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COMMENTS ON LONGO NEUTRAL BEAM

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M. Longo has described some neutron experiments[1] which might be done on a small angle ($\theta_{prod} < 2.5$ mr), small aperture ($d\Omega < 5 \times 10^{-8}$ GeV) neutral beam. The principal reason for choosing the small production angle is to get a neutron spectrum peaked sharply near the energy of the EPB[2]. The intensity is more than adequate.

1. <u>"Front Porch"</u>

The total cross section experiment relies on the peaking of the spectrum close to the energy of the primary protons for some of its momentum resolution. It will clearly be of interest to carry out this experiment with one setup over the energy range from 70 to 200 GeV. This experiment is therefore a candidate for front porch operation of the EPB. (It won't require much beam time at energies other than 200 GeV, but it should be added into the front-porch list nonetheless.)

2. <u>Experiment Layout</u>

From the exit of the beam from the downstream end of the muon shield, the experiments foreseen by Longo will require a distance of ~ 300'. A width of ~ 5 meters is needed on one side of the beam at the upstream end of the experimental area. About 3 meters on the other side is needed over the whole length.

3. Shielding

5×10^8 neutrons/second incident on a 6" liquid hydrogen target will give 1.2×10^7 interactions/second. This seems an upper limit of usefulness for experiments where detectors subtend large solid angles at the target, so we will use this number to estimate the shielding problems. Out of the 5×10^8 neutrons/second, there are $\sim 2 \times 10^8$ in the 160-200 GeV range. Suppose some experimentalist's mistake results in 2×10^8 neutrons in this energy range interacting in the region of the hydrogen target. The drift length for pion decay is $\sim$ 100 meters to the backstop. To estimate the muon backstop required, we consider this equivalent to 4×10^9 protons (interacting) with a π decay length of $\sim$ 5 meters and consult the curves given by Awschalom (FN-131, 1130.0, NAL report). For heavy NAL concrete, estimate about 90 meters required. Assume mistakes can be "allowed" which give x 100 normal working doses for a short time. Then get $\sim$ 40 meters, using crude eyeball extrapolation. Main point of this remark: high-intensity, high energy, neutron or proton beams will need big backstops. Exact size is a question of detailed examination.

Lateral shielding for this intensity of beam is equivalent to the lateral shielding needed for a few times 10^9 beam at 20 GeV, i.e., considerable. Mistakes (such as lead bricks being put in the beam) are an order of magnitude more dangerous at this machine. Experimental beam shielding philosophy looks like a subject worthy of a significant amount of thought.

4. Protection Against EPB Getting Down Channel

Longo suggests using the neutral channel to get charged particles. This doesn't seem to me a good idea; it would allow the possibility of the EPB itself coming down. The channel should have permanent magnet protection against this hazard. Charged particles can still be got by putting a target in the neutron beam.

5. Alignment

The neutrons can not be steered, therefore, the defining collimators will have to be remotely adjustable to compensate for movements of the shielding mass. The radius of the permanent hole through the shielding must be greater than any foreseeable shift due to settlement, etc.

REFERENCES

1. M. Longo, "Neutral Beam Experiments at the 200 GeV Accelerator," National Accelerator Laboratory Internal Report FN-142, April 30, 1968.

2. According to H. White (private communication) the peaking of the neutron spectrum does not change appreciably between 0 and 2.5 m-rads. This then removes the $<$ 2.5 m-rads restriction.