# NOTE ON AVAILABILITY OF METALLIC URANIUM FOR SHIELDING PURPOSES

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Uranium metal is attractive for shielding purposes on extracted proton beams where muons dominate the shielding in the forward direction. The need for ranging out muons leads to long shields which limits the accessible solid angle for experiments in many cases. This is especially true of bubble chambers for neutrino experiments. At any accelerator the length of shielding may be reduced by the use of uranium merely because of its much greater density relative to iron. Above 50 GeV, pair production and bremsstrahlung, which vary as $Z^2/A$, contribute significantly to make uranium a more effective shield for muons than iron or other common shielding materials. A range curve for various materials, after Thomas, is attached as Fig. 1.

In view of these desirable properties detailed discussions have been held with the appropriate AEC contractors to determine the availability of metallic uranium for such purposes. The canonical number used in these discussions was 35 kilotons, representing a full uranium shield for the 25-foot bubble chamber at 400 GeV. The discussion skirts around classified information so round numbers will be used that are in the correct ball park.

The amount of uranium metal as such that is available is in the hundreds of tons range and not thousands of tons. The standard form is an 18-19 inch diameter right cylinder of height about 6 inches. The mean deviation from smoothness of these "derbies" as they are called, appears to be about 1/8 inch to 1/4 inch. Derby weight is approximately 1100 lbs. These derbies are produced from uranium tetrafluoride salt, so-called "green salt," in a thermite reaction. There does, or will, exist from routine processing sufficient green salt for foreseeable uranium usage by accelerators including the full 400-GeV neutrino shield.

However, the cost of reducing the green salt to metallic uranium must be borne by the accelerators since the ordinary end product of the processing plants is the green salt. Processing capability of the major AEC producer of depleted uranium is such as to be capable of producing 6500 tons of derbies a year on a 21-shift/week basis. A 200-GeV shield could be produced in the three years to beam time in the neutrino area at this rate. Indications are that the cost of this is in the range $600-700/ton for uranium metal delivered at the site. Cost of any packaging and of stacking must be added to this for the final shield cost.

Any processing, casting, machining, etc., beyond the rough derby adds significantly to the cost of the shield so it does not seem feasible to talk about anything but derbies. It is planned to carry out an engineering study at BNL on the attainable packing fractions and associated handling problems in stacking a shield from derbies.

There seem to be no significant health physics problems associated with handling the non-irradiated uranium metal. A number of metallurgical problems potentially exist which will be worked out with the AEC contractor's metallurgists if such uranium shields are built. The outlook for a full uranium shield seems to be unfavorable in view of production limitations and available cost estimates. Derbies or 4000-lb cast billets run \$600-700/ton as compared with \$100/ton for steel.

More detailed information is available in a trip report filed with the Experimental Facilities Division.

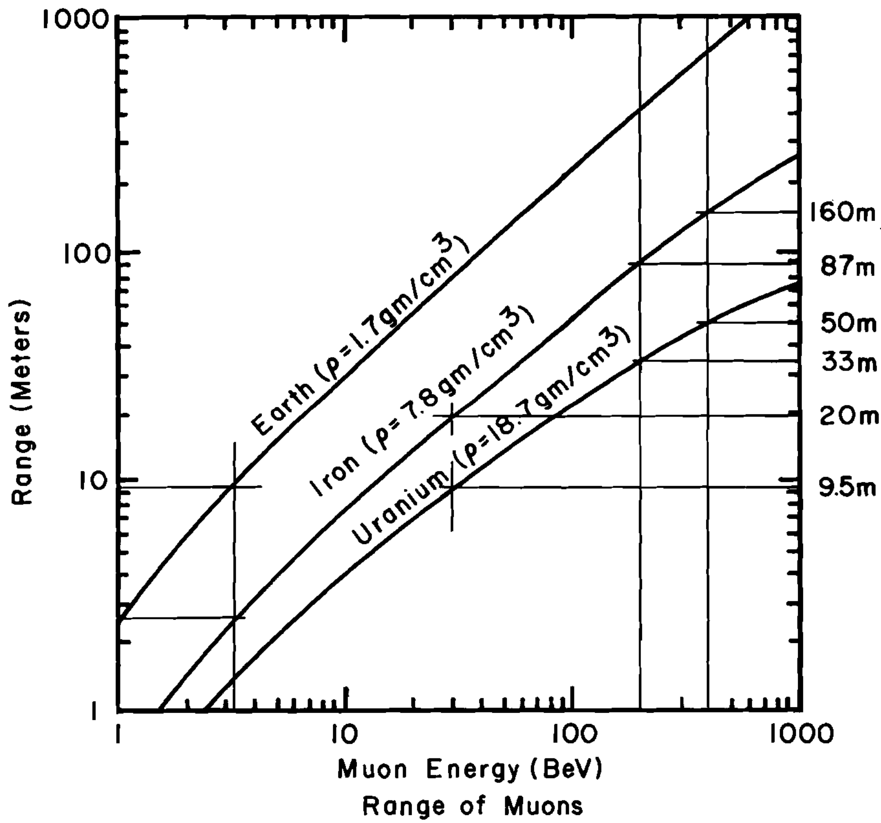


Fig. 1. Range-energy relation for muons in various material (after Thomas).