

DIRAC status report 2012

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The main goal of the 2012 and 2011 runs was substantial data taking for clear observation of long-lived $\pi^+\pi^-$ atoms. By investigating lots of these excited pionia it should be possible to measure their Lamb shift and so to check precise low energy QCD predictions.

I. Run 2012

During 4.7 months data taking in 2012, DIRAC received in total 740'000 spills, what corresponds to 3.07 spills per supersycle. With the beam intensity of 3×10^{11} protons/spill, the total number of proton interactions with the 100 μm thin Beryllium target amounted to 5.4×10^{13} .

In the neighbourhood of the target, a magnet was installed to improve the identification of the long-lived atoms. Unfortunately, this magnet is irradiated by neutrons and other particles produced in the target. Therefore, that magnet used in 2011 (Nd-Fe-B alloy) suffered from a large strength decrease during that year (50%), whereas the new one installed in 2012 (Sm-Co alloy) showed a much smaller decrease (0.26%).

At present, data from July till September 28 (5.05×10^5 spills) are processed. The full number of produced $A_{2\pi}$, $N_A = 5700 \pm 500$, has been derived via the Coulomb $\pi^+\pi^-$ pair analysis. In accordance with the Monte Carlo simulation, the corresponding number of atomic pairs, resulting from the long-lived $A_{2\pi}$ breakup in the Pt foil, will be $n_a = 130 \pm 12$. Therefore, the expected atomic pair signal, obtained after background subtraction, for all the 740000 spills from 2012 should be better than 6σ .

II. Run 2011

1. All experimental data have been preselected and ntuples prepared.

2. Multiple scattering measurement:

In the present investigation, only events with one track in each projection have been selected and analysed for the 100 μm and 150 μm thin Ni targets. Preliminary measurement precision for the multiple scattering angle in each of the targets is 0.7 %, whereas 0.5% is expected by using the whole 2011 data sample. This measurement has been continued in 2012.

III. $\pi^+\pi^-$ atoms (run 2008, 2009, and 2010)

After e^+e^- background subtraction, the systematic error analysis has been performed by using 2008 data. Atomic pair numbers have been obtained for the events with low level scintillation fiber detector (SFD) background from the pair distributions on Q , Q_L and $Q_L - Q_T$. The difference between the atomic pair numbers in this three parameter analysis is due to the systematic error connected with the new SFD planes. After systematic error reduction, the atomic pair numbers n_a are the following ones: $n_a = 3455 \pm 163$ (Q), $n_a = 4059 \pm 270$ (Q_L) and $n_a = 3601 \pm 162$ ($Q_L - Q_T$). The atom breakup probability $P_{br} = (45.6 \pm 3.4)\%$ (Q_L) is compatible with $P_{br} = (44.6 \pm 0.9)\%$ as gained from the runs 2001-2003.

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A way to decrease the systematic error is known. The total number of atomic pairs detected in 2008-2010 will be greater than 21000 for the statistics with low and medium SFD background, corresponding to about 70% of the data sample.

IV. π^-K^+ and π^+K^- atoms (run 2008, 2009 and 2010)

The multiplicity in all the detectors is the same for $\pi\pi$ and πK -triggers. Therefore, the systematic error suppression used in the $\pi^+\pi^-$ atom analysis can also be applied in the πK atom analysis. Preliminary results on πK atom and πK atomic pair production will be ready in April 2013. This analysis will take into account nonpoint-like π -K production. The total number of πK atoms in the runs 2008-2010 will be around 600 as estimated from the experimental statistics with low and medium SFD background (about 70%).

V. New ionization hodoscope

The present ionization hodoscope (IH) consists of 4 planes (area=108×108 mm²) with 16 slabs (thickness=1 mm), each connected to its PM via a Lucite light-guide.

The 4 planes of the new IH consist each of 32 slabs. The increased granularity allows to decrease the signal overlapping and the electronics dead time. During October and November 2012 this detector has been installed and investigated in the beam line.

VI. DIRAC dismantling

In accordance with the plan prepared by CERN and DIRAC, the setup should be dismantled before June 2013.

VII. Calculation of the πK and $\pi\pi$ atom yield at the CERN SPS