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Laser tests of irradiated detectors at low temperatures.

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Outline

- Focus
- Experimental arrangement
- Results
- Outlook

Focus

The tested sensors are ATLAS07 minis (10x10mm):

- different designs
- irradiated to different doses

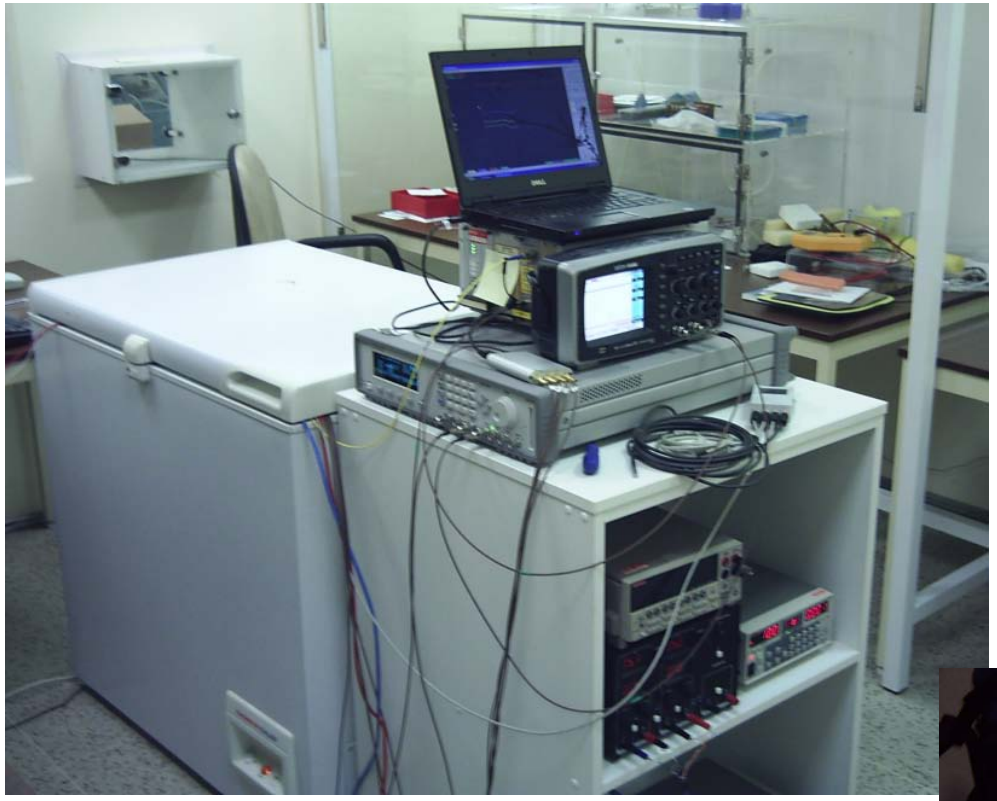
Measurement of response from laser pulse at low temperatures

Goal: confirmation of usability of irradiated sensors for trackers in HEP experiments

