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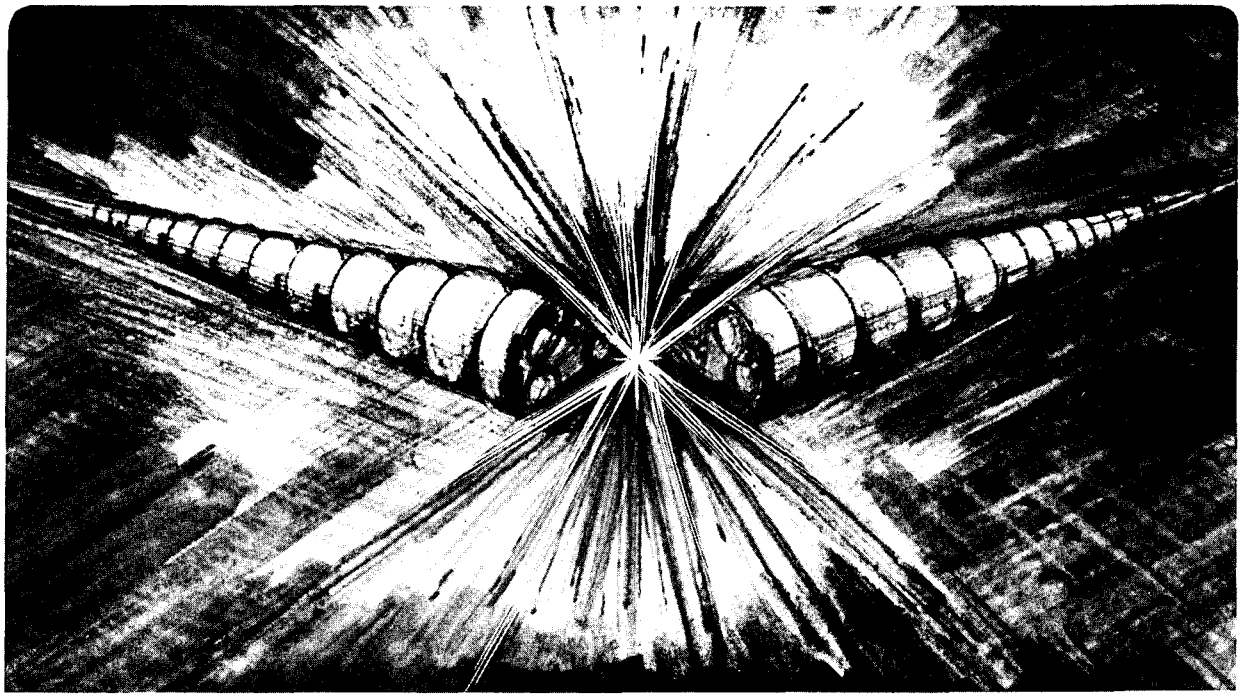

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Radioactive Source Holder*

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Abstract

A holder has been designed to safely contain unsealed fission and alpha sources without limiting their usefulness for the test and calibration of charged particle detection systems.

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Radioactive sources are important during the setup stages of nuclear physics experiments for the test and calibration of detection systems. In many cases, particularly for setting the coincidence timing between detectors, very strong sources are required to provide acceptable coincidence counting rates. These levels of activities often exceed 100μCi, and therefore require careful handling by experimenters.

The intensity for radiations having a long range in matter, i.e. γ-rays and neutrons, falls off approximately as $1/r^2$. Such sources may be fully encapsulated to eliminate contamination of material or personnel, and may be handled at a distance to reduce personal dose. Sources which have short range emissions, i.e., α-particles or fission fragments, must often be deposited on a substrate as a thin layer (~100μg/cm^2) and left uncovered to prevent degradation of the energy of the emitted particles. The recoiling daughter nuclei from these sources often possess enough energy to break free from this layer and contaminate surrounding areas. This type of source must be contained in such a way as to allow the source to be closed in general and opened when its short-range emissions are needed.

Two isotopes of Californium, 252 and 249, are particularly important to heavy-ion nuclear physicists for detector testing, setup, and calibration. ^{252}Cf ($t_{1/2}$ = 2.65 years) emits a 6.1 MeV α-particle, but also fissions in ~3% of its decays. These fission fragments are useful for testing detectors, such as gas filled ionization chambers, where an energy loss larger than that available from α-particles is required. ^{249}Cf ($t_{1/2}$ = 360 years) is valuable since it decays to ^{245}Cm by emitting a 5.8 MeV α-particle which is promptly (~0.5ns) followed by a 388 keV γ-ray. This α-γ coincidence allows

one to adjust the timing between arrays of particle and γ-ray detectors. Without this source, one typically uses expensive accelerator time to perform the same adjustment. These sources are potentially hazardous because of possible contamination by radioactive recoils. The prominent daughter nuclei have very long half lives (^{248}Cm: $t_{1/2} = 5 \times 10^5$ years; ^{245}Cm: $t_{1/2} = 9 \times 10^3$ years).

