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Investigation of plasma effects in silicon sensors for the European XFEL

The dynamic range of the European XFEL will cover from single photons to 10ˆ5 12 keV photons per pixel per pulse, which is a challenge to the design of silicon sensors and front end electronics. The AGIPD consortium is building a detector for the European XFEL.
The high number of photons per pixel per pulse will create charge carrier densities exceeding the bulk doping of the sensor, having an impact on the sensor performance by influencing linearity and response time, amongst others.
The main physical effect of this so called electron hole plasmas is the change of the electric field inside the sensor. In the low density case this change is small and can be neglected, whereas in the case of high densities the changed electric field plays a dominant role in the charge collection process.
Electron hole densities of up to 10ˆ16 cmˆ-3 (10ˆ5 focused 12 keV photons) were created with sub-ns lasers and the time resolved current pulses of segmented sensors were recorded for strip sensors of 280 µm thickness and 80 µm pitch as well as 450 µm thickness and 50 µm pitch. An increase of the charge collection time and an increase of the charge spread with increased charge carrier density was observed. Increasing the bias voltage decreases both charge collection time and charge spread.

Summary (Additional text describing your work. Can be pasted here or give an URL to a PDF document):

http://www.desy.de/~beckerj/VCI/Abstract.pdf

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