DEAR Technical Note IR-16

# The DEAR Kaon Monitor: results of the first measurements

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The kaon monitor not only will allow the determination of the absolute yields of the transition X rays which give the pattern of the lines of the spectra, but can also be used to obtain an accurate determination of the machine luminosity (the actual luminometers of DA$\Phi$NE, based on single Bremsstrahlung, are 10-15% precise up to 30 bunches), as well as to accurately tune the $\phi$-factory on the resonance energy. The main characteristics of the DEAR kaon monitor are:

- fast response;
- certain identification of charged kaons from background;
- reasonable counting rate, also at a luminosity of the order of $10^{30}\mathrm{cm}^{-2}\mathrm{s}^{-1}$.

The monitor is made by two thin scintillators, which are fast NE104, 2 mm thick each. The scintillators are both 10 cm high and 15 cm long and are placed back-to-back on the two sides of the DEAR pipe, 10 cm apart from the I.P., perpendicular to the radial plane. Each scintillator is seen by two fast XP2020 phototubes.

In figure 1 the experimental setup of the kaon monitor is shown. With a geometry optimized by a Monte Carlo simulation in order to get a compromise between the space at disposal within the experimental setup and the need of a reasonable counting rate, an efficiency of 7.93% turns out at disposal of the charged kaons detected in coincidence. Charged kaons reach the scintillators 1.2–1.4 ns after minimum ionizing particles (m.i.p.s) and deposit an energy of about 6 MeV, against the 0.47 MeV of a m.i.p. The analog signals from each phototube are sent to a Dual Constant Fraction and Mean Time Module, in order to obtain a timing independent of pulse height and crossing point on the scintillator. The module releases also the (attenuated and delayed) analog input signals which can hence be used for any subsequent linear analysis. In figure 2 the scheme of electronics used in the first tests is shown.

The time-of-flight distribution of the coincidences between the two scintillators was recorded. A machine bunch signal was used as STOP in the TDC, whilst the START was given by the coincidence. The circuit had a 100 ps resolution per channel. As expected, the huge peak of the coincidences produced by the fast background m.i.p., is followed, after 1.3 ns, by a smaller peak due to the slow kaons. If the bunches of the two beams do not collide, the lower peak disappears. In figure 3, the recorded spectra in the first tests *with* colliding bunches and *without* colliding bunches are shown. In the first tests, we measured about 130 counts/$nb^{-1}$, with the machine working with 23 bunches, in agreement with the Monte Carlo evaluation. The average integrated luminosity per day delivered by the machine is actually about 130 $nb^{-1}$. This means that the kaon monitor rate is presently on average about 0.2 Hz. Even at the actual luminosity, the kaon monitor is therefore capable of giving a precise and relatively fast luminosity measurement.

In the next future an improvement in the electronics of the detector will be implemented in order to:

a) allow the kaon monitor to work up to the maximum number of bunches (120) foreseen for DA$\Phi$NE, which means a bunch spacing of 2.7 ns. Therefore a 1 ns level fast electronics becomes compelling, whilst the actual one is at the level of not less than 5 ns;

b) provide both time and energy distributions of events, to be recorded.

The new electronics will be installed during the shut down of the machine.

