Summer school on Neutron scattering

(9-) 11-21 September 2017
University of Tartu

NNSP and SwedNess

Welcome!

- 43 students
  DK (6), N(4), S(25),
  EST(7), LV(1)
- Sponsors:
  - NNSP (Nordforsk)
  - SwedNess (SSF)
- Course: 4 ECTS
  Exam on the 21st
- Course material:
  Notes aligned with
  e-learning

Meals:
Breakfast on hotel
Lunch at AHHAA
Dinner on your own

AHHAA: entry free from 10/9

Gala dinner: 15/9

Sign-up for leisure day:
before 13/9

Please keep reciepts

Any problems:
contact one of us
(Heisi, Camilla, Gitte)

E-learning and software

- We will use a number of software packages during the course
- You should all have an e-learning account by now
- You should install a number of software packages
  - Fullprof
  - SASview
- Questions about this and all other software: Mads

NNSP

- Nordic Neutron Science Program
- Funded by Nordforsk
  - 6 projects with total 17 students
  - Topical networks
  - Topical workshops
  - This school
  - Hands-on training

Intro Course in Neutron Scattering

Tartu, Estonia

9-21 September 2017

Time / Date	7:00 – 8:30	Lecture Session I 8:30 –10:15	Exercise Session I 10:30 – 12:15	12:30 – 14:00	Lecture Session II 14:00 – 15:45	Exercise Session II 16:00 – 17:45	18:00 – 19:00	19:00 – ...
9 Sep	ARRIVAL DAY 1			Lunch	Mathematical Foundation 1 Kim Lefmann, Sidse Lolk & Johan Hellsvik	Mathematical Foundation 2 Kim Lefmann, Sidse Lolk & Johan Hellsvik	Free Time	Dinner *
10 Sep		Mathematical Foundation 3 Kim Lefmann, Sidse Lolk & Johan Hellsvik	Mathematical Foundation 4 Kim Lefmann, Sidse Lolk & Johan Hellsvik	Lunch	Mathematical Foundation 5 Kim Lefmann, Sidse Lolk & Johan Hellsvik	Mathematical Foundation 6 Kim Lefmann, Sidse Lolk & Johan Hellsvik	WELCOME RECEPTION	
	ARRIVAL DAY 2							
11 Sep	Break-fast		**Welcome to the School** • Practicals • ... Kim Lefmann, University of Copenhagen Martin Månsson, KTH	Lunch	**L1: Intro** • The Neutron • Production / History / Future • Basic interaction mechanism (+x-rays) • Scattering from 1 & 2 nuclei • Coherent / Incoherent • Absorption Kim Lefmann, University of Copenhagen	Ex. 1 • Scattering from 1 & 2 Nuclei • Coherent / Incoherent	Free Time	Dinner *
12 Sep	Break-fast	**L2: Neutron Sources & Instrumentation** • Sources Moderators • Monochromators / choppers • Collimation / Filters • Guides • Detection Kim Lefmann, University of Copenhagen	Ex. 2 • Build your virtual neutron instrument (e-learning)	Lunch	**L3: Neutron Interaction with Matter** • Cross Section • Isotope Sensitivity • Elastic / Inelastic • Nuclear / Magnetic • X-rays / Electrons • Multiple Scattering Kim Lefmann, University of Copenhagen	Ex. 3 • Cross Section • Selection of materials * (e-learning)	Free Time	Dinner *
13 Sep	Break-fast	**L4: Crystallography** • Crystallography • k-space • Brillouin Zone Magnus H. Sørby, IFE	Ex. 4 (e-learning)	Lunch	**L5: Diffraction I** • Instrumentation • Powder • Neutron / x-rays Magnus H. Sørby, IFE	Ex. 5 • Refinement	Free Time	Dinner *
14 Sep	Break-fast	**L6: Diffraction II** • Laue • Single-crystal • Total Scattering • Nuclear / Magnetic Magnus H. Sørby, IFE	Ex. 6 • Refinement (cont.)	Lunch	**L7: Magnetic Scattering** • Magnetism • Magnetic Scattering Diana Lucia Quintero Castro, Univ. Stavanger	Ex. 7 • Refinement (cont.)	Free Time	Dinner *
15 Sep	Break-fast	**L8: SANS I** • Instrumentation2 • Scattering Length Density • Form-/Structure Factor • Approximations Andrew Jackson, Lund University / ESS	Ex. 8 "Experiment" • Virtual SANS experiment • Resolution (wavelength vs. angle) • Data Treatment (e-learning)	Lunch	**L9: SANS II** • Geometrica2l models • Contrast Variations • Time-resolved / stroboscopic • Applications Andrew Jackson, Lund University / ESS	Ex. 9 "Data Modeling" • Spheres vs. cylinders • Polydispersity • Resolution	Free Time	GALA DIN-NER

Estonian Road Museum – Who would go to museum to see a road?

Otepää Adventure Park – am I ready for this?

Rough program for the intro days

- 9 Sept.:
  - Intro and scattering
  - Math prerequisites
    - Sines and Cosines
    - Exponential functions
    - Complex numbers
    - Integrals
  - All from KhanAcademy.org
- 10 Sept.: Morning 9:00
  - Wave physics
  - Fourier Transform
  - Complex exponentials
  - Scattering

Scattering of radiation

•What is similar between X-ray and neutron scattering ?

– Other similar techniques ?

• How do you measure the scattering intensity – scattering angle ?

• Mathematical description of scattering from one atom

– And from a lattice?

– $I \sim | \Sigma_j b_j \exp(i \mathbf{q}\cdot\mathbf{r}_j) |^2$