Giordano Diambrini Palazzi: remembering the activity in Frascati and at ISR

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1 Giordano at Frascati

The 50's were exceptional times: enthusiasm and desire to rebuild pervades all levels of the Italian society. A group of young scientists, physicists and engineers chosen from the most brilliant graduates in different universities, was about to transform a vineyard cultivated land in a center of scientific excellence. The group, joined by technicians trained in the industry, is led with infinite energy and great obstinacy by Giorgio Salvini (see Fig.1).

The land was donated on August 4^{th}, 1954 by the Mayor of Frascati. Giordano, just graduated, builds a high sensitivity magnetometer, and this is why - I guess - Giorgio Salvini asks him to take care of the magnetic measurements of the magnets which constitute the synchrotron ring. Giordano also builds the electron-positron pair spectrometer for a precision measurement of the bremsstrahlung spectrum produced by an amorphous target placed inside the pipe.

In the evening, after the intense working hours, well controlled by the Director, Giordano looks for an interesting application of the spectrometer in the recent literature.

The synchrotron is the most powerful machine for electrons in the world! High energy electrodynamics processes in the periodic structure of a crystal show an interesting behavior that allows the production of almost monochromatic and polarized beams. The theoretical predictions of Ferretti [1] and Überall [2] are well understood by Giordano. There are also two experimental results: the first one obtained by Frisch and Olsen at the Cornell Synchrotron [3], the second one by Panofsky and Saxena at SLAC [4]. The results disagree with each other and with the theoretical predictions by Überall.

Giordano realizes that the disagreement is related to the inadequate energy and angular resolution of the instruments. It looks like a perfect opportunity for the use of his spectrometer. The group formed by three people, Gianfranco Bologna, Gian

Figure 1: The Frascati group; Giorgio Salvini is at the center; Giordano Diambrini Palazzi is the first from right in the first standing row (Courtesy of INFN LNF-SIS).

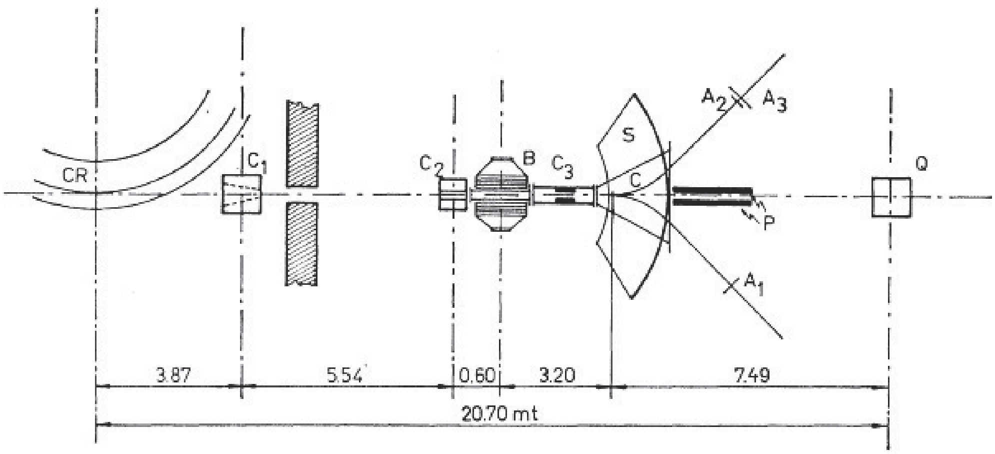

Figure 2: Experimental setup used by the Frascati group for measuring the coherent bremsstrahlung and electron pair production [6].

Paolo Murtas, and Giordano himself, starts performing experiments observing the electron pair production in a Si target placed in the vacuum pipe inside the spectrometer (see Fig.2). The angular accuracy required for pair production in crystal is quite less stringent than that for bremsstrahlung; moreover the goniometer must not be inside the beam pipe.

