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Proposal of TPC calibration laser beam position control system for NICA/MPD

In order to minimize the error in the absolute position measurement by TPC, it is necessary to account for both static and time-dependent distortions in the drift path of the ionization cloud. The time-dependent distortions can result from the changes in gas performance, in environmental variables (temperature or atmospheric pressure), or from spontaneous failures. A calibration system that can reproduce fiducial tracks is needed to monitor the TPC performance.

Laser calibration system is based on two lasers NL303HT-10FH with beam expander telescopes what provide 18-20 mm diameter output beams. Each laser creates calibration rays at a half of detector (until high voltage electrode membrane). Lasers are situated on optical tables together with mirrors, which direct initial beam to TPC detector. NL303HT-10FH laser provides vertical polarized (90%) UV (266 nm) beam. In order to align mirrors a control system of beam position should be designed, produced and aligned. There will be eight beam output channels where laser beam position should be checked while in each channel two mirrors are adjusted. This procedure will be necessary once or, maybe, few times in period of mounting of optical system. Later, in period of 7-15 years the system can be switched on for short time to check that all 8 laser beams are at the same places as they were oriented starting TPC job. To choose materials and devices it should be taken into account that all materials must be nonmagnetic and chemically stable (vapors do not cause aging of TPC readout proportional chambers). All 8 control blocks should be removable. On the other hand, system will work without TPC personal interference in period of 7-15 years.

Our proposed solution is based on the simple visible light camera, consists of detecting and imaging component, suplemented by the luminiscent component, provided the UV laser light transformation to visible difuse light. The luminiscent plate serves as the transparent screen, the laser beam profile image is observed by the standard CMOS camera as detector using the imaging component. Two solutions of imaging were designed, either the standard lens or the pinhole aperture. Contribution gives teoretical principles, technical designs and evaluations of advantages/disadvantages of both aproaches that are important for the final decision about the control system construction.

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