Progress Report and Renewal Request for R&D on

Silicon Drift Chambers

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Summary

We present a brief summary of work accomplished at Princeton U. in FY90 towards a silicon drift chamber subsystem at the SSC. A budget of **$60k** is proposed for FY91 to continue this work. We also present an interim budget request of **$15k** for the first quarter of FY91.

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1 Progress Report

Work at Princeton towards a silicon drift chamber subsystem in FY90 was funded by the SSC Generic R&D program, with an increment of $35k still awaited from the SSC Subsytem R&D program.

One third of the Generic funding was for detector simulations. We have purchased two VMS and two UNIX workstations for this. Extensive simulations of a B-physics experiment for the SSC have been made, as reported in the Bottom Collider Detector Expression of Interest (EOI0008, May 25, 1990), and the BCD Response to the SSC PAC (July 11, 1990).

The simulations show, among other things, the need for a precision vertex/tracking chamber with element size smaller than that in present silicon vertex detectors. This arises because of multiple-hit confusion in larger detector elements. The silicon drift chamber, when configured as a tracking device rather than a pixel detector, offers performance intermediate between a silicon strip detector and a full pixel detector at a cost perhaps less than a silicon strip detector.

In FY90 we have interacted with the Rehak group at BNL in bringing up a set of circular silicon drift chambers. Recently we may have been of some help in identifying a difficulty in the mechanical assembly. Very recently M. Wall spent two weeks at BNL participating in the tests of an older silicon-drift chamber. Once several of the new detectors are working we should be able to obtain one for testing.

Meanwhile we have been accumulating various pieces of test equipment, but the test setup is not complete. We have assembled an infrared diode laser that can penetrate several mm of silicon, simulating the line deposition of ionization of a minimum-ionizing particle. With suitable optics the laser pulse can be split to test double hit and double pulse resolution. The test setup can be placed in a magnetic field to study the effect of $E \times B$ drifts. We have an oven that can regulated to 0.1°C to examine the temperature stability of the drift velocity.

We have purchased a PC-clone computer for experimental control, various precision electronic test equipment, two oscilloscopes, 8 channels of 80-Msamples/sec CAMAC transient digitizers, and 18 channels of front-end electronics of BNL design.

While awaiting the arrival of the silicon drift chamber, much of this test equipment has been put to use in our straw-tube R&D program.

Surveys of the state of R&D on silicon drift chambers have been presented by K.T. McDonald at the DPF90 Conference (Rice) and at the PANIC Conference (MIT).

2 Budget Proposal for FY91

Once a silicon drift chamber is available at Princeton we can commence local activity on our R&D program, which has been generously funded already. Funds remain to complete the test setup as originally envisaged. We do wish to continue the program, and request modest additional funding. The most obvious need not previously anticipated is additional channels of readout electronics, for which we seek $5k. We also seek $5k for an addtional 2-channel 1-GHz plug-in amplifier for the high-speed digital oscilloscope requested as part of our Straw-Tube Subsytem Proposal.

On Sept. 6 we will visit H. Kagan of OSU, who has been constructing a new set of silicon drift chambers in a rectangular geometry. He has allocated a few channels of these devices for large cells, as would be suitable for a tracking device. If possible, we would like to obtain a pair of these detectors and try out the scheme of back-to-back readout needed to associate hits with the proper interaction time in a high-rate enviroment. Such capability is not needed in Kagan's application at CLEO, but it vital for use as the SSC. This project will likely entail new costs that we roughly estimate at $10k.

We will continue our simulation program, and would benefit from increased computing power. We seek $10k for this.

We also request $5k for travel, housing at BNL, and miscellaneous operating expenses.

In summary:

1. Permanent Equipment

1. 2-channel, 1-GHz plug-in amplfier for digital oscilloscope $5k
2. Test equipment for rectangular silicon drift chambers $15k
3. Unix workstation with hard disk $15k

Total Permanent Equipment $35k

2. Materials, Supplies, and Travel

1. Supports for silicon drift chambers $5k
2. Hybrid premaplifier/shapers $5k
3. Travel, housing, miscellaneous operating expenses $5k

Total Materials, Supplies and Travel $15k

Indirect Costs of 67% on Materials, Supplies, and Travel $10k

3. Total $60k

3 Interim budget Proposal for First Quarter FY91

1. Permanent Equipment

1. Test equipment for rectangular silicon drift chambers $7,000

Total Permanent Equipment $7,000

2. Materials, Supplies, and Travel

1. Miscellaneous materials and supplies $4,800

Total Materials, Supplies and Travel $4,800

Indirect Costs of 67% on Materials, Supplies, and Travel $3,200

3. Total $15,000

4 Personnel

In FY91 J.G. Heinrich and C. Lu will work full time on SSC Subsystem projects, split between the silicon drift chamber and the straw tube efforts. K.T. McDonald will spend 90% of his researh time on these projects. Graduate Student M.E. Wall will spend all of his research time on the silicon drift chamber project. In addition, we benefit from access (at no cost to the SSC) to the technical staff of the Princeton High Energy Physics group which includes 2 mechanical engineers, 2 mechanical technicians, 1 electrical engineer, and 1 electrical technician. All salaries of the above people are supported by the DoE HEP Division, except for K.T. McDonald (academic year salary from Princeton Unviersity).