RL 5 - Electronic, optical and magnetic properties of low-dimensional systems

- **CdTe detector for fast X-ray Spectro-imaging**
- **Variable Energy Positron Annihilation Spectroscopy**
- **Dynamical electron spectro-microscopy of nanoscale and low dimensional systems**
- **Advanced scanning microscopies for real-time monitoring of molecular interactions in organic nano-crystals**
- **Nano-Photonics and Plasmonics**
- **Femtosecond time- and angle- resolved photoemission spectroscopy on 2D quantum materials**
- **Monte-Carlo simulation of complex statistical phenomena**

CdTe detector for fast X-ray Spectro-imaging

Improving the performances of a new generation X-ray solid state detector through the study of CdTe physics

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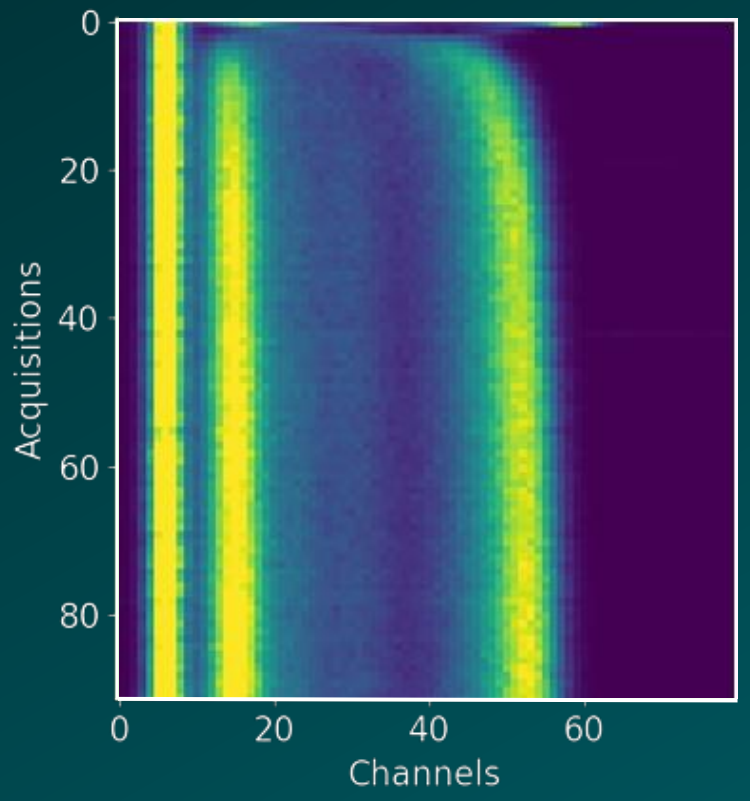
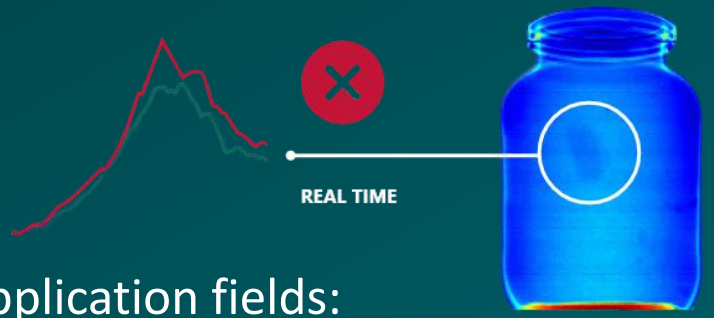
XNEXT
ADVANCED INSPECTION TECHNOLOGY



- **Get in touch with XSpectra®: Xnext patented technology**
- **Multienergy radiography**
- **Development of a Pockels effect setup for electric field mapping**



Application fields:

Useful links:

