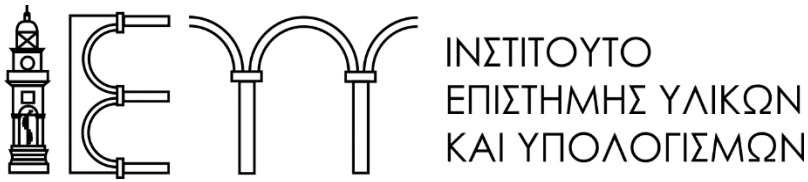
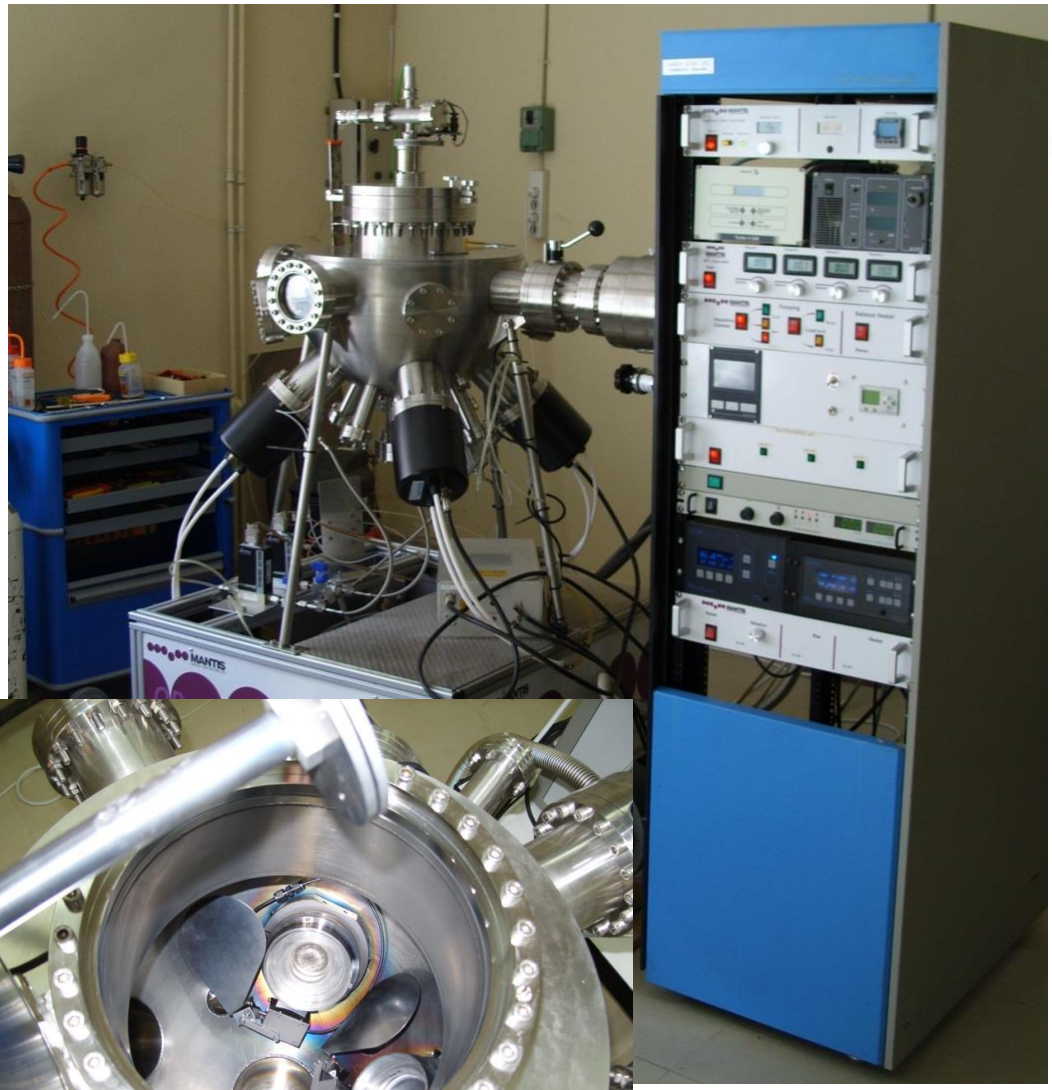
Παναγιωτόπουλος Ιωάννης
Μαγνητικά Υλικά



Περίγραμμα

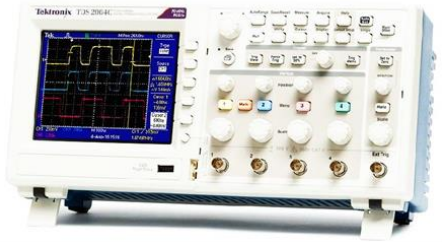
- Εξοπλισμός
- Πολυστωματικά Υμένια
- Δίκτυα Νανοσφαίρων
- Τοπολογικές μαγνητικές δομές
  (μη συμμετρική επιστοίβαση)
- Φοιτητές/Συνεργάτες