Experimental arrangement

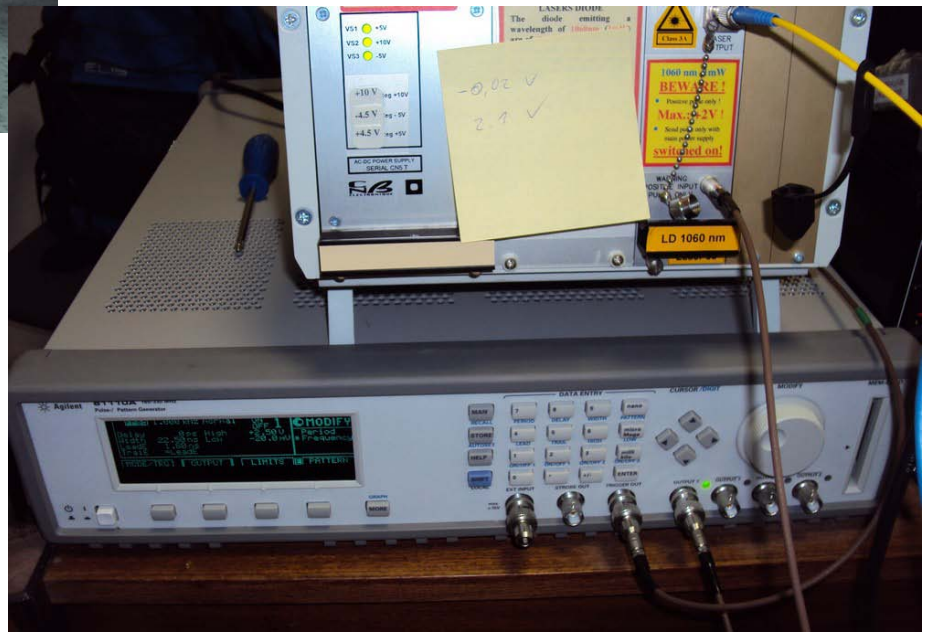
- Four custom made preamplifiers connected to group of strips
- Automatic data acquisition
- Laser of infrared light (wavelength 1066 nm)
- Connected to a box with electronics and detector via an optical fiber
- Defocusser to generate large laser spot covering many strips
- Data acquisition was performed with a digitizer DRS4 V2
- Trigger by a pulse generator
- Whole box is situated in a freezer – the temperature is about -30^{o}C
- Monitor by a thermometer probe placed close to the detector.
- Data rate – (using DRS digitizer software) at frequency 200 - 300 Hz.

