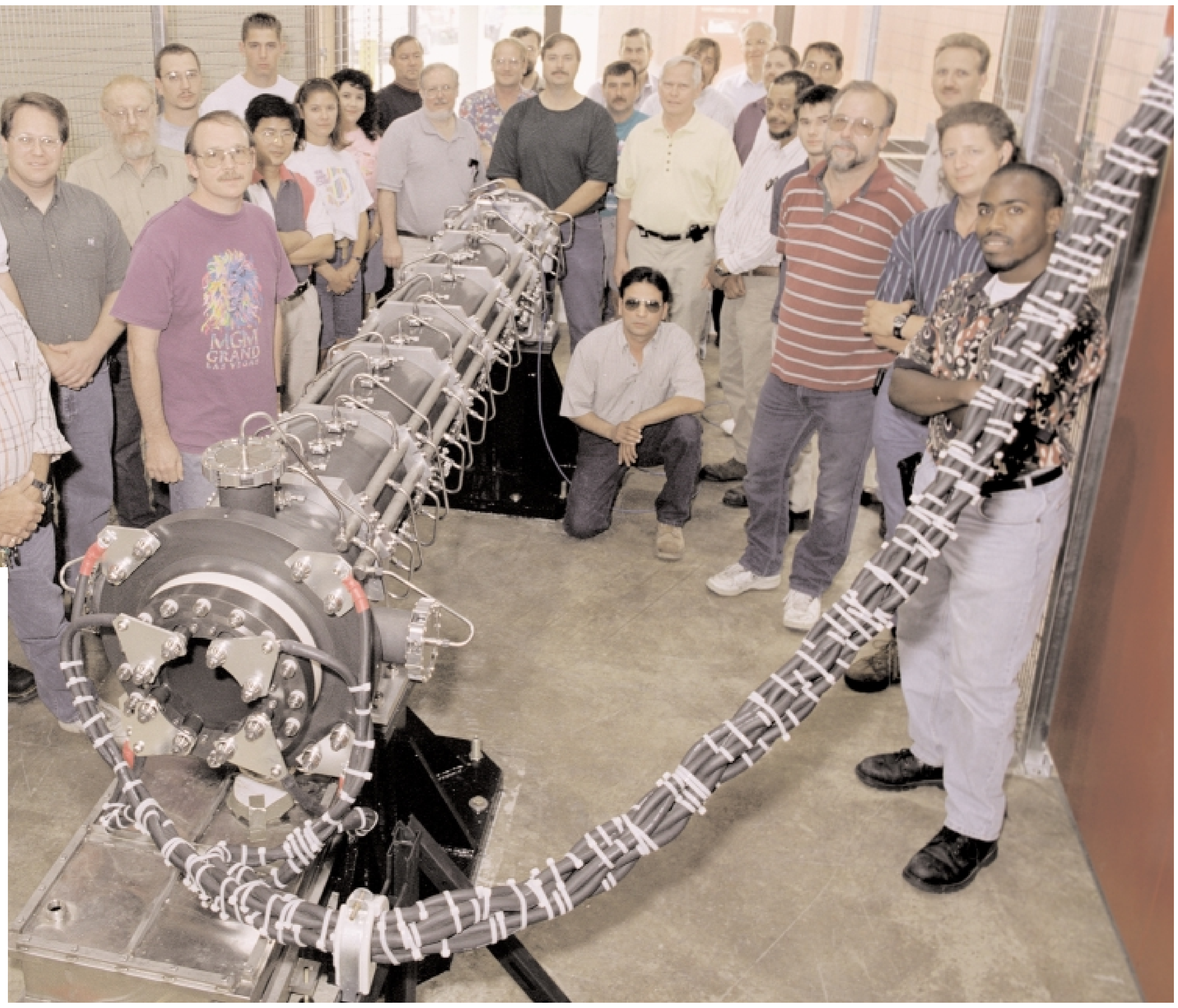
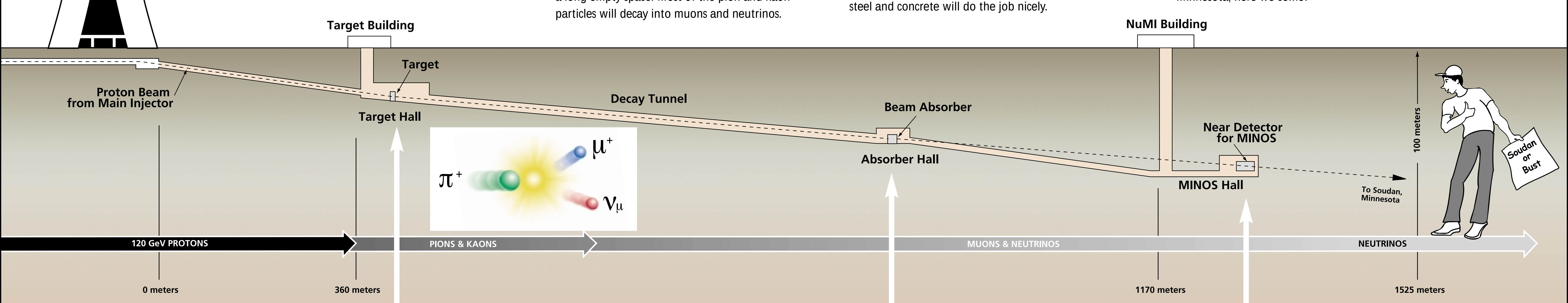
How to MAKE a Neutrino Beam

