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PROGRESS AND COMMISSIONING OF THE SLD CHERENKOV RING IMAGING DETECTOR*

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Abstract

We report the recent progress of the SLD Cherenkov Ring Imaging Detector. All of the individual components of the device (TPCs, mirrors, liquid radiator trays) have been completed and installed. Almost half of the electronics packages are installed and operational, and the data acquisition system has been commissioned. The liquid C_6F_{14} recirculation system is functioning. The drift gas supply systems are operating well with TMAE, and the gaseous Freon C_5F_{12} recirculator is being brought on-line. Our monitor and control systems are fully functional. The commissioning of all 40 TPCs at full operating voltage has gone very smoothly. The system shows a remarkable immunity to the SLC backgrounds, and yields very clean events, while operating with a single electron sensitivity.

A large Cherenkov Ring Imaging Detector (CRID) has been constructed and is being commissioned for the SLD detector at the SLAC Linear Collider (SLC).[1] The barrel component of the CRID will provide SLD with excellent particle identification over the central 70% of its solid angle (Fig. 1). A combination of gaseous and liquid radiators allows $\pi/K/p$ separation up to 30 GeV/c and e/π separation up to 6 GeV/c. The Cherenkov photons are directed onto quartz-windowed time-projection chambers (TPCs), where they photo-ionize a 0.1% concentration of tetrakis(dimethylamino)ethylene (TMAE)[2] dopant in C_2H_6 drift gas at atmospheric pressure. The resulting single photoelectrons are drifted up to 1.27 m to proportional wire planes of 7 μm diameter carbon filaments with charge-division readout.

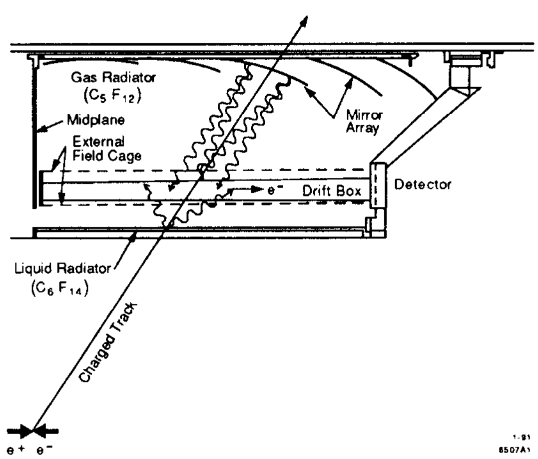

Fig. 1: Quarter section of the SLD barrel CRID showing its principal components.

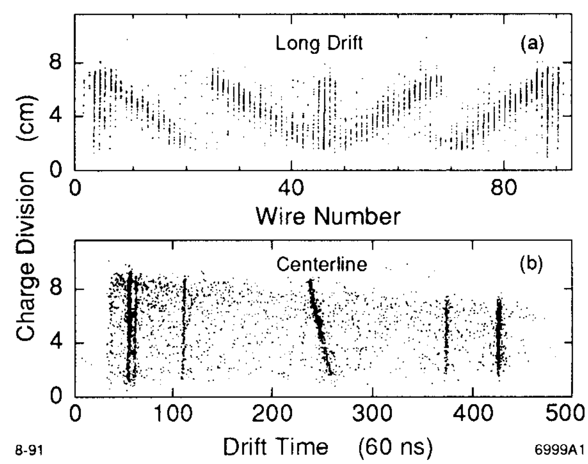

Fig. 2: Representative results from UV fibers on TPCs: (a) in a plane parallel to the detector wire plane; and (b) in a plane down the centerline of the TPC.

All of the individual components (400 mirrors,[3] 40 TPCs,[4] 40 liquid radiator trays) of the SLD barrel CRID have been completed and installed since November 1990. Electronics packages[5] have been installed and are operational on almost half of the 40 TPCs. All of the TPCs and detectors[6] have been commissioned at full voltage. The CRID vessel has been filled with CO_2 in place of the perfluoro-*n*-pentane (C_5F_{12}) gaseous radiator. The liquid perfluoro-*n*-hexane (C_6F_{14}) has been successfully recirculated through 6 of the 40 trays, while achieving low levels of O_2 contamination.

The C_5F_{12} radiator gas is stored in the liquid phase at −80°C, and recirculated through the CRID vessel by an electrically driven turbine. The C_5F_{12} is cleaned of oxygen and water vapor by a mixture of activated copper and 13X molecular sieve.* The temperature of the CRID vessel is maintained above the condensation point of C_5F_{12} (30°C). We have successfully recirculated a 50% C_5F_{12}/50% N_2 mixture through one of our empty endcap CRID vessels (about 3000 *l* volume), while maintaining pressure to within 1 Torr above atmospheric pressure.

The drift gas delivery system has been operational for six months, using filtered CP-grade ethane† which we have found to have good UV transparency above 1600 Å. Our pressure control system[7] has been successfully operated since the installation of the TPCs, and has kept pressure differences across the quartz windows to less than 2 Torr. The doping of the drift gas with TMAE is accomplished by bubbling the C_2H_6 through liquid TMAE held at a known temperature. We have constructed two large bubblers, each capable of supplying TMAE for the designed ethane flow of 10 *l*/min.[8] Currently, we have operated the TMAE at temperatures of up to 15°C.

We purify the TMAE for operation by mixing it repeatedly with HPLC-grade water and letting contaminants[2] be washed away with the water. The TMAE is then dried and purified by gravity-draining through 3Å and 4Å molecular sieve and silica gel. About 5 *l* of TMAE, enough for two months of running at the nominal temperature of 28°C, have been purified in this manner.

The quality of the various CRID gases is monitored in a system with the capability of measuring electron lifetimes, UV transparency, and trace oxygen or water vapor content.[7] We measure the oxygen content in our drift gas returns to be typically 1 ppm, and have found the O_2 content to be a sensitive indicator of leaks in the system. During TMAE running, we monitor the drift gas returns for electron lifetime, using a miniature ion chamber,[9] and we have found lifetimes consistent with those of the cleanest drift gas.

A system of UV optical fibers[4] is attached to all 40 TPCs for the purpose of calibrating drift velocities during operation, and measuring spatial distortions. It also allows us to monitor the detection efficiency for single photoelectrons and to calibrate the charge division. This system has been operated during data runs, and

*Vacuum Atmospheres Co., Hawthorne, CA.

†Liquid Carbonic, San Carlos, CA; filters are 13X molecular sieve and Oxysorb from Messer Grieshiem GMBH, D-4000 Düsseldorf 30, FRG.

single photoelectrons from the fibers have been observed (see Fig. 2). By looking at the oblique fibers, charge division can be seen to be working well in our system.

The commissioning of all the TPCs at full operating voltage has gone very smoothly. The system has shown a remarkable immunity to the SLC backgrounds and has yielded very clean events, with the CRID operating with a single electron sensitivity. Analyses are underway to study the alignment of the CRID with the SLD Central Drift Chamber, as well as to search for rings in the approximately 50 Z^0 candidates collected with C_6F_{14} radiator present.

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