Hadronic Targets

• There is a lot of experience with targets used to produce hadronic beams.
  – At first glance relevant parameters (i.e. heat deposition) look similar
  – Physical process is different
    • Interaction lengths vs. radiation lengths
    • Hadronic production vs electromagnetic shower
    • Beam rates are different
  – Fermilab experience points to using metal such as copper, nickel for superior shock-stress properties
  – Question .. Is the antiproton production experience really relevant
Fermilab Antiproton Production

- Parameters
  - Hadronic production (electromagnetic shower)
  - 2 e12 protons/batch (4 e10 electrons/pulse)
  - 84 bunches (1.6 microseconds)
  - 120 GeV (30 GeV)
  - 0.5 Hz (120 Hz)
  - 0.5 mm (0.8-1.0 mm)
Fermilab Pbar Target Assembly

Figure 2.2 Cross section of target assembly
NLC - The Next Linear Collider Project

Fermilab summary from Jim Morgan

• The ideal target would be very short (dense) with a small beam spot size.
• Tungsten/Tungsten alloys were in the original design report, but they did not hold up well operationally because the localized heating caused melting and damage from thermal shock. The Tungsten family can only withstand an energy deposition of about 200 J/g.
• Copper targets were used in the '86–87, '88–'89 collider runs as well as most of Run I. Copper could take about 3 times the energy deposition of the heavy metal targets with only about a 7% reduction in yield. As Main Ring intensities increased about 3E12 per pulse, there were indications of local melting in the target.
Jim’s summary continued

- Nickel began to be used during the latter part of Run I. It can withstand about twice the energy deposition of Copper. Frank experimented with thin disk targets in an effort to enhance yield. Although there was a yield enhancement in AP-2, it was not observed in the Debuncher. We haven't yet had any problems with Nickel, but calculations suggest that we are approaching intensities that will lead to local melting. We intend to eventually sweep

- the beam across the target to spread out the energy deposition. The sweeping system is still months away from being commissioned. Main Injector intensity improvements expected for later in Run II will make sweeping mandatory.
Jim’s Summary Continued

- FNAL continues to consider alternative target materials, but it's hard to improve on Nickel with the particular set of constraints. Nickel alloys such as inconnel have been discussed, but haven't been tried to this point.

- Pbar notes 464, 512, 547 and 554 are all worth reading and are available on line. The document index is