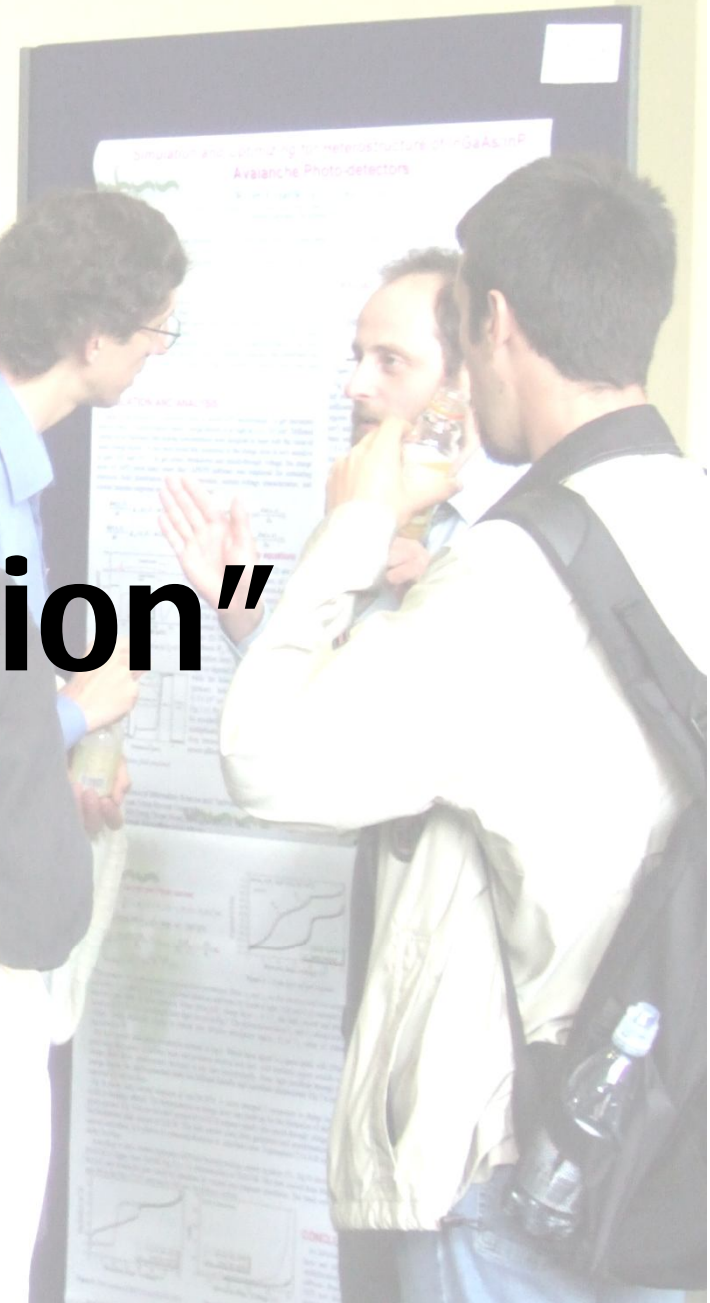NUSOD'08

"Rump Session"

