

Working Group Meeting Linz 2012

03-02-2012 to 04-02-2012

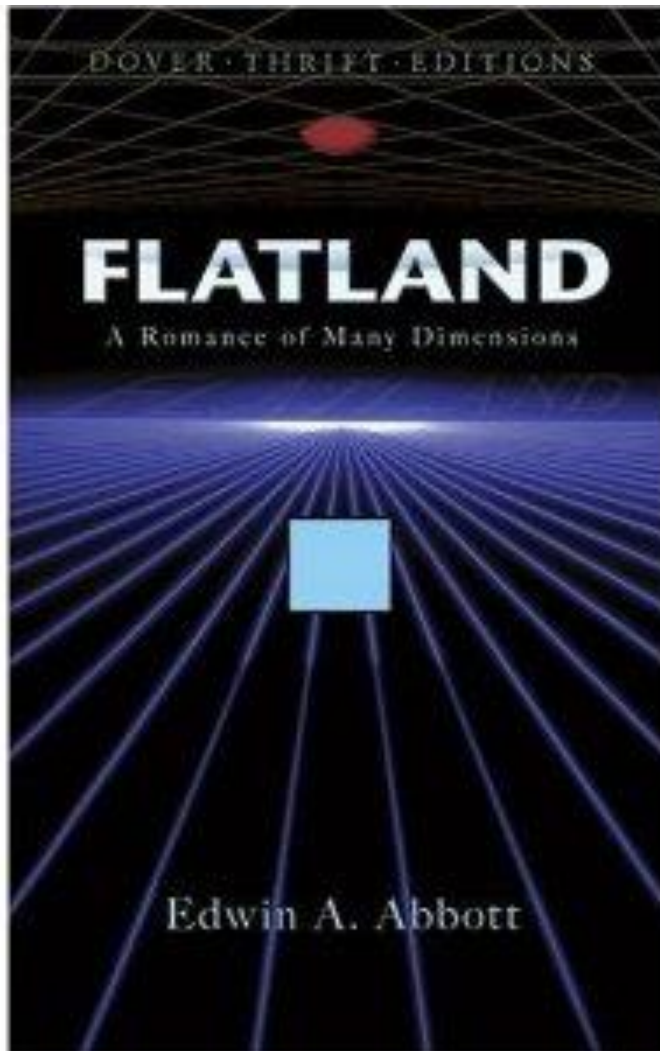
EU COST Action: TD1002

Neil H Thomson

University of Leeds, United Kingdom

Local Organiser : Prof. Peter Hinterdorfer

Johannes Kepler University, Linz, Austria



The future of SPM ??

“Getting out of Flatland”

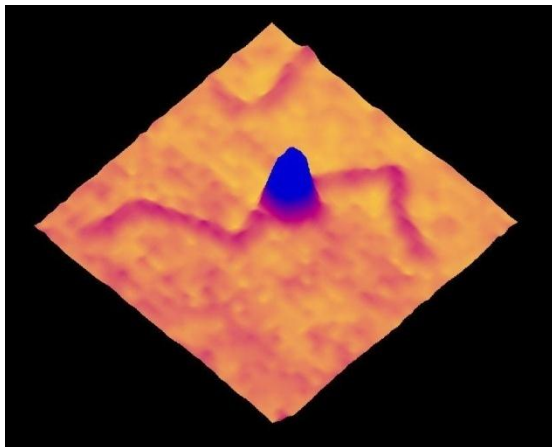
Making AFM truly
3-dimensional

- Better Tips
- Novel Probes
- Multiple Frequencies
- New scan schemes
- Accurate Modelling
- Reliable Data Analysis

Heterogeneous *versus* Homogeneous

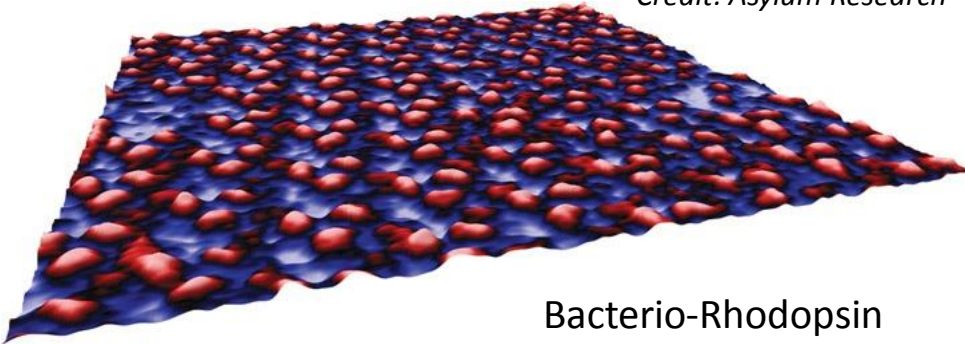
DNA gyrase on linear dsDNA

Heddle JG,
Mittelheiser S,
Maxwell A,
Thomson NH (2004)
J. Mol. Biol. 337,
597-610.



