Lectures of visiting professors
Faculty of Physics and Applied Informatics, University of Lodz

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Lecture topic:

Surface Structure and Number Theory for Physicists

- **60 hours of classes – lecture with practical sessions**
- **Term: summer semester, academic year 2018/2019**
- **Taught entirely in English**
- **Lecture is primarily intended for students of PhD studies at Faculty of Physics and Applied Informatics, University of Lodz, however, other interested students are invited**

Lecture contents:

The lecture covers important methods of theoretical crystallography applied to systems of 2- and 3-dimensional periodicity. This knowledge is important for many experimental and theoretical studies of physical as well as chemical phenomena at surfaces. The mathematical treatment of surface structure leads, in many cases, to relationships between integer numbers. Here number theoretical methods can be quite useful and will be discussed in some detail. A tutorial with exercises is offered upon request. The lecture covers amongst other subjects:

- 3-dimensional crystal lattices: non-unique representations, cubic lattices, centered lattices, periodicity cells, neighbor shells, lattice symmetry, Bravais lattices, reciprocal lattices, crystallites, incommensurate crystals.
- 2-dimensional lattices, netplanes: netplane-adapted crystal lattices, Miller indices, Minkowski reduction, Miller indices for cubic / trigonal lattices, netplane symmetry, 2-dim. Bravais lattices.
- ideal and real single crystal surfaces: surface morphology, vicinal surfaces, Miller index decomposition, chiral/achiral surfaces, reconstruction, relaxation, faceting.
- adsorbate layers: adsorbate sites, periodic overlayers (commensurate, incommensurate), Wood notation, high-order commensurate overlayers, interference lattices, symmetry and domain formation, chirality.
- experimental analysis of surface structure: experimental methods, surface structure compilations, database formats
- periodicity and nanotubes: nomenclature, symmetry
- number theoretical methods: basic functions, Euclid's algorithm, linear/quadratic Diophantine equations.

Basic knowledge of solid state physics and surface science is required.

Recommended resources:

- K. Hermann, "Crystallography and Surface Structure: an introduction for surface scientists and nanoscientists", Wiley-VCH, Berlin 2011 (2nd ed. Berlin 2017)
- Web pages: http://www.fhi-berlin.mpg.de/KHsoftware/ and http://surfexp.fhi-berlin.mpg.de