The results are good and in agreement with the theory, showing the expected central minimum (see Fig.3); they are published in a noteworthy series of papers on the Physical Review Letters journal [5].

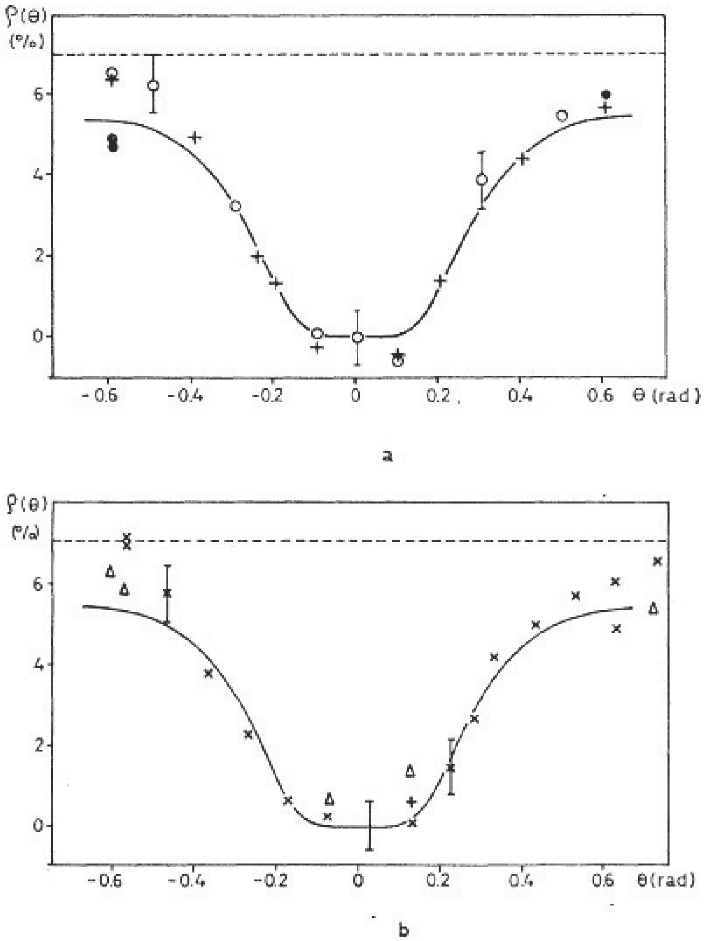

Figure 3: Relative variation of the electron pair production cross section in a silicon single crystal versus θ (angle between γ-ray direction and the crystal axis [100]) [5, 6].

After the successful experiment on the pair production in a crystalline silicon target, the initial group, now joined by Guido Barbiellini, starts a series of measurement of the coherent bremsstrahlung from 1000 MeV electrons in a diamond target.

During the execution of the experiment, the mechanical workshop, led by Guido Di Stefano, an expert optical technician, had developed a high precision goniometer that was installed in the vacuum pipe of the synchrotron.

The decision to use a diamond crystal, that has a high Debye temperature (1870°K) and a small lattice spacing, and the excellent performance of the goniometer turned out to be the key elements to achieve truly amazing results. The photon energy spectra by 1 GeV electrons at various angles (~ 5, 11 and 23 mrad) between the direction of the beam and the crystal axis normal to the diamond surface are in very good agreement with the theoretical predictions (see Fig.4).

The peak position changes as a function of the angle between the electron beam direction and the crystal axis, because the recoil momentum transferred to the crystal during the photon emission must be discrete and coincident with a reciprocal lattice vector of the crystal (see Fig.5).

In the Frascati experiments the emerging photon beam polarization was also measured (see Fig.6), demonstrating the possibility of performing new kind of experiments, such as the meson photoproduction experiments with polarized photons of definite energy.

