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The Recent Upgrading of the Brookhaven Double MP Facility and Plans for the Future

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The recent improvements of the Brookhaven tandems have resulted in operation at higher terminal voltges for both accelerators. MP6 can now operate at about -11 MV when used as an injector for MP7. The terminal voltage of MP7 can easily reach 16 MV, and 16.5 MV operation has been used for one experiment.

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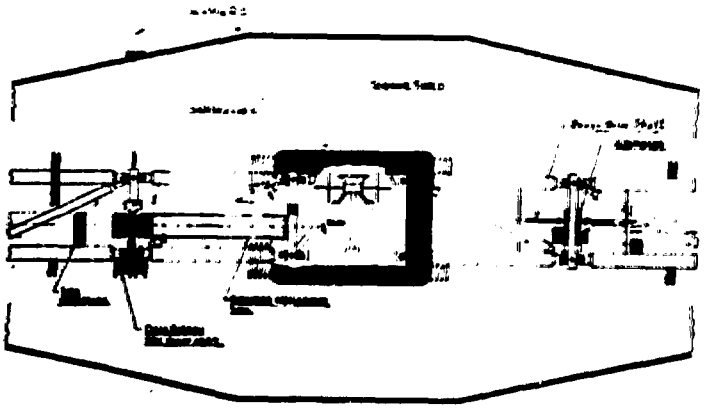


Figure 1

The MP7 improvements are schematically shown in Fig. 1. A smooth stainless steel terminal shield, identical to the one shown for MP7, has also been installed in MP6. Also, the shorting system for tube conditioning is identical in both machines.

The terminal shields improve the electrostatic configuration of the terminals. They help contain particles that would otherwise drop to the floor of the tank and they provide improved shielding of the systems contained in the terminals. As expected, the improvement due to these terminal shields is most noticeable for negative operation. While neither machine could previously exceed -9 MV, MP6 has now operated at -11 and MP7 has reached -12 MV.

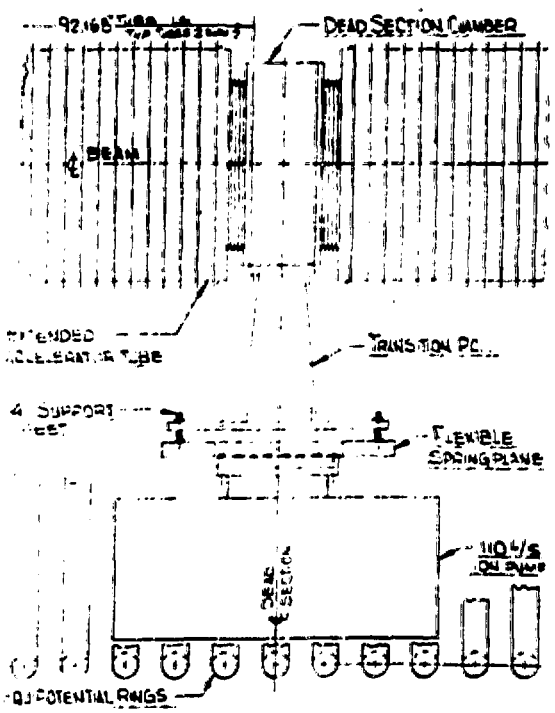


Figure 2

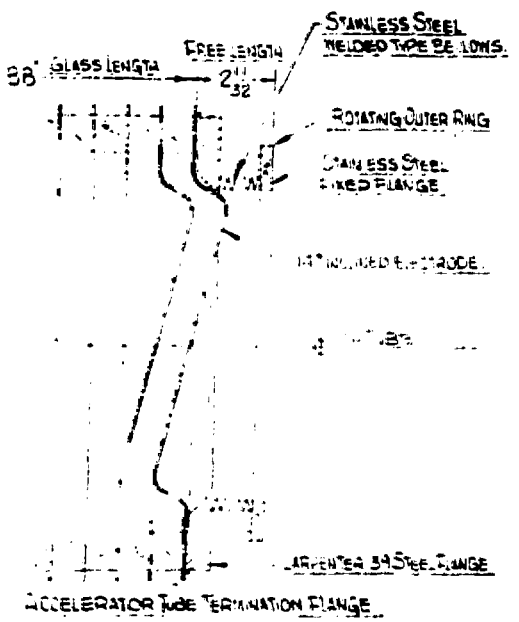


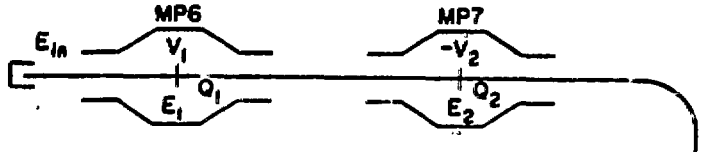
Figure 3

Ion pumps were installed in the three low-energy MP7 dead sections and in the central high energy dead section of both accelerators. These are 110 l/sec ion pumps powered by drive shaft operated generators. Figure 2 shows in more detail how these pumps are mounted in the MP7 dead sections. Since the extended acceleration tubes protrude into the previously field-free regions no room for pumping would have been available between the tubes if the standard tube terminations had been used. Therefore, special terminations were designed which incorporate flexible bellows as can be seen in Fig. 3. This arrangement also decouples any deformation of the end flange from the first glass insulator.

