Laboratori Nazionali di Frascati

LNF-60/61 (1960)

C. Bernardini, G. Corazza, G. Ghigo, B. Touschek: THE FRASCATI STORAGE RING.

Estratto dal: Nuovo Cimento, 18, 1293 (1960)

The Frascati Storage Ring.

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(ricevuto il 7 Novembre 1960)

It was decided in a program meeting held in February 1960 in Frascati to study the possibility of a colliding beam experiment with electrons and positrons. The discussion of this proposal led to the design of the machine, which we want to describe briefly in this letter.

Electrons and positrons of 250 MeV each are stored in a DC weak focussing magnet. The electrons and positrons circulate on the same orbit (this is guaranteed by the *TCP* theorem) meeting in the gap of the radio frequency and in the neighbourhood of three other points spaced along the orbit at 90° from one another. The particles are produced by converting the γ-rays of the Frascati electron synchrotron on two targets placed inside the acceleration chamber and alternately exposed to the beam.

The magnet (which weights about 8 tons) as well as the arrangement of the acceleration chamber are shown in the figures. The orbit contains four « quasi-straight » (weak field) sections, 18 cm in length, accommodating respectively the radiofrequency, injection ports and the « experimental section » in which about one quarter of all the interactions between electrons and positrons should become observable. The doughnut is made of stainless steel and it is intended to evacuate to about 10^{-10} mm giving a lifetime of 250 h to either beam.

The magnet which at the moment is being assembled at Terni is scheduled to arrive at Frascati in November 1960. Magnetic measurements will be carried out in December and work on the beam should start by the middle of January. In the first period of operation we intend to study the process of injection with the purpose of finding an optimal target arrangement. Electrons and positrons will be registered by observing their synchrotron radiation.

Application of a statistical theory of the injection process shows that only about 5 electrons/s should be accumulated in the ring. This means that in 100 h of charging one should be able to accumulate about $1.8\cdot 10^6$ electrons. To observe 1 pulse per minute of the mon-