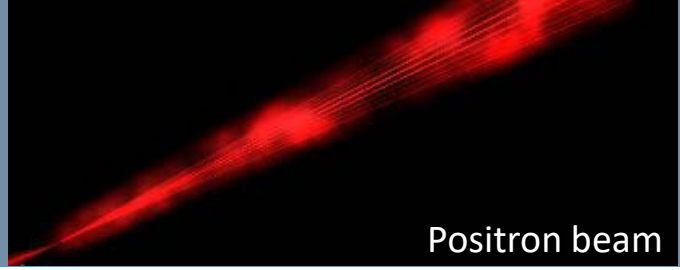
Prof. Giacomo Ghiringhelli

PoliMiX

XNEXT
ADVANCED INSPECTION TECHNOLOGY

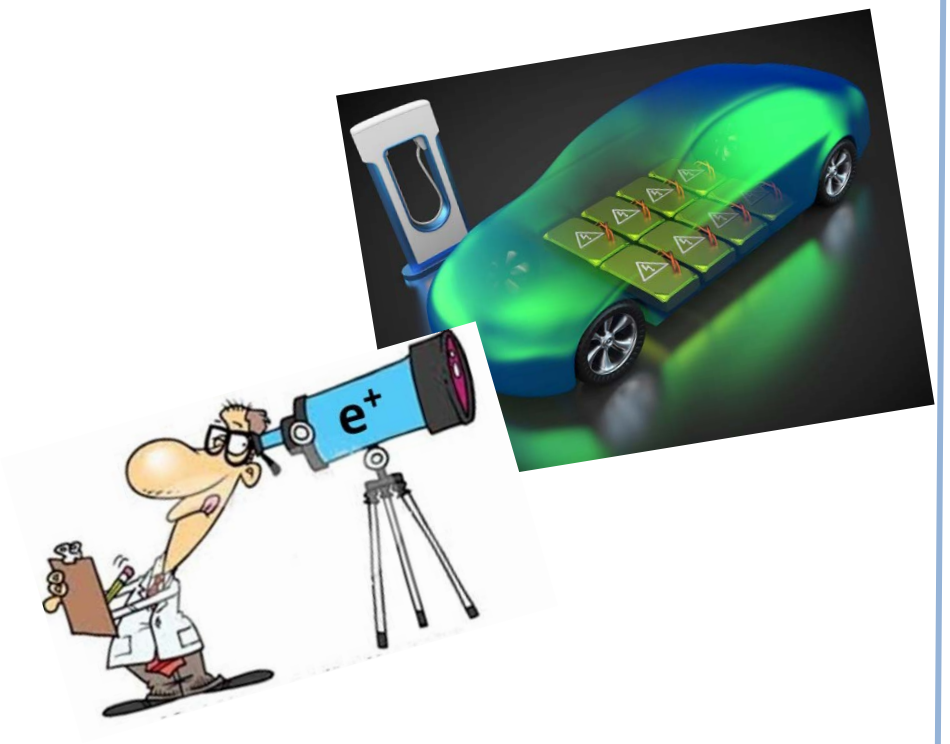
Paolo Distefano

Variable Energy Positron Annihilation Spectroscopy



Applied Physics thesis

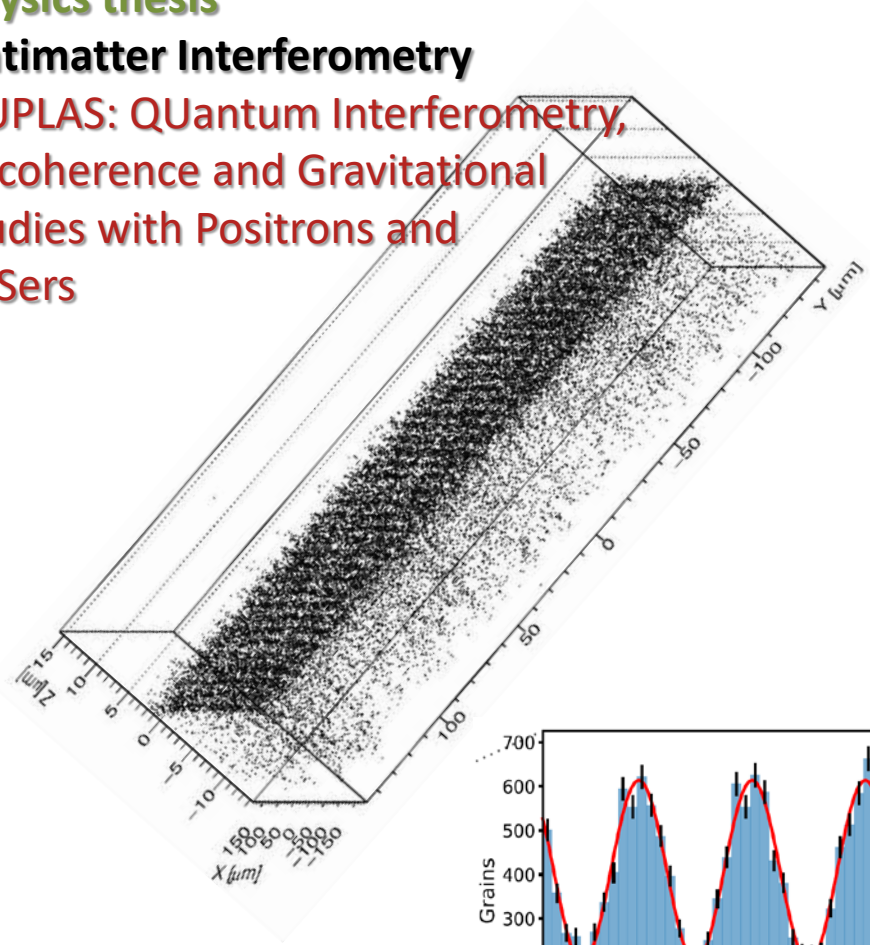
Lithium and sodium-ion batteries



Physics thesis

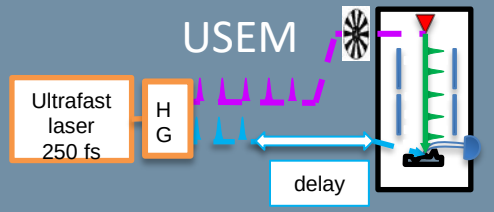
Antimatter Interferometry

QUPLAS: QUantum Interferometry, decoherence and Gravitational studies with Positrons and LASers



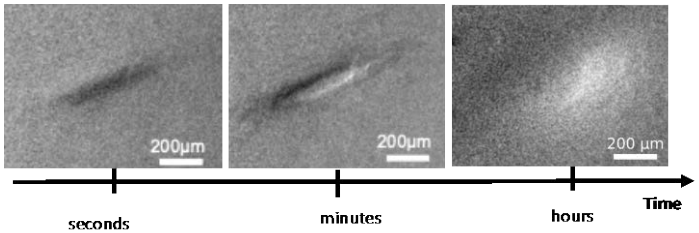
Contact: Rafael Ferragut – rafael.ferragut@polimi.it

Dynamical electron spectro-microscopy of nanoscale and low dimensional systems



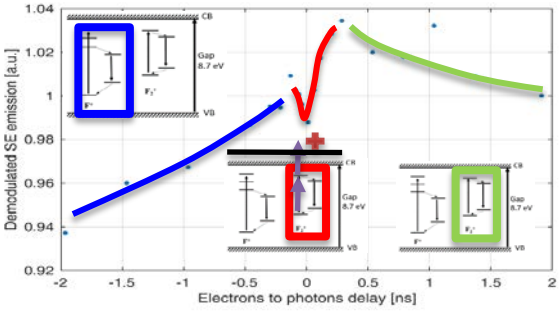
We develop **time-resolved electron imaging & spectroscopy** to investigate **dynamical micro-nanostructures** and **ultrafast phenomena in low dimensional systems**

Evolution of photo-induced space charge in perovskite thin films



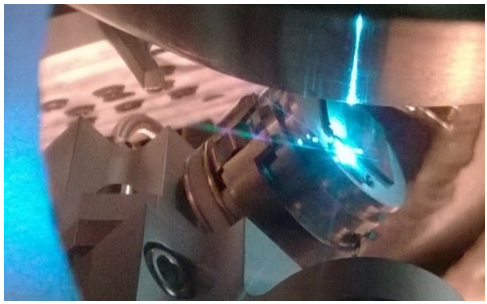
*G. Irde et al, Micron **121**, 53 (2019)*
*S. M. Pietralunga et al., Adv. Mat. Interf. **7**, 16 (2020)*

Dynamics of color centers at Al_2O_3 surface



*M. Zani et al.,Ultramicroscopy **187**, 93, (2018)*

USEM set up and sample chamber



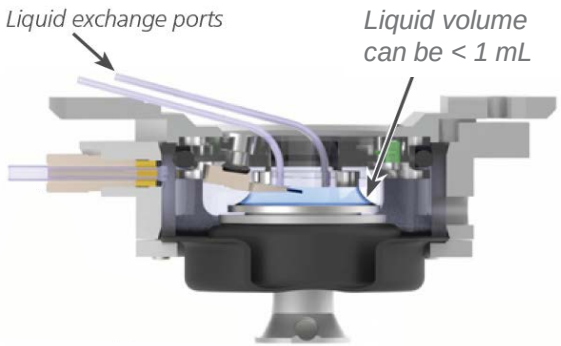
Theses:

- Surface electro-dynamics in semiconductor surfaces and low dimensional materials (experimental)
- Imaging MEMS and NEMS (micro and nano electro-mechanical systems) dynamics
- Modelling of charge transport, emission and collection in dynamical Electron Microscopy (numerical)
- Electron sources, detectors and spectrometers for dynamical Electron Microscopy
- Electron Micro-Spectroscopy at the nanoscale in novel and nanostructured materials

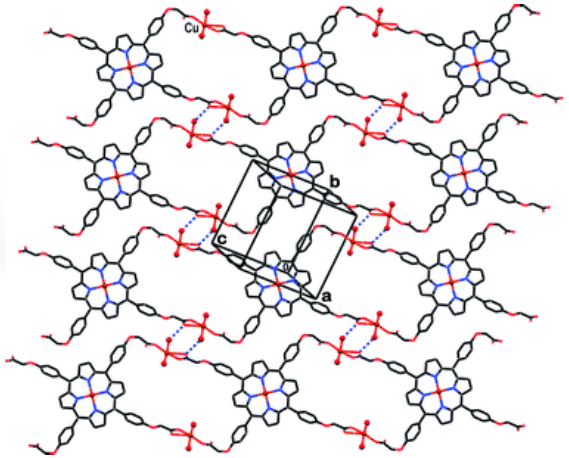
Prof. Tagliaferri (alberto.tagliaferri@polimi.it)
Dr. Pietralunga (silviamaria.pietralunga@cnr.it)

Advanced scanning microscopies for real-time monitoring of molecular interactions in organic nano-crystals

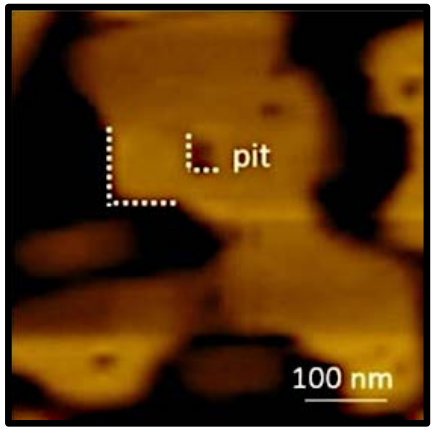
NT-MDT microscope



Cross-sectional drawing of the ambient stage and fluid perfusion probe holder



Porphyrin (TPP) nanoarray

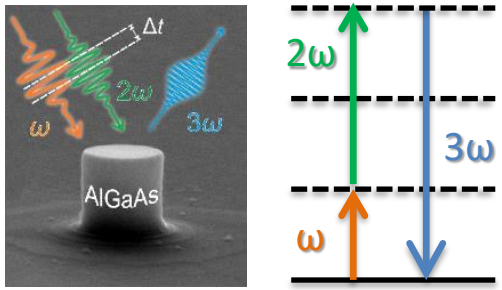


ChemNANOMat **6** (2020) 567-575

Thesis topics @ SNOM Lab: Nano-Photonics and Plasmonics

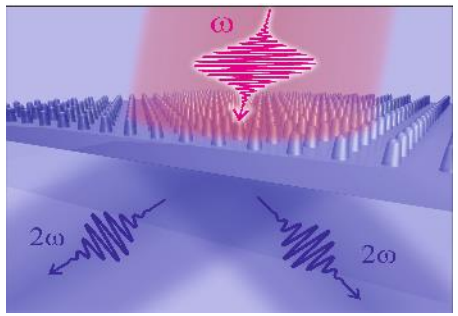
Tailoring the nonlinear optical properties of nanostructures and metasurfaces

Nonlinear optics in dielectric antennas



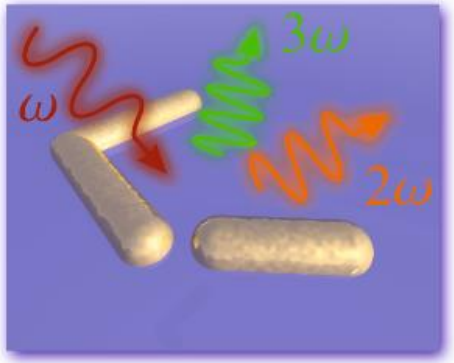
V. Gili et al., *Opt. Express* **24**, 15965 (2016)

Nonlinear optics in metasurfaces



L. Carletti *et al. ACS Photonics* **8**, 731-737 (2021)

Nonlinear optics in plasmonic antennas



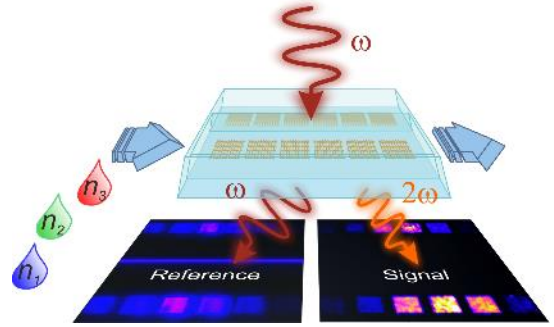
M. Celebrano et al., *Nat. Nanotech.* **10**, 412 (2015)
M. Celebrano et al. *Nano Lett.* **19**, 7013 (2019)

- Nonlinear nano-photonics for integrated all-optical logic
- Nonlinear ultraflat optics with metasurfaces

Enhanced light-matter interaction for sensing

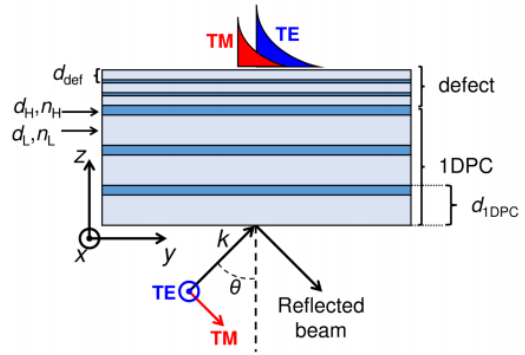
- Label-free optical sensing
- Recognition and sorting of chiral biomolecules

Nonlinear sensing



L. Ghirardini et al. *JPCC* **122**, 11475 (2018)

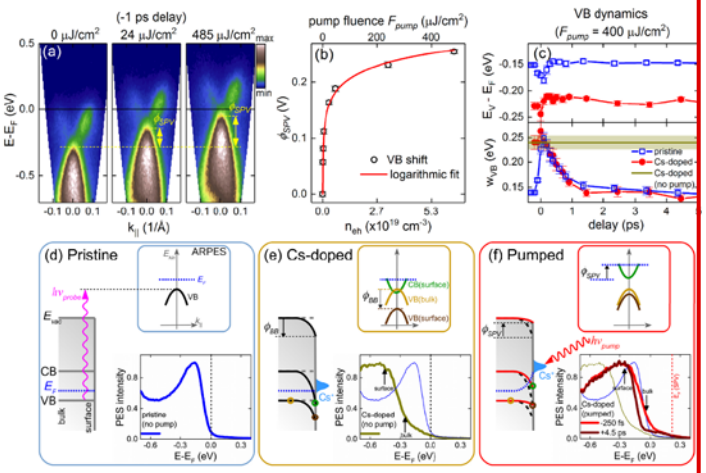
Chiral surface waves



G.Pellegrini et al., *Phys. Rev. B*, **95,** 241402 (2017)

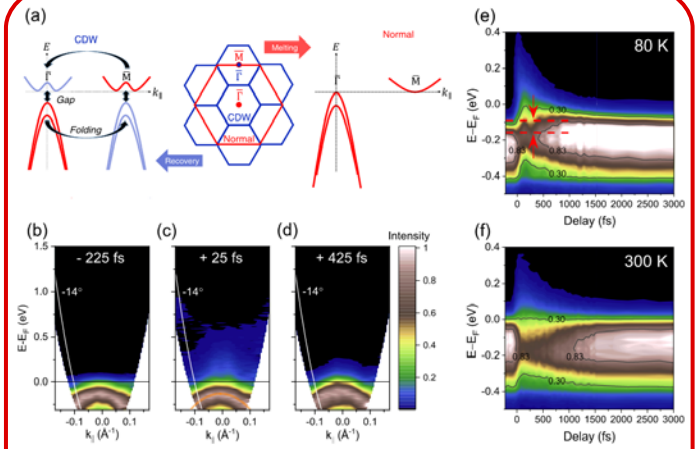
Femtosecond time- and angle- resolved photoemission spectroscopy on 2D quantum materials

We investigate electronic structure and dynamics in novel two-dimension layered materials by femtosecond time- and angle-resolved photoemission spectroscopy (tr-ARPES)
Our latest interests involve: Topological and excitonic insulators, Mott and Charge Density Waves (CDW) phase transitions



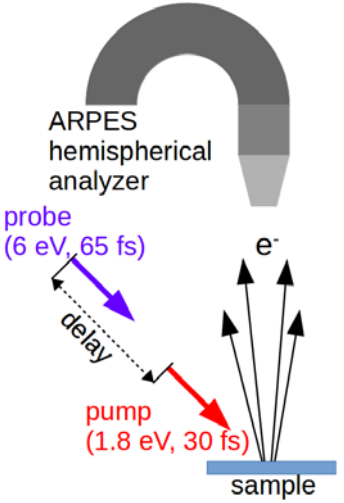
Non-equilibrium band broadening, gap renormalization and band inversion in black phosphorus

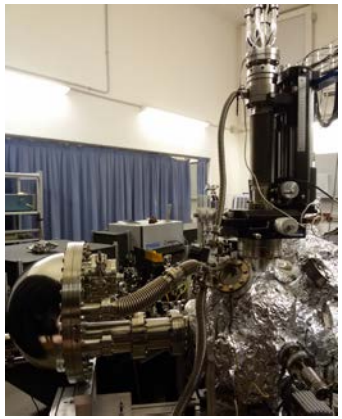
H. Hedayat, A. Ceraso, G. Soavi, S. Akhavan, A. Cadore, C. Dallera, G. Cerullo, A.C. Ferrari, E. Carpene, *2D Mater.* ***8*** *025020 (2021)*



Excitonic and lattice contributions to the charge density wave in 1T-$TiSe_2$ revealed by a phonon bottleneck

H. Hedayat, C.J. Sayers, D. Bugini, C. Dallera, D. Wolverson, T. Batten, S. Karbassi, S. Friedemann, G. Cerullo, J. van Wezel, S.R. Clark, E. Carpene, E. Da Como, *Phys. Rev. Res.* ***1*** *023029 (2019)*





POLITECNICO MILANO 1863

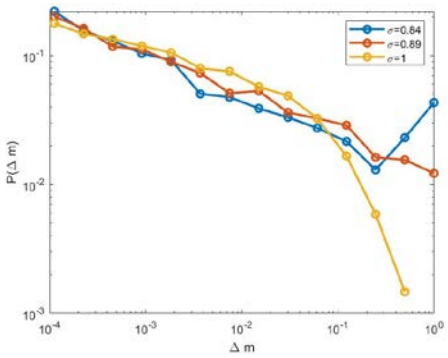
Claudia Dallera: claudia.dallera@polimi.it
Ettore Carpene: ettore.carpene@polimi.it

Monte-Carlo simulation of complex statistical phenomena

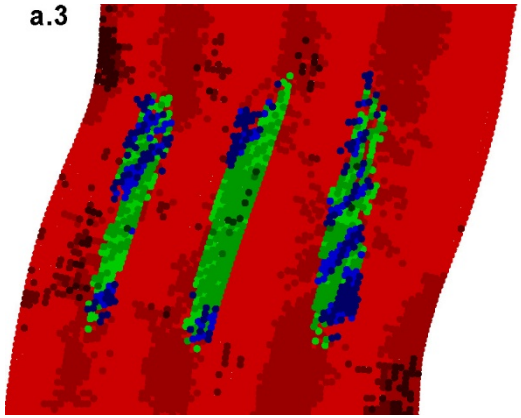
POLITECNICO MILANO 1863

We study and simulate the evolution of complex systems including
- Random Ising models (including ferromagnets and spin glasses)
- Avalanches in plasticity and phase transitions

Avalanches in ferrogmanets with below-critical / critical / above-critical randomness
M. Metra et al (2021)



Bursty phase transitions in martensitic solids
E. Arbib et al, Int. J. Plasticity (2020)



Representation of the Poincaré disk
MC Escher, Angels and Demons

Theses:

- Cluster Monte-Carlo simulations of phase transitions
- Dynamic (real-time) simulations of non-equilibrium pheonomena
- Phase transitions in planar martensitic solids
- Poincaré disk representation of plastic evolution in planar solids

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paolo.biscari@polimi.it