# Suggested Topics

- Physics-based models for complex materials — Ulrich Schwartz
- Photonic modelling opportunities in life sciences – Eric Larkins
- Simulation of multi-mode Fabry-Perot lasers — Hans Wenzel
- Common photonics material database — Wei Choon Ng
- Numerical Modelling: Trends for the near future – Pavel Ivanov
  - ➤ Design tools for functional photonic Ics — Eric Larkins
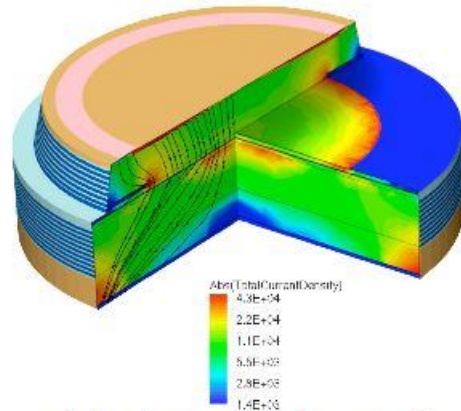  - ➤ Funding prospects for simulation networks — Mauro Pereira
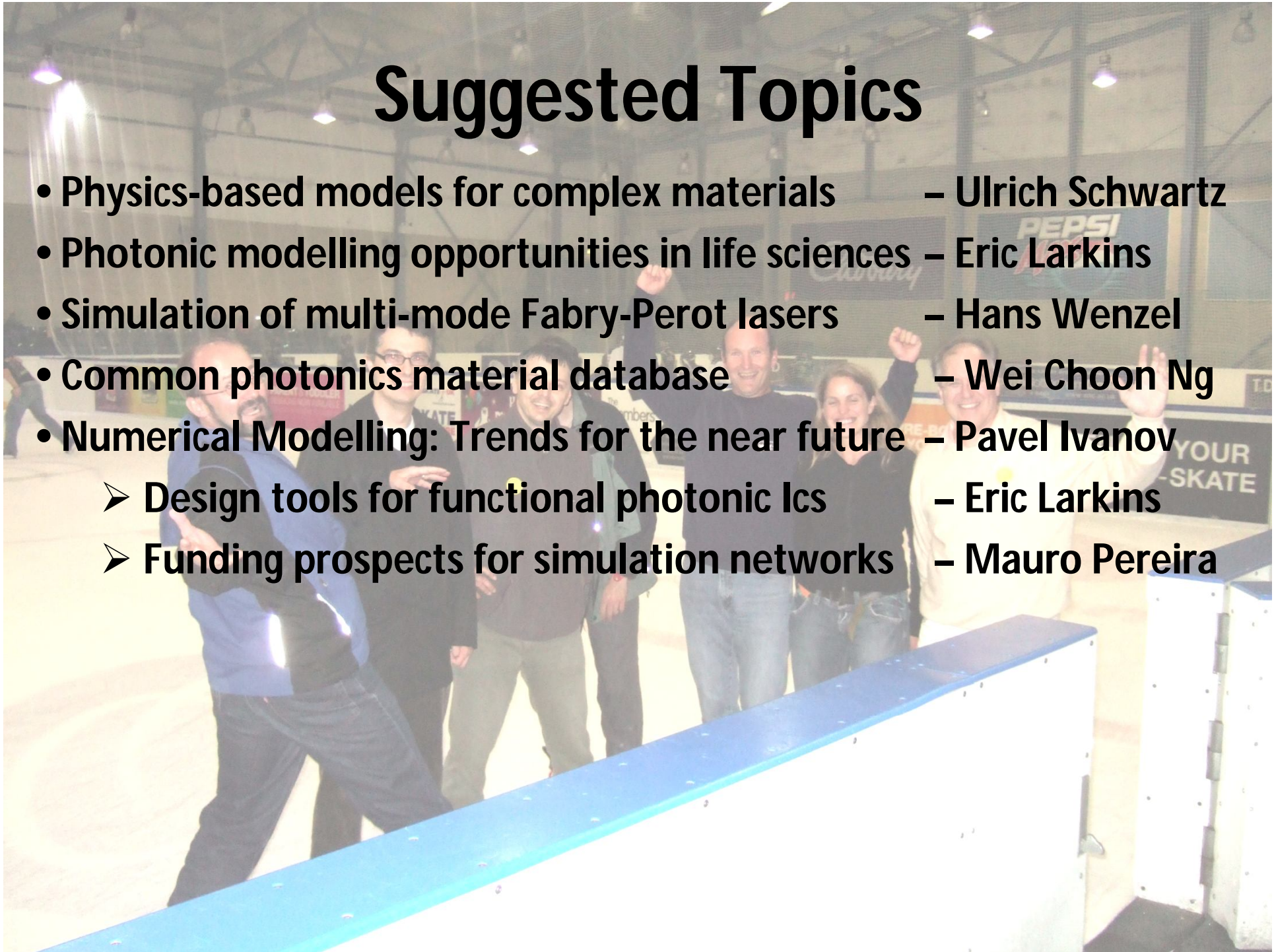
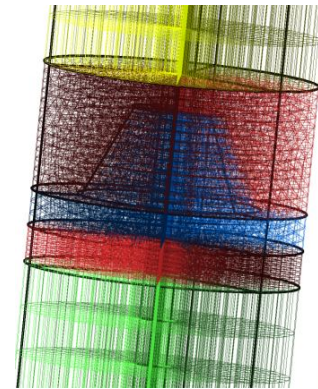**Physics-based models for complex materials**
- quaternery materials
- InGaN
- photonic crystals?
- metamaterials?
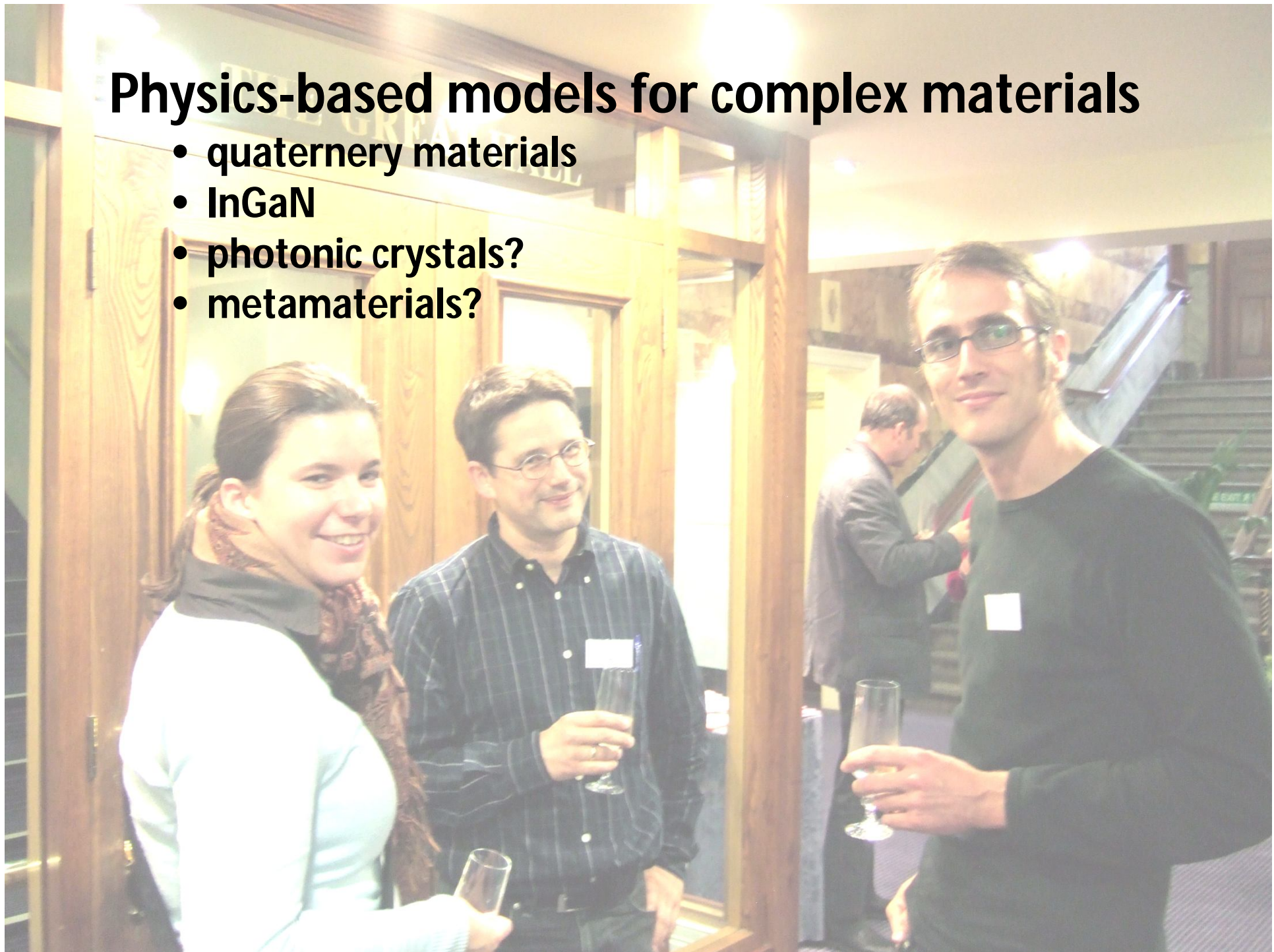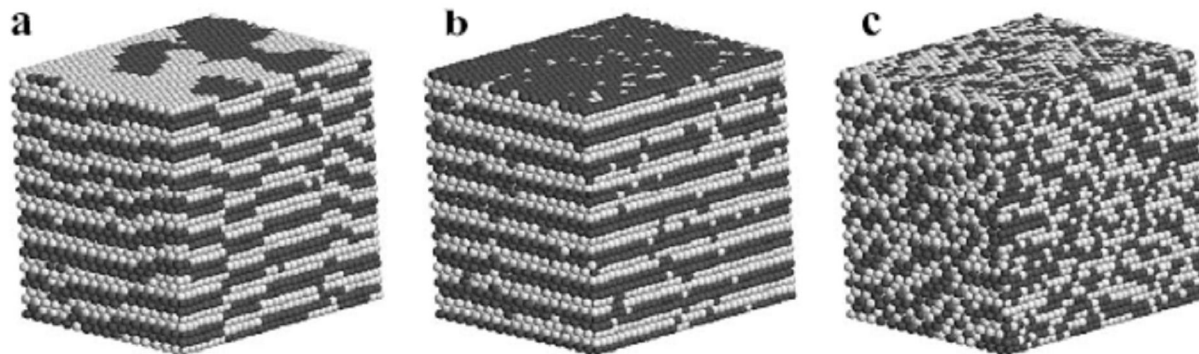
# Physics-based models for complex materials



