



Prototype instrument for fluence monitoring based on carrier lifetime control by microwave probed photoconductivity transients (AIDA - WP8.3.2)

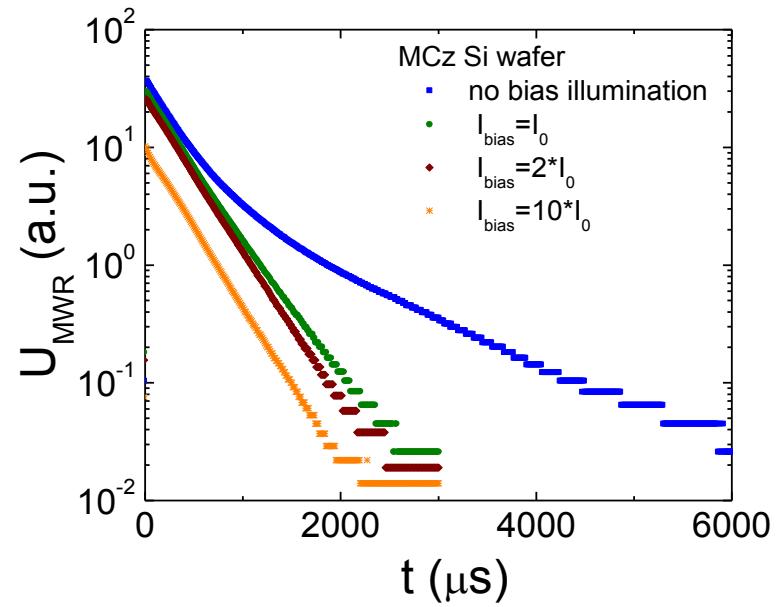
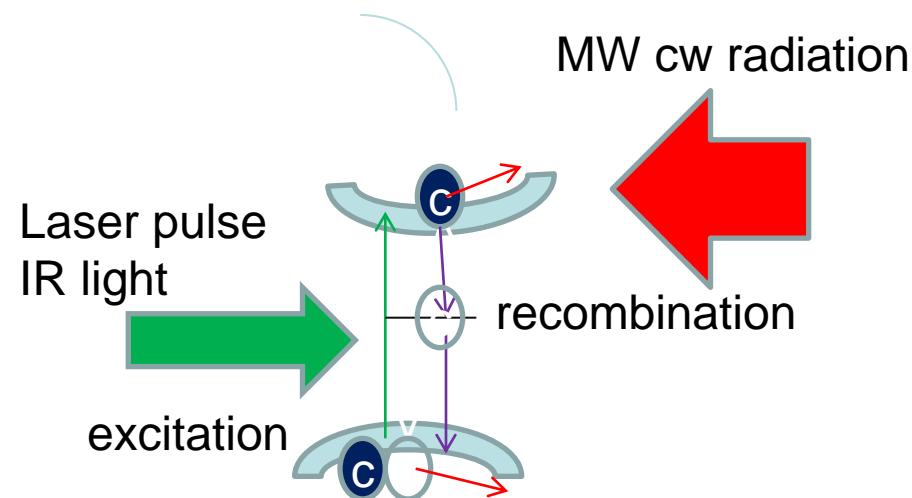
E.Gaubas, J.Vaitkus, T.Ceponis, A.Uleckas

Institute of Applied Research, Vilnius University, Saulėtekio av. 9-III,
LT-10222 Vilnius, Lithuania

