DIAGNOSTIC OF INTENSE PROTON BEAMS BY HYDROACOUSTIC MEANS

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Detecting and parameters' measurement of intense beams of charged particles in accelerators' laboratories is possible to make in water volumes, using conventional measuring hydrophones with applying of new means and algorithms of hydroacoustic signals' processing. The new experimental results is given and discussed.

Effects related to the emission of acoustic signals generated during the propagation of charged particles through water have been under study for more than 40 years in a large number of theoretical and experimental works[1]. Most experimental investigations were performed using intense electron and proton accelerator beams[2]. The results obtained in these experiments can be used to estimate the parameters of the acoustic signals arising in cosmic showers. Although these effects have been studied in a large number of works, many problems remain unsolved. The amplitudes of the acoustic signals calculated in different studies for identical neutrino energies differ from each other by more than an order of magnitude. Experimental data are also ambiguous: some researchers observe a single bipolar signal[2,3], while, in other experiments, acoustic transducers record several wave packets[4]. Of high importance is therefore the systematic continuation of research on the acoustic radiation generated by intense beams of charged particles in water volumes. The present work contains the new experimental results of proton accelerator beams generated hydroacoustic signals' registration.

To carry out the experiments on registration of cosmic particles in sea conditions the reception channel has been developed for underwater acoustic signals with internal noise lower than in all known devices and much lower then the minimum sea noises, therefore the reception channel noise immunity required for measurements in natural conditions has been achieved. The model of equipment for input, analysis and registration of signals as well as the set of software which allows to obtain the amplitude-phase dependences of signals, narrow band spectrum, thirdoctave spectrum, three-dimensional representation of space and

time dependences and other signal characteristics has been developed. The model was used in laboratory conditions and is suitable for sea conditions. For the work with particle beams a water target (a basin) equipped with remote control electromechanical scanner has been created. The methodological and metrological conception of measurement of parameters of acoustic field produced in water by a cascade of charged particles formulated at the first stage of the project has been reported at the 16th International Simposium on non-linear acoustics (Moscow, 2002).

For the first time in the accelerator experiments the representation of space-time structure of hydroacoustical field of proton beam has been obtained. The shape of acoustic signals observed in the experiment is in good agreement with calculated shape mentioned in a number of publications. Such coincidence has not been observed in analysed papers. It makes possible to improve the noise immunity in sea conditions by receiving the signal through the filter with calculated weight function. The dependence of signal amplitude on the position of hydrophone along the beam axis was measured with much better resolution (43 points on the aperture of 43mm) then in well-known papers of Russian and American scientists (8 and 6 points respectively). As a result the dependence contains a well pronounced maximum correspondent to Bregg's peak – the area of maximum loss of energy along the braking path of the proton beam.

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