Εξοπλισμός

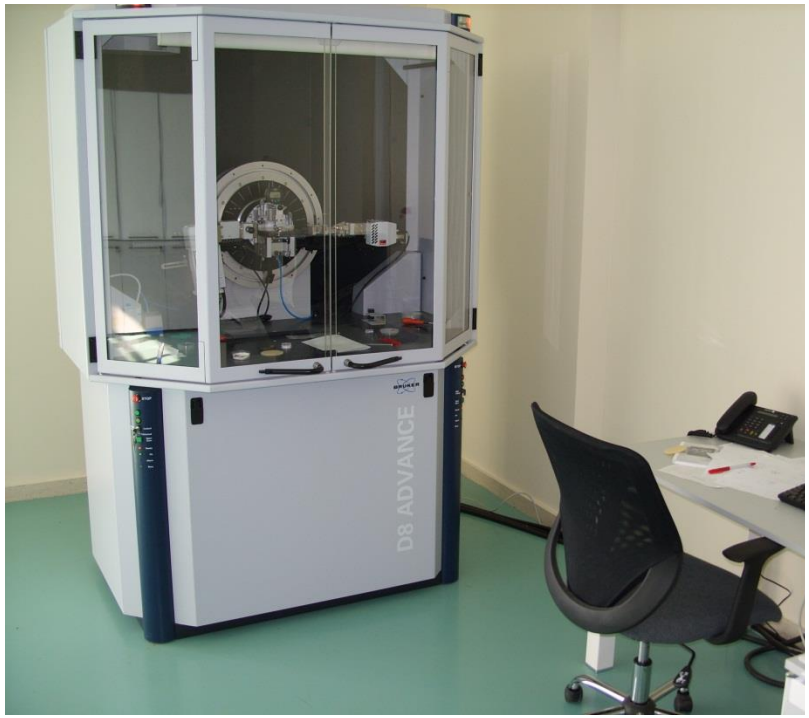

MANTIS

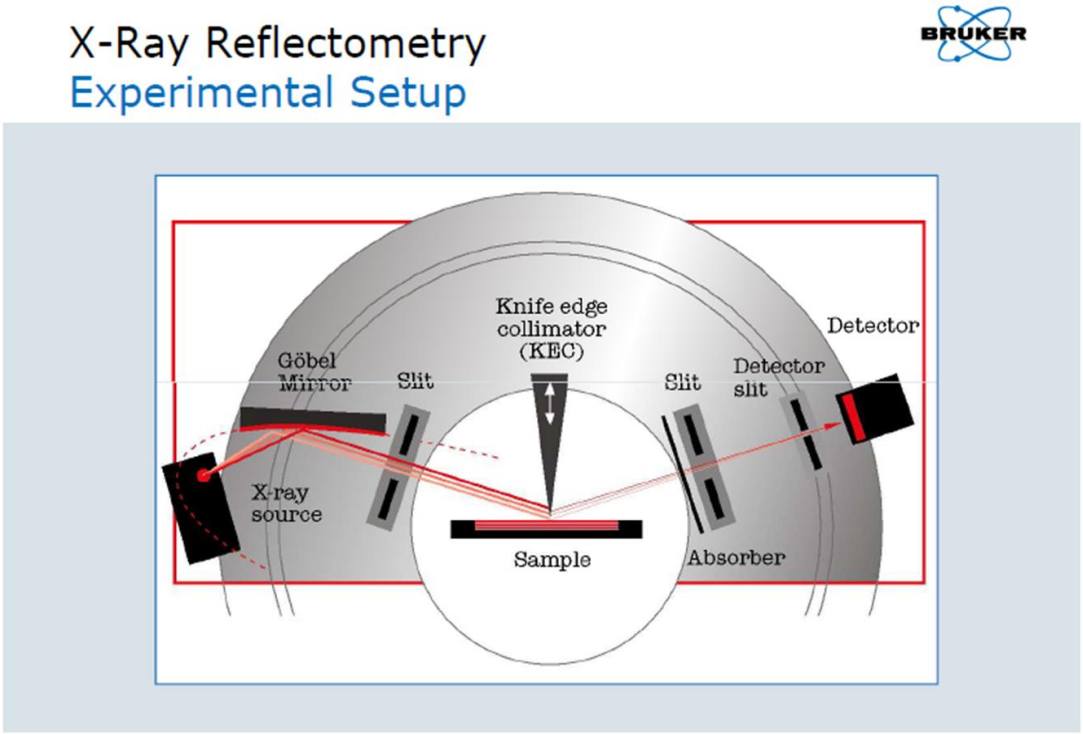

+1.0000 nA
SINE


TTi
TG1000 10MHz DDS FUNCTION GENERATOR
WAVE:+pulse SYM:50%
FREQ:10.0000MHz CONT
AMPL:+10.0V
DC:+0.00mV (+0.00mV)


Tektronix

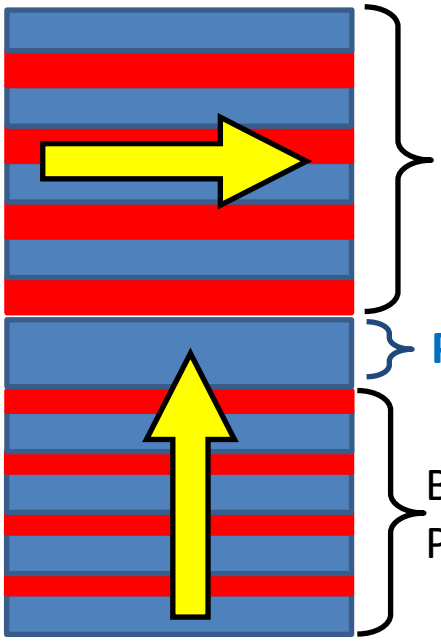
Περιθλασιμέτρο ακτίνων-Χ παράλληλης δέσμης





- Γωνιόμετρο υψηλής ακριβείας με χωριστή κίνηση για γωνίες λυχνίας και ανιχνευτή
- Παραβολικός καθρέπτης (Goebel mirror) για παραλληλισμό της δέσμης.
- Τράπεζα δείγματος με μικρομετρική ρύθμιση ύψους και δυνατότητα άντλησης από αντλία διαφράγματος για σταθεροποίηση του δείγματος.
- Μαχαίρι αποκοπής της αρχικής δέσμης με με μικρομετρική ρύθμιση ύψους

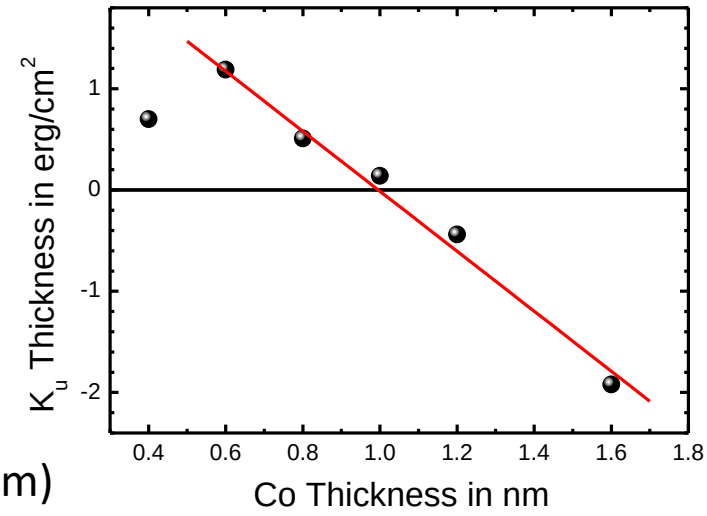
[Co(6Å)/Pt(15Å)]$_4$/Pt(s)/[Co(10Å)/Pt(15Å)]



Top Stack Pt(1.5nm)/Co(1nm)
In-plane anisotropy

Pt-Spacer = extra 0 to 4.5nm

Bottom Stack Pt(1.5nm)/Co(0.6nm)
Perpendicular anisotropy



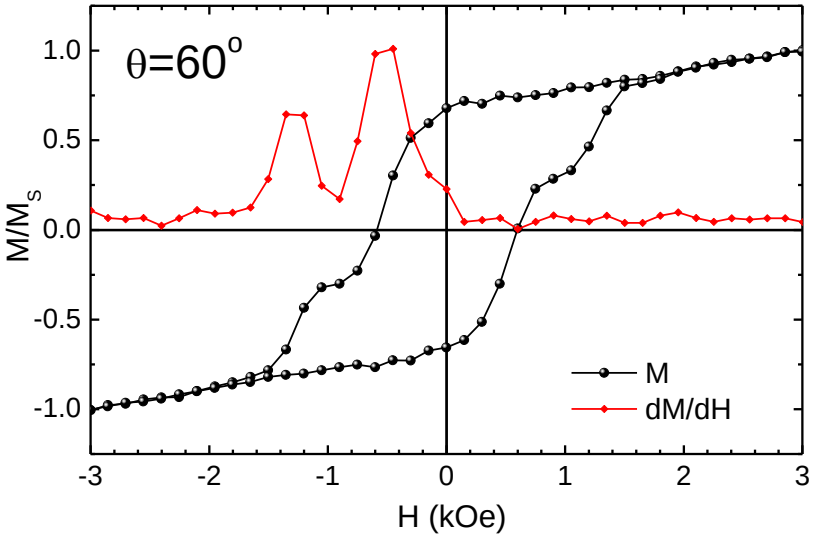
"Coupling dependent reversal in Co/Pt based mixed anisotropy multilayer stacks" A.Markou et al, J Magn and Magn Mater **485** (2019) 205–211

"Study of magnetization reversal in layered heterostructures by vector magnetometry" A. Markou et al, JMMM **445** (2018) 95–102

"Magnetization reversal in graded anisotropy Co/Pt multilayers" A. Markou et al J. Appl. Phys. **112**, 123914 (2012); doi: 10.1063/1.4770487

