# A Brief Description of TRISTAN Project

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"TRISTAN" is a nickname abbreviated from the " Transposal Ring Intersecting Storage Accelerators in Nippon". The project is under consideration among the scientists in the field of high-energy physics and high-energy accelerators in this country as the future plan of the present proton synchrotron at KEK.

The original TRISTAN Project was composed of three rings installed in the same tunnel; two of them are superconducting and the remaining one is conventional. Now, however, considering financial and technical feasibilities we modified the original scheme to divide the project into Phase I and Phase II. In Phase I, two rings will be built; both conventional or one superconducting and another conventional. Thereafter, further rings will be added at Phase II to achieve the final goal of the project.

The circumference of these transposal rings are about 2 km, i.e. 6 times of the present main ring. Using superconducting rings as the proton intersecting storage accelerators, one could obtain the maximum center-of-mass energies of about 360 GeV. The protons extracted from the present main ring will be injected into a conventional ring and accelerated upto 50 GeV before acceleration in the superconducting rings. Thus one can decrease the magnitude of magnetization and consequent a.c. losses in the superconducting rings. The transition energy will also be safely passed through during a fast acceleration in the conventional ring.

After it acted as a proton booster, the conventional ring can be used as an electron or a positron storage accelerator upto 17 GeV, giving the possibility of electron-positron, electron-proton and positron--proton colliding beam experiments. In Phase I, a 17 GeV electron-beam collision with a 70 GeV proton beam will be carried out leading to the experiments at the center-of-mass energies of 70 GeV, or with a 180 GeV proton beam at the center-of-mass energies of 110 GeV.

The proton or electron beams accelerated one of the composed rings could also be extracted to experimental halls for fixed target experiments, such as neutrino experiments. As a future option, an anti-proton beam could be obtained and used for $p-\bar{p}$ or $e-\bar{p}$ colliding beam experiments. Therefore, one will be able to carry out various types of high-energy physics experiments by choosing different sets of transposal rings. The

main aim of this project, however, will be directed to the e-p colliding experiments at the energy region where weak processes involving neutrino would become comparable to electromagnetic processes or large momentum-transfer strong interactions.

Preliminary parameters of p-p and e-p systems of TRISTAN project are listed in Table I and Table II, respectively. In Fig.1 is shown an outline plan of the TRISTAN project. It should be noted here that the notable technical developments are expected in many parts of the accelerators; in particular, injection and acceleration of strong electron or positron beams should be investigated in addition to developments of the superconducting magnet system. In this respect, a 2.5 GeV electron linac designed for the purpose of providing electron beams for a synchrotron radiation facility would also be employed as a powerful injector for the TRISTAN electron ring. The laboratory is now in an effort to start the construction of the "Photon Factory".

The other aspects of the TRISTAN project in the course of its design study have been reported in several papers and are given in the following "References".

