DAΦNE - 2020 Summary

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In 2020 DAΦNE, the Frascati lepton collider, was supposed to complete the preliminary phase aimed at providing data to the SIDDHARTA-2 experiment exploiting the well-established Crab-Waist collision approach. Therefore, the main part of the scientific work was finalized to setup, optimize, and tune the main rings optics for collisions.

Initially a low-β optics has been computed, applied and fully characterized. It provides the following values of the betatron functions at the interaction point: $\beta_y^* = 0.008$ m, $\beta_x^* = 0.26$ m. Beam measurements have been used to setup an optimal correspondence between rings optics and both linear and non-linear lattice model. Betatron coupling has been preliminary corrected, down to the order of 1% for both rings, even thanks to the identification of spurious sources of coupling coming from some quadrupole faulty alignment in the interaction region. Collimators have been optimized relying on γ-monitor used for fast luminosity measurements. Collision studies at low current gave very promising results: as shown by beam-beam vertical scan at low current presented in Fig. 1. In this measurement an electron beam carrying a 128 mA total current stored in 100 bunches was let in collision and moved vertically through a 105 mA positron beam current. This scan allows to evaluate the convoluted vertical size of the colliding bunches at the interaction point Σ_y which was found to be of the order of 7.6 μm in perfect agreement with the values estimated using the nominal collision parameters.

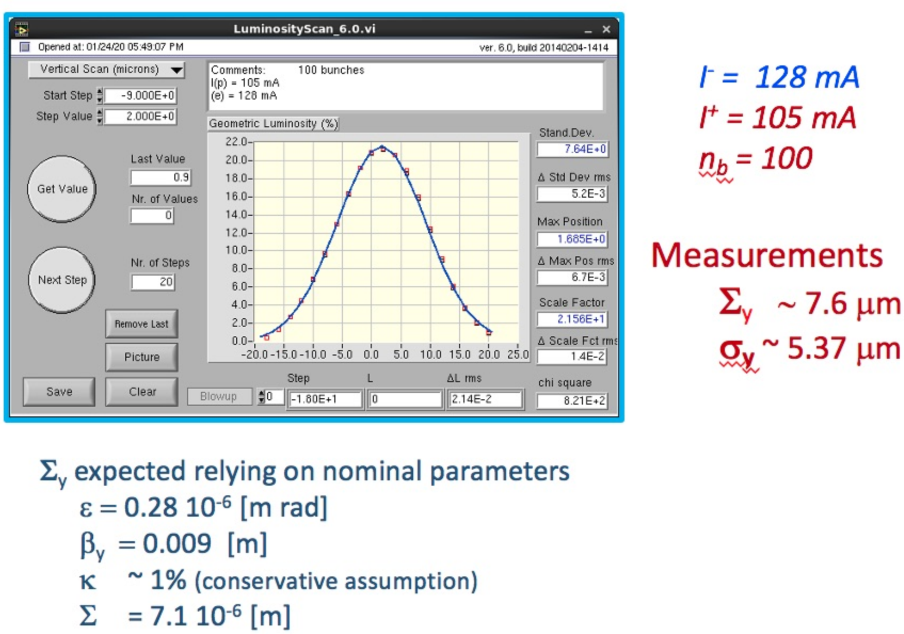

Figure 1: Vertical beam-beam scan at low current with 100 bunches in collision.

After verifying optimal beam-beam interaction, the first luminosity was measured at low current by using the CCALT luminosity monitor. It was of the order of $3.5 \times 10^{31} cm^{-2} s^{-1}$, see Fig. 2. This value was in reasonable agreement with the theoretically estimated luminosity and with the measurement given by the kaon monitor of the SIDDHARTA-2 apparatus.

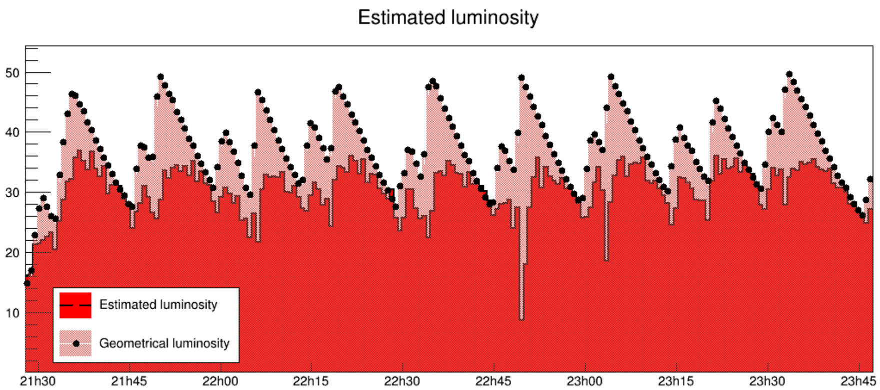

Figure 2: First luminosity measured with the low-β optics.

By the end of February 2020 a Crab-Waist optics, computed relying on the improved ring model, has been applied on both rings. It has the same $\beta^*_{x,y}$ values as the low-β optics, but, in addition, it provides the suitable phase advance between the Crab-Waist sextupoles and the collision point. The optimization of the feedback systems allowed to store 1.8 and 0.8 A maximal current in the electron and positron ring, respectively. Machine studies devoted to characterize the Crab-Waist optics have been abruptly stopped on March 12^{th} due to the restrictions imposed by the Covid-19 pandemic. The collider uptime in the first months of 2020 has been largely dominated by vacuum discharge in the RF plant C of the LINAC and from water leakages from the WIGGLER magnets cooling system. Since June 2020 the DAFNE LINAC has been operating with a dedicated setup in order to provide data to the PADME experiment. Concerning the DAFNE collider, the remaining part of 2020 has been used, compatibly with the limited manpower allowed to be present in the LNF, to implement some consolidation activities: a vacuum leak in the electron ring has been fixed, two power amplifiers of the positron feedback systems have been repaired, a vacuum fault affecting a spare klystron of the main rings RF system has been repaired, and new DAQ systems have been implemented for Sputter ion Pumps and DCCT current monitors.

During Fall 2020, an extensive campaign of measurements using cosmic rays on the CCALT luminometer has been undertaken in order to accurately verify single sector hardware efficiency and energy scale calibration. A further improvement in the CCALT data flow management comes from the usage of KAFKA middle layer in the !CHAOS infrastructure serving as DAQ and Data Storage system. Online dedicated applications will access directly the data stream of the luminometer trough KAFKA interface in order to suppress background and measure instantaneous luminosity with a repetition rate between 1 and 0.1 Hz depending on the available accuracy.