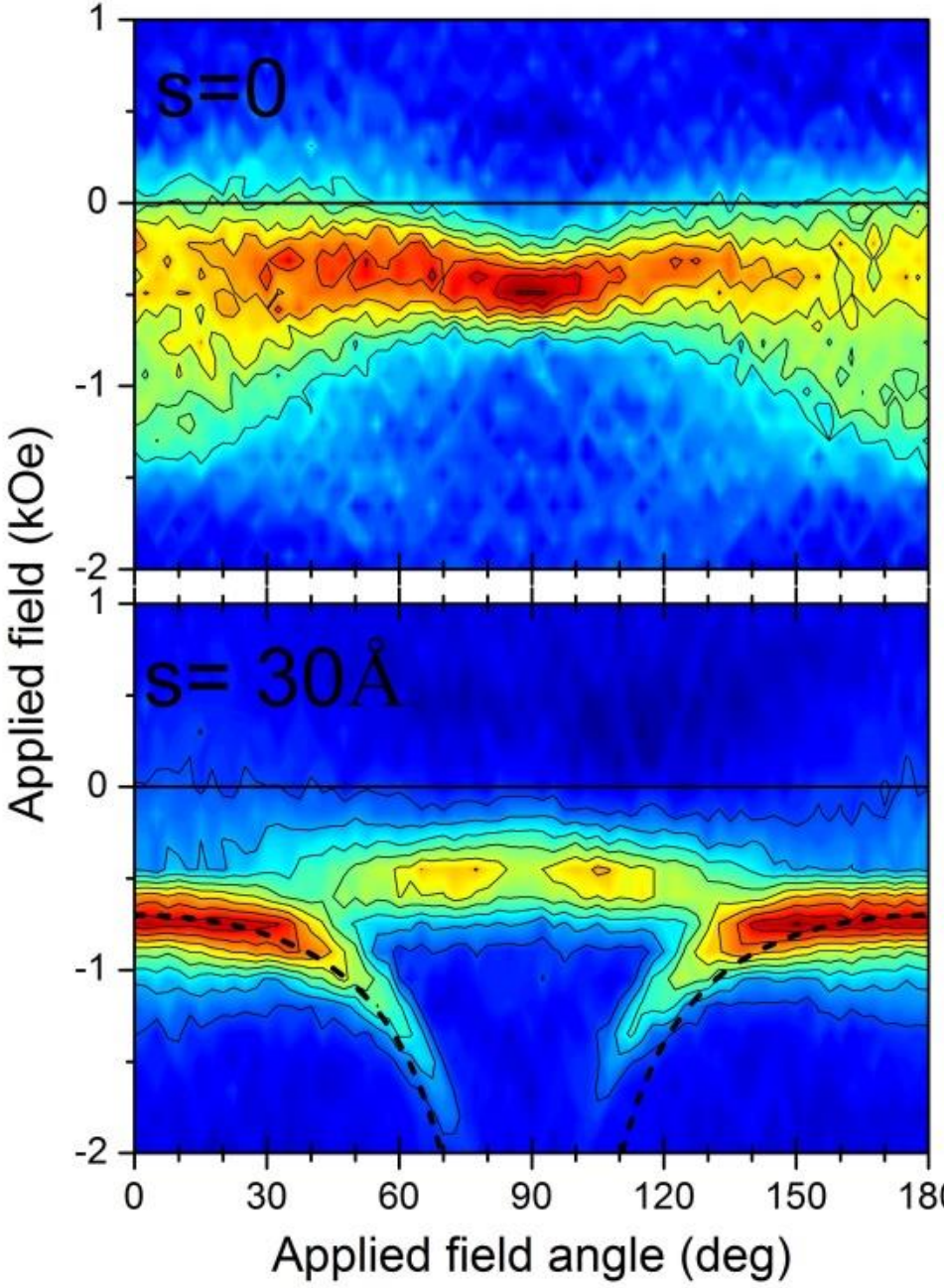
"Magnetization reversal in [Ni/Pt]$_6$/Pt(x)/[Co/Pt]$_6$ multilayers", N. Siadou et al. JMMM323 (2011) 1671–1677

Decoupling: dM/dH plots

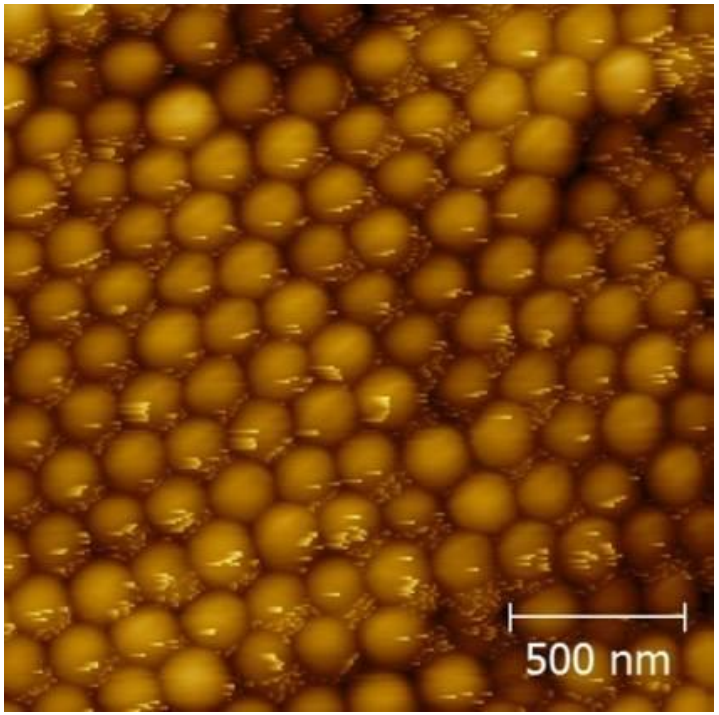


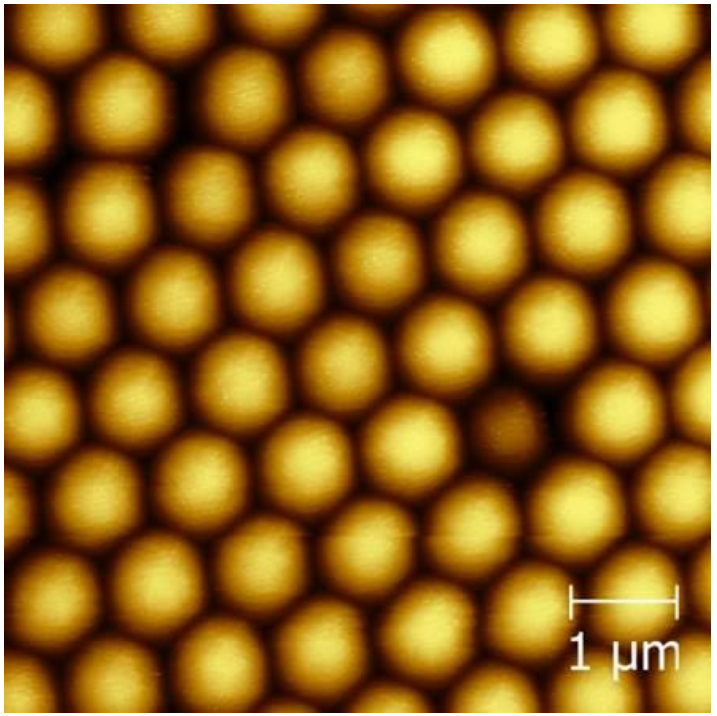
The decoupling can be visualised by two dimensional maps of the derivative of M(H) curve as a function of H, θ that depict the decoupling range for each θ

The switching field of the softer part remains almost constant (while the harder one follows a pinning type H_C= 0.7 kOe/cosθ angular dependence