References


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Table I

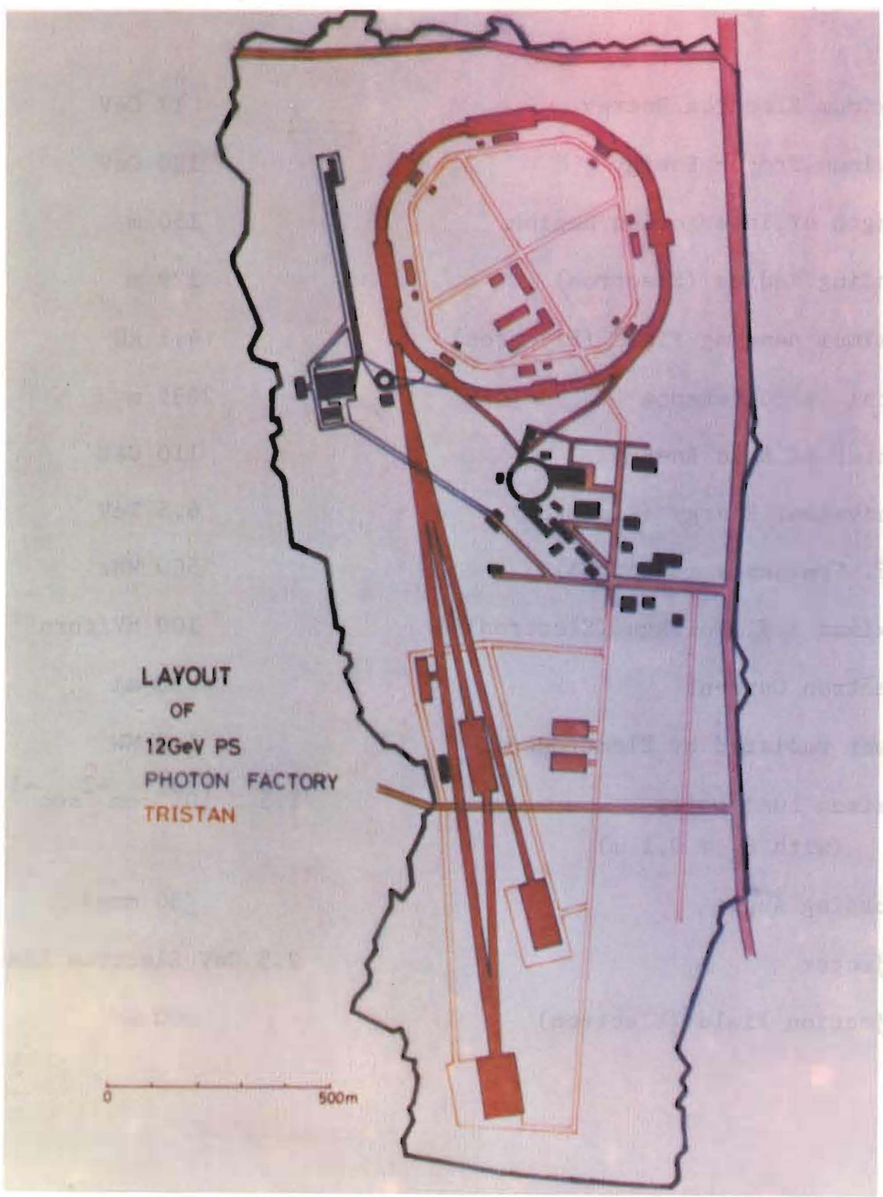
PRELIMINARY PARAMETERS OF TRISTAN pp RINGS

| | |
|---|---|
| Injection Energy | 12 ∿ 50 GeV |
| Maximum Final Energy (Each Ring) | 180 GeV |
| Number of Intersecting Points | 4 |
| Average Radius (Curved Section) | 204 m |
| Long Straight Section Length | 150 m |
| Short Straight Section Length | 30 m |
| Total Circumference (6 × 12 GeV Ring) | 2035 m |
| Maximum Magnetic Field | 45 kG |
| Total Stored Energy | ∿70 MJ |
| Acceleration Time | ∿150 sec |
| Number of Betatron Oscillations | 22.25 |
| Cell Structure | Separated Function FODO |
| Number of Cells (Each Ring) | 68 |
| Cell-Length | ∿16.4 m |
| Full Vacuum Chamber Aperture | 6 cm |
| Crossing Angle | $\lesssim$77 mrad |
| Total Charge (Each Ring) | $6 \times 10^{14}$ |
| Circulating Current (Each Ring) | 15 A |
| Luminosity (180 GeV) | $7.5 \times 10^{31}$ $cm^{-2}sec^{-1}$ |
| Maximum Luminosity for Collinear Crossing | $10^{34}$ $cm^{-2}sec^{-1}$ |

Table II

PRELIMINARY PARAMETERS OF TRISTAN ep RINGS

| | |
|---|---|
| Maximum Electron Energy | 17 GeV |
| Maximum Proton Energy | 180 GeV |
| Length of Interaction Region | 150 m |
| Bending Radius (Electron) | 129 m |
| Maximum Bending Field (Electron) | 4.1 kG |
| Total Circumference | 2035 m |
| Center of Mass Energy | 110 GeV |
| Equivalent Energy (Electron) | 6.5 TeV |
| R.F. Frequency (Electron) | $\sim$500 MHz |
| Maximum R.F. Voltage (Electron) | 100 MV/turn |
| Electron Current | 30 mA |
| Power radiated by Electrons | 1.5 MW |
| Maximum Luminosity (with $\beta_e^* \approx 0.1$ m) | $1.5 \times 10^{31}$ cm$^{-2}$sec$^{-1}$ |
| Crossing Angle | $\lesssim$30 mrad |
| Injector | 2.5 GeV Electron Linac |
| Injection Field (Electron) | 600 G |


LAYOUT
OF
12GeV PS
PHOTON FACTORY
TRISTAN
0
500m