

## DIRAC (PS212) Annual report for 2008

In 2008, the efforts of the DIRAC collaboration were concentrated on tuning the upgraded setup and on taking data with a Nickel target for observation of  $\pi K$  atoms, the lifetimes measurements of the  $\pi\pi$  and  $\pi K$  atoms and on processing the data collected in 2007.

### **I Beam** (R.Steerenberg, A.Grudev, L.Gatignon and their colleagues from PS division):

A two-bunch injection scheme to the PS was implemented and many other efforts were done to provide for the DIRAC spills a uniform time-distribution of the extracted proton beam that led to a lower accidental rate and a smaller dead time. This allowed us to increase the intensity up to  $1.2 \times 10^{11}$  protons per spill.

### **II Setup:**

The upgraded setup was fully tuned in 2008, including new, upgraded and old detectors:

1. The new Micro Drift Chambers with new electronics and preamplifiers. The coordinate precision is about  $50 \mu\text{m}$  and the maximum drift time 30ns.
2. Two new Scintillation Fiber Detectors (SFD-X,Y) with 480 columns each with a coordinate precision  $60 \mu\text{m}$ . In addition, an old SFD-W plane was implemented ( $120 \mu\text{m}$  resolution, 320 columns). For SFD-X the new readout system was used. SFD-Y,W were read out with old electronics.
3. The old Ionisation hodoscopes were read out with new electronics.
4. The old Drift Chambers were fully repaired before data taking.
5. The new Horizontal hodoscopes and upgraded Vertical hodoscopes were readout with new electronics. The intrinsic time resolution of the Vertical hodoscope is about 100 ps.
6. The new Aerogel Threshold Cherenkov detector is used for p-K separation. Its performance was studied with e,  $\pi$ , K, p of both charges.
7. New Heavy Gas Cherenkov counters filled with  $\text{C}_4\text{F}_{10}$  were used for  $\pi$ -K separation. The gas system worked with recirculation and gas cleaning.
8. The old Nitrogen Cherenkov counters used for electron identification were mechanically modified for installation of the Heavy Gas Cherenkov counters.
- 9 The new Preshower detectors for additional identification of the electrons and positrons.
- 10 The Upgraded Muon Detector.
11. The new electronics which includes the front-end part with TDC and ADC units and the readout system have been implemented for all scintillation detectors of the setup. The triggers were modified to accept simultaneously  $\pi\pi$  and  $\pi K$  events.
12. The DAQ has been modified to accept data from the modified detectors and electronics. The revised software for automatic and interactive on-line monitoring of data was adjusted to running conditions.

### **III Data taking:**

During the first part of the run, the full setup with the new electronics and DAQ were tuned. The data with the Nickel target were collected during the last 10 weeks of the run. Altogether, 1.6 billion triggers were recorded. The number of ionised  $\pi K$  atoms is expected to be of the same magnitude as in 2007, but the level of the background is expected to be a factor 4 lower due to the implementation of the forward detectors.

### **IV 2007 results:**

In 2007,  $1.6 \times 10^9$  triggers were recorded with a Platinum target. The analysis of these data, based only on the detectors downstream the magnet, gave the **first evidence for production and breakup of  $173 \pm 54$   $\pi K$ -atoms**. The total number of atoms produced was obtained from the analysis of the observed  $\pi K$  Coulomb pairs and provides the experimental value of the probability of  $\pi K$  atom breakup. Based on this value, a lower limit on the lifetime of 1.5 fs is estimated with a confidence level of 84%. The corresponding publication has been submitted to Physics Letters. During the same data taking,  $7100 \pm 530$  pairs from  $\pi\pi$  atom-breakup were collected.

### **V Old data processing:**

The work on the analysis of the data collected in 2001-2003 was continued, especially for a better understanding of the systematic errors.