

 Report from a French incident**Accidental exposure of researchers' hands to an x-ray crystallography beam****Description of the incident**

During a crystallography analysis, two people handled the sample when the x-ray diffraction device was on. The collimator as well as the leaded glass, which normally used to provide protection, had been removed.

The two people did not realize that the device was on. The exposure time was estimated at 40 seconds and the distance between the x-ray source and the persons was approximately 40 cm. It is the hands that were the most exposed because they crossed the x-ray beam on several occasions.

Radiological consequences

The handlers were not wearing film badges. A reconstruction of the incident with two film badges (one corresponding to exposure to the hands and the other to that of the chest of operators) revealed :

- an equivalent dose of 480 mSv (on a surface of 2 cm in diameter) to the hands; and
- and an effective dose of less than 0.1 mSv at the chest.

The dose received by the hands is practically equal to the annual limit for workers in category A (500 mSv/year). Given the high equivalent dose to the hands, and the uncertainties involved, the handlers underwent a clinical examination (of which we do not know the results).

Lessons to be learned from the incident

On this kind of equipment, the dose rate can go up to 340 Gy/min (without a collimator). The improper use of this type of equipment can lead to significant localised exposures of the hands from handling the sample while the equipment is turned on. For this reason, users should be reminded of the conditions of use on the protective glass.

Users of this type of device should be equipped with two film badges (one at the level of the wrist and one at the level of the chest) allowing for the assessment of the dose received at the level of the hands and chest.

The stopping of the radiation should be effective as soon as the leaded glass protection or the collimator is withdrawn.

It must be emphasized that the persistence of the risk of exposure during maintenance operations, which must be carried out by the manufacturer, on this type of device because of the release of safety mechanisms. Releasing the safeties should be reserved for the manufacturer.

RADIOPROTECTION

Do not prevent the operation of the "sheath window" safety by artificially maintaining it open by means of a voluntary mechanical lock.

Ensure that there is no discontinuity between the tube and the experimental connection. Carefully position the collimators.

Use the adequate filter to the extent that it is possible in order to mitigate the unnecessary and undesirable radiation in radiation protection.

Do not unnecessarily increase high voltage. Do not forget that the continuous bottom obtained by braking is proportional to the square root of the voltage. It is not generally useful to increase the high voltage beyond 3 or 4 times the voltage required to obtain the ray of emission. For copper whose line K alpha1 is 8.04 keV, a voltage of 35 kv is quite sufficient.

Check the operation of indicator lights.

During the check for leaks, observe the duct completely. Screws missing, a gap between the tube and the sheath, for example, may leave room for radiation of the leak.

Avoid approaching the sample at all costs when the radiation is present. During adjustments, which should be reserved to a limited number sufficiently trained staff, use leaded glass and leaded gloves.

Privilege the use of an extremity dosimeter (ring), which is the best suited.