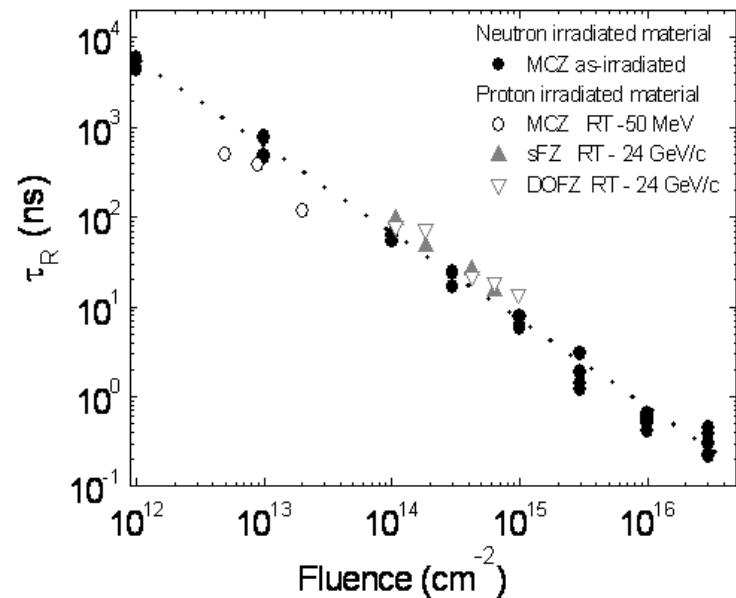
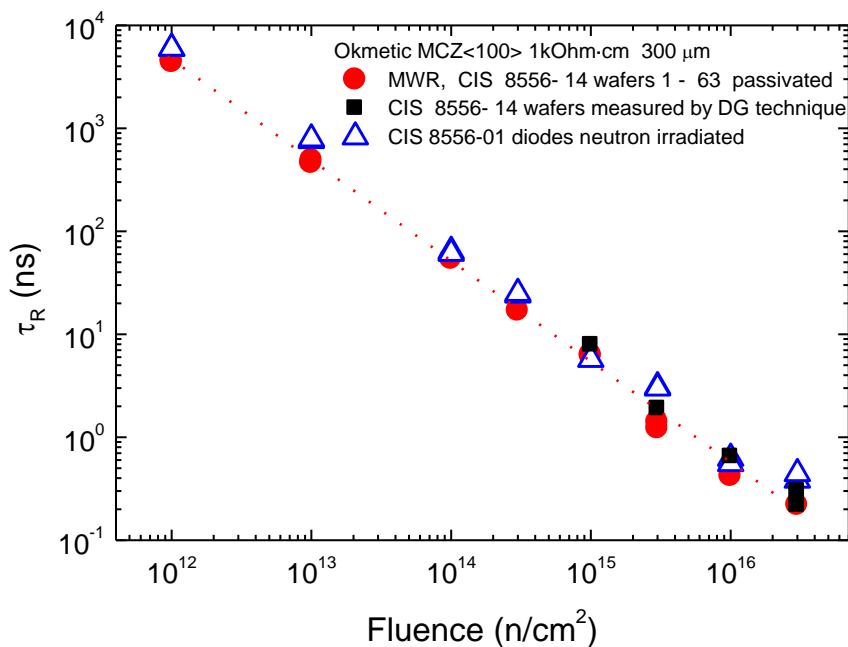
Outline:

- WP8/ 8.3.2 VU task
- Prototype instrument
- Calibration of samples and characteristics
- Coming tasks

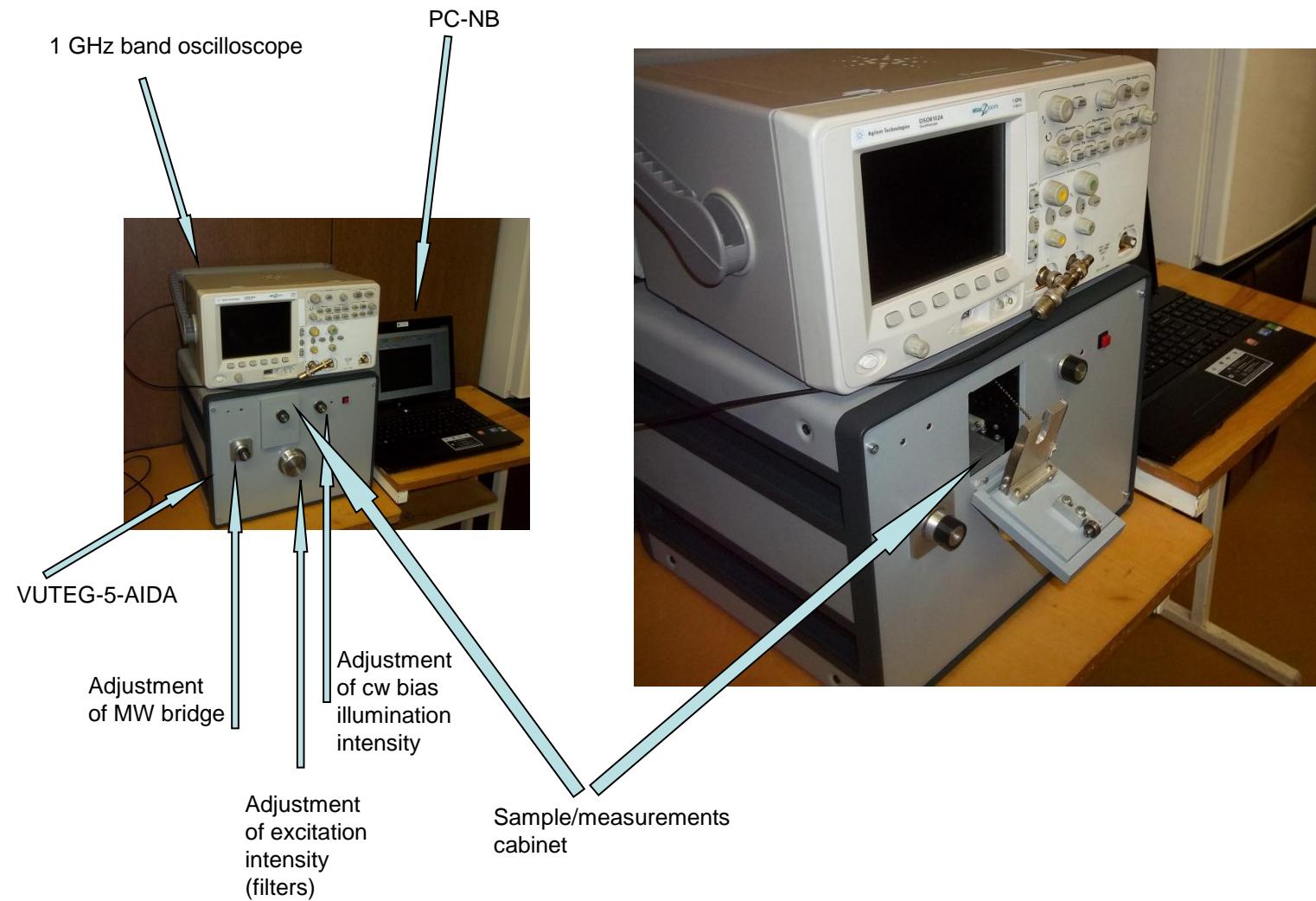
- WP8 8.3.2 VU task:
fluence monitoring based on carrier lifetime control by microwave
(absorption) probed photoconductivity transients
- To design and fabricate an instrument for fluence monitoring
- To develop methodology (polythene bags) of measurements
- To calibrate the samples and characteristics under different irradiations