Experimental arrangement

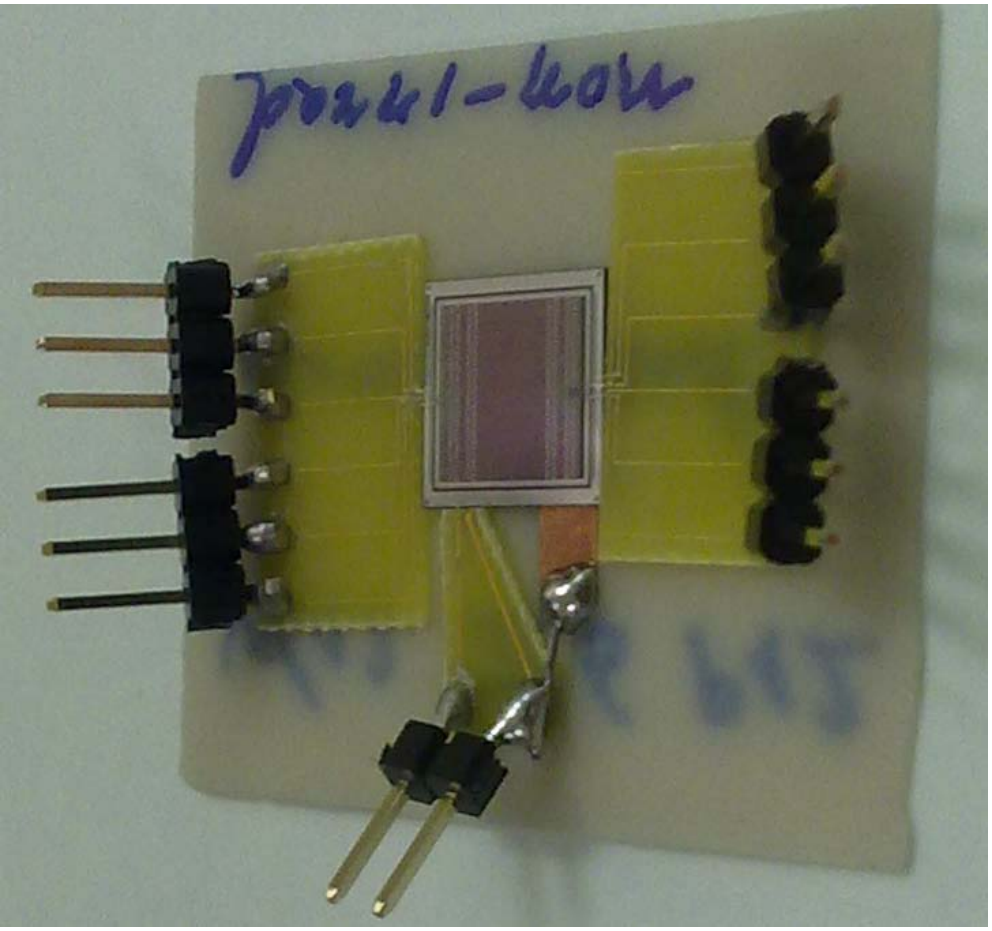


Experimental equipment at laboratory of Institute of Physics ASCR

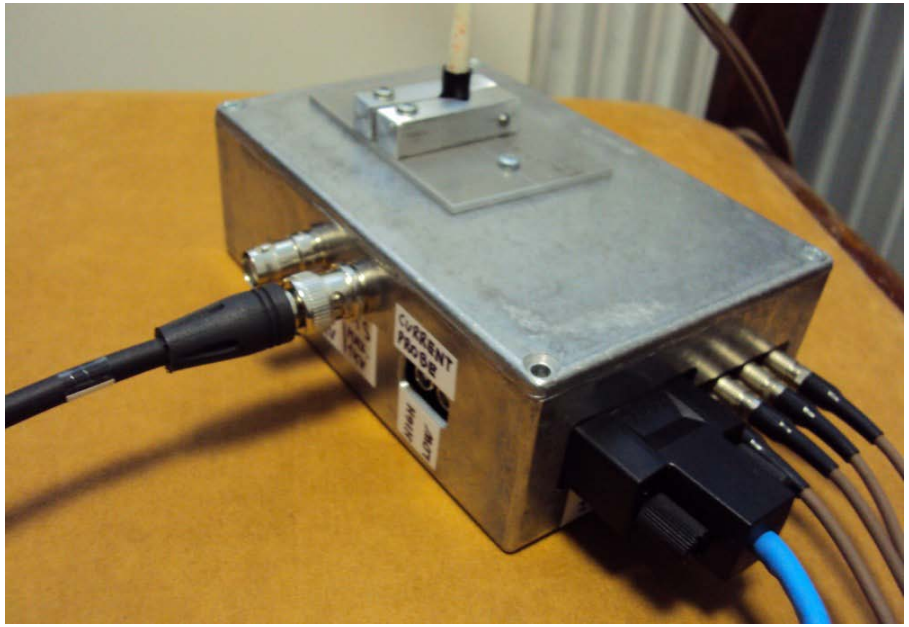
Signal generator and laser



Experimental arrangement



Sample bonded to pins for connectors



Box with preamplifier and detector, black cable in front is high voltage supply, RS232 connector is low voltage supply, four data cables on right are connected to the Evaluation board, on the top it is optical fibre