Vertical-Cavity Laser (Witzigmann et al.)
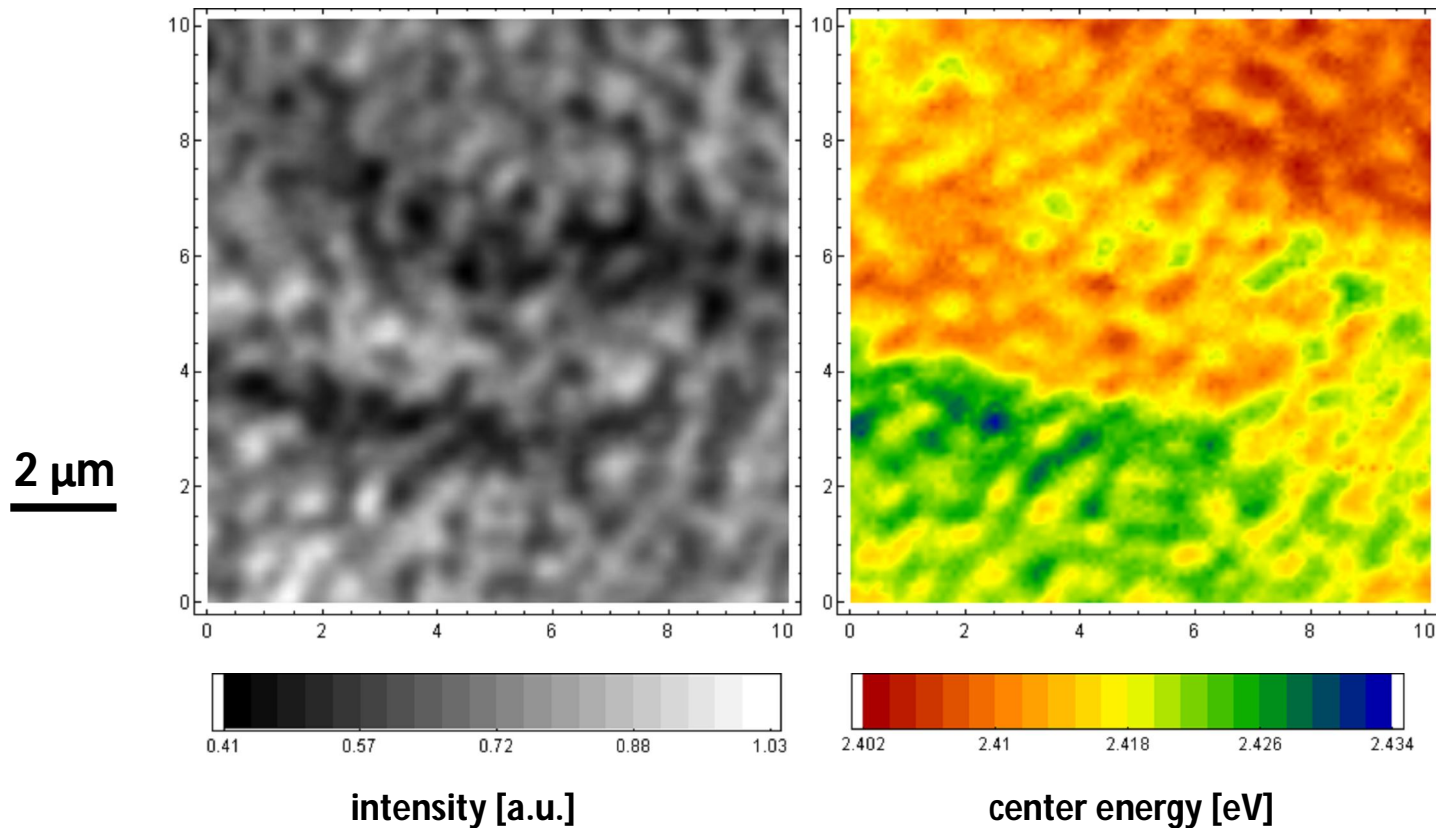