Experience of VU team in monitoring of radiation impact on carrier recombination and generation lifetime control: Post-irradiation

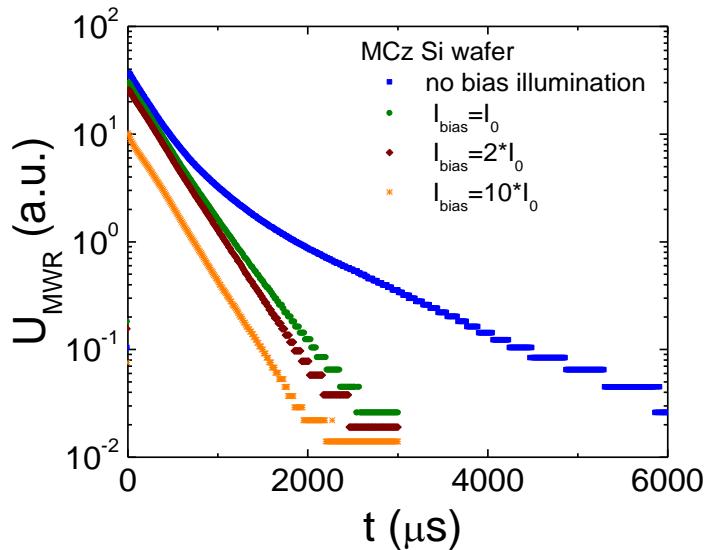


- Prototype instrument for AIDA WP8.3.2: designed and fabricated

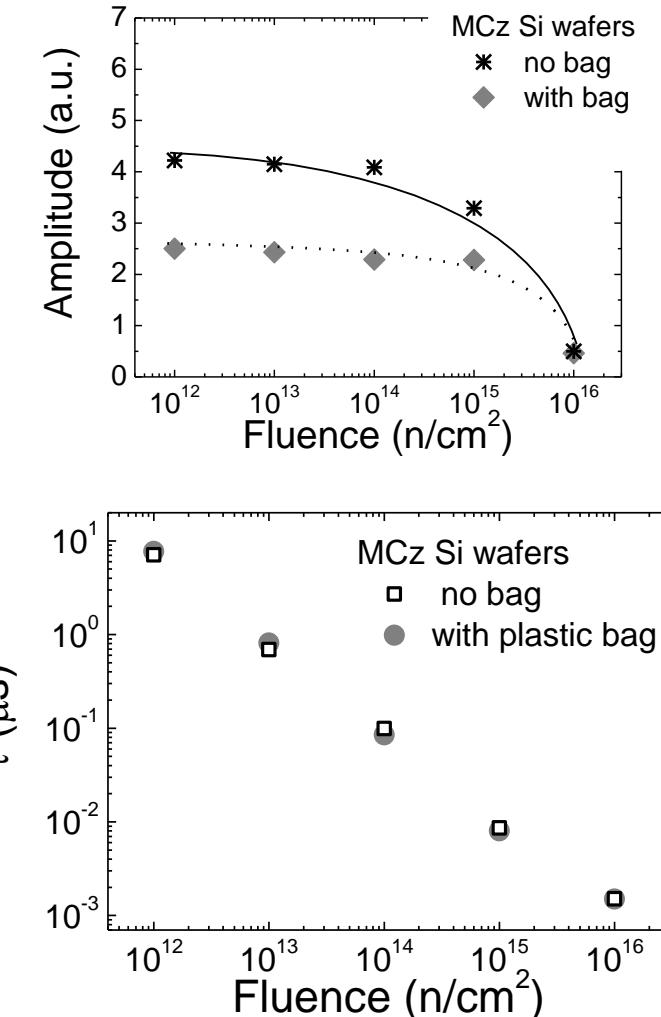


• Calibration of samples and characteristics

For non-irradiated samples recombination with trapping effect can be important, therefore CW bias illumination should be applied to extract recombination lifetime. Also, neutral filters are installed to vary excitation intensity.

