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Introduction - Status of the SLAC Linear Collider*

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In this session on High Energy e^+e^- Experiments we shall hear four presentations on recent results obtained at TRISTAN, the highest energy e^+e^- storage ring presently in operation. We will not hear results from the Stanford Linear Collider, because this machine has unfortunately not yet reached a stable mode of operation. We shall instead begin this session with a brief report on the status of the SLC.

The SLC was designed and built with a dual goal: a) to test the concept of e^+e^- linear colliders for future extension to higher energy and b) to produce a large number of Z^0's to allow for precision tests of the Standard Model and searches for new couplings.

To present the status of the SLC and relate it to its design goals, the values of the parameters most relevant to the luminosity are summarized in the table below. The luminosity of the SLC can be written as follows:

$$\mathcal{L} = \mathcal{L}_o \times \frac{f}{30\,\mathrm{Hz}} \frac{N_-}{10^{10}} \frac{N_+}{10^{10}} \frac{4\,\mu\mathrm{m}}{\sigma_x} \frac{4\,\mu\mathrm{m}}{\sigma_y}$$

where $\mathcal{L}_o = 2 \times 10^{27}\mathrm{cm}^{-2}\mathrm{s}^{-1}$, f is the collision frequency, N_- and N_+ represent the number of electrons and positrons at the interaction point, and σ_x and σ_y are the transverse beam sizes for the larger of the two beams. At the peak of the Z^0 resonance, the Z^0 rate per day will be $5\ \epsilon\ \mathcal{L}/\mathcal{L}_o$, where ϵ is the average efficiency for colliding beams. The goals for the initial phase of the machine take into account a lower repetition rate and the present limitation of the beam currents due to the bunch lengthening in the damping rings and the positron source. The larger bunch sizes are caused primarily by emittance growth in the linac and residual dispersion in the arc transfer lines and the final focus section.

The data in the table illustrate that the basic concept of a linear collider can be, and to a large degree has been, realised. At the interaction point, beam sizes of

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Table: Parameters of the SLC Beams at the Interaction Point.

Parameters	Design Goal	Initial Goal	Achieved Value
f	180 Hz	60 Hz	30 Hz
N_-	7×10^{10}	1×10^{10}	1.5×10^{10}
N_+	7×10^{10}	1×10^{10}	0.7×10^{10}
$\sigma_x \times \sigma_y$ (μm $\times \mu$m) : e^-	1.6 × 1.6	4 × 4	3 × 5
$\sigma_x \times \sigma_y$ (μm $\times \mu$m) : e^+	1.6 × 1.6	4 × 4	5 × 6
Luminosity $\mathcal{L}/\mathcal{L}_o$	3000	2	0.5
Efficiency ϵ	0.67	0.1	?
Z^o/day	10,000	1	

a few μm have been measured routinely. Also, the mutual deflection of the beams and so-called beamstrahlung, radiation emitted by one beam passing through the intense electromagnetic field of the other beam, have been observed and are being used to monitor beams position and size.

To date, the Mark II detector has recorded some 20 hours of colliding beam data with an estimated integrated luminosity of 0.01 $\mathcal{L}_o$. The main asset of these data has been the study of beam-related backgrounds. They fluctuate tremendously, but so far, they have not posed serious problems for off-line event reconstruction, though they do increase the trigger rate and thereby the detector deadtime. During the next few months, large iron toroid magnets will be installed in the final focus section of the machine tunnel to reduce the muon flux generated by collimators in this section.

The principal problem encountered during the last few month has been the very low efficiency for obtaining and maintaining colliding beams. It is, indead, a major challenge to consistently operate various components of the 22-year-old linac at specifications well beyond the their original design. Computer control and feedback systems are being extended, linac components are being replaced and modified, and a variety of improvements are underway in the damping rings and at the positron source. Expectations are high that the initial goal of this machine will be reached and surpassed in the near future.