Experimental arrangement

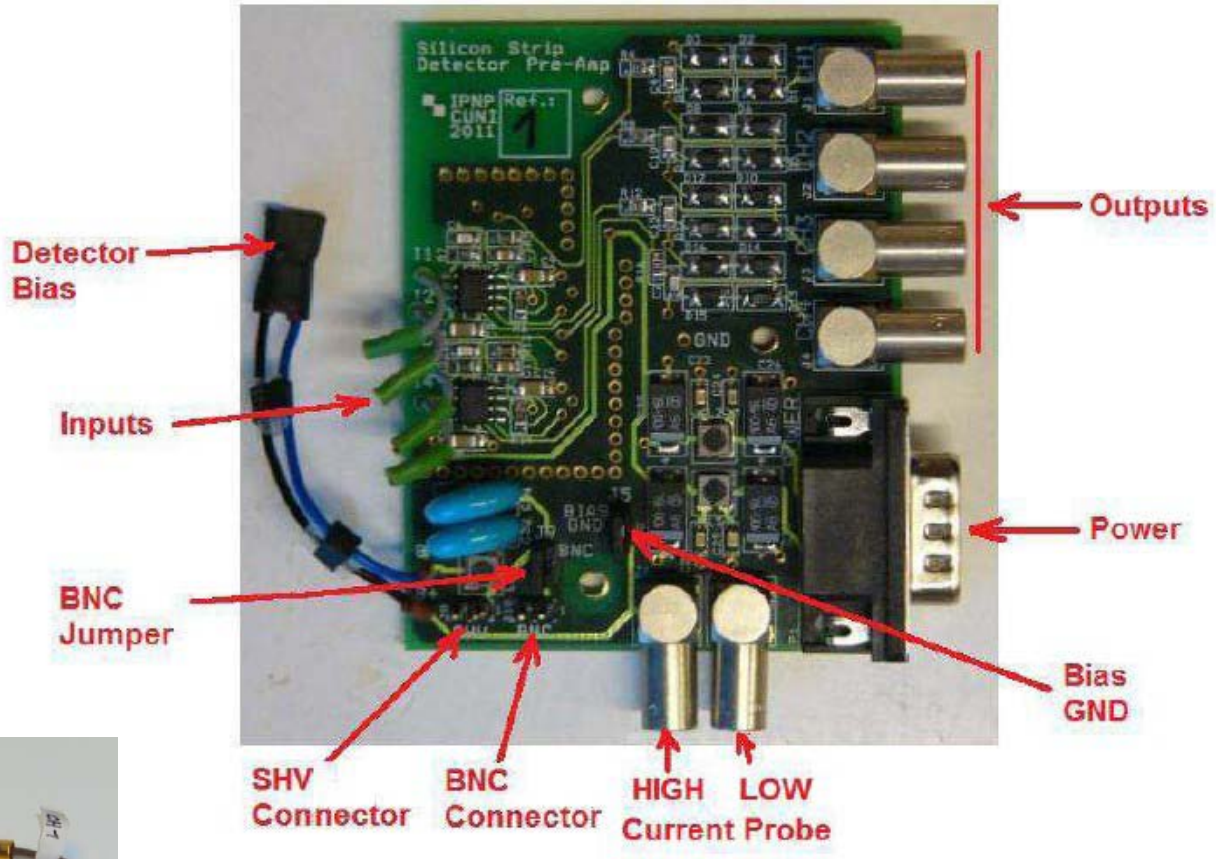
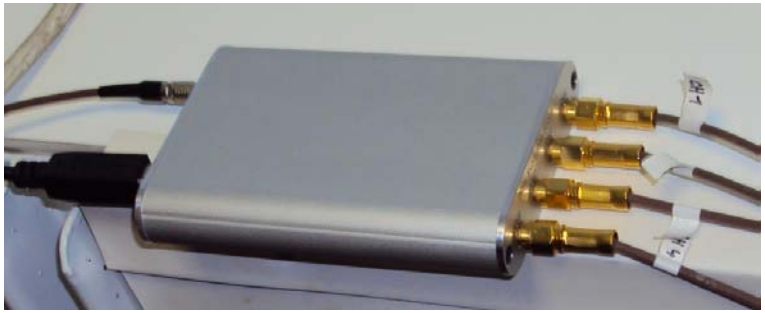
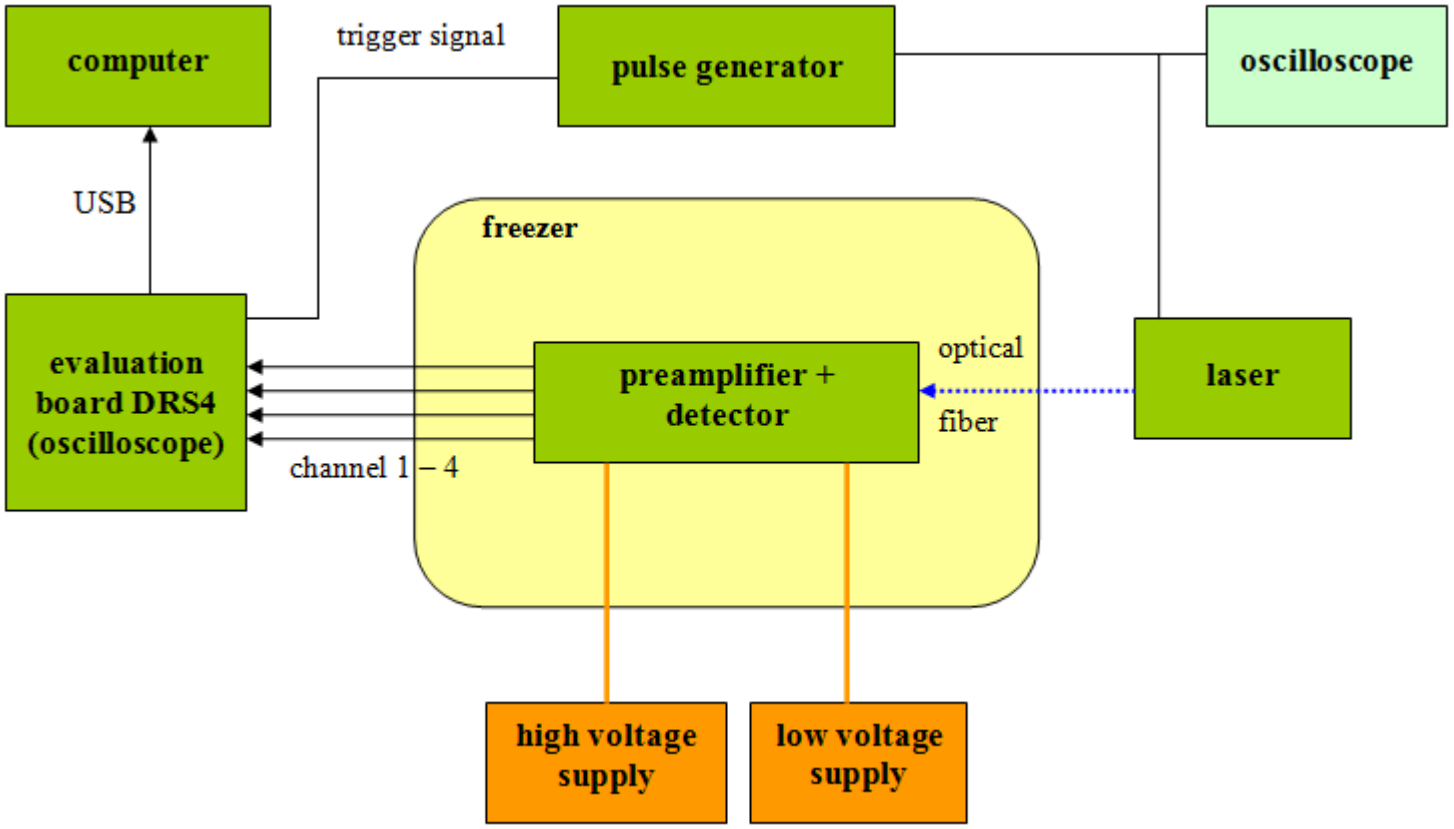


