Measurement of the accelerator beam parameters using Cherenkov radiation intensity dependence on the radiator refractive index "n"

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Cherenkov radiation (CR) occurs when velocity of charged particle in a medium exceeds the phase velocity of light in it. The unique properties of CR hold great potential for its use in spectrometry of charged particles. A methods for determining accelerator beam velocity distributions on the basis of the CR parameters dependence on the radiator refractive index n is considered in the current work.

The threshold condition for CR is $\beta = 1/n$, where β is a ratio of a particle velocity to the velocity of light in vacuum (c). The number of photons with wavelength λ per unit wavelength interval and per unit path of the particle in the radiator is $N_{ph}(\lambda) = q\cdot(1- 1/(\beta\cdot n(\lambda))^2)\cdot \lambda^{-2}$ where q is some coefficient. The CR forms a cone of light extending at an angle to the trajectory of a particle $\cos\varphi = 1/(n(\lambda)\cdot\beta)$.

As shown in Fig. 1 most long-wave part of the spectrum of CR is generated by a fast particle.

We considered two methods of accelerator beam energy spectrum control: (1) CR intensity dependence on refraction index for a given β and (2) CR wavelength dependence on β for a given n – as shown in Fig. 2 a,b.

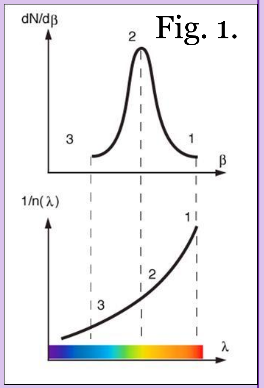

Fig. 1.

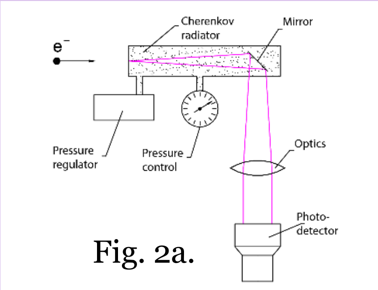

Fig. 2a.

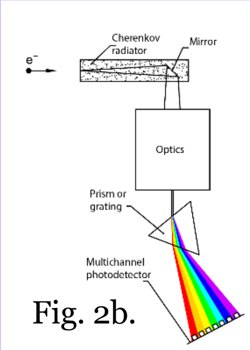

Fig. 2b.

At Fig. 3 we illustrate energy spectrum measurements for race-track microtron by method (1) – (a) is photodetector signal dependence on gas pressure;
b – is reconstructed energy spectrum.

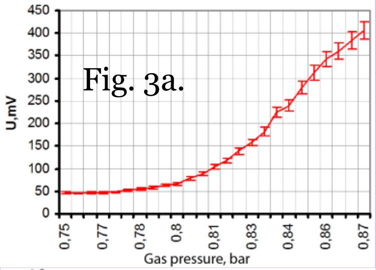

Fig. 3a.

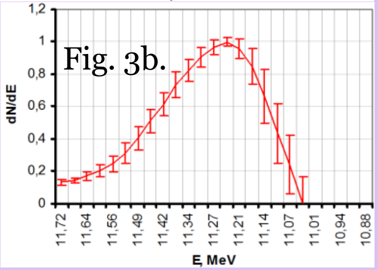

Fig. 3b.