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Tandem Accelerator with Vacuum Insulation and its Applications

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Tandem accelerator with vacuum insulation was proposed and constructed in BINP [1]. The accelerator is characterized by fast acceleration of charged particles (25 kV/cm), large distance between ion beam and insulator, large stored energy in the accelerating vacuum gaps (up to 26 J) and strong input electrostatic lens. The high-voltage strength of vacuum gaps was investigated. The way of consistent training of accelerating gaps was proposed and realized and the required voltage of 1 MV was obtained [2]. The behaviour of dark currents was studied and then they were reduced to an acceptable level [3]. An auto-emission current was detected, the cause of its occurrence was established, and changes in the design of the accelerator to prevent it were made. It was proved that the application of a magnetic focusing lens allows realizing a consistent input of a beam of negative hydrogen ions in the accelerator without loss. A method of calibrating a gas stripping target was proposed and implemented. These investigations allowed us to significantly increase the 2 MeV proton beam current: from 100 – 200 μA in the initial experiments [4, 5] to 1.6 mA with 0.1% energy monochromaticity and 0.5% current stability now. To conduct boron neutron capture therapy [6] it is planned to increase the beam parameters to at least 2.5 MeV and 3 mA. It is planned to achieve the current increase by improving the vacuum conditions in the beam transporting channel and by using of a new source of negative hydrogen ions with pre-acceleration. It is also expected to conduct research on the development of operative detection of explosives and drugs [5] and of the monoenergetic neutron generation for calibration of dark matter detector [7].

References

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