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# Laser Tests of the DEPFET Gated Operation

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DEPFET is an active pixel particle detector, in which a MOSFET is integrated in each pixel, providing first amplification stage of readout electronics. Excellent signal over noise performance is provided this way. The DEPFET sensor is planned to be used as an inner pixel detector in the BELLE II experiment at electron-positron SuperKEKB collider in Japan. Gated operation of the DEPFET is a unique function which allows making sensor insensitive for incoming radiation for defined time interval. The charge previously integrated is saved and integration can continue afterwards. Laser tests of gated DEPFET operation will be presented.

## Summary

The DEPFET is an active pixel particle detector, which is planned to be used as an inner pixel detector in the BELLE II experiment at electron-positron SuperKEKB collider in Japan. A MOSFET is integrated in each pixel, providing first amplification stage of readout electronics with excellent signal over noise performance.
The DEPFET detector consists of a high-resistivity depleted n-substrate and two front and back p-inplants, which create a pnp-sandwich. The n-substrate is depleted sidewards from both sides by applying negative voltages to the p-implantations with respect to the bulk. A minimum of electrons potential crates an internal gate, where charge generated by incoming particle is stored. The internal gate is located directly under the MOSFET channel below the MOSFET gate contact, so the charge stored in the internal gate affects the MOSFET channel current. When the integration cycle is over, it is necessary to empty the internal gate. This is done by a clear contact next to the MOSFET transistor. The electrons are extracted from the internal gate by applying a high positive voltage to the clear contact. This causes the electrons drift to the clear contact, where they are removed.
Gated operation of the DEPFET allows making sensor insensitive for incoming radiation for defined time interval. The charge previously stored in the internal gate is saved and integration can continue afterwards. This operation stage is achieved by applying positive voltage at the MOSFET gate electrode and positive voltage at the clear contact in the same time. In contrast to the normal clear, when negative voltage is applied to the MOSFET gate and electrons can escape from the internal gate by thermoionic emission, during the suppressed clear a potential barrier for electrons in the internal gate is formed and electrons cannot be cleared. The potential of the internal gate is shifted by a capacitive coupling to the external gate electrode. The positive clear voltage applied during the insensitive period creates a shielding potential which deflects trajectories of newly generated electrons and they are extracted to the clear electrode.
Such fast mechanism which can define a time window, where detector stops integration of new charge, can be used for example to select out noisy bunches injected in an accelerator. To prove this concept of operation, measurements with red and infra red laser were carried out on the DEPFET Mini-matrix system. It was proven, that DEPFET can operate in this way. The average charge selection in the insensitive mode is lower than 0.4% and the suppressed clear mechanism doesn't cause charge loss higher than 200 electrons. More details about measurements and gated detector performance will be presented.

**Primary author:** SCHEIRICH, Jan (Charles University (CZ))

**Co-authors:** RITTER, Andreas (MPI für Physik); Dr WASSATSCH, Andreas (MPI Physik); KOFFMANE, Christian (MPI für Physik); OSWALD, Christian (Bonn University); MULLER, Felix (LMU Munich); MOSER, Hans-Guenther (MPI fuer Physik); NINKOVIC, Jelena (Max PlanckInstitute for Physics); ANDRICEK, Laci (Werner-Heisenberg-Institut-Max-Planck-Institut fuer Physik-Max-); Dr KODYS, Peter (Charles University); RUMMEL, Stefan (LMU Munich); DOLEZAL, Zdenek (Charles University (CZ))

**Presenter:** SCHEIRICH, Jan (Charles University (CZ))

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