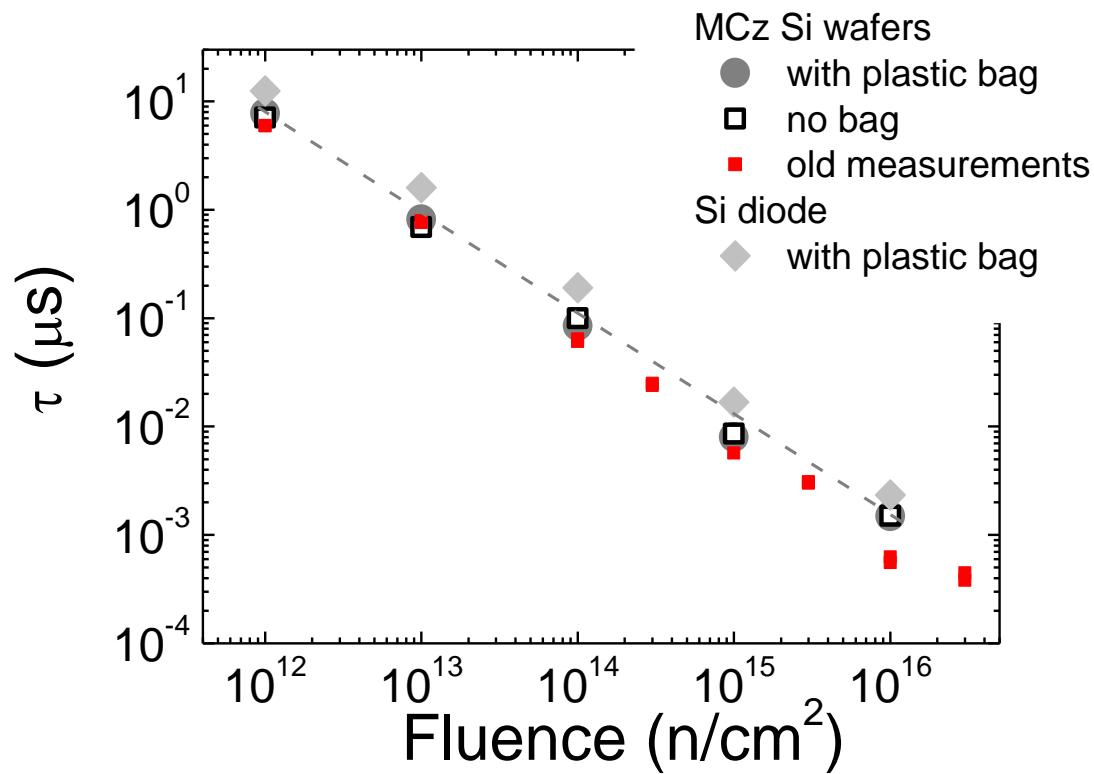


Samples being in plastic (polythene) bag would be irradiated and tested. Therefore, MW-PCD signal amplitude is reduced due to excitation light scattering, and sensitivity of measurement instrument should be tested. For the examined set of irradiated wafer fragments and pad-detectors sensitivity is relevant. Lifetime values are not perturbed due to bag.



- Calibration of samples and recombination characteristics

Lifetime values measured on the same irradiated samples by 5 years (2007-2012) time interval did not change significantly.



- Coming tasks

- Preparation of sets of the samples for test measurements;
- Comparative study of MW-PCD lifetime on wafers, diodes and transistors (FET);
- Investigation of cross-correlation between carrier lifetime variations and electrical characteristics of diodes/ transistors.