Following the success of the Frascati experiment, all existing electron accelerators produced high energy and polarized coherent photon beams. In few years important experiments were made thanks to this new tool. The list of the most famous laboratories adopting the new technique is very long and ranges from SLAC, Harvard, MIT, and Cornell in the U.S., to Tokyo, Dubna, Yerevan. In particular a coherent bremsstrahlung beam was produced at the DESY laboratory in Hamburg in collaboration with Frascati (see Fig.7).

2 Giordano and ISR

I had another opportunity to work together with Giordano at CERN. The first experiments at the Intersecting Storage Rings (ISR) were of considerable scientific interest [7]. The Scientific Committee had to select a large number of proposals for the measurement of the elastic scattering at small momentum transfer, which extrapolated to zero momentum transfer is related the total cross section.

The experience was again very interesting also from a human perspective. Carlo Rubbia was leading the experiment with his style, while Giordano, very thoughtful according to his character, was perhaps the most followed.

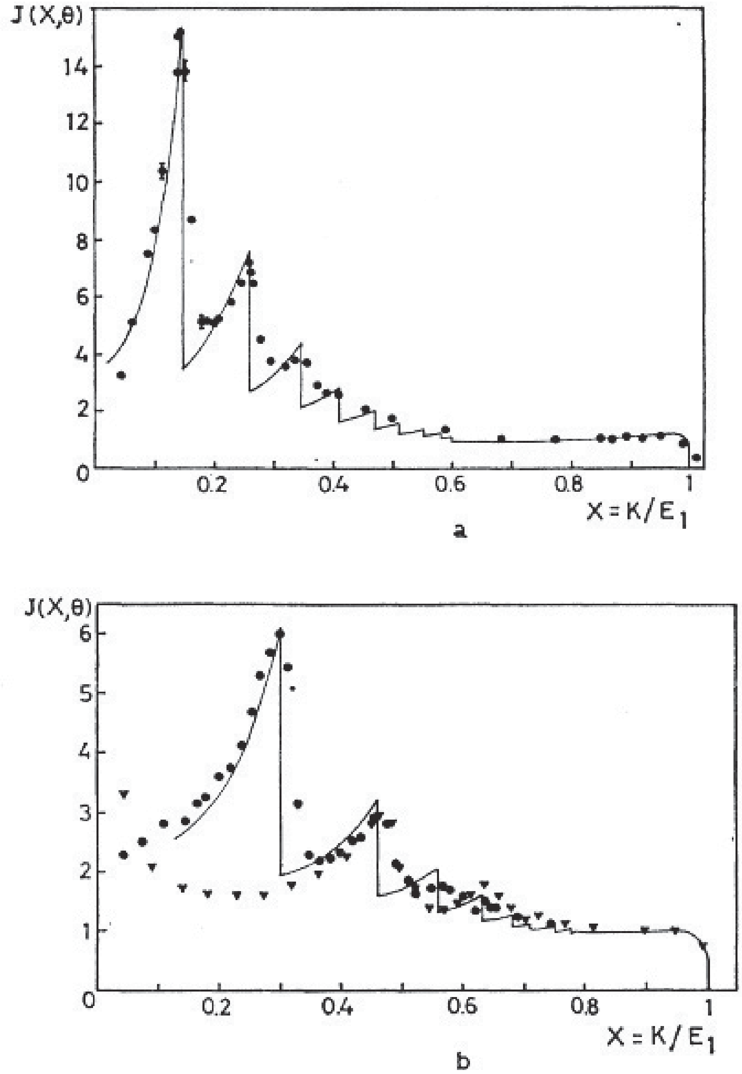

Figure 4: Bremmstrahlung intensity for 1 GeV electrons in a diamond crystal [6].

