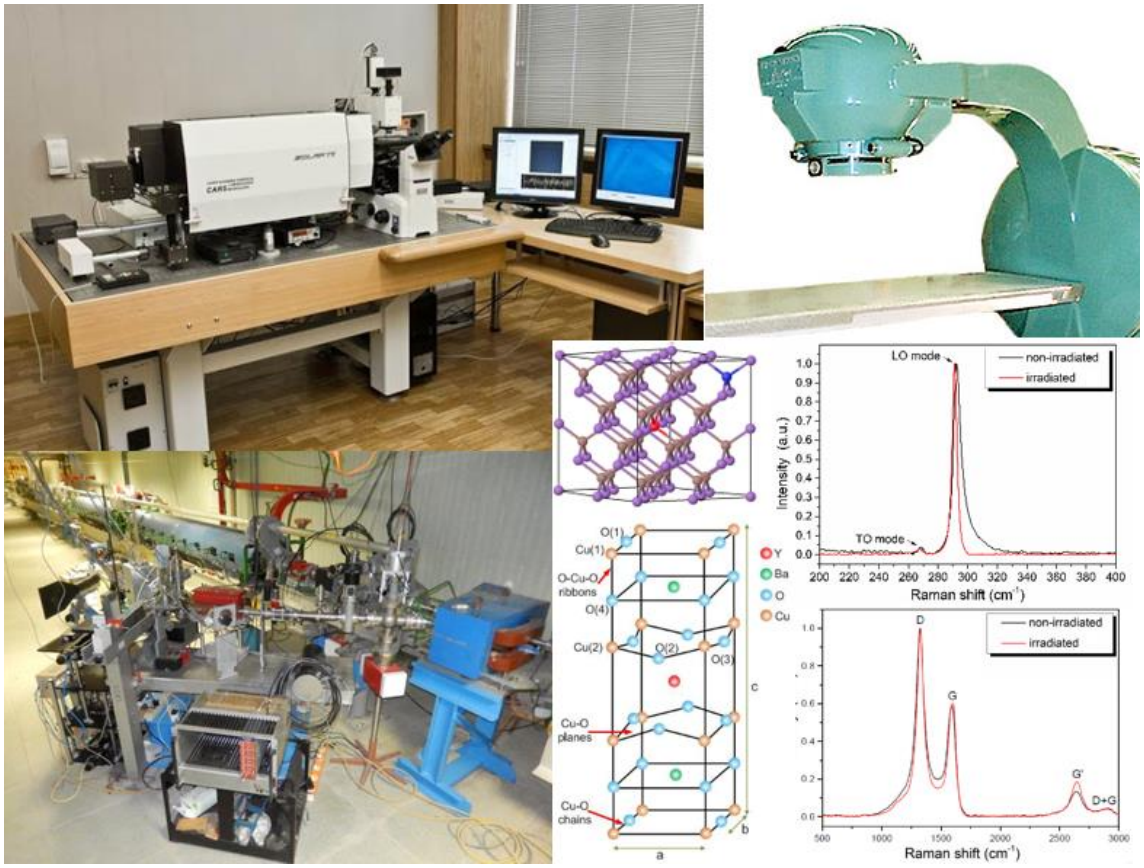
Study of radiation effects on advanced materials exposed to electron beams and gamma rays using Raman Spectroscopy.



- Applied Research Using Nuclear Physics Methods
- 1 student

The project aims to study the effect of irradiation with 20 MeV electrons and 1.25 MeV gamma rays in advanced materials, such as GaAs:Cr, $YBa_2Cu_3O_{7-\delta}$ and MWCNT, using Raman spectroscopy measurements taken before and after radiation exposure. The work will require a broad search of the published literature on the subject, necessary for familiarization with the spectrometric technique itself, to know the most outstanding properties of the targets and their expected responses to radiation, to deepen the mathematical treatment methods of spectra, etc. The obtained Raman spectra will undergo deconvolution mathematical processing, in order to facilitate their interpretation. The inter-comparative analysis of these spectra will allow reaching conclusions about the structural processes that have taken place stimulated by irradiation in the targets.

Tasks

- Study of the Raman Spectroscopy fundamentals.
- Study of the selected target general properties: GaAs:Cr, $YBa_2Cu_3O_{7-\delta}$ or MWCNT.
- Analysis of the irradiation experiments carried out in the linear electron accelerator LINAC-800 and in the gamma camera POKYEM, both facilities of the JINR.

- Effective depth calculation for the Raman effect measurement in the target material.
- Preliminary analysis of the obtained Raman spectra.
- Deconvolution of the Raman spectra.
- Analysis and interpretation of the deconvoluted spectra.
- Preparation of final report.

Preliminary schedule by topics/tasks

The expected project duration is 5-6 weeks. The work schedule will follow the order of the tasks indicated above, admitting the student initiative. The first two weeks will be introductory, followed by three weeks dedicated to the processing and analysis of Raman spectra, leaving the last week for the report preparation. The final schedule will be agreed upon directly with the student.

Required skills

General Physics, courses on Nuclear and Solid-State Physics.
Experience in working with data processing software.
Experience in the search for bibliographic information and its appropriate processing.
Satisfactory communication in English, Russian or Spanish language.

Acquired skills and experience

Understanding of the Raman Spectroscopy fundamentals.
Familiarization with the properties of some advanced materials and their applications.
Deepening of knowledge related to the mechanisms of radiation interaction with matter.
Application of mathematical methods for spectra deconvolution.
Experience in the use of Raman Spectroscopy applied to the study of radiation damage in solid materials of technological and scientific interest.
Increased knowledge in the use of Office Excel and OriginPro software programs for processing and presentation of the experimental results.
Acquired experience in the preparation and defense of scientific work reports.

Recommended literature

- C-K Chris Wang, Atoms, Nuclei, and Interactions of Ionizing Radiation with Matter, (First Edition), Cognella Academic Publishing, (2016).
- Hooshang Nikjoo, et al., Interaction of Radiation with Matter, CRC Press, 1st edition (September 30, 2020).
- Ferraro J. R., Nakamoto K. and Brown C. W. Introductory Raman Spectroscopy. 2da edición. Academic Press, (2003).
- Weber W. H. and Merlin R. Raman Scattering in Materials Science. Springer-Verlag (2000).
- https://www.originlab.com/index.aspx?go=Products/Origin/DataAnalysis/PeakAnalysis#Peak_Fitting_PRO