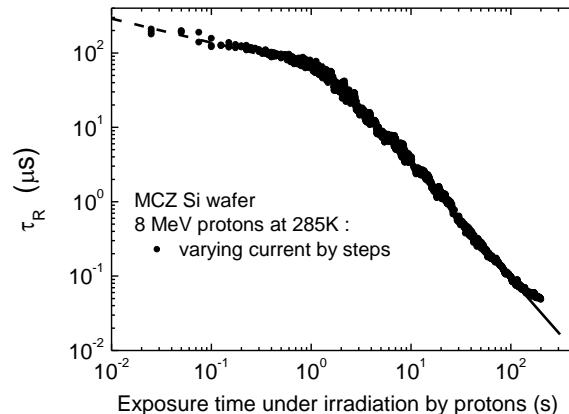
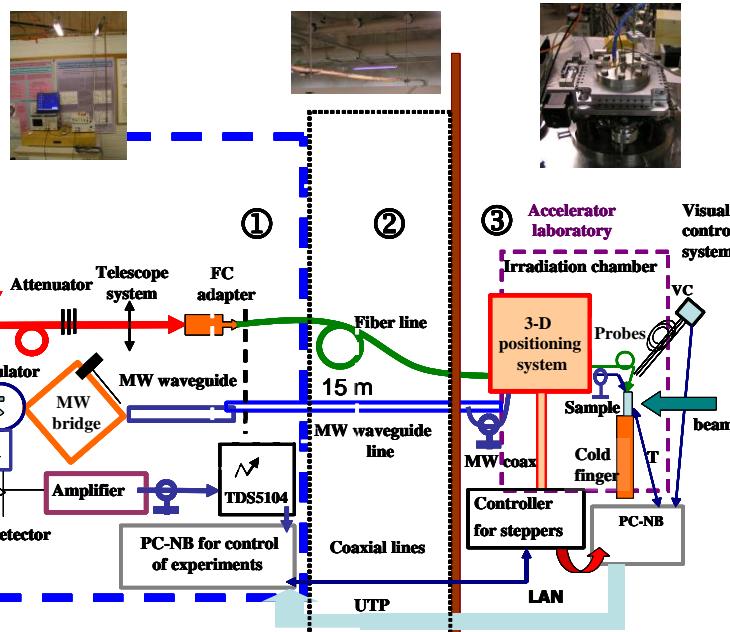
Thank You for attention!

● WP8 task for Vilnius University team

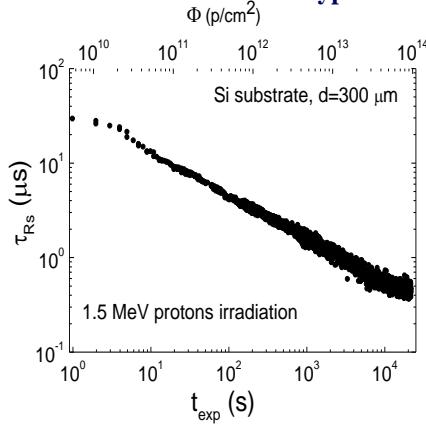
“Design and fabrication of the device for monitoring of radiation based on the carrier lifetime measurements”

Experience of VU team in monitoring of radiation impact on carrier recombination and generation lifetime:
in situ

