

A NEW SCATTERING CHAMBER OF ION-IRRADIATION
FOR BIOLOGICAL SAMPLES IN AIR

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An ion-irradiation chamber for biological samples is produced in the RCNST tandem accelerator laboratory. It takes aim at the following. 1) For irradiation of biological samples in air, ions are drawn out of the vacuum chamber through a thin film. 2) To irradiate simultaneously many samples with various doses, the Rutherford scattering is utilized. 3) To determine precisely exposed doses by measuring the ion flux at any incident angle, a Si solid state detector (SSD) is used.

In the radiation biology, irradiation doses are generally used from rads to 100 krads. Thus, the secondary beams scattered by heavy element are more suitable than the primary beam from the accelerator. For example, when 6 MeV proton beam of 100 nA are scattered by a Au-foil target of 2 mg/cm², thin samples, such as cells, placed at 90 deg. from the beam direction and at a distance of 10 cm from the target are irradiated with about 4 rads per minute. In accordance to the angular distribution of the Rutherford scattering, samples at 47 deg. are exposed by 10 times more than those at 90 deg. and samples at 26 deg. by 100 times.

Biological samples are desirable to be irradiated in air. As a matter of fact, samples which enable to be exposed in the vacuum are restricted to the samples, such as dry seeds¹⁾. The use of scattering beams makes it easy to extract the beam from the vacuum chamber into air through a thin film, because the damage of the film by the scattered beams is not so severe as by the primary beams. The window film should rather withstand the atmospheric pressure. For a circular window of 1 cm diameter, a plastic film of 20 μ m thick sufficiently withstands the atmospheric pressure. The energy loss of 6 MeV proton in a 20 μ m plastic film is about 150 keV, and the range in air is 45 cm.

Beam-extracting windows are placed at regular intervals of angles, and beams of various flux are extracted from those in accordance to the angular distribution of the Rutherford scattering. Beam fluxes of each window are determined by monitoring with SSD at the window where the beam flux is rather as low as measurable with the SSD. Doses are easily calculated from the fluxes.

In Fig.1, the cross-sectional view of the whole system is shown. It consists of a quick valve, a beam collimator, a scattering chamber, a Faraday cup and a SSD. Beam-extracting window are placed at every 10 deg. from 20 deg. to 110 deg. and at 130 deg.. Aperture of the window is 11 mm in diameter. Fig.2 shows the holder of the window film. The film are fixed between the holder body and the film cover. Upper and lower sides of the holder body some tapped holes are cut to fix the sample. Fig.3 shows the energy spectrum of protons extracted through the 20 μ m mylar film at the 130 deg. window when measured by the SSD.

- 1) S. TANO, H. EGUCHI, I. YAMANE, H. YAMASHITA and H. YAMAGUCHI,
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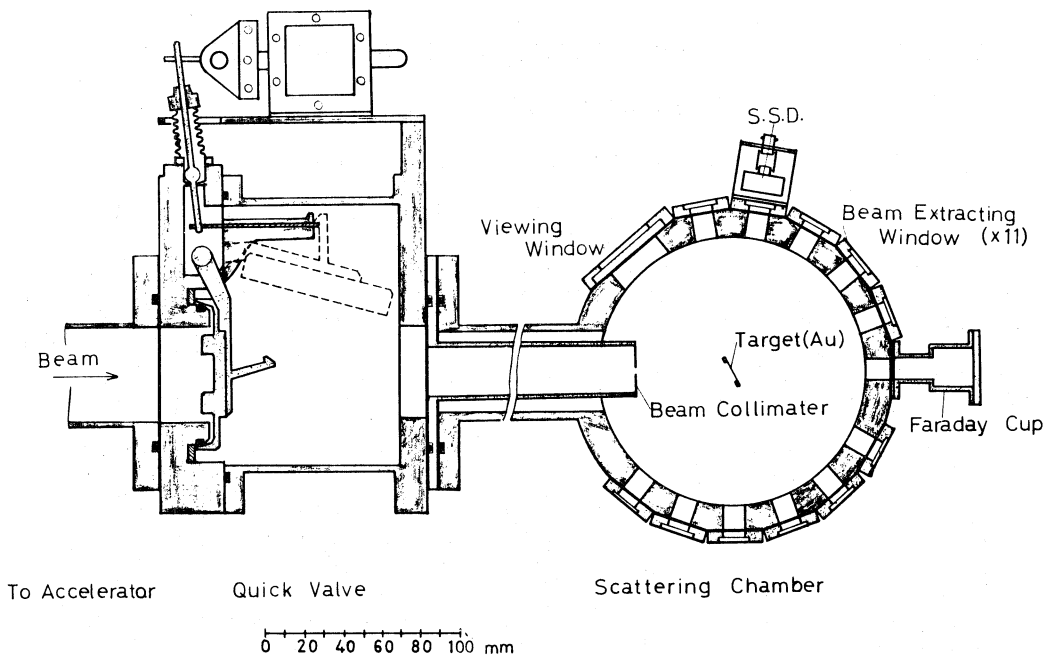


Fig.1, The cross-sectional view of the ion-irradiation chamber for biological samples

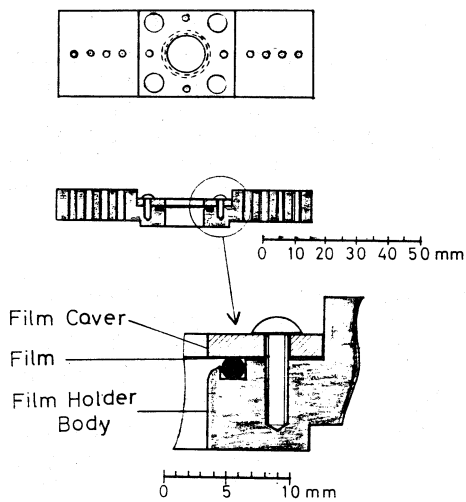


Fig.2, The holder of the window film

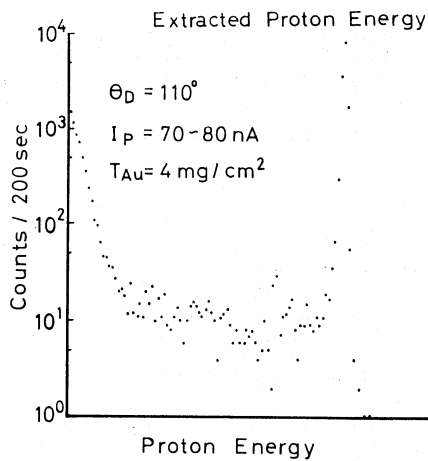


Fig.3, The energy spectrum of protons extracted through the 20 μ m mylar film