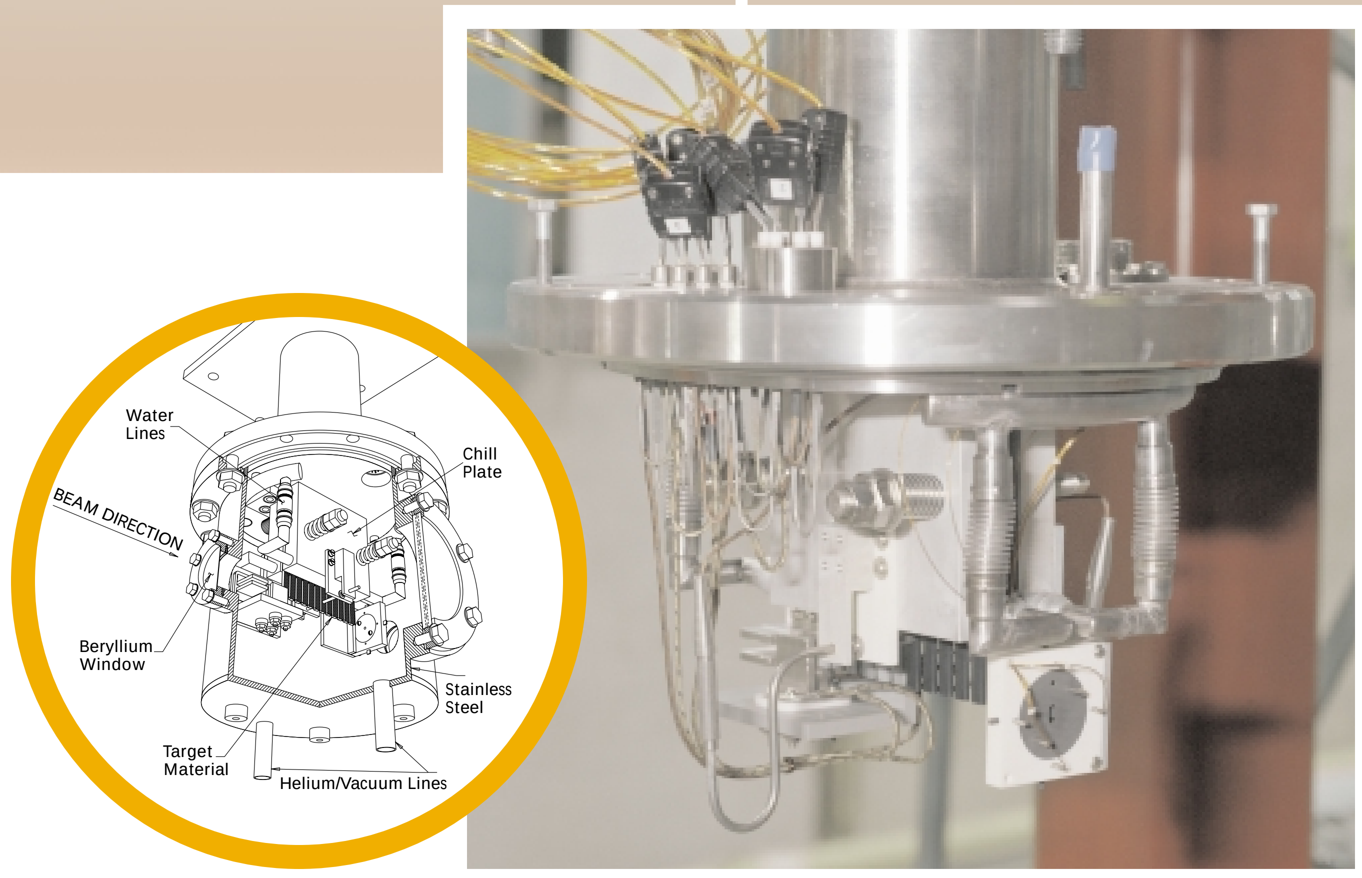
TAKE A BEAM OF PROTONS...



