



# Spinoptical nanoantenna-assisted magnetic storage at few nanometers on femtosecond timescale

Funded from European Union's Horizon 2020 research and innovation program (under the call EC H2020-FETOPEN-1-2016-2017) under grant agreement no. 737093

















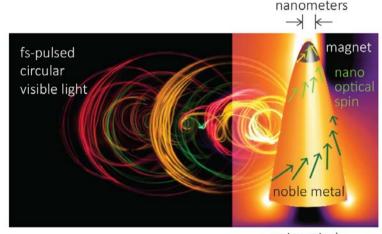






The key ICT challenges: (i) to achieve the ability to store and process information at the highest possible rate with the lowest possible energy consumption and, (ii) to increase further data storage density beyond Moore's law

Our vision: A magnetic recording technology beyond the present industry roadmap in terms of speed (= all-optical) and density (= at the nanoscale).



spinoptical nanoantenna























## FEMTOTERABYTE partners:







































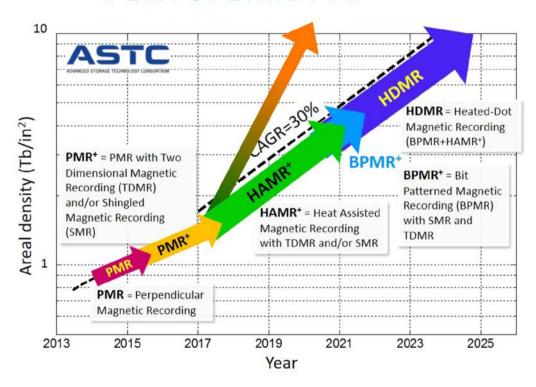




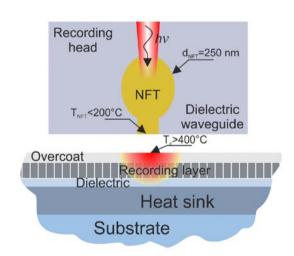
### Context: Ultrasmall magnetic memory

Project aim: from terabit/inch<sup>2</sup> to terabytes/inch<sup>2</sup>, 2 x 2 nm or down to molecular magnets (sub-nm).

#### FEMTOTERABYTE



Currently developed technology: Heat-Assisted Magnetic Recording (HAMR)



C. Vogler et al., *Appl. Phys. Lett.* 108, 102406 (2016)















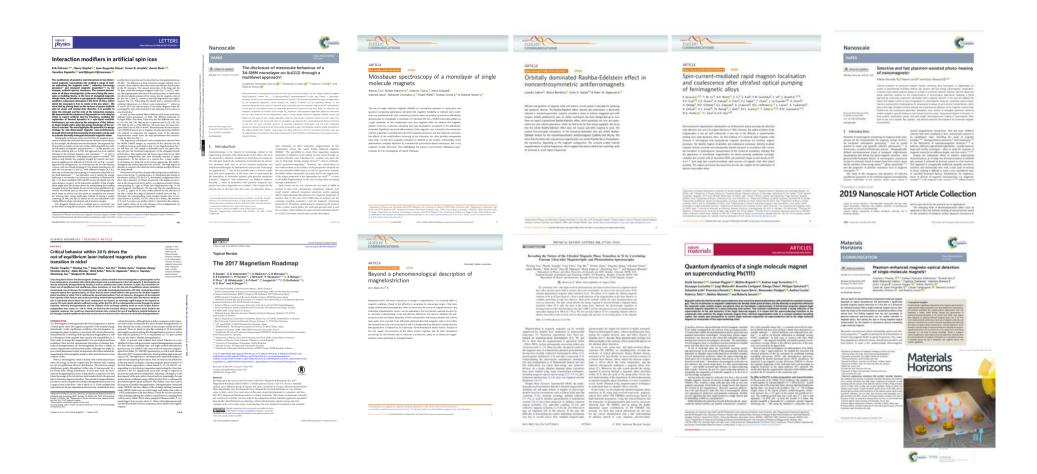








### FEMTOTERABYTE: Publishing highlights

























### FEMTOTERABYTE: Publishing highlights

# 32 publications in high-impact peer-reviewed journals

# 6 publications involve two or more Femtoterabyte partners























### FEMTOTERABYTE: Conferences, workshops, exchanges

# Participation in more than 100 conferences & workshops

# Dedicated symposia at JEMS 2019, META2019 and ECMM2019

(our mission: merging nano-optics and nanomagnetism)





























### FEMTOTERABYTE: Communication targeting industry

Participation in EFECS 2019 (November 2019, Helsinki, Finland)





Participation in the North German network for nanotechnology

http://www.nina-sh.de/?page\_id=492























### FEMTOTERABYTE: Participation of early-career researchers in scientific conferences

5 conferences / 5 talks (S. Ruta); MRS - Boston 2019, poster (R. Rowan-Rpbinson); JEMS - Mainz 2019, poster (R. Rowan-Robinson); APS March Meeting 2018 (Los Angeles, USA, March 2018): 1 Poster and 1 Oral (M. Zapata); Nicolás Cabrera School (Madrid, 2018): assistant (M. Zapata); COST Action Magnetofon workshop, poster "GdFeCo nanoparticles for all-optical magnetization switching" (S. Parchenko): International School on plasmonics, Magnetoplasmonics and applications ISPMA-2019 (Bogotá-Colombia): co-organizer (M. Zapata); 9th International conference on Surface Plasmon Photonics (Copenhagen-2019): 2 posters (M. Zapata); 2019 ETSF Young Researchers Meeting (San Sebastián, Spain): Invited speaker (M. Zapata): META 2019, the 10th International Conference on Metamaterials, Photonic Crystals and Plasmonics; poster (M. Zapata): International School of Plasmonics and Nano-Optics, Cetraro (Cs), 15-18.06.2018, Pitch presentation ("Self-Assembly of Magnetic Nanoparticles

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# Participation of early-career researchers of the project in more than 50 conferences & workshops

Ultrafast optical science outrarastright-zoto, moscow, mussia, ot-os october (zoto), E. sinetanina, magnetopiasmonies. magnetic control of light in the nanoscale landscapes", talk at "METANANO 2018" conference, Sochi, Russia, 17-21 September (2018), E. Smetanina; "Investigation of magnetization dynamics of Fe<sub>20</sub>Pd<sub>80</sub> circular island arrays" May, 29th to 31st 2017, 11th Symposium on Hysteresis Modeling and Micromagnetics (HMM 2017), in Barcelona, Spain, Talk (A. Ciuciulkaite); "Au/TbxCo1-x layered pillars as tunable magneto-plasmonic resonators" July 10 to July 13, 2018, 16th International Nanotech Symposium & Nano-Convergence Exhibition (NANO KOREA 2018) in Ilsan, The Republic of Korea, Poster, (A. Ciuciulkaite); "Au/Tb<sub>x</sub>Co<sub>1-x</sub> layered pillars as tunable magneto-plasmonic resonators" 3<sup>rd</sup> to the 7<sup>th</sup> of September 2018 Joint European Magnetic Symposia (JEMS) in Mainz, Germany, Poster, (A. Ciuciulkaite); "Au/Tb<sub>x</sub>Co<sub>1-x</sub> layers for tunable magneto-plasmonic nano-resonators" 17-28 September 2018, European School on Magnetism 2018 in Krakow, Poland, Poster, (A. Ciuciulkaite); "Collective magnetization dynamics in nano-arrays of thin FePd discs", February 6th-8th 2019, Workshop on Frontiers in Artificial Spin Ice in Bad Zurzach, Switzerland, Poster, (A. Ciuciulkaite).





















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### FEMTOTERABYTE: Intellectual property protection

- Several patents for multiple applications being elaborated as a result of the project
- Proof-of-concept device for memory is created
- Demonstration of building blocks achieved: optical writing and electrical reading
  Building blocks combined => ultra-fast, energy-efficient, scalable demonstrator
- Exploitation plans for memory and beyond with industrial partners

























HORIZON 2020



**FUTURE AND EMERGING TECHNOLOGIES** 

FEMTOTERABYTE, SPINOPTICAL NANOANTENNA-ASSISTED MAGNETIC STORAGE AT FEW NANOMETERS ON FEMTOSECOND TIMESCALE

#### COORDINATOR:

### Göteborgs universitet

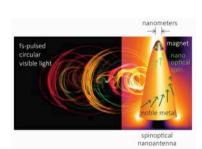
#### PARTNERS:

Uppsala universitet (SE) CIC NANOGUNE (ES) Università degli Studi di Firenze (IT) University of York (UK) Stichting Katholieke Universiteit (NE) Paul Scherrer Institut (CH) NