

The Central Facility for Electron Microscopy of the RWTH Aachen University in collaboration with the European Microbeam Analysis Society would like to invite you to the

## Monte Carlo Simulations for Electron Microscopy Workshop

from June 10th to 12th, 2014

[www.gfe.rwth-aachen.de/montecarlo](http://www.gfe.rwth-aachen.de/montecarlo)

### Scope

The aim of this workshop is to provide electron microscopists in-depth knowledge of Monte Carlo simulation methods to assist them in their daily scientific work. Lectures from leading Monte Carlo experts will cover both theoretical and practical aspects of current Monte Carlo programs. Tutorials and live demonstrations will highlight common applications of Monte Carlo simulations to the field of electron microscopy.

The course is designed for any scientist (students, technicians, researchers) having basic knowledge in EPMA, SEM and TEM.

### Lecturers

- Prof. Raynald Gauvin (McGill University, Canada)
- Dr. Xavier Llovet (University of Barcelona, Spain)
- Dr. Silvia Richter (RWTH Aachen University, Germany)
- Philippe Pinard (RWTH Aachen University, Germany)

### Venue, travel and accommodation

The workshop will be held in the building of the Central Facility for Electron Microscopy located on Ahornstraße 55 (entrance: Mies-van-der-Rohe Straße), 52074 Aachen. Information about accommodation and detailed directions are given on the website.

### Registration

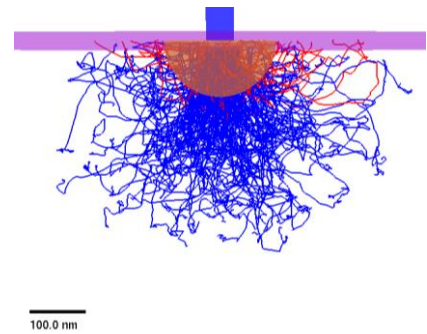
The registration for the workshop costs € 150 for EMAS members or RWTH personnel, and € 200 for other participants. EMAS registration forms can be found at [www.emas-web.net](http://www.emas-web.net). Lunches, refreshments during the coffee breaks, and Wednesday's evening dinner are graciously offered by our sponsors. To register, please fill out the attached form (additional copies are available on the website) and return it by e-mail or fax. The registration deadline is May 23rd, 2014. The number of participants is limited to 35.

### Additional information

The participants are expected to bring their own laptops in order to follow and participate in the tutorials. Each participant will receive a USB drive with Monte Carlo programs. Arrangements will be made to support all common operating systems (Windows, MacOS and Linux).

For any further information or questions, please do not hesitate to contact us. Silvia Richter and Philippe Pinard, tel.: +49 241 80 24348, e-mail: [pinard@gfe.rwth-aachen.de](mailto:pinard@gfe.rwth-aachen.de)

### Sponsors



## Programme

### Tuesday, June 10th 2014

- 14:00** Registration
- 14:30** Welcome  
Prof. Mayer and Dr. Richter
- Theory and applications (Part I)*
- 15:00** Basic concepts of Monte Carlo methods  
Raynald Gauvin  
Inelastic and elastic scattering processes; mean free path of electrons; probability distributions; calculation of the electron path and its energy loss; X-ray production: characteristic and continuum spectrum; X-ray absorption.
- 16:00** Coffee break
- 16:15** Monte Carlo simulations as a tool to assist SEM/TEM measurements  
Raynald Gauvin  
Optimisation of experimental conditions for performing X-ray microanalysis and imaging (backscattered and transmitted electrons); simulation of energy-dispersive X-ray spectra; quantification.
- 17:15** Quantitative analysis of thin films  
Silvia Richter  
Applications in plasma assisted thin film deposition, semiconductor heterostructures and wear protecting layers of bearing materials, depth profile analysis by using destructive techniques (dimple grinder and FIB).
- 18:00** End of first day

### Wednesday, June 11th 2014

- Theory and applications (Part II)*
- 9:00** Cross-sections for Monte Carlo simulation of electron transport and X-ray generation  
Xavier Llovet  
Elastic scattering; inelastic collisions; inner-shell ionisation; Bremsstrahlung emission; photoelectric absorption; mass-attenuation coefficients; Monte Carlo simulation in practice; accuracy of Monte Carlo simulation; comparison with experimental data.
- 10:00** Coffee break
- 10:15** Applications of Monte Carlo simulation to EPMA  
Xavier Llovet  
Simulation of EPMA measurements; lateral and depth resolution; secondary fluorescence across phase boundaries; analysis of particles/inclusions; validation of analytical methods.
- 11:15** Brute force Monte Carlo simulations  
Philippe Pinard  
Monte Carlo simulations as a routine pre-measurement checkup; precision and spatial resolution evaluation; running simulations in batch.
- 12:00** Lunch

## Programme (continued)

## Wednesday, June 11th 2014 (continued)

*Practical sessions on Monte Carlo simulation programmes - Part I*

- 13:00** Installation of programmes (optional)  
Time reserved to ensure that all programmes are running on participants laptops.
- 13:30** MC X-Ray, Casino and WinX-Ray  
Raynald Gauvin  
Presentation of MC X-Ray as a successor of Casino and WinX-Ray; tutorials how to use the programmes; examples of simulated electron, X-ray imaging and spectroscopic experiments of complex sample geometries.
- 15:30** Coffee break
- 15:45** PENELOPE / PENEPMA  
Xavier Llovet  
Presentation of PENEPMA as a dedicated programme that uses the general purpose Monte Carlo programme PENELOPE; basic overview of the main characteristics of PENEPMA and examples of application.
- 17:45** End of second day
- 19:00** Dinner

## Thursday, June 12th 2014

*Practical sessions on Monte Carlo simulation programmes - Part II*

- 9:00** Monaco  
Silvia Richter  
Presentation of programme designed for the inverse calculation of composition of bulk and thin film samples.
- 10:00** pyMonteCarlo (Part I)  
Philippe Pinard  
Presentation of a generic interface to run identical simulations using different Monte Carlo programmes; comparison of different Monte Carlo programmes.
- 10:30** Coffee break
- 11:00** pyMonteCarlo (Part II)  
Philippe Pinard  
Guided tutorials on how to use the programme; setup of series of simulations, data analysis and visualisation.
- 12:00** Final discussion
- 12:30** Lunch and end of workshop