MW-PCT measurement setup – Helsinki tandem type proton accelerator

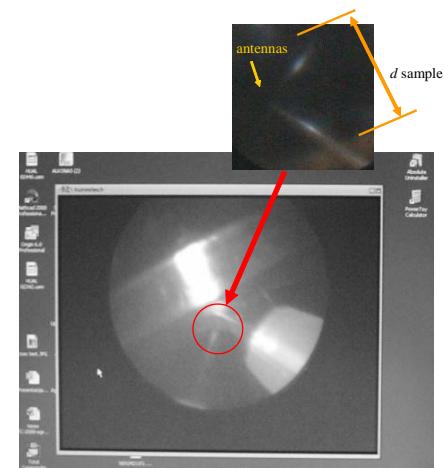


MW-PCT in situ – Vilnius tandem type accelerator



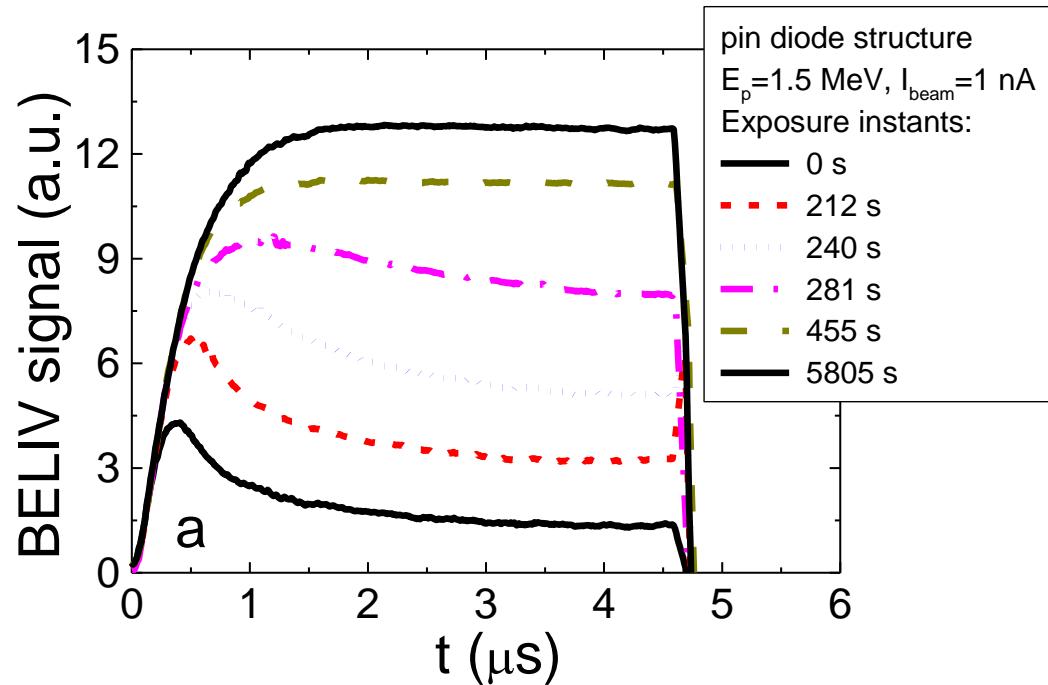
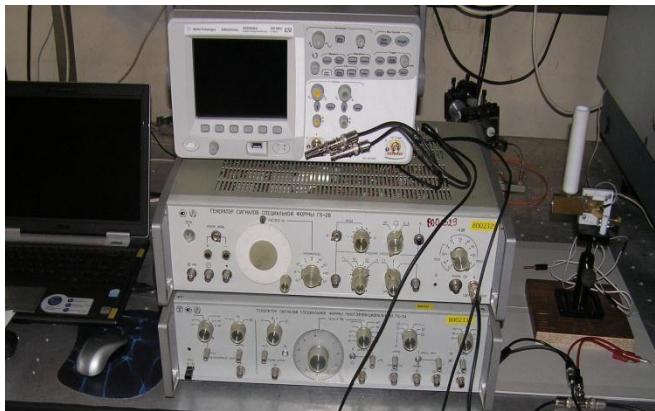
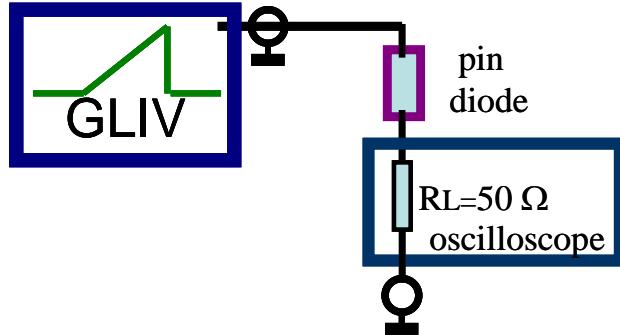
E. Gaubas, A. Uleckas, J. Vaitkus, J. Raisanen, P. Tikkanen. *Instrumentation for the in situ control of carrier recombination characteristics during irradiation by protons*, Review of Scientific Instruments **81**, 053303 (2010).

T. Ceponis, E. Gaubas, V. Kalendra, A. Uleckas, J. Vaitkus, K. Zilinskas, V. Kovalevskij, M. Gaspariunas, and V. Remeikis, JINST (Journal of INSTRumentation), **6** (2011) P09002.



Experience of VU team in monitoring of radiation impact on carrier recombination and generation lifetime control: in situ

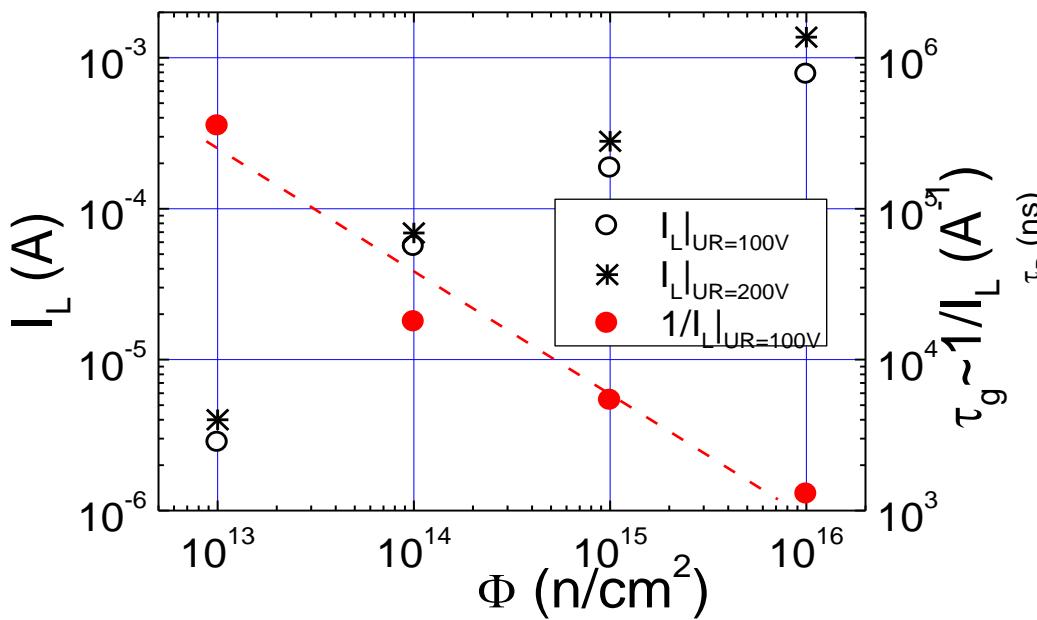
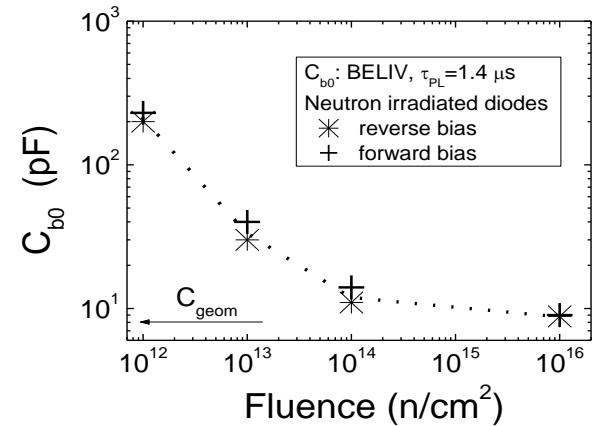
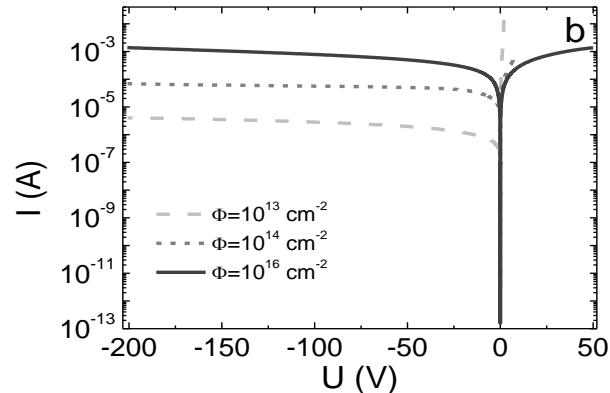
BELIV in situ – Vilnius tandem type accelerator



