CMS related materials research and device design
(deetectors and scincilators)

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Two roots of interests and contributions

- Starting 1995 VU prof. G.Tamulaitis team contributed in characterization PbWO$_4$ as a part of Ukrainian team which supplied CERN by these materials. (With this Ukrainian team VU collaborated in Soviet time, too.) Later other materials were included, also.

- CMS detector group initiated founding the Central European Consortium (CEC) in 2009 for modeling of semiconductor detectors related with the coming upgrades, and investigation of its parameters in the realistic conditions, we joined this CEC, but shortly was decided to transfer it to RD50 community.
Early CMS related activities


2. **Influence of variable tungsten valency on optical transmittance and radiation hardness of lead tungstate (PWO) scintillation crystals** By: Burachas, S; Beloglovski, S; Makov, I; et al. NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A 505 (3) 656-662 (2003)


New challenges

• During discussions with CMS leaders and at RD 50 Workshops after presentations of CMS experiment because evident the necessity to enter $1 \text{ and above } e^{17}$ neutrons/cm$^2$ integrated fluence environment.

• It become a challenge for both: semiconductors and scintillators, including a necessity of fast timing (10 ps).

• These tasks appeared in the AIDA-2020 program.
The selected publications related to CMS calorimeters (scintilators)
Prof. G.Tamulaitis group, CERN RD 18 & AIDA 2020 WP 14


• 2. Influence of variable tungsten valency on optical transmittance and radiation hardness of lead tungstate (PWO) scintillation crystals. By: Burachas, S; Beloglovski, S; Makov, I; et al. NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT Volume: 505 Issue: 3 Pages: 656-662 Published: JUN 11 2003

The selected publications related to CMS calorimeters (scintillators)
Prof. G.Tamulaitis group, CERN RD 18 & AIDA 2020 WP 14


• 8. **Significant improvement of GAGG:Ce based scintillation detector performance with temperature decrease.** By: Korjik, M.; Alenkov, V.; Borisevich, A.; et al. NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION 871 Pages: 42-46 Published: NOV 1 2017

• 9. **Subpicosecond luminescence rise time in magnesium codoped GAGG:Ce scintillator.** By: Tamulaitis, G.; Vaitkevicius, A.; Nargelas, S.; et al. NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION 870 Pages: 25-29 Published: OCT 21 2017
The selected publications related to CMS tracking detectors and calorimeters (semiconductor detectors)

Prof. E.Gaubas group, CERN RD 50 & AIDA 2020 WP 15

Starting by:

• Wide bandgap semiconductor detectors for harsh radiation environments. By: Grant, J; Cunningham, W; Blue, A; et al. NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT Volume: 546 Issue: 1-2 Pages: 213-217 Published: JUL 1 2005

Recent publications

• 1. In situ characterization of radiation sensors based on GaN LED structure by pulsed capacitance technique and luminescence spectroscopy. By: Gaubas, E.; Ceponis, T.; Meskauskas, D.; et al. SENSORS AND ACTUATORS A-PHYSICAL Volume: 267 Pages: 194-199 Published: NOV 1 2017

• 2. Study of neutron irradiated structures of ammonothermal GaN. By: Gaubas, E.; Ceponis, T.; Deveikis, L.; et al. JOURNAL OF PHYSICS D-APPLIED PHYSICS Volume: 50 Issue: 13 Article Number: 135102 Published: APR 5 2017

• 3. Anneal induced transforms of radiation defects in heavily electron irradiated Si diodes By: Rumbauskas, V.; Meskauskaite, D.; Ceponis, T.; et al. JOURNAL OF INSTRUMENTATION Volume: 11 Article Number: P09004 Published: SEP 2016

• 3. Study of Charge Carrier Transport in GaN Sensors. By: Gaubas, Eugenijus; Ceponis, Tomas; Kuokstis, Edmundas; et al. MATERIALS Volume: 9 Issue: 4 Published: APR 2016

• 4. Study of surface recombination on cleaved and passivated edges of Si detectors. By: Gaubas, E.; Ceponis, T.; Vaitkus, J. V.; et al. SEMICONDUCTOR SCIENCE AND TECHNOLOGY Volume: 31 Issue: 3 Article Number: 035003 Published: MAR 2016

• 5. ESR SPECTROSCOPY OF ALANINE IMPACTED BY HIGH ENERGY IRRADIATIONS FOR WIDE RANGE DOSIMETRY. By: Ceponis, T.; Gaubas, E.; Venius, J.; et al. LITHUANIAN JOURNAL OF PHYSICS Volume: 56 Issue: 1 Pages: 49-54 Published: 2016

The selected publications related to CMS tracking detectors and calorimeters (semiconductor detectors)

Prof. J.Vaitkus group, CERN RD 50

Starting by:


The selected publications related to CMS tracking detectors and calorimeters (semiconductor detectors)

Prof. J.Vaitkus group, **CERN RD 50 & AIDA 2020 WP 15**

**Recent publications**


**Carrier mobility dependence on the fluence is one of key parameters that defines CCE in the detectors and the required bias voltage**
Nearest plans

- Test the GaN pixels (fabricated at Amono, Ltd., Poland, according our design
- TCAD detector simulations taking into account the mobility and lifetime dependence on fluence
- Look forward to approach 10 ps resolution for calorimeters
THANK YOU
FOR YOUR ATTENTION!