Qdot (TiberCAD)

**Complex structure**



Does an InGaN alloy look like a), b), or c)?

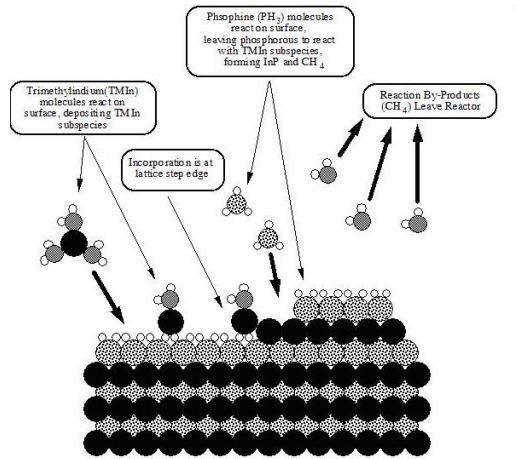**Complex material**

Ulrich T. Schwarz, Regensburg University

Ganchenkova et al. PRB **77**, 075207 (2008)

# Physics-based models for complex materials

Green light emitting InGaN QW of very low defect density ($10^5$ bis $10^6$ cm$^{-2}$)



2 µm

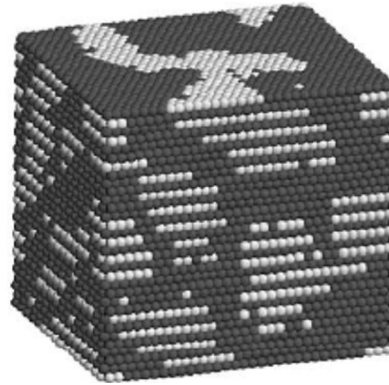intensity [a.u.]

center energy [eV]

How to include in a device model? Carrier transport?
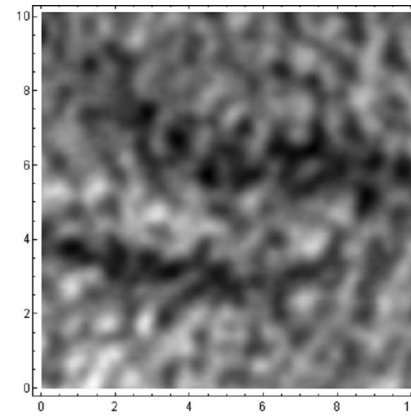
Ulrich T. Schwarz, Regensburg University

# Physics-based models for complex materials



Growth



Material science



Microscopic structure

Device
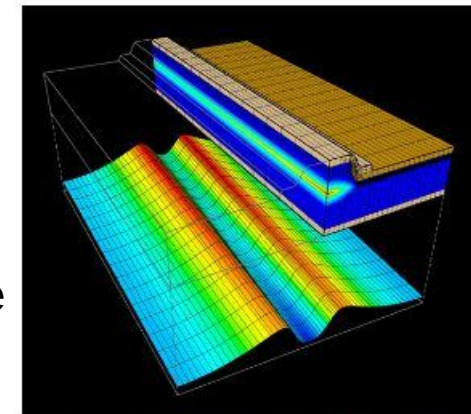


Fabry-Perot Laser Diode (Witzig et al.)