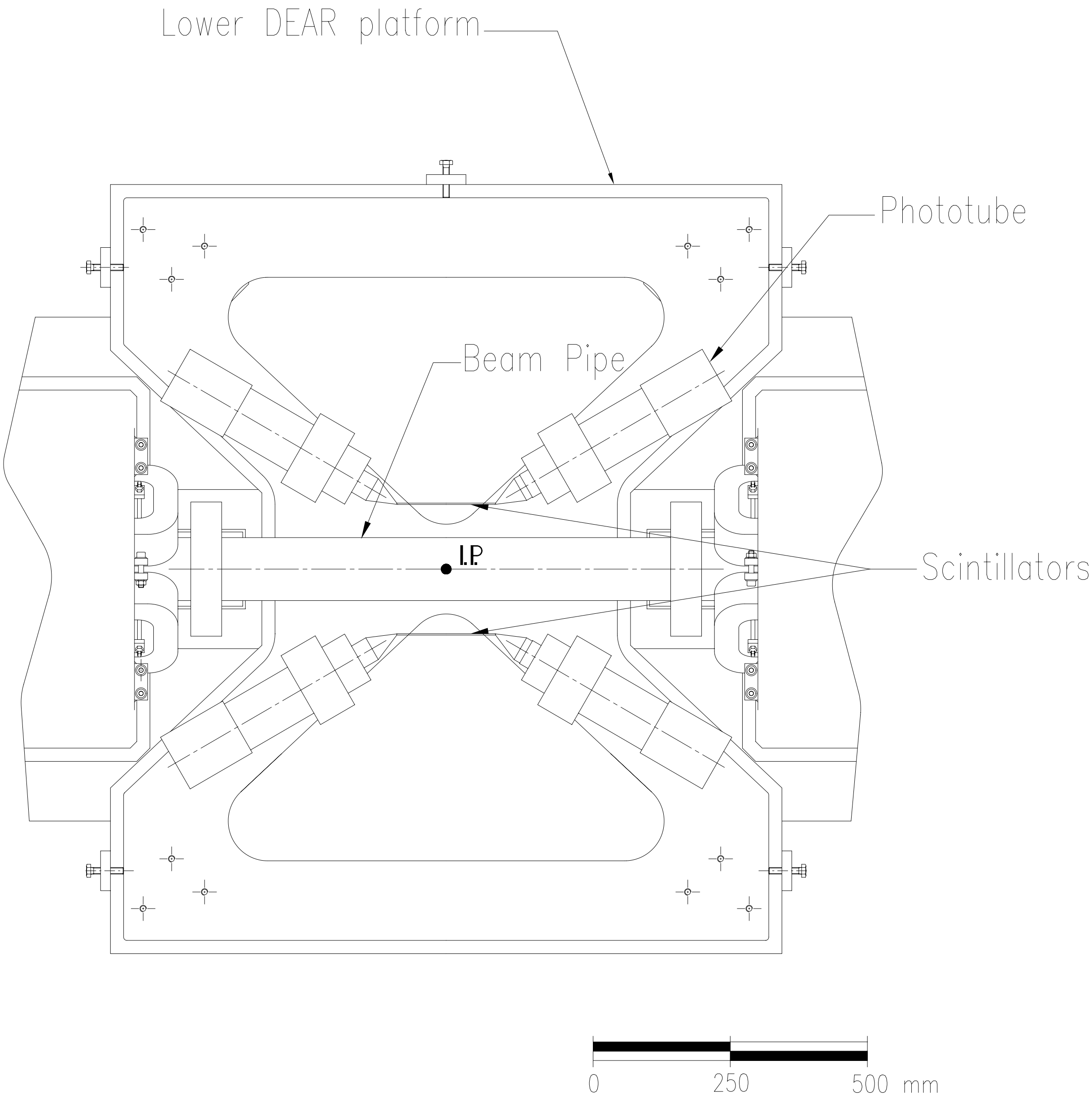


Figure 1: The Kaon Monitor setup

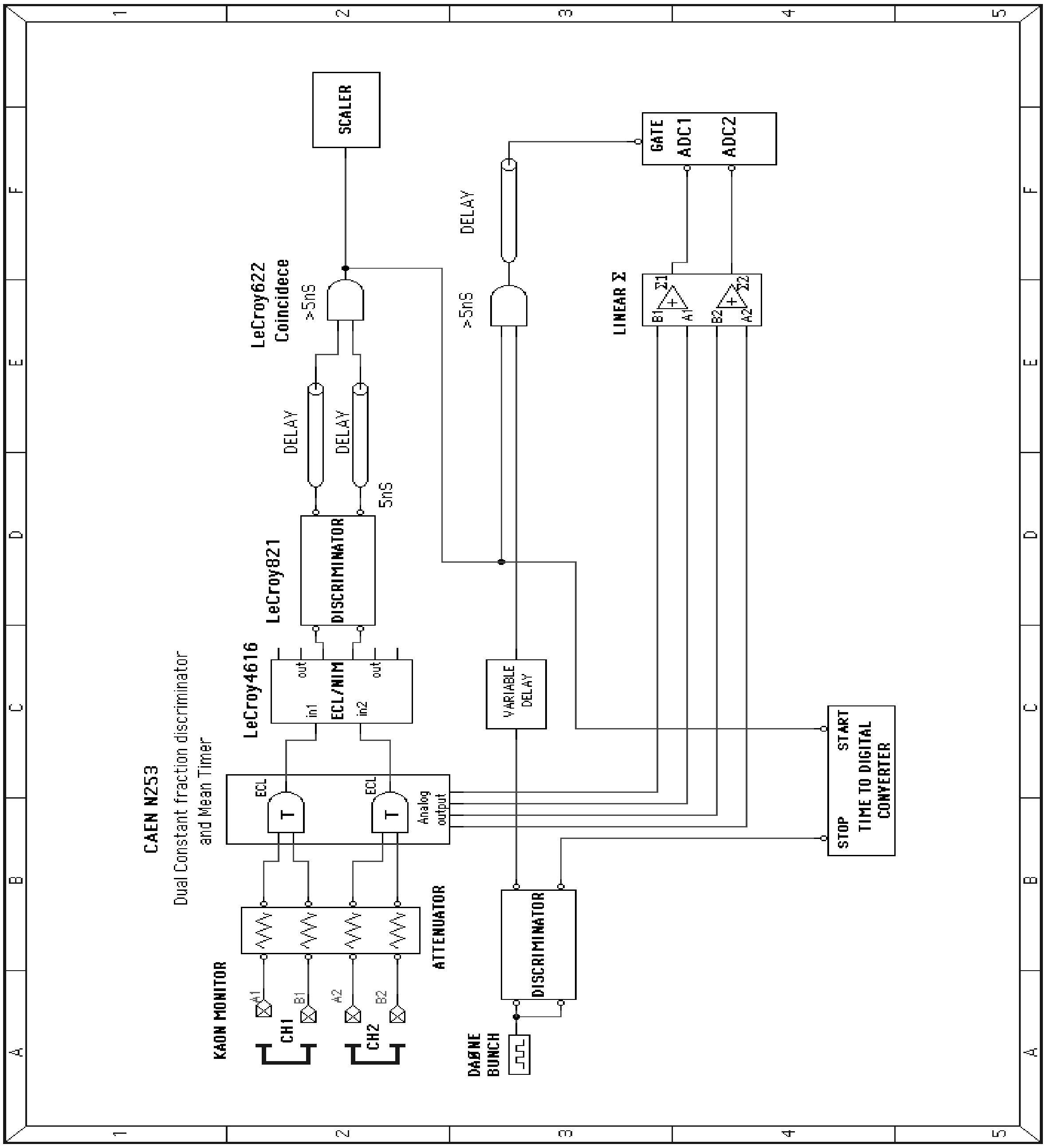