3D
Mechanically Heterogeneous

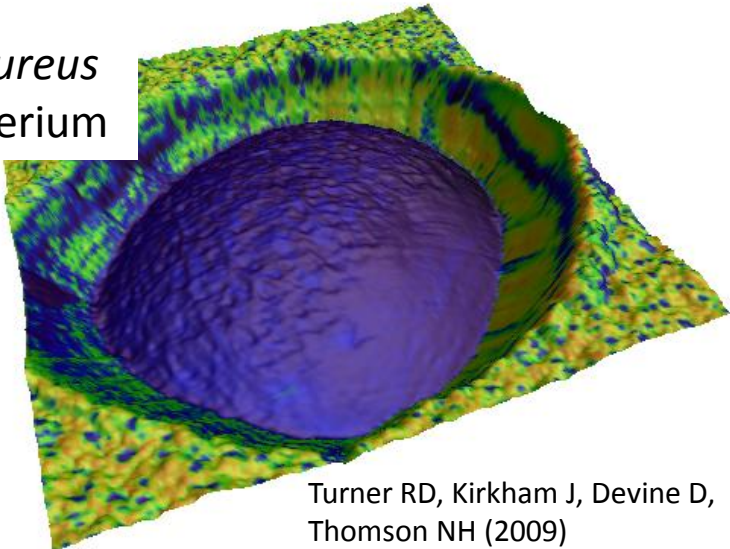
Credit: Asylum Research



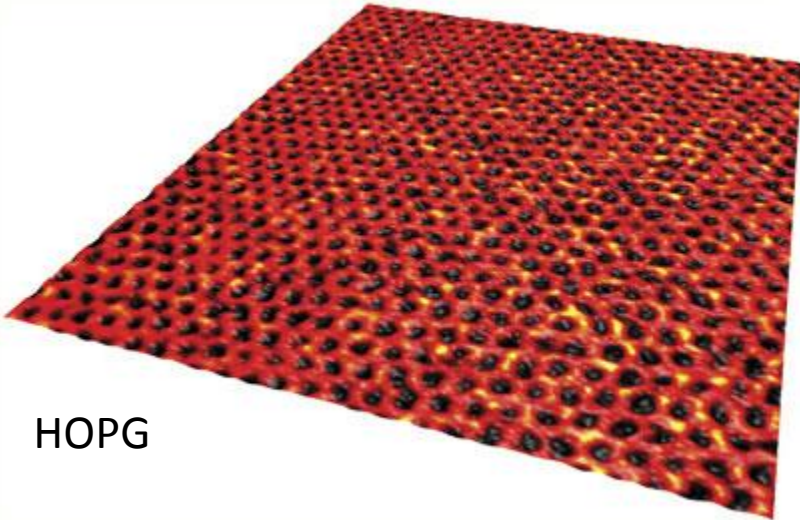
Bacterio-Rhodopsin

2D: infinitely planar
Mechanical homogeneous

S. Aureus
Bacterium



Turner RD, Kirkham J, Devine D,
Thomson NH (2009)
Appl. Phys. Lett. 94, 034901



HOPG

Credit: Asylum Research

Key challenges in development and applications of atomic force microscopy

1. Resolution

Tips: sharpness, aspect, preservation and characterisation
Gentler imaging modes (SAM and SASS)

2. Sensitivity

Materials property mapping at high spatial resolution
(Multi-frequency, Be-spoke tip design, Contrast agents ...)

3. Quantification

Effective tip size, interaction area, pressure distribution, energy dissipation....