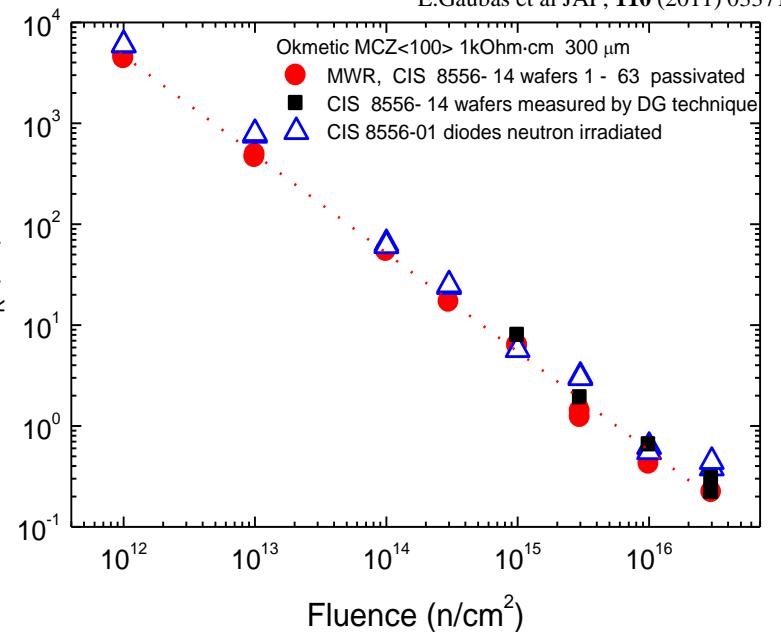
T. Ceponis, E. Gaubas, V. Kalendra, A. Uleckas, J. Vaitkus, K. Zilinskas, V. Kovalevskij, M. Gaspariunas, and V. Remeikis, JINST (Journal of INSTRumentation), **6** (2011) P09002.

E. Gaubas, T. Ceponis, A. Uleckas and R. Grigoniš, JINST (Journal of INSTRumentation), **7** (2012) P01003.

Experience of VU team in monitoring of radiation impact on carrier recombination and generation lifetime control: Post-irradiation



Qualitative emission lifetime dependence on fluence can be estimated from I-V



Nearly linear reduction of generation lifetime with enhancement of fluence is similar to that of recombination lifetime characteristic

Experience of VU team in monitoring of radiation impact on carrier recombination and generation lifetime control: Post-irradiation