Ulrich T. Schwarz, Regensburg University

# Photonic modelling opportunities in life sciences

- European photonics production higher than for telecoms
- Growth rate much higher than telecoms
- Greater funding availability
- Lasers (surgery, PDT, opthamology, fluourescence spectroscopy, wound treatment, cosmetic surgery, etc.)
- Optical Biochips (drug development, personalised medicine)

# Simulation of multi-mode Fabry-Perot lasers

- Need for simulation tools for broad area lasers
- Beam propagation methods using Fox-Li iteration fail
- Time dependent models tied to reference frequency
  (spectral range limited)

# Common photonics material database ?

- How large is the demand?
- Where should it be located? Centralised or distributed?
- What should it include?
- Who maintains it?
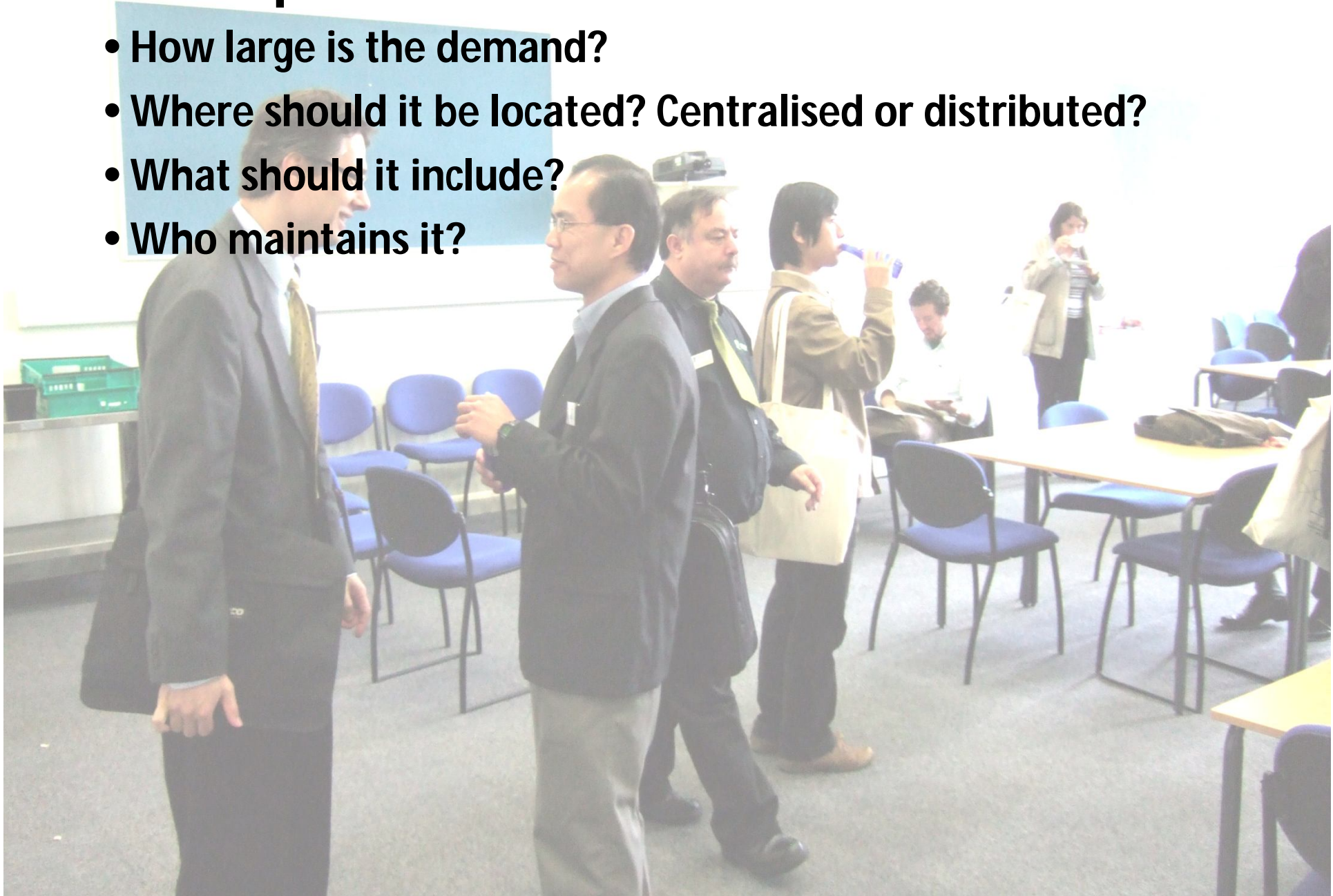
# Numerical Modelling: Trends for the near future

➢ **Design tools for functional photonic Ics**

- **CAD tools expected to do for PICs what they have for VLSI**

- **Large dimensionality (x, y, z, t or f)**

- **Diversity (components, technology, applications)**

- **Optical nonlinearity**

➢ **Funding prospects for simulation networks**