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An important criterion for detectors near the target in the MPS is the need to minimize the amount of material in the path of particles entering the main drift chamber system. This is difficult to achieve with standard wire chambers because of the need to support tension in the anodes and field wires. The time projection chamber can have a significant advantage in this case since the active volume is the drift region, and the parts of the chamber with critical wires can be located very much "out of the way," near the magnet pole. Other than gas containment, one has just to arrange to support a field cage to provide a uniform electric field. Since the pioneering work of the PEP4 TPC many have been built, each tailored to a specific experiment. Figure 1 shows a TPC module built for E-810, a study of charged particle production by ion beams at the AGS. This technique was chosen

Figure 1

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because the "3D" nature of the TPC is ideally suited to the high multiplicities expected in the collisions of relativistic silicon ions with target nuclei; 100 outgoing charged particles is not unusual in silicon/lead central interactions. The active volume of each module is 60 cm high, 60 cm wide and 42 cm long. The readout is achieved via rows of short anode wires parallel to the incoming beam. The anode wire spacing is 1/10 inch, with 12 rows of 256 wires each. The readout electronics is based on custom hybrid circuits, each containing 16 channels of amplifier, comparator, and time digitizer. Circuit boards holding these hybrids are mounted directly on the chamber, minimizing interconnections. An event from a recent test run with two smaller test modules is shown in Fig. 2. This is a central collision of an oxygen ion on a lead target. In spite of the fact that only 20% of the final setup was used the pattern recognition worked quite well, reconstructing 78 tracks from the target. This illustrates the ability of TPC's to handle very high multiplicities.

Figure 2

The principle problem in the use of TPC's in the SEB experiments at the MPS is the long drift time, ~ 20 microsec/meter. Using a typical beam rate at the MPS, 2×10^6 per sec., and with a target thickness of .05 interaction lengths one gets an average of one event per 10 microsec, or about two accidentals per

event. For many detectors this would be prohibitive. However, the superior tracking of the TPC allows very efficient track reconstruction, easily accomodating 10 typical events. In addition, out-of-time tracks are displaced in the drift direction by 1 mm. per 20nsec time difference. Thus the accidental events can easily be removed from the data. Hence an intrinsically slow detector, the TPC, can be used for relatively high rate experiments. Another question to do with rate is the potential track distortion due to positive ion buildup in the drift region. It is clearly necessary to gate the TPC so that amplification takes place only on triggered events. Gating efficiencies of 10^4 have been achieved in E-810. As a further bonus, the slow drift speed of positive ions permits one to close the gate after the electrons pass through, but before the ions feed back into the active region of the TPC. The final question of distortion due to positive ions concerns the ions from dE/dx . Studies for E-810 have shown that a TPC with good gating functions with an incident flux of 20,000 oxygen ions/sec in a few cm^2 . This corresponds to $> 10^6$ minimum ionizing particles, substantially more than the flux expected in a target region detector.

Having established that the TPC is fast enough for a target region detector at the MPS, let us consider some of its advantages. As discussed above, 3D point information is obtained by measurements in a single readout plane. Thus a relatively small number of readout channels covers a large number of pixels. The electronics for E-810 uses a custom hybrid circuit whose cost per channel is ~ \$25, a figure comparable to typical PWC readout schemes, leading to a low cost for a powerful detector; in addition the 12,000 readout channels used in E-810 are available for use in a target region detector during SEB operation, really reducing detector costs!