While these sources cannot be made as safe as fully encapsulated sources, intelligent design of a holder can minimize contamination without diminishing usefulness. Our design includes a sealing door which can be closed for storage and opened when the source is used. Figures 1a and 1b show the ^{252}Cf source holder with the sealing door (a) closed and (b) open. Figure 2 shows an assembly drawing. The ^{252}Cf holder is constructed of aluminum. The ^{249}Cf holder is identical but is made of PVC plastic to reduce attenuation of the 388 KeV γ-rays.

The back plate of this holder is made to fit the target ladder in our experimental apparatus so this source may be mounted in the exact location of the target which will be bombarded by the accelerator beam. The source simulates radiations from a target. The door is held in place by two pieces of finger stock and the whole assembly may be handled by a threaded piece of 1/8" diameter rod attached to the lower right side of the source holder (see Figure 1). After locating the source in the target position, the rod may be unscrewed and used to open the door on the source holder. There is no reason for fingers to touch the source holder itself or to get closer to the source than the length of the 1/8" rod. After each use, the rod may be examined for contamination. Periodically, the holder itself should be examined and any contamination should be removed.

The goal of safe handling of radioactive sources by nuclear physics experimenters requires that a part of the source holder be configured to the

intended use, otherwise it may be attached to the apparatus in a less safe way. This part of the holder must be specific to the attachment needed. Since applications constantly differ, this design will not suit all users, but the concepts inherent to this source holder design may be tailored to individual needs and significantly reduce the hazards of using uncovered sources.

Sketches of individual pieces, sufficient to build the holder, are shown in Figure 3.

Figure Captions

Fig. 1a) A picture of the ^{252}Cf source holder with the sealing door closed. The 1/8" diameter rod used for manipulating the holder is attached to the bottom right side.

Fig. 1b) A picture of the ^{252}Cf source holder with the sealing door open.

Fig. 2) The assembly of the radioactive source holder.

Fig. 3) Sketches of the individual parts used in building the radioactive source holder.

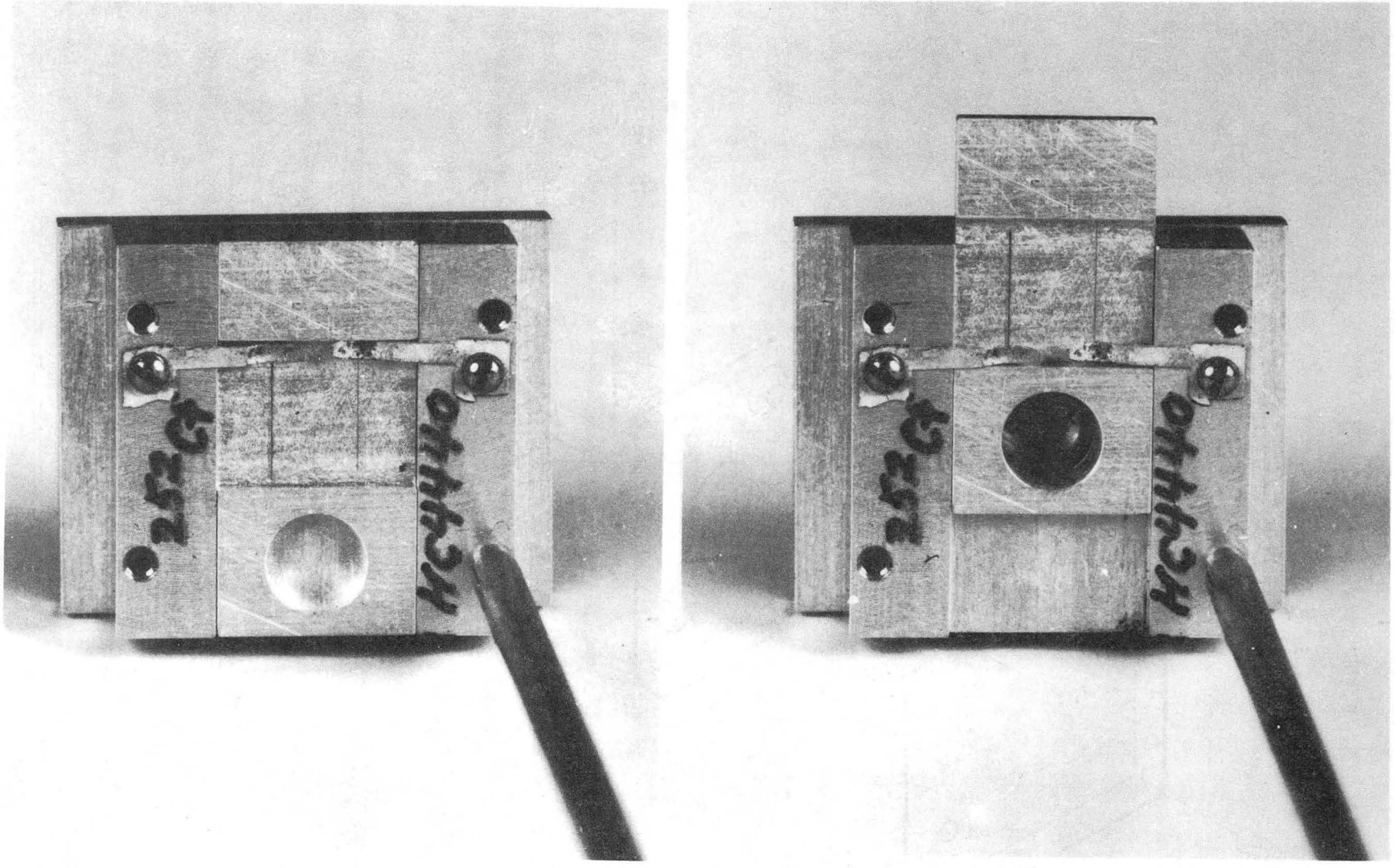

Fig. 1

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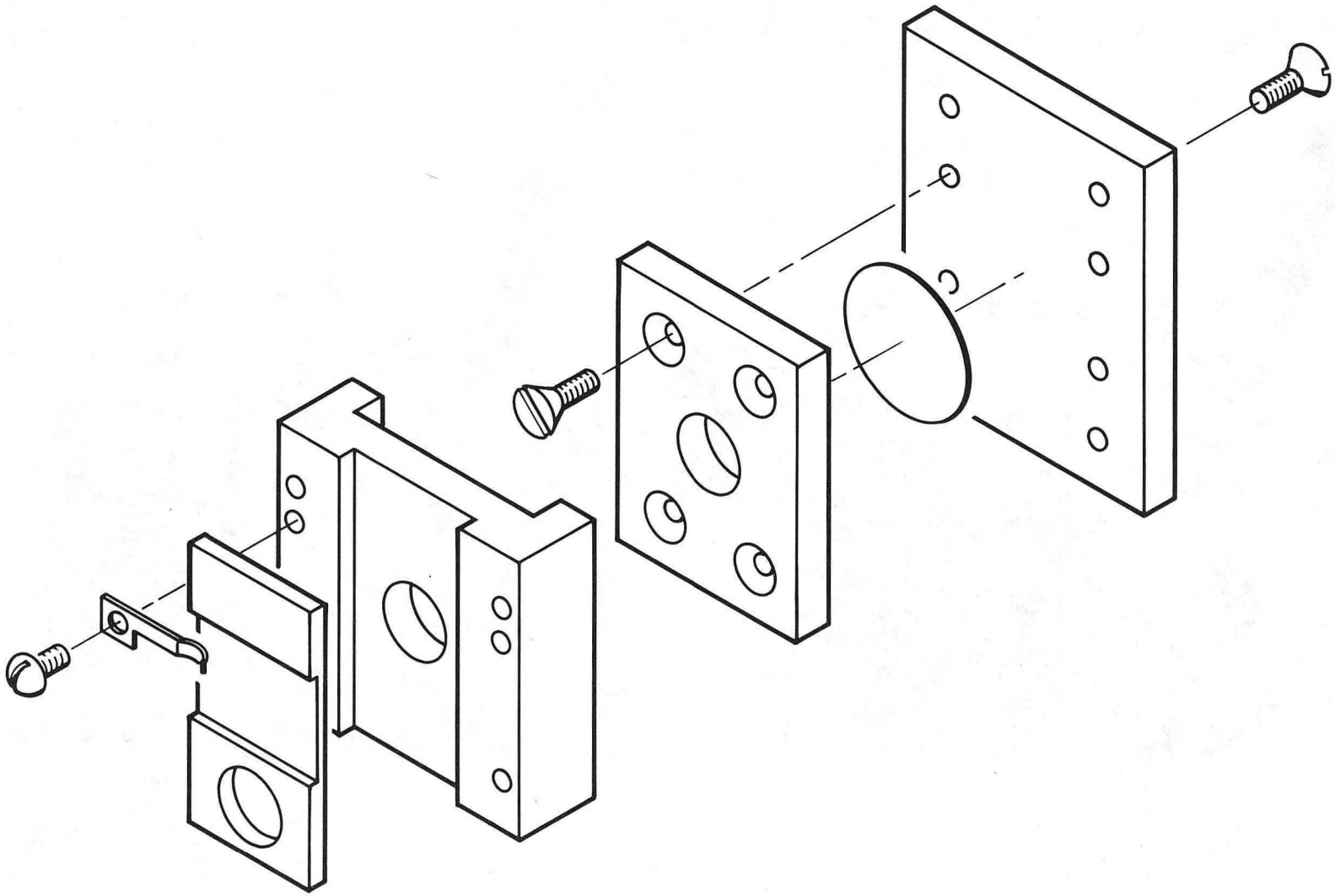