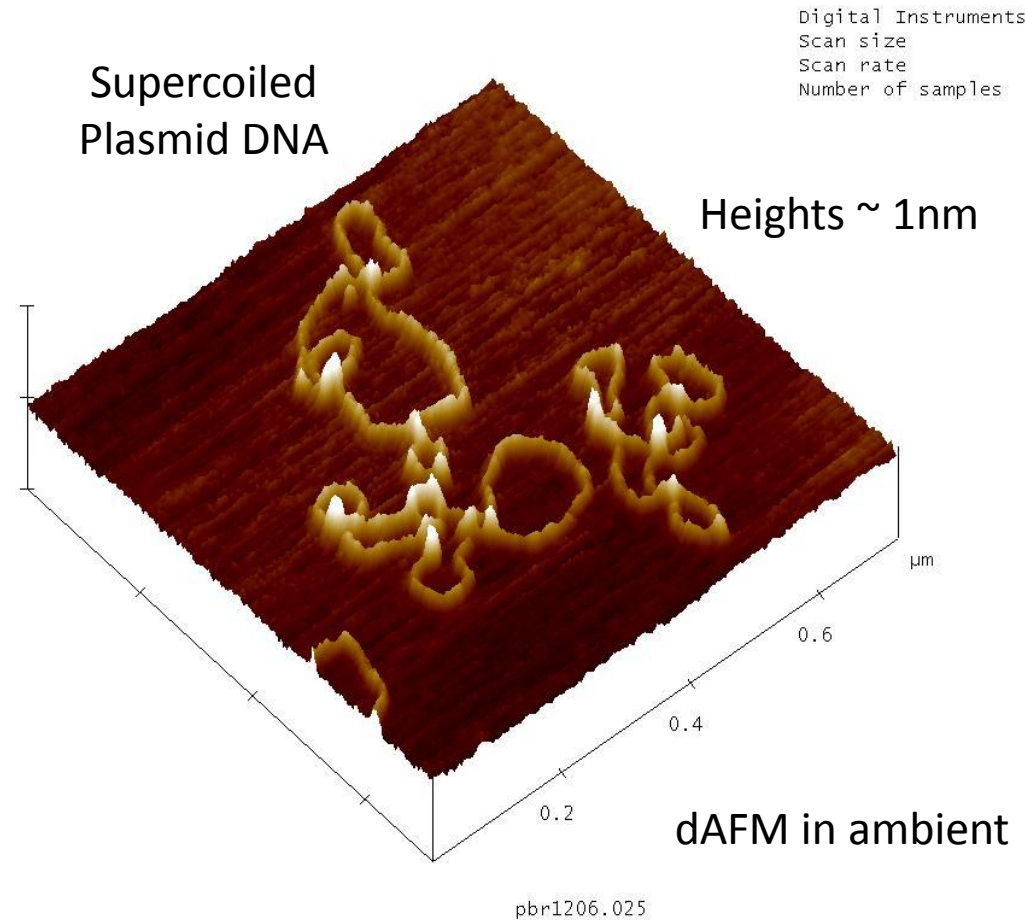
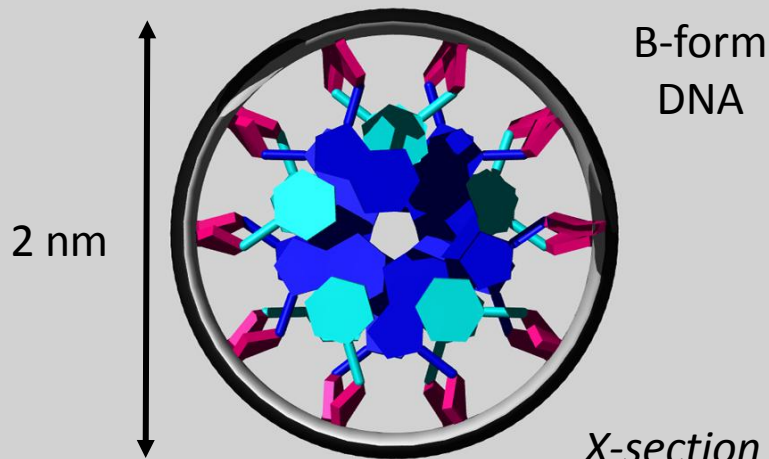
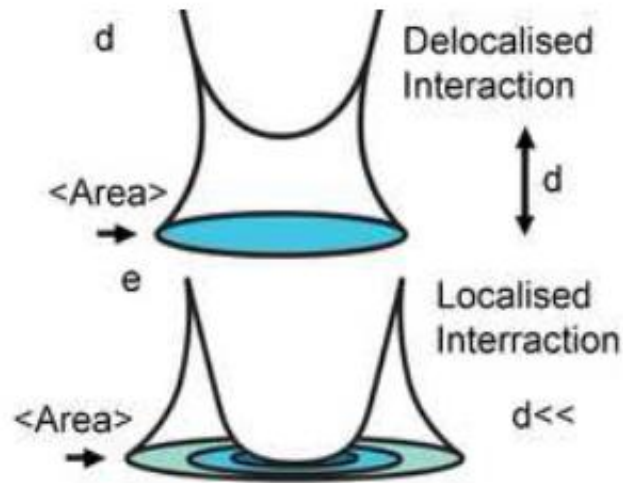
4. Speed or Throughput

Higher scan speeds (resonant scanning, small cantilevers etc.)
Dynamic methods (multi-frequency, band excitation etc.)

5. Integration and Complementarity

Techniques – Trapping, Microfluidics, Optical

Why are the apparent heights of my molecules too small ??