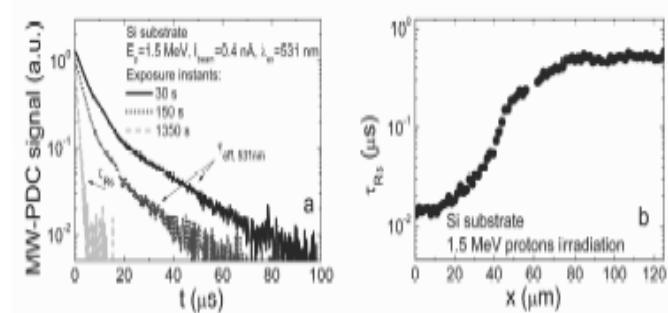
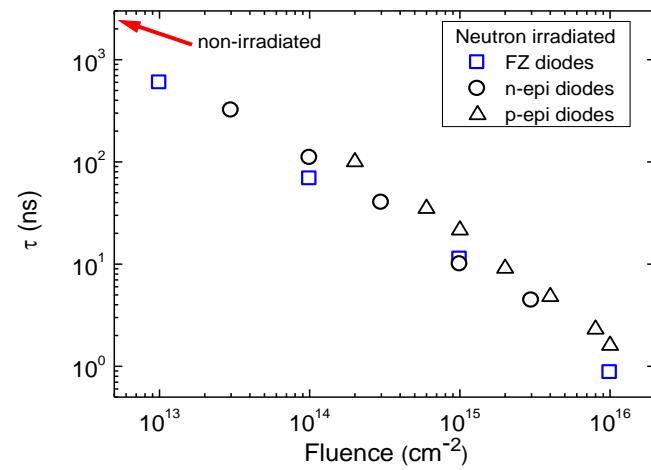
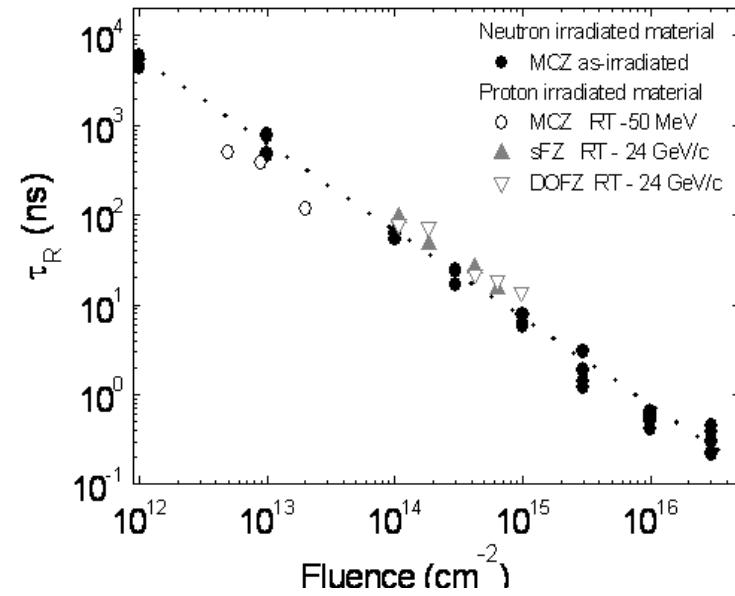
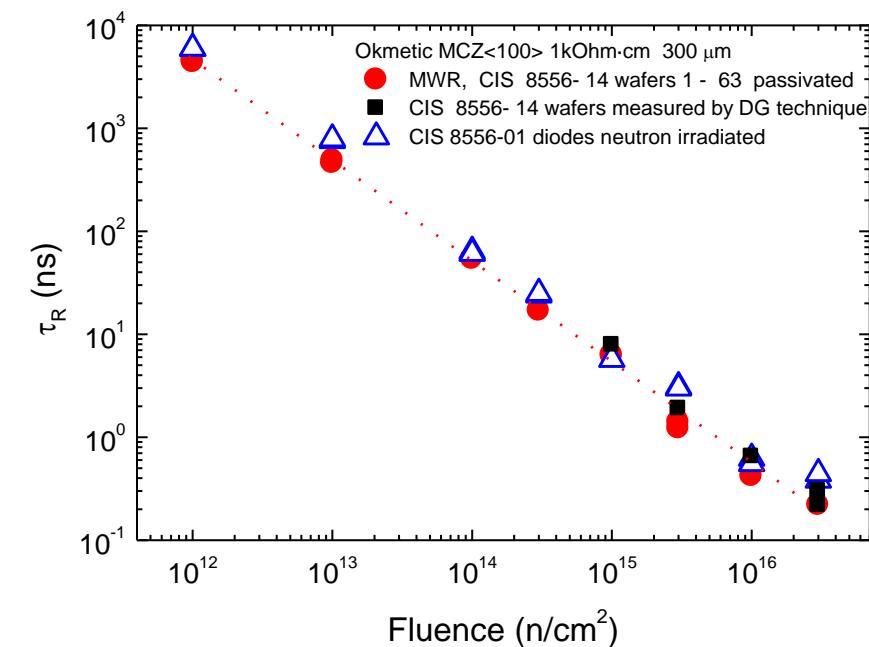


Figure 2. (a) Variations of carrier decay transients versus protons irradiation exposure time. (b) Distribution profile of the carrier decay lifetime (τ_{RS}) within Si wafer cross-sectional boundary measured after 1.5 MeV protons implantation.