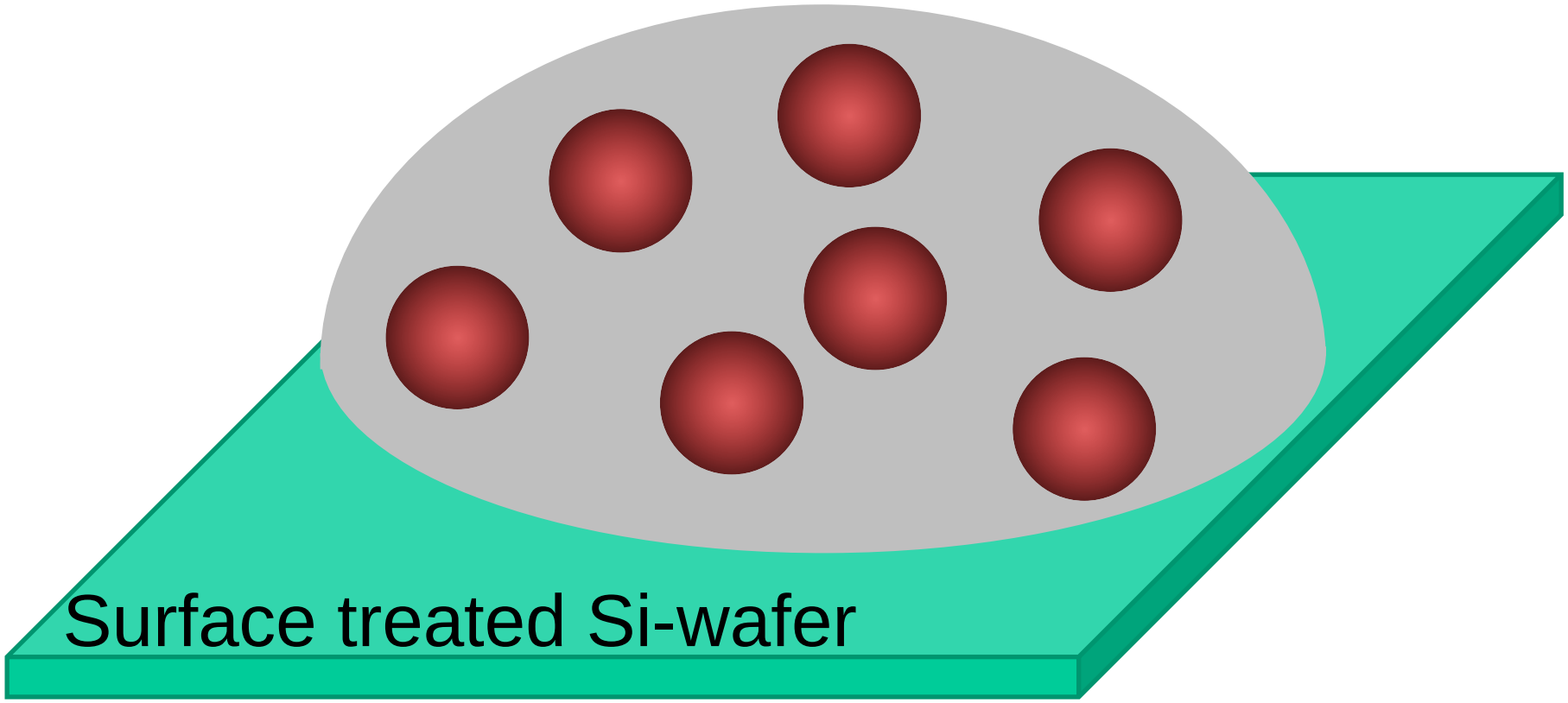
Polysterene Nanosphere Arrays



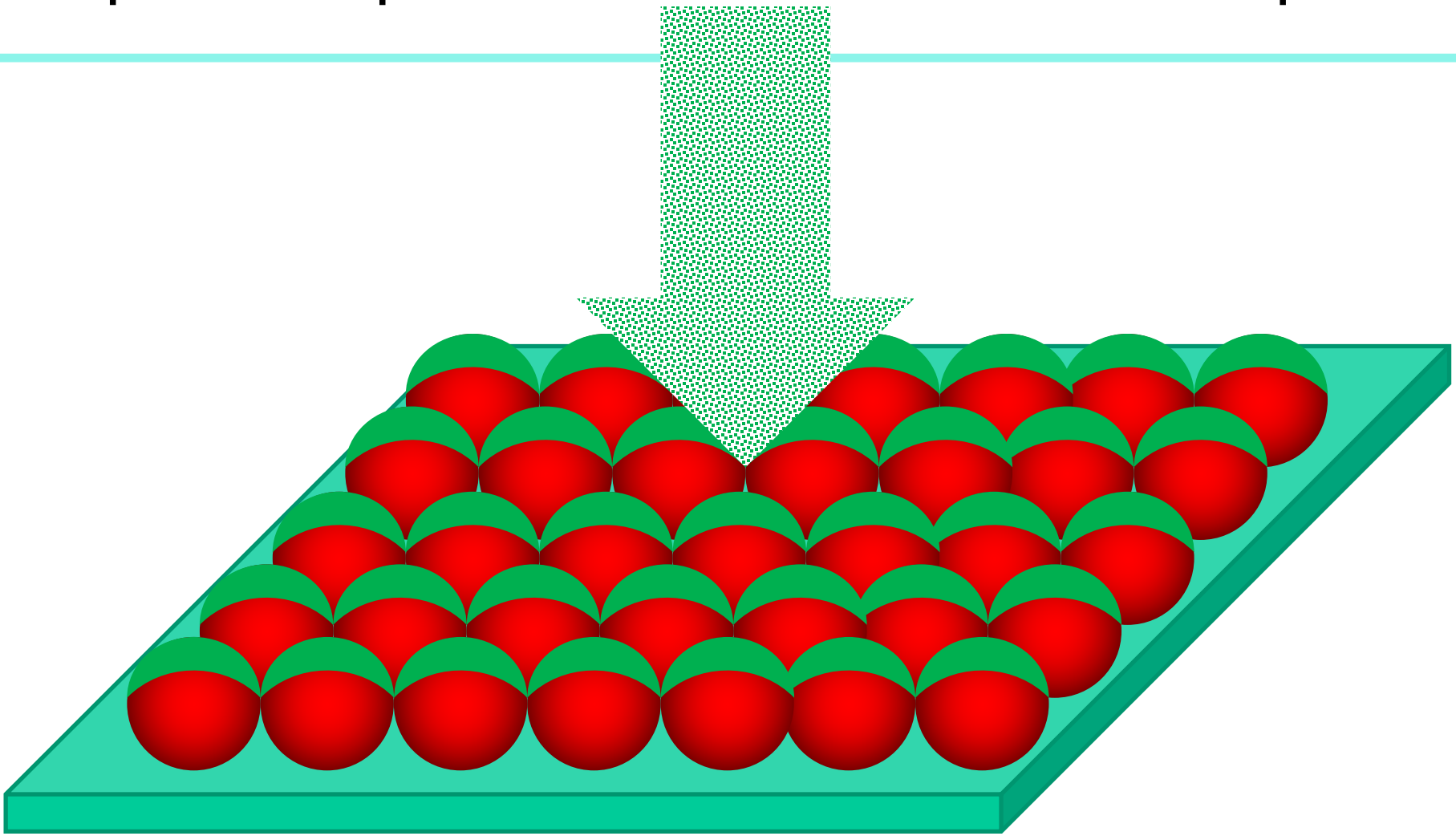


Markou et al. J. Appl. Phys. 112, 123914 (2012); doi: 10.1063/1.4770487

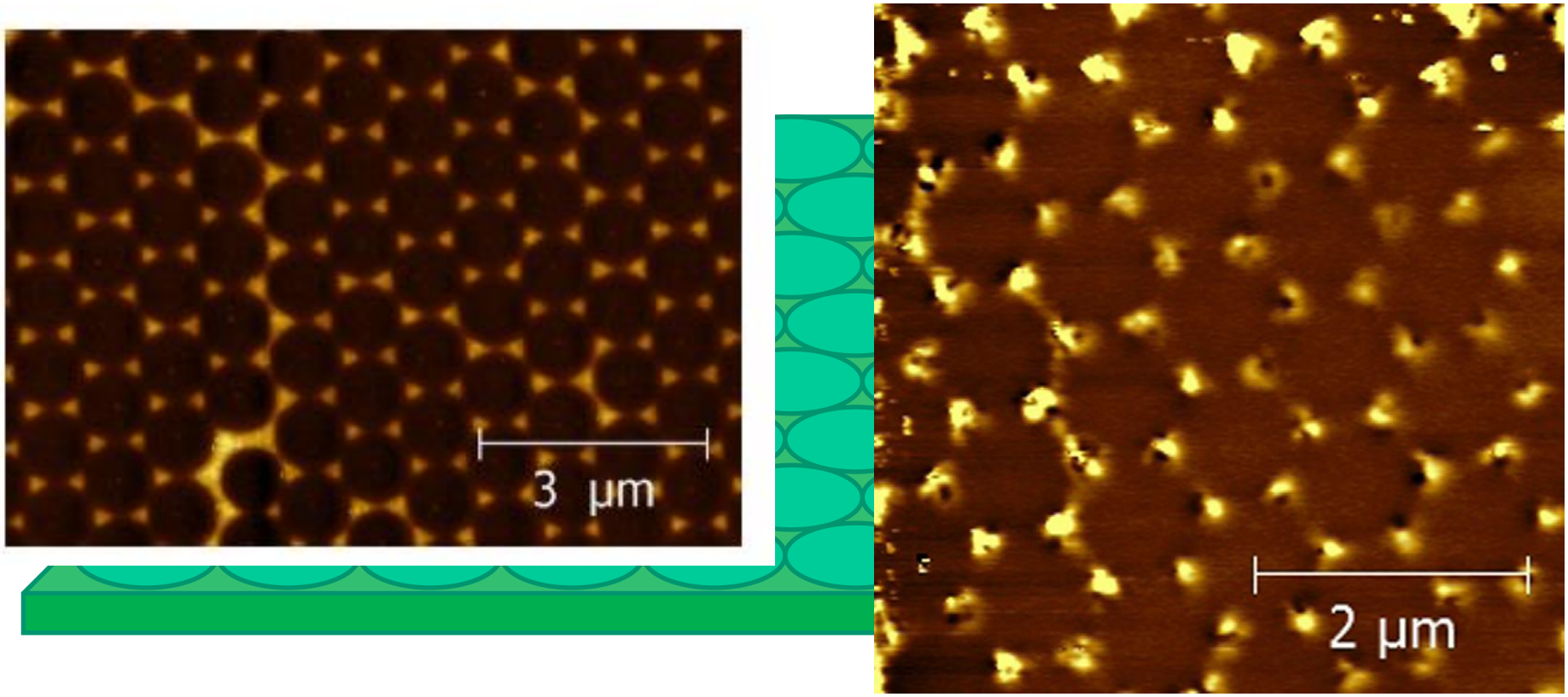
Nanosphere dilute suspension



Sputter deposition: Formation of nanocaps