Figure 2: Scheme of the electronics used in the first runs

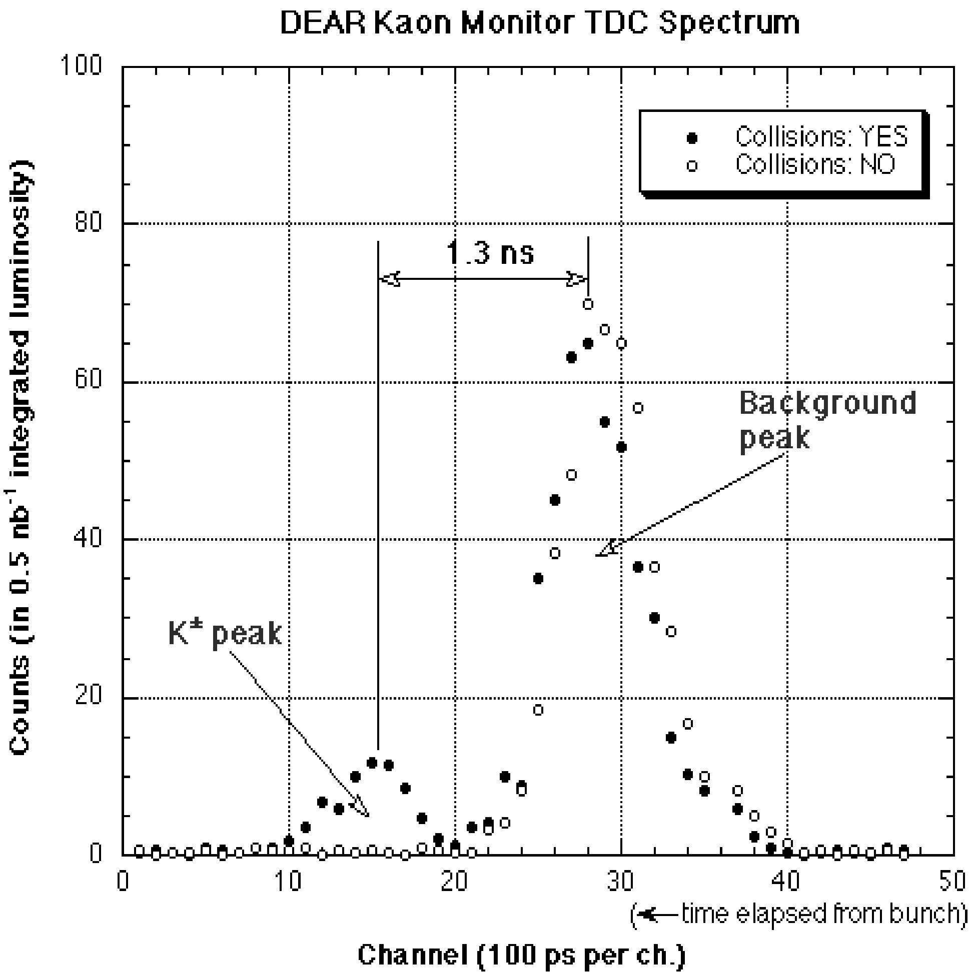


Figure 3: DEAR Kaon Monitor TDC spectrum