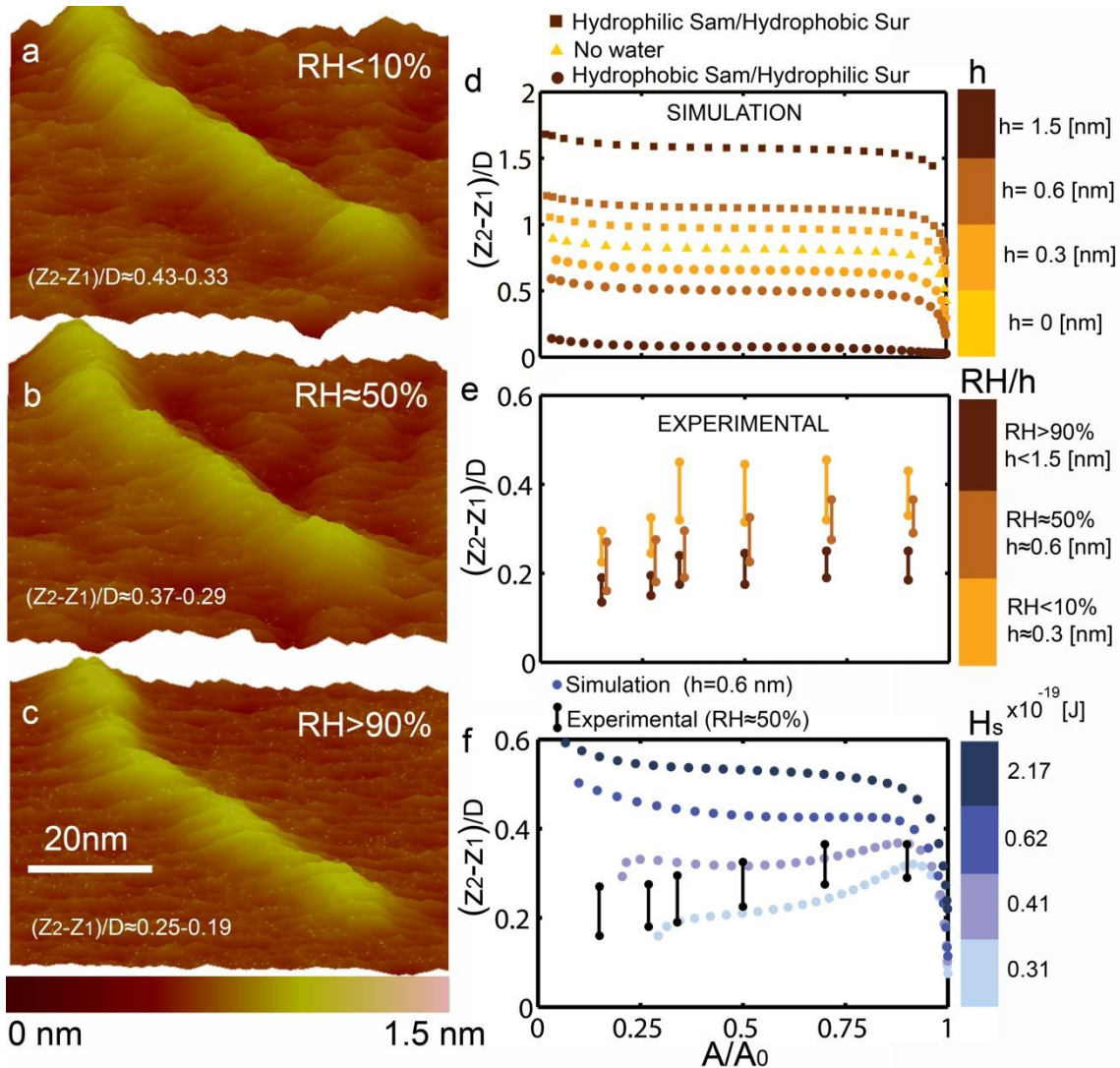
Santos S., Barcons V., Christenson H.K., Font J. and Thomson N.H.
**“The intrinsic resolution limit in the atomic force microscope:
 implications for heights of nanoscale features.”**
PLoS ONE (2011) 6 (8) e23821.

Santos S., Stefancich M., Hernandez H., Chiesa M. and Thomson N.H.

“The hydrophilicity of a single DNA molecule.”

J. Phys. Chem. C (2012) in press

Apparent Height of DNA decreasing



Hamaker for DNA to water across air gap is;
 $H = 0.35 \times 10^{-19} \text{ J}$

SUMMARY

Medium Term Goals

- Optimise AFM tips for different applications
 - Integration of AFM with microfluidics
 - Multi-frequency methods
- Trapping and Manipulation of nano to micro-sized objects