CONCLUSIONS

The measurements on the integrated external bremsstrahlung have shown that when the beta particles from Sr-Y-90 are incident on targets of different thicknesses of various atomic numbers, the external bremsstrahlung intensity first builds up to a maximum value for $t < 0.4R$ and then decreases slowly for higher values of target thicknesses, even when the target thickness is only a fraction of the range of beta particles of maximum energy. This means that for target thicknesses up to $0.4R$ the production of external bremsstrahlung predominates over attenuation and the reverse is true for target thicknesses greater than $0.4R$.

In the case of targets of high atomic number the decrease in bremsstrahlung intensity for $t > 0.4R$ is faster showing larger attenuation of bremsstrahlung intensity in the target itself.

However, the increase of the external bremsstrahlung intensity with $t$ is not linear for $t < 0.4R$, and this deviation from linear increase is shown to be due to the slowing-down of beta particles. The integrated external bremsstrahlung intensity above 50 KeV, as well as above 400 KeV is found to follow an empirical formula

$$I_{EB} = K \frac{Z^n N_{e}}{A} e^{-\sum_{e} t} = K' \frac{Z^n}{A} t e^{-\sum_{e} t}$$
for \( t < 0.4R \) for all target elements studied. \( \Sigma_B \) is found to be a constant and independent of the atomic number of the target, showing that this is related to the slowing-down beta particles in the target.

The fraction of the beta particles that are absorbed within the target foil for the same target thicknesses in the range of 0.1 to 0.4R, of various elements is also found to follow a relation of the type

\[
N_a = K \cdot t - \Sigma_A \cdot t
\]

where \( \Sigma_A \) is constant and independent of the atomic number of the target. It is interesting to note that the values of \( \Sigma_B \) and \( \Sigma_A \) are the same within 15 percent. This means that the production of bremsstrahlung and the slowing-down of beta particles within the target have the same dependence on the thickness of the target.

This offers a linear extrapolation method by which the external bremsstrahlung produced in an infinitely thin target by electrons having a continuous energy distribution can be obtained. The intercept of the curve \( \log \left\{ \frac{I_{EB} A}{t} \right\} \) versus \( t \) gives the external bremsstrahlung intensity per atom of the target in the limit of the target thickness \( t \) tending to zero. The intensity thus determined is free from the effects
of attenuation of the bremsstrahlung photons and the slowing-down of beta particles in the finite thickness of the target. It has been found that the production of external bremsstrahlung per atom of the target is proportional to $2.97 \pm 0.06$ and $2.05 \pm 0.07$ in the case of integrated bremsstrahlung measurements above 50 KeV and above 400 KeV respectively; from the Bethe-Heitler theory it is expected to be proportional to $Z^2$.

It has been experimentally observed that the production of external bremsstrahlung over the entire energy range from 200 KeV to 1800 KeV, follows the relation $t = \Sigma_B$ for each photon energy band. This means that the number of beta particles slowed-down below any fixed energy follow the same relation and that the spectrum of beta particles remains almost the same as that of the incident spectrum. It has been found that the value of $\Sigma_B$ is almost constant and independent of the atomic number of the target material over the entire photon energy range from 200 KeV to 1800 KeV.

The external bremsstrahlung spectrum that is differential in photon energy determined using linear extrapolation method corresponds to an infinitely thin target. This spectrum is independent of the effects of slowing-down of beta particles within the foil and from
the attenuation of bremsstrahlung intensity in the finite thickness of the target. It is obvious from Fig. 22 that the measured spectrum disagrees with the theoretical spectrum at higher photon energies. But the disagreement between the theory and the experiment is independent of the atomic number of the target within about 20 percent.

The difference method adopted in these investigations cannot be used for targets whose atomic number is not large compared with the effective atomic number of the perspex beta stopper or beryllium stopper. But in such cases one may use magnetic fields to deflect the beta particles away from the target and away from the detector, and the true external bremsstrahlung intensity can be determined as a function of target thickness using the difference method; thus the extrapolation method can be extended to low Z targets also. It is worthwhile investigating the Z-dependence of the external bremsstrahlung using this extrapolation method for low Z elements also. Further, whether the production of external bremsstrahlung in targets follows a relation of the type \( t e^{-\Sigma_B t} \) for beta spectra of non-relativistic end point energies also is yet to be investigated. Whether the number of beta particles absorbed within the target also follows a law of the type \( t e^{-\Sigma_B t} \) for each band of beta energy is yet to be investigated; this can be done using a beta ray scintillation spectrometer.
However, the linear extrapolation method adopted in these investigations offers a method of obtaining the external bremsstrahlung spectrum which is free from the effects of the slowing-down of beta particles and attenuation of photons in the finite thickness of the target, even in the case of beta particles having continuous spectrum of energy.