The MP7 acceleration tube sections numbers two through seven have been extended from the original 72 inches to 88 inches and sections numbers 1 and 8 to 96 inches. Of these 96 inches, 16 are half-gradient straight sections and therefore the gradients on the inclined sections of all tubes are the same.

The exit of tube number 8 has been provided with these 16 straight sections to make the accelerator symmetrical so it can be used together with MP6 in a new accel-decel configuration, schematically shown in Fig. 4. The purpose is to produce very low energy highly stripped heavy ions which are of great interest for some atomic physics

experiments. These low energy highly charged ions would be deflected too much by the inclined field as they exit the accelerator.



$$E_1 = V_1 + E_{in}$$
$$E_2 = V_1 + Q_1(V_1 + V_2) + E_{in}$$
$$E_f = V_1 + Q_1(V_1 + V_2) - Q_2 V_2 + E_{in}$$

Figure 4

Plans for future developments of the facility which have been proposed but not yet funded include the addition of a booster cyclotron based on an existing large surplus room temperature magnet with which one could reach 150 MeV/amu oxygen beams and 30 MeV/amu uranium beams. A layout of the proposed facility is shown in Fig. 5. A beam transport could then be built to the Brookhaven high energy alternating gradient synchrotron (AGS) and beams from the cyclotron could be injected and further accelerated to 11 GeV/amu. Finally, once the colliding beam accelerator is built at Brookhaven, heavy ions from the AGS would be further accelerated to 400 GeV/amu center of mass energy. The range of heavy ion energies that would then be available at Brookhaven is shown in Fig. 6.

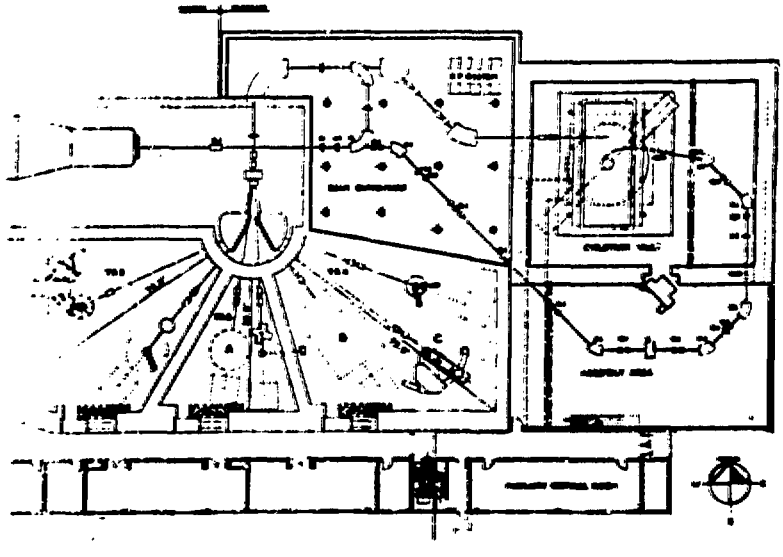


Figure 5.

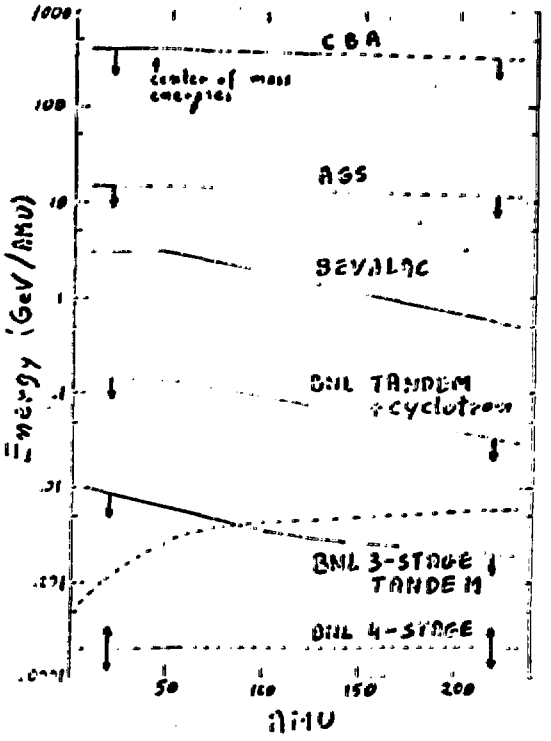


Figure 6

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Discussion

Schmitt: How do you get power to your ion pumps?

Thieberger: We have a power drive shaft system and a 3 kW generator in each dead section where there is an ion pump.