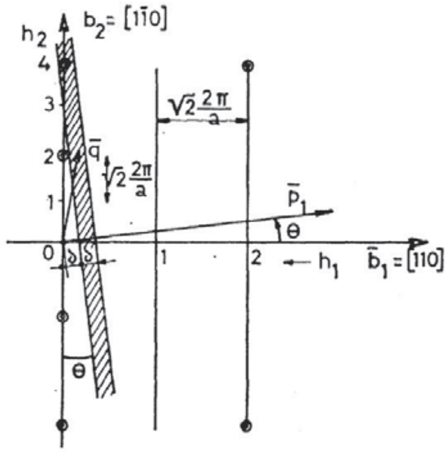

Figure 5: The reciprocal lattice in the incidence plane, with the intersection of the recoil momentum space [6].

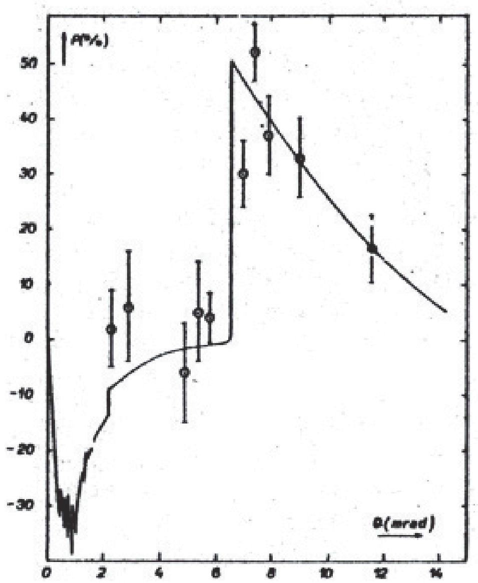

Figure 6: Bremmstrahlung photon polarization as a function of the angle θ between the incident beam and the crystal axis [6].

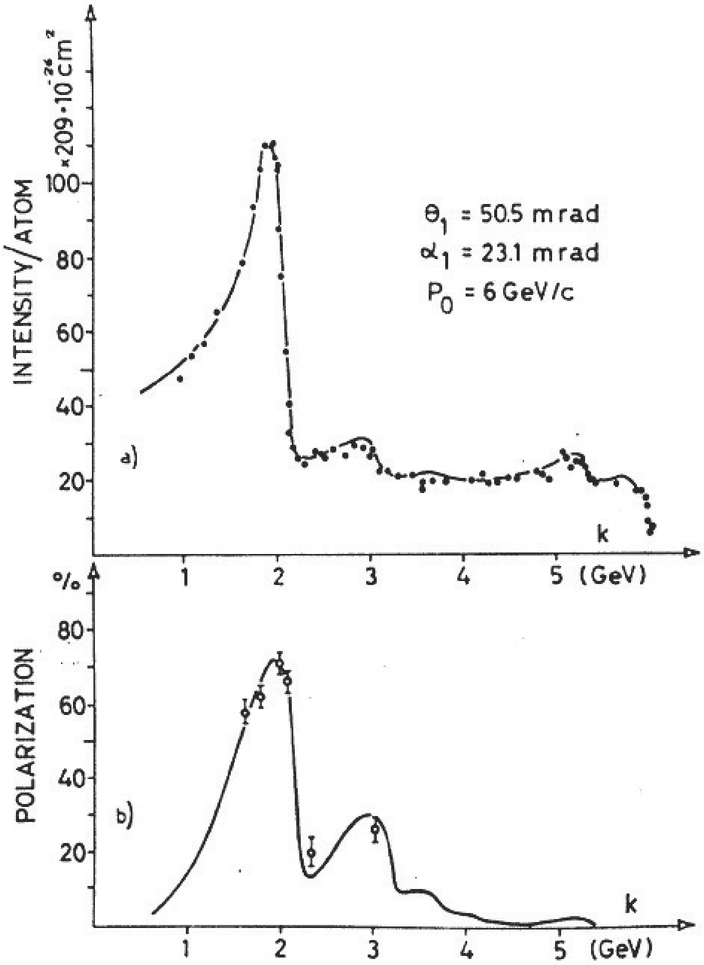

Figure 7: Measurement of the polarization of the coherent bremsstrahlung photons at DESY [6].

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