The first of two horns (magnetic filters) that align the positively charged particles produced in the target, posed with the team that built it. Current pulses of 200,000 amps are applied to the horn for a thousandth of a second at the same time as the proton beam strikes the target.

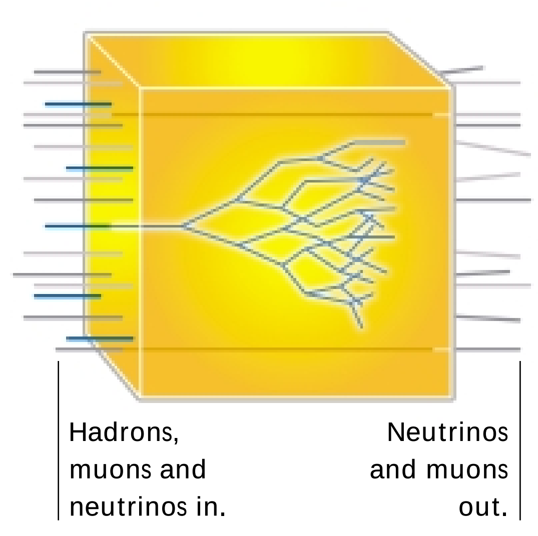
1. Take a beam of protons, accelerated to 120 GeV.
2. Smash protons into a target. (Beryllium, graphite or aluminum will do.) NOTE: Expect many different particles to come out of the target, in all directions.
3. Filter particles. Use a magnetic filter, or "horn" (above), to retain most of the positive particles. NOTE: Discard negative particles.
4. Allow the positive particles to travel down a long empty space. Most of the pion and kaon particles will decay into muons and neutrinos.
5. At the end of the empty space, position a specialized particle sponge to absorb all remaining particles. This sponge will mop up the pions, kaons and protons, but have little effect on the muons—and no effect on the neutrinos. A few tons of aluminum, steel and concrete will do the job nicely.
6. Allow the remaining muons and neutrinos to pass through a few meters of rock. NOTE: Most of the muons will slow down and stop.
7. Result: Billions of fresh neutrinos, northward bound. Minnesota, here we come!





A prototype of the MINOS target. 4 x 10^{13} protons, accelerated to 120 GeV, will strike the black graphite fins of the target every 1.9 seconds. Water cooling keeps the target from melting.

Particle Beam Absorber



The near detector, located at Fermilab, is a smaller version of the main MINOS detector at Soudan, Minnesota. The near detector is used to verify the flavor of the neutrino beam at the source. The detector is smaller because the neutrino beam hasn't yet spread out very much.

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