Photo of preamplifier



Evaluation board DRS4 V2, on the left USB output and trigger input, on the right input of channels 1 - 4

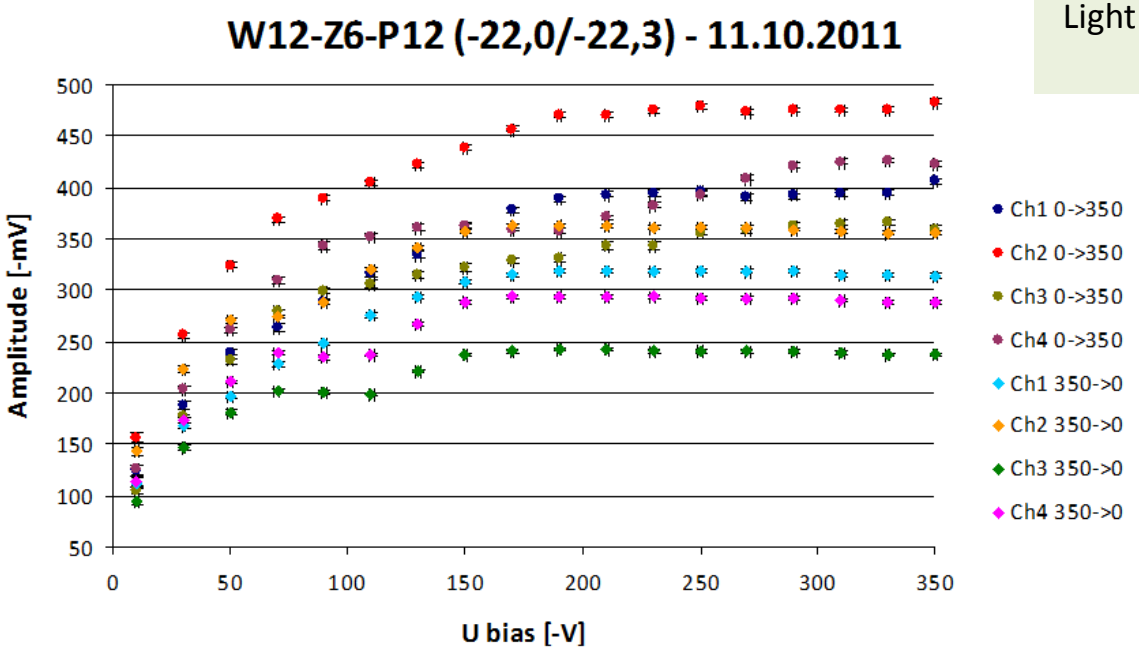
Experimental arrangement



Block scheme of measurement

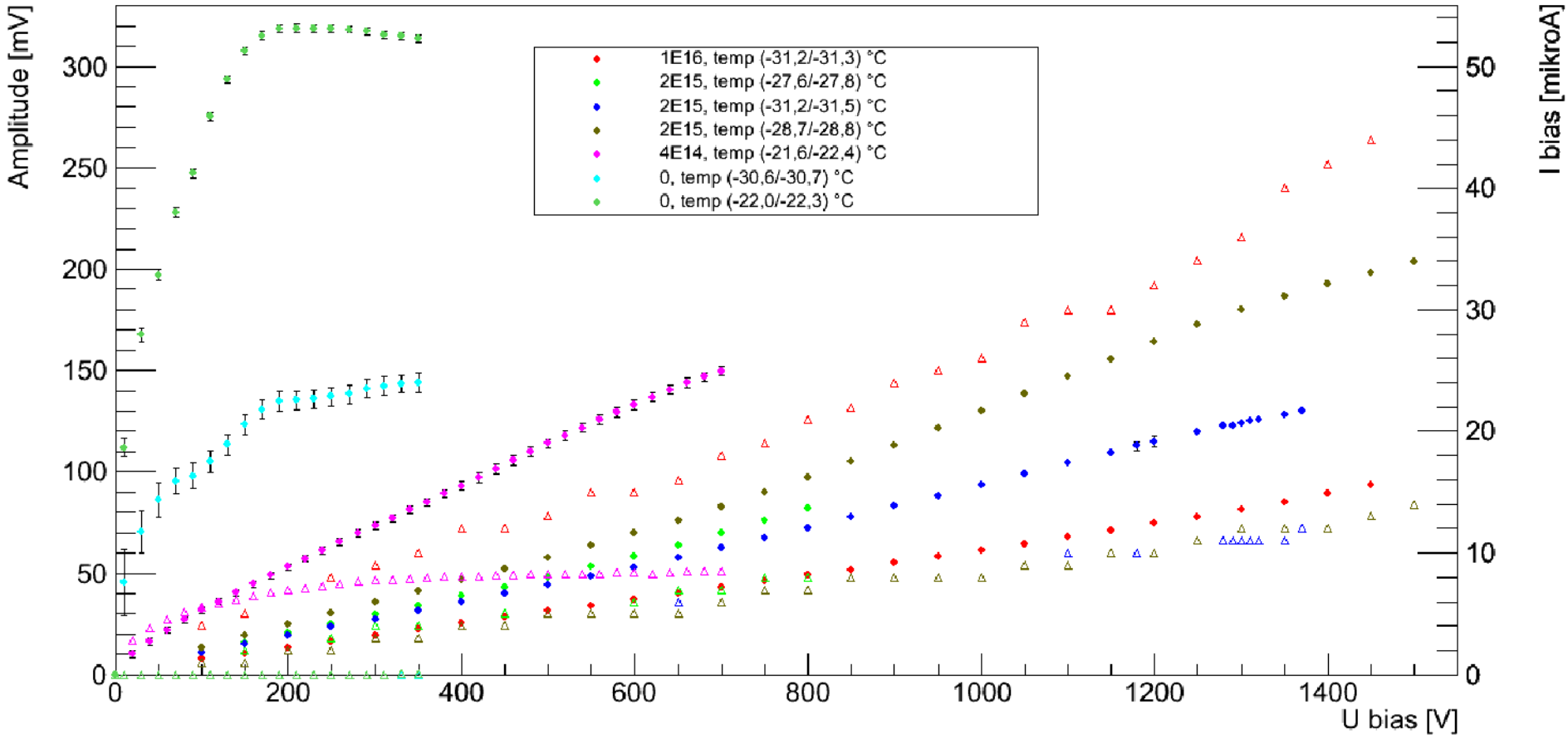
Results

Light spot from laser, frequency 1 kHz and width 22.5 - 50 ns



Example of measurement for unirradiated module

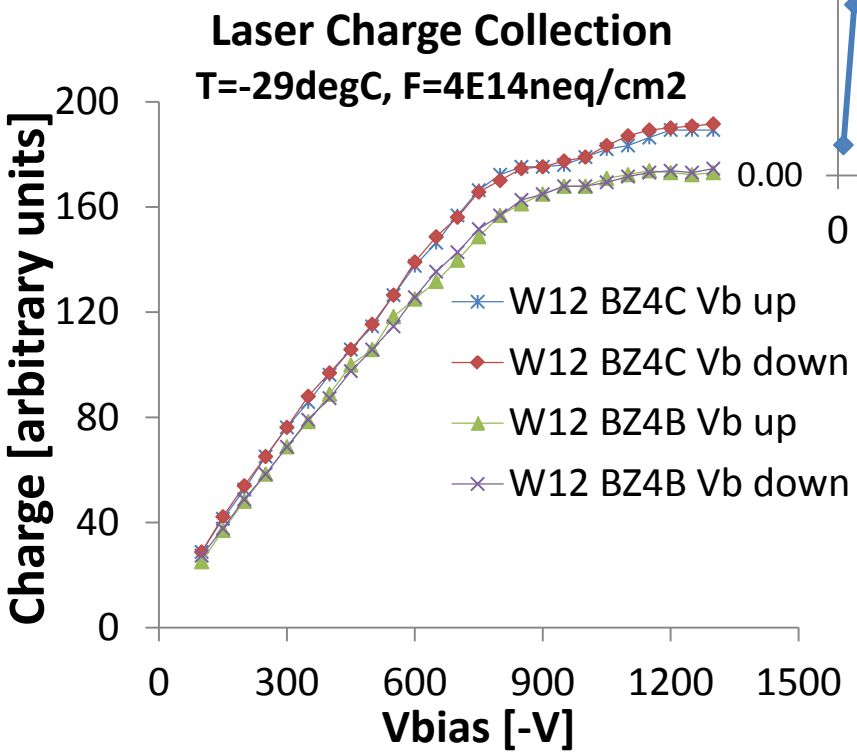
Results

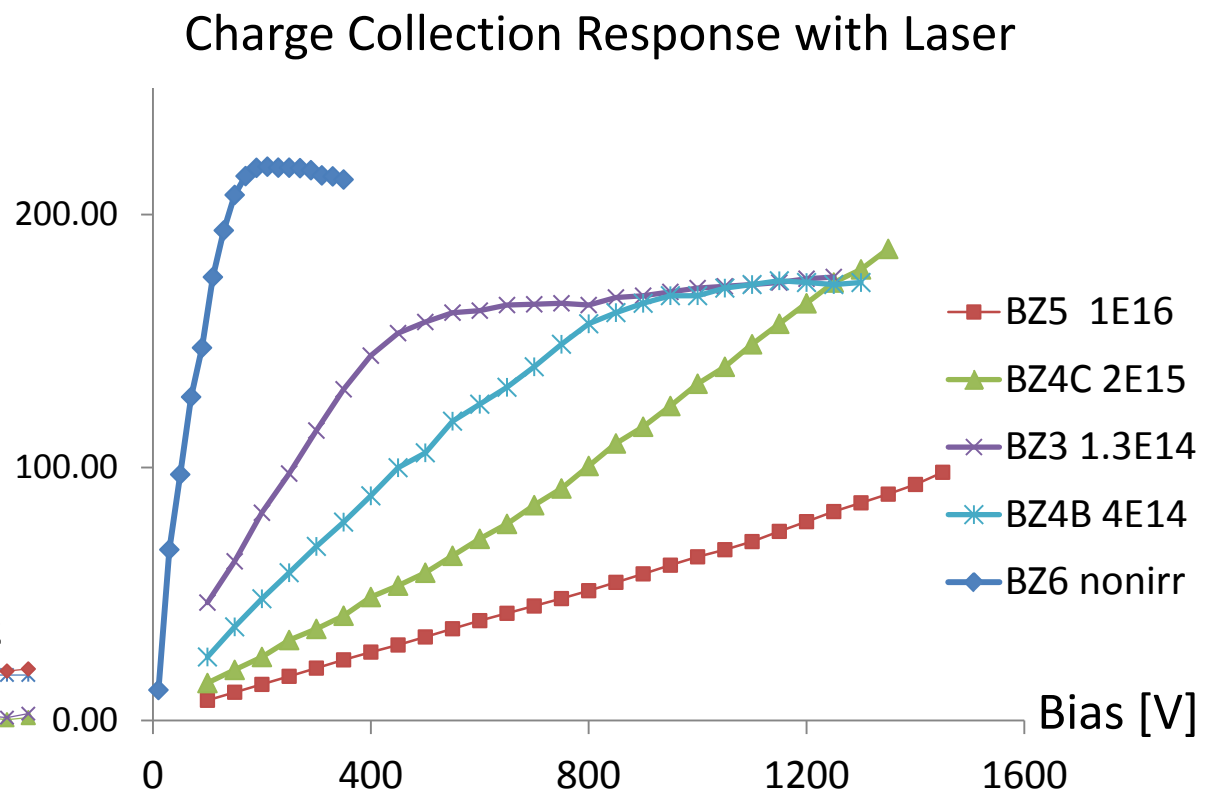


Sumary , dots are values of amplitude [mV], triangle is symbol of bias current [μA], information of each detector has the same color

Results

Example of measurement of response in increasing of bias voltage (up – green, blue markers) and decreasing bias (down – red, violet markers) for two different samples and the same irradiated dose





Response of detectors for different doses

Summary

Charge collection efficiency of ATLAS07 mini sensor irradiated to various dosed has been performed using infrared laser

As a reference unirradiated detector W12-Z6-P22 was measured at several temperatures (room temperature, -22 C and -31 C).

Sensors W13-BZ4A-P04, W13-BZ4D and W13-BZ4B were irradiated by dose 2x10^15 cm-2, sensor W12-BZ4D-P22 by 4x10^14 cm-2 and sensor W13-BZ5-P11 by 1x10^16 cm-2.

For unirradiated sensors, as well as for sensors irradiated to 1.3x10^14 and 4x10^14 n/cm2 the bias dependence of the collected charge reached plateau corresponding to the full depletion voltage as found from the CV scan.

Plans

Tests with source to estimate response for high irradiated detectors.

Beam tests with Alibava readout on beam at DESY

Cooling in DESY beam test area

Continuing of laser tests and irradiation program

Thank you for attention!