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Radiation at Charge-exchange of Ions

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In the charge-exchange accelerators, negatively charged accelerated ions lose their electrons in a charge-exchange target and become positively charged ions. In the present report, radiation arising at charge-exchange of ions a thin transparent charge-exchange target is considered. It is shown that the spectral and angular distribution of the number of quanta emitted by the hydrogen ion that change its charge from -1 to +1 is described by the formula

$$\mathrm{dN}_{d\Omega d\omega=\frac{e^2}{\hbar c}\frac{\sin^2\theta}{\pi^2\omega\left(\frac{c}{v}-\cos\theta\right)^2}} \qquad (1)$$

where dN is the number of quanta with frequency ω emitted in the spectral range $d\omega$ into the solid angle $d\Omega$, $e^2/\hbar c = 1/137$, θ is the observation angle, v is the incident ion velocity. It is interesting that properties of the distribution (1) are independent of the properties of the charge-exchange target if it is thin enough. The applications of such charge-exchange radiation for diagnostics of the charge-exchange process in charge-exchange accelerators are proposed and discussed. Observation of the charge-exchange radiation from the beam of non-relativistic incident ions can be performed by a photon detector installed at observation angle θ close to $\pi/2$, where the distribution (1) has the maximum. The observed frequency range should be out of the spectral peaks of characteristic X-ray radiation of the charge-exchange target atoms.

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