INVITATION

Scientific Course

"SMALL-ANGLE SCATTERING"

BY

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FunGlass, June 5-26, 2023

PLACE: **Conference room B 4.03 FunGlass TNUAD**

LECTURES:

Friday, June 9

10:00 a.m. – 11:00 a.m.

Lecture 1: Small-Angle Scattering: what you should know and why you should care?

Friday, June 16

9:00 a.m. – 10:00 a.m.

Lecture 2: From kitchen to battlefield, small-angle scattering applications in real life

June 19 – 21, FunGlass School (will be announced in the programme)

Lecture 3: Examples of data reduction & analysis of small-angle scattering data (1-N)

- **Materials science application of small-angle scattering**
- **Absolute calibration of small-angle scattering data**
- **Ultra-small angle scattering instrumentation**
- **Software for analysis of small-angle scattering**
- **Complex engineering materials microstructures**
- **Materials for energy generation, conversion, and utilization**

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Small-Angle Scattering: what you should know and why you should care?

Small-angle scattering is “old” technique with history dating back to 1930s. It has been successfully used in wide range of fields and – at least in some - contributed critically important information. Its major value is in typically simple sample preparation, speedy and not destructive data collection, and relatively easy access to X-ray and neutron instrumentation. For X-rays availability of laboratory devices is major advantage. This lecture will briefly review the history, technique itself, basic theory, and analysis methods, as well as essentials of applications. This introduction will be structured for novices and beginners with intend to elevate everyone’s expertise to “excellent beginner” level and prepare audience for scientific examples. The lecture will be presented with minimum number of equations but lot of graphics and directed towards the comprehension and understanding. Furthermore, lecture will also discuss various radiation sources for small-angle scattering and other types of diffraction experiments, such as synchrotrons, neutrons sources, as well as new desktop sources.

From kitchen to battlefield, small-angle scattering applications in real life

Materials scientist job is being a detective, investigating nature processes in order to provide humanity with better materials, new drugs, or simply better understanding of complex materials processes. This requires open mind, understanding of wide range of techniques and careful, sometimes tedious work of combining results together to build as reliable model of what is happening as possible. Small-angle scattering can be small – or large – part of portfolio of tools necessary for this investigative work. This presentation will discuss examples in which small-angle scattering technique has contributed keystone information necessary for these specific applications. From chocolate and food fats, through particle suspensions, polymers structures, new generation metallurgy necessary for 3D printed structure, to understanding of processes during explosions, in all these problems the small-angle scattering technique offered unique information which could not be obtained by other means.

Examples of data reduction & analysis of small-angle scattering data (1-N)

Small-angle scattering is technique which has been described as “simple experiment, difficult analysis”. It is generally understood, that due to its relatively poor “resolution” the analysis of the SAS data is complicated, the results are rarely unique, and most analysis needs to be model based in order to be really useful. Proper model selection is “Achilese heel” of SAS analysis. Furthermore, most models available in community available toolboxes are typically quite crude approximations of real-world structures. Understanding of the model limitations, how they can be applied, and what are limitations of the obtained results, is critical for users of any SAS method. This series of lectures will go through example of data reduction of 2D data using *Nika* and analysis examples using *Irena*, common SAS support tools authored by the speaker. First lecture will walk audience through data reduction steps necessary to reduce, normalize, and calibrate 2D data into 1D data needed for data modeling tools. Following lectures will walk users from simple Guinier analysis to complex hierarchical structures modeling using various data available from the speaker. Audience can either observe the method and tools or follow using their own computer with the tools which will be installed during the first lecture.