Fig. 2

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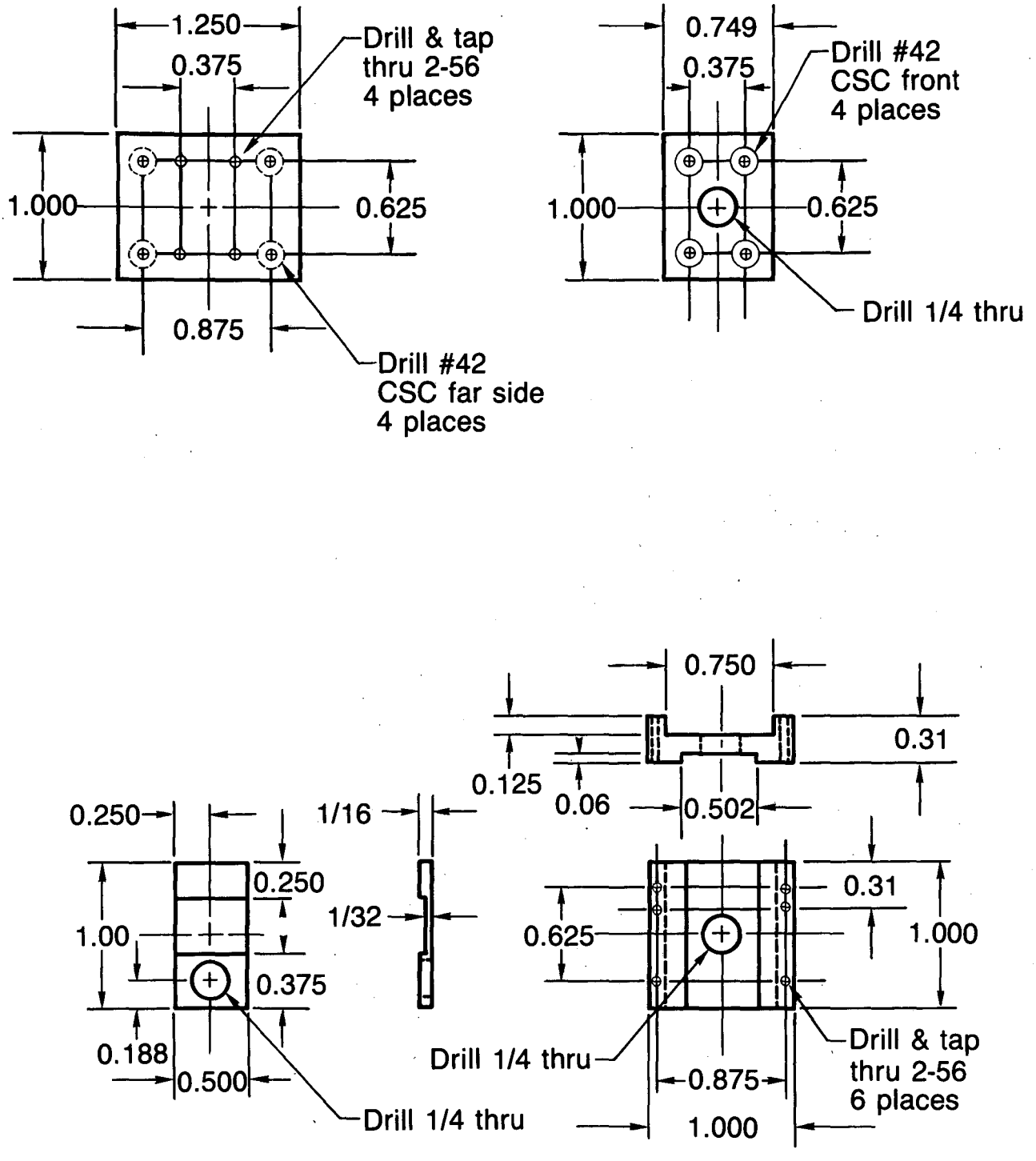

Fig. 3

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