**Time-pickoff method to the PIN diode signal based on the mathematical formalism of subjective modeling**

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The report discusses a new method and algorithm for solving the problem of determining the velocity of a heavy ion using a semiconductor detector (PIN diode) [1,2], using the mathematical formalism of subjective modeling (MFSM) [3,4], which allows to mathematically formulate both a subjective model of the object under study and a subjective mathematical model of its measurements and their subjective interpretation.

In experimental practice, the ion velocity is measured by ``time-of-flight''. To measure the time-of-flight, it is necessary to obtain the timestamps “start” and “stop” corresponding to the moments of the beginning and end of the ion movement along the flight path. The “stop” timestamp is often obtained from a so-called PIN diode. A signal (voltage pulse) appears at the output of the diode, can be represented as the sum of the actual voltage pulse caused by the recorded ion and additive probabilistic noise. The physics of the interaction of a heavy ion with a semiconductor is such that the waveform first represents a slowly growing function, the graph of which is *unknown*, then comes out to an almost linear dependence (the length of this section is also *unknown*). It is required to determine the moment of time when the ion hits the detector (“absolute time reference”) ‑ despite the fact that the initial part of the pulse leading edge lies inside the area with a high noise level.

To solve the problem of determining the velocity of a heavy ion, an algorithm based on the mathematical formalism of subjective modeling has been developed and implemented, which allows to restore the unknown shape of the pulse leading edge by a smoothing spline with the following special condition: the initial part of the spline (on the left) is given by the parabola equation, and the vertex of this parabola should lie on the averaged noise line, since in the absence of noise the leading edge begins to grow from the zero line. To determine the optimal smoothing factor of the spline, subjective optimality criterion [4] was used. Correctness of new time pick-off algorithm was tested in experiment at the accelerator in the Laboratory of Nuclear Reactions of the Joint Institute for Nuclear Research (Dubna).

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