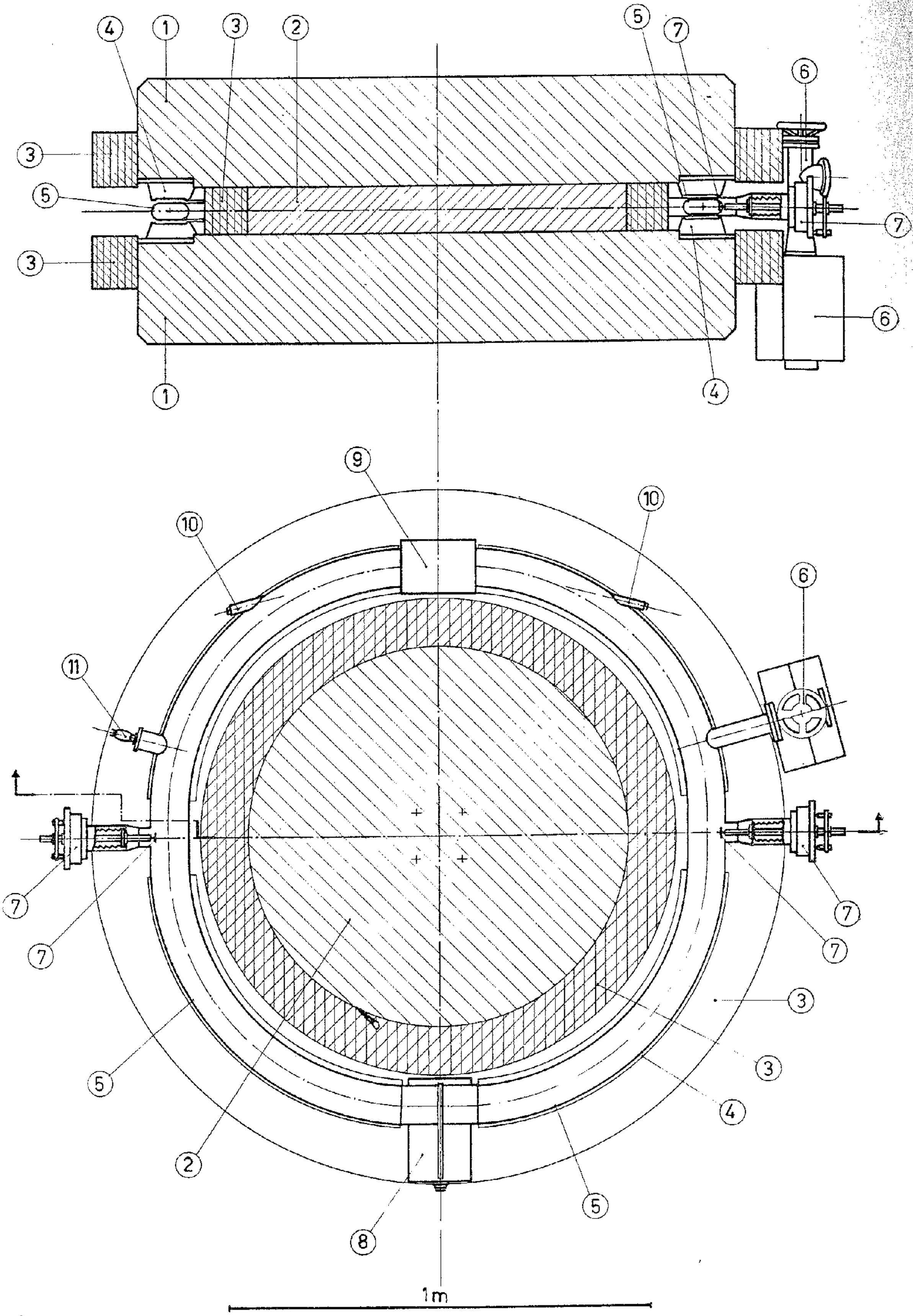

Fig. 1. – Elevation and plan section of the Frascati Storage Ring (anello di accumulazione = AdA): 1) magnet yoke; 2) magnet core; 3) coils; 4) polepieces; 5) doughnut; 6) titanium pump; 7) injection ports; 8) RF cavity; 9) experimental section; 10) windows for the observation of the synchrotron radiation; 11) vacuum gauge.

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itoring reaction

$$e^+ + e^- \to 2\gamma \, ,$$

one has to accumulate about 10^8 particles of either kind. Defining as a « successful » ring one which gives more than 1 pulse per minute of the monitoring reaction it is seen that according to the statistical theory the machine should not be successful by a factor of about 50. To bridge this gap it is hoped that we can profit from some of the following factors:

Distance synchrotron — storage ring	5
Non linear injection effects	10
Target improvements	20
Improved synchrotron intensity . .	4

With a successful machine a study of the pion-pion interaction in the process

$$e^+ + e^- \to \pi^+ + \pi^- \, ,$$

seems possible and feasible — provided that this interaction is strong enough —; the production of muon pairs in an experiment intended as a check of quantum electrodynamics will require a higher intensity (by about a factor 10). If such an intensity can be achieved the measurement of the π^0 lifetime by means of the reaction

$$e^+ + e^- \to \pi^0 + \gamma \, ,$$

does not seem completely impossible.

The following is a list of data concerning the beams circulating in the ring:

Length of orbit	408	cm
Radio frequency ($k=2$)	147	MHz
Radio voltage	10	kV
Length of bunches . . .	16.7	cm
Radial width of bunches	.22	cm
Height of bunches (at 10^{-10} mm)	$5.6 \cdot 10^{-4}$	cm
Radiation loss/revolution	580	eV
Lifetime of beam at 10^{-10} mm	250	h

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It is a pleasure to give our thanks for valuable help in the planning and execution of the project to the staff of the National Physical Laboratories in Frascati and in particular to Dr. SACERDOTI for the design of the magnet and to Dr. PUGLISI for his work on the radiofrequency.

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