MWPCs as well as the transition radiation detector. Also, the high-speed read-out system (12000 channels for the MWPCs and Si- strip detectors) was designed and made at LNPI. The start of the experiment is scheduled for February 1990, and it should be finished by August 1990.

In addition to the main programme, a parallel experiment is prepared, aimed to measure the Σ^+ magnetic moment using new technique developed at LNPI. In this method, the magnetic moment will be determined by the spin precession of the Σ^+ hyperons channeling along a 2 sm long bent Si--crystal. The bent crystal serves also as a $\Delta E/\Delta x$ detector that helps to select the Σ^+ particles captured into the channeling regime. The positive result of these measurements will allow to apply the method to measure the magnetic moments of very short-lived particles when the usual method of spin precession in magnetic fields cannot be used.

REFERENCES

1. 'An Electroweeak Enigma: Hyperon Radiative Decays'. Fermilab Proposal, 761, April 1985.
2. *Gershwin L. K. et al.* Phys. Rev. 1969. 188. 2077;
Manz A. et al. Phys. Lett. 1980. 96B. 217.
3. *Azimov J. I.* The XXII LNPI Winter Physics School, 'Physics of High Energies'. Leningrad, 1987. P. 200.