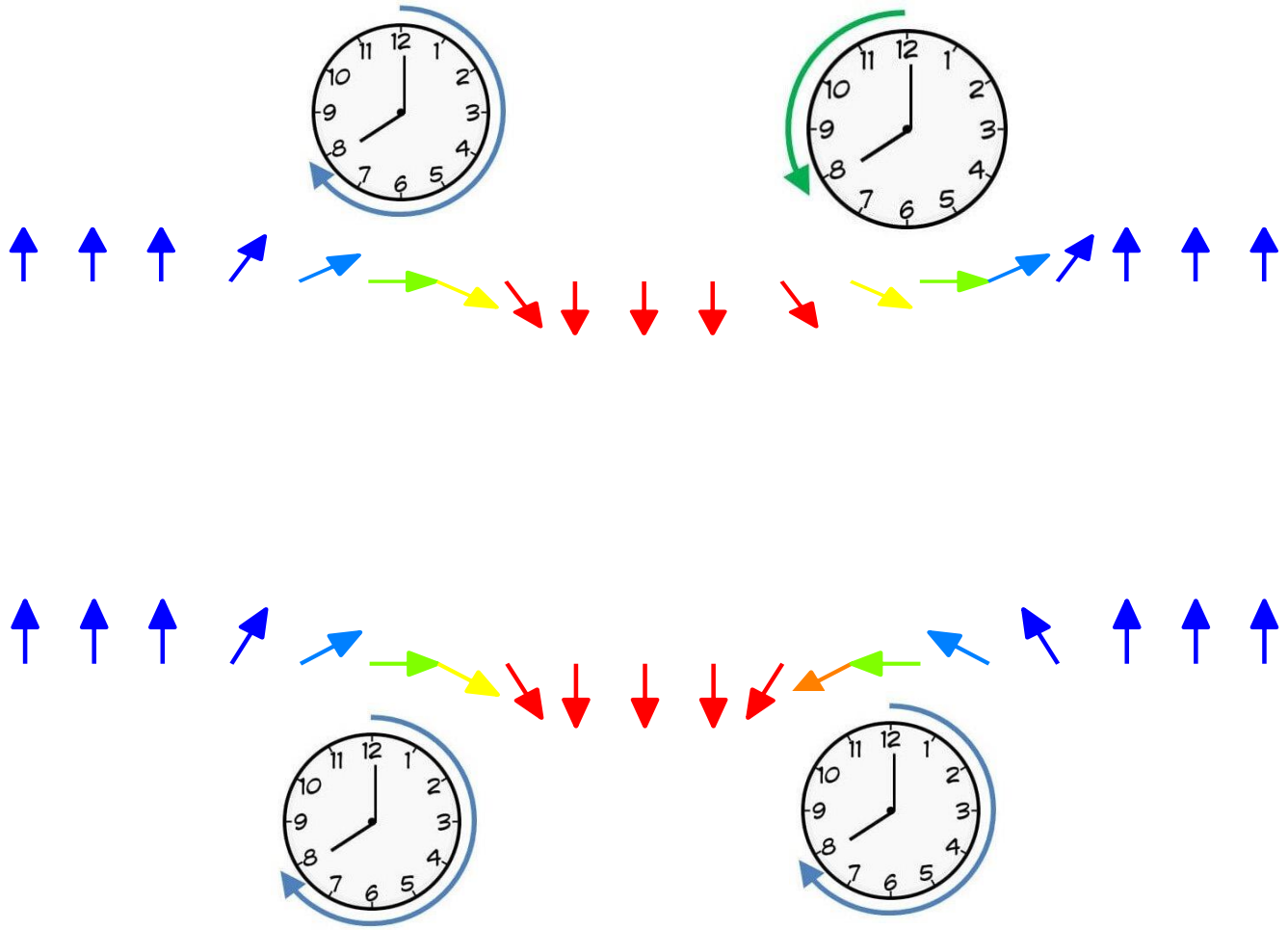


Nanosphere Removal:
Formation of triangles , Covered Area≈9.4%

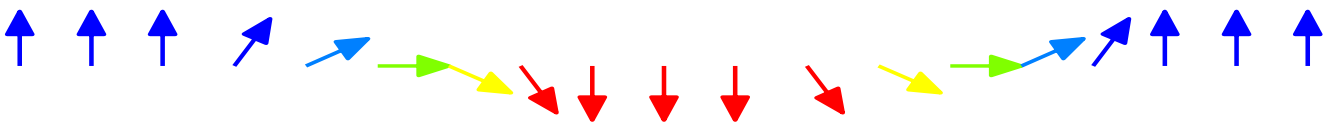


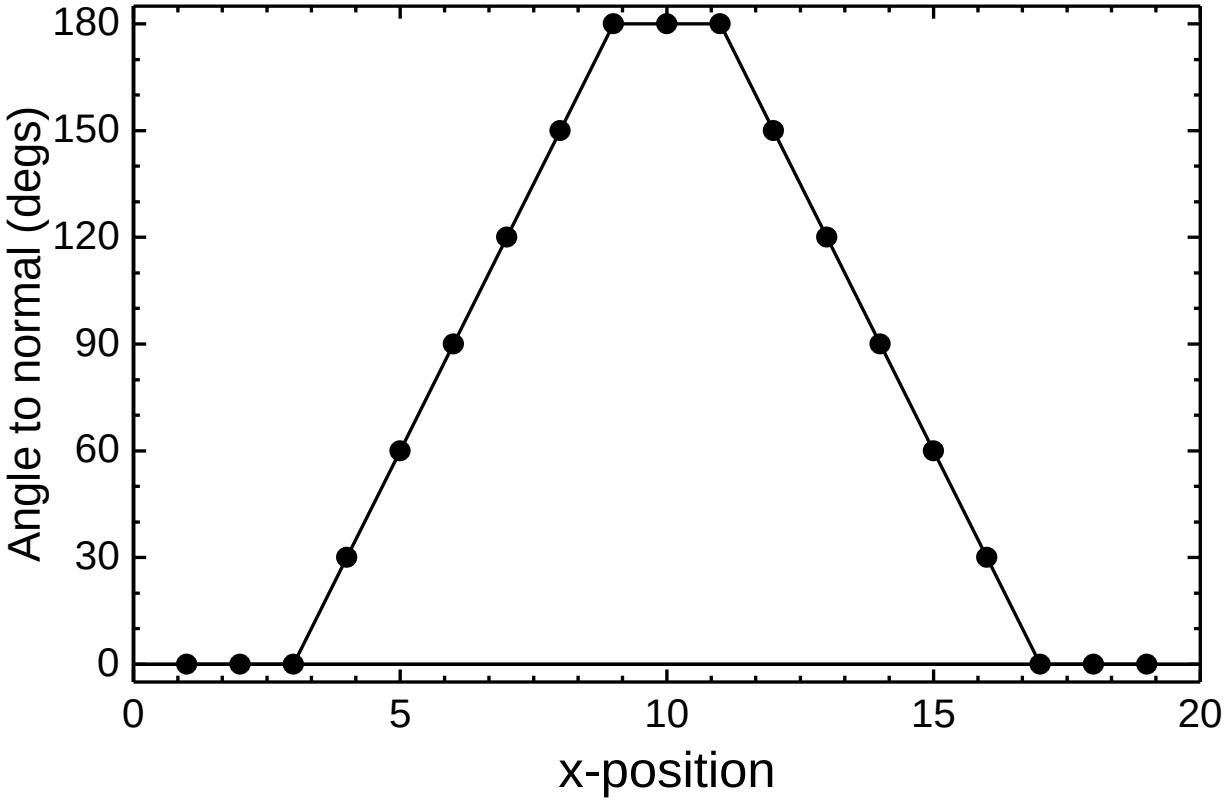
"Magnetization reversal in triangular $L1_0$-FePt nanoislands" Markou et al. Journal of Magnetism and Magnetic Materials 334 (2013) 107

Χειρομορφία σε 1d-Τοίχωμα

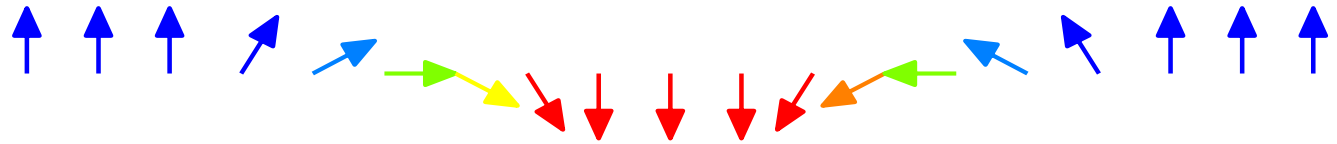


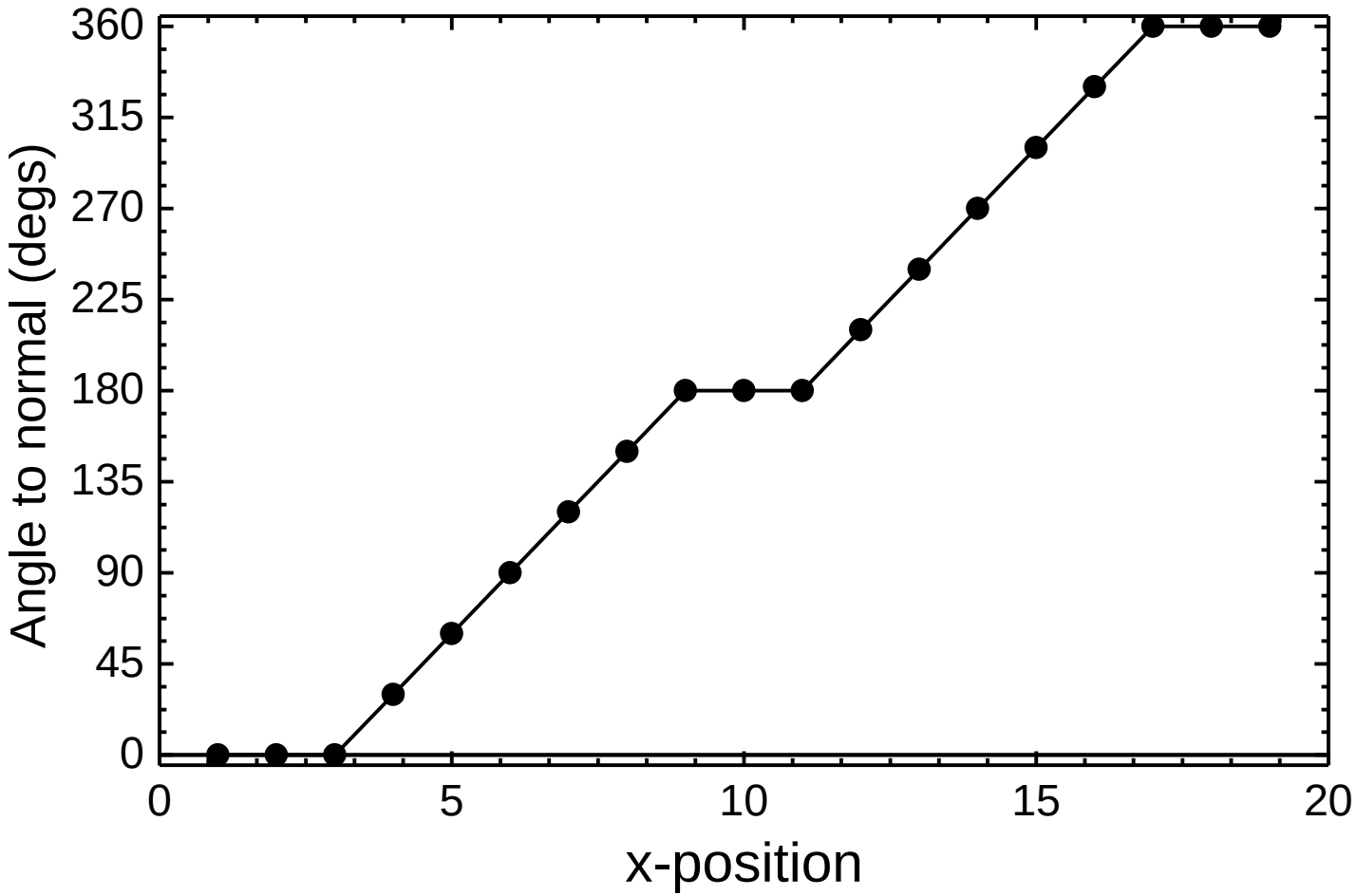
Τοίχωμα χωρίς χειρομορφία





Τοίχωμα με χειρομορφία



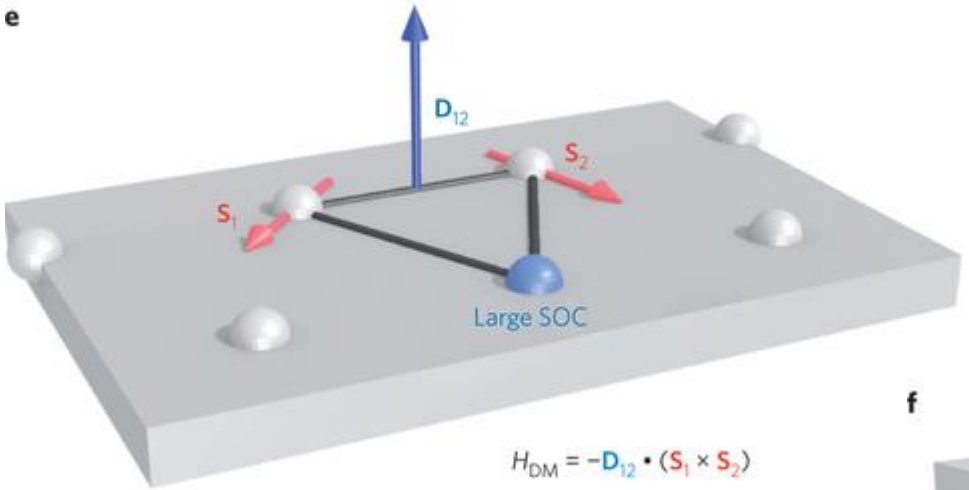


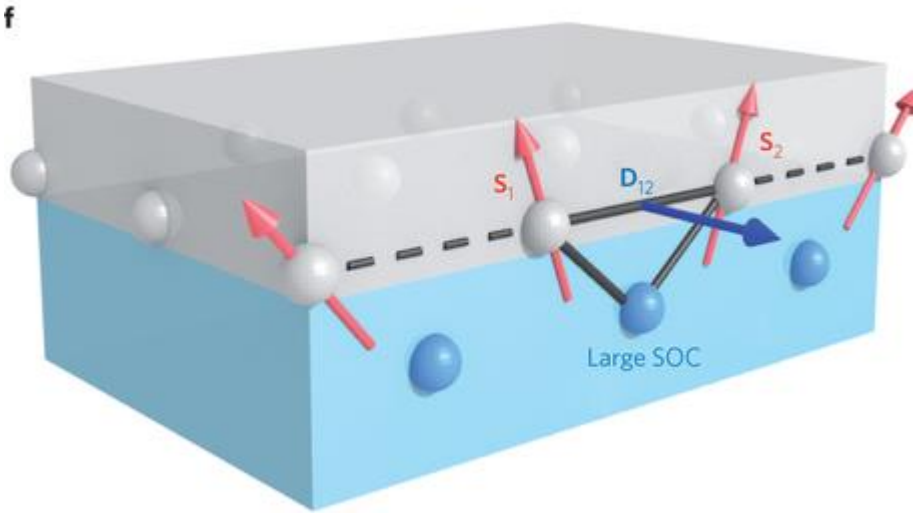
«Τοπολογικά προστατευμένες» μαγνητικές δομές

$$N_{Skyrmion} = \frac{1}{4\pi}\int m \cdot \left(\frac{\partial m}{\partial x} \times \frac{\partial m}{\partial y}\right) \overset{\Theta(r)}{\underset{\Phi(\phi)}{=}} \frac{1}{4\pi}\int Sin\Theta d\Theta \cdot \int d\Phi$$

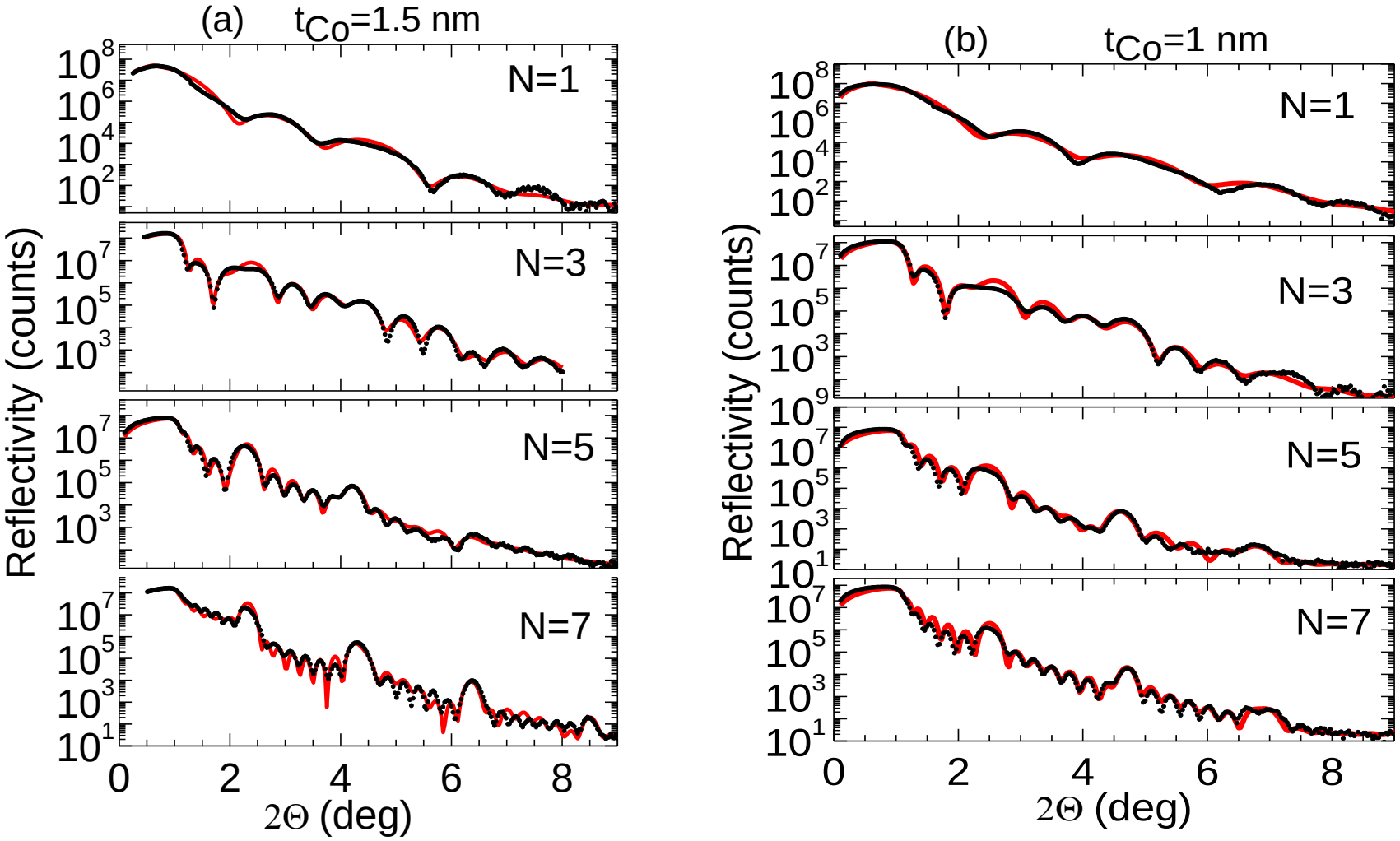
Dzyaloshinskii–Moriya Interaction (DMI)

$$E = -2J_{ex}\vec{S}_1\vec{S}_2 - \vec{D}\cdot\left(\vec{S}_1 \times \vec{S}_2\right)$$

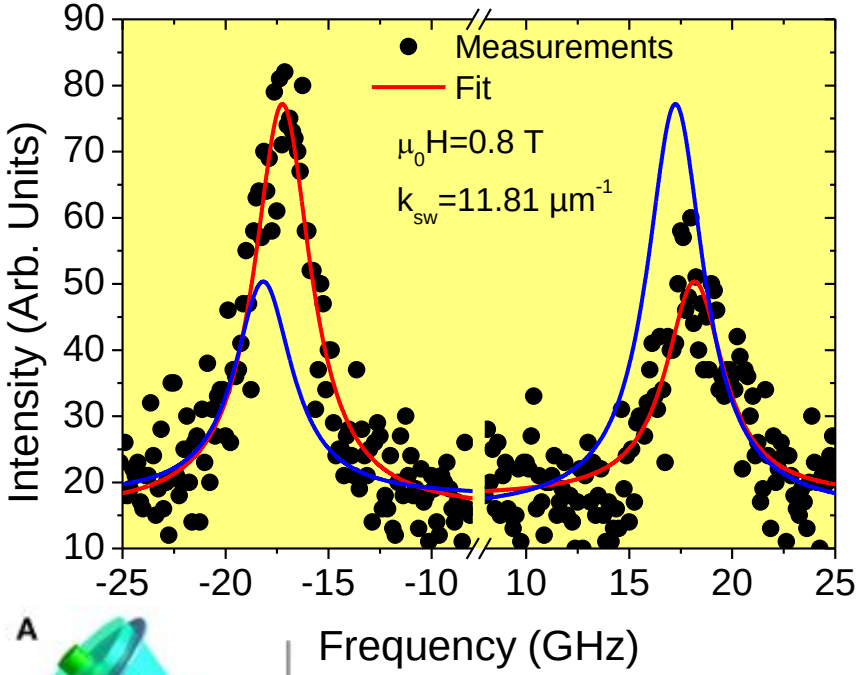


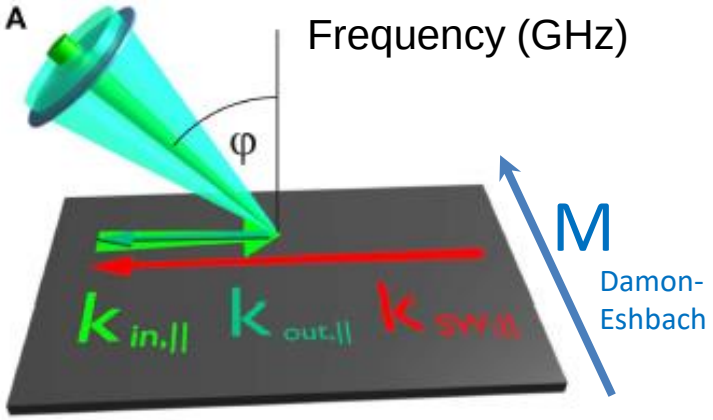


XRR $(Pt_{1.5}/Co_X/W_{1.5})_N$

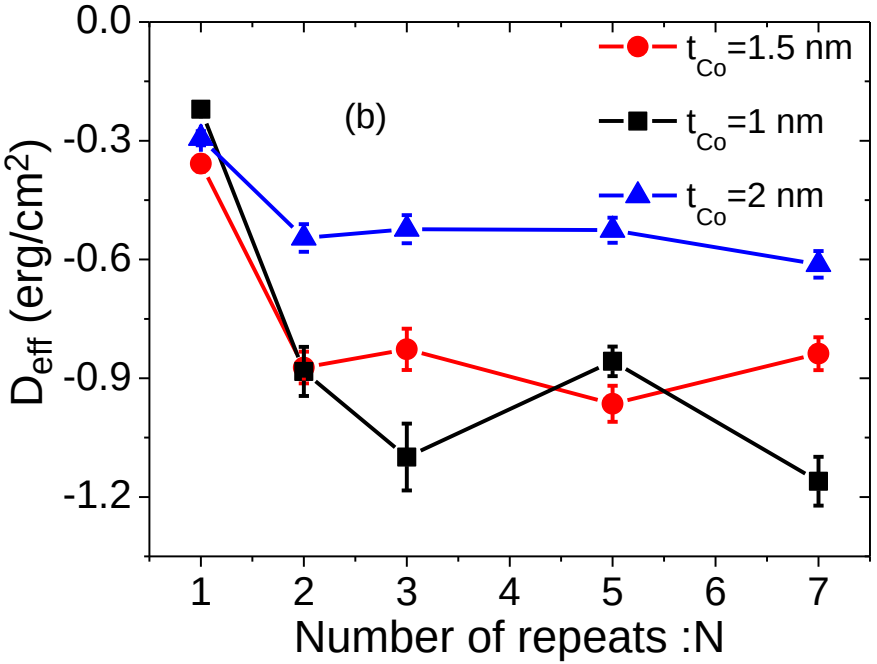


Pt/Co/W – BLS (nonreciprocal spin waves and DMI)





Brillouin Light Scattering Geometry



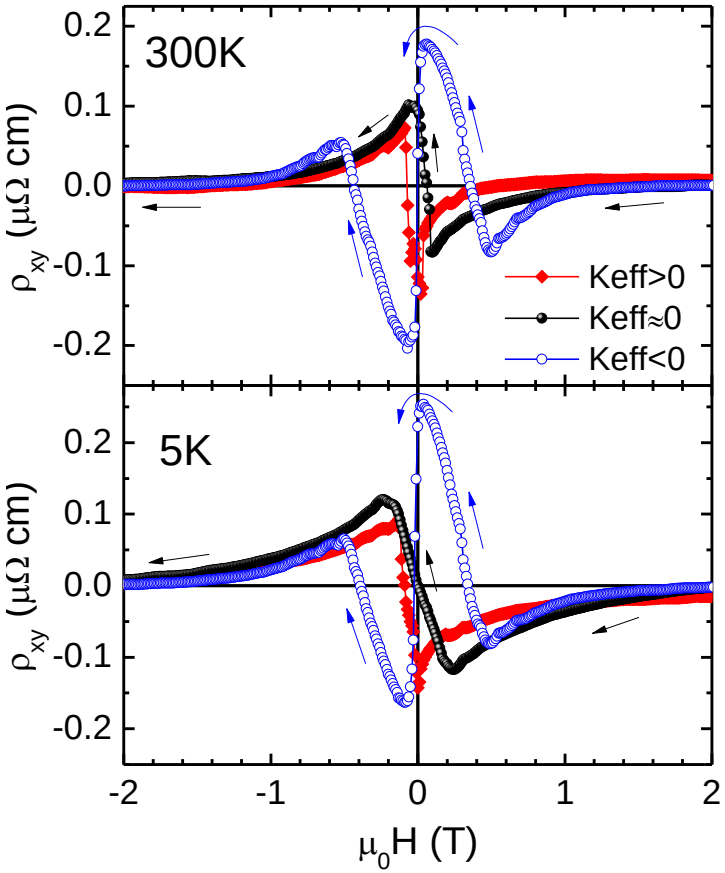
«Interfacial Dzyaloshinskii-Moriya interaction, interface-induced damping and perpendicular magnetic anisotropy in Pt/Co/W based multilayers», Benguettat-El Mokhtari et al, J. Appl. Phys. **126** (2019) 133902

Spin-wave wavelengths are orders of magnitude smaller compared to electromagnetic of the same frequency, they allow for the design of micro- and nano-sized devices.

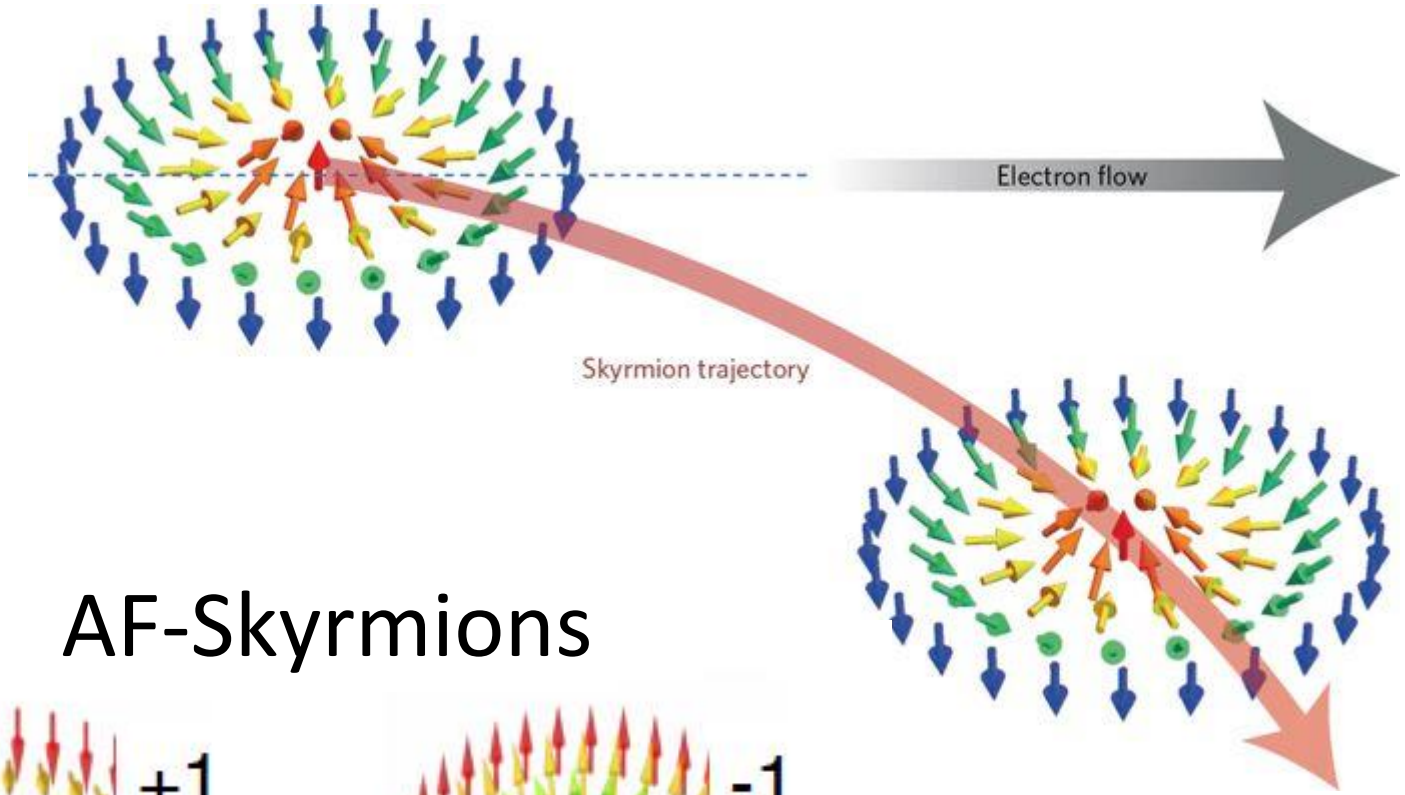
Pt/Co/W Τοπολογικό φαινόμενο Hall

$$\rho_{xy}(H) = R_0 H + R_S M(H) + \rho_T$$

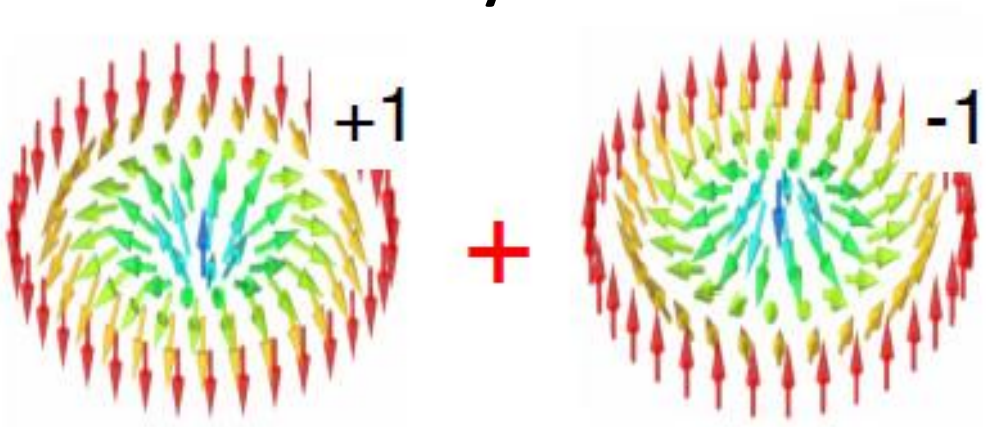
	Co layer	K_{eff} (kJ/m^3)	AHE (μΩ cm)	
		at 300 K	at 5K	at 300K
$K_{eff}>0$	1.5 nm	165	1.30	1.18
$K_{eff}\approx0$	1.7 nm	-30	1.35	1.24
$K_{eff}<0$	2.0 nm	-310	1.59	1.55



Skyrmion Hall effect



AF-Skyrmions



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Thanos Christos Micromagnetics

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- Niarchos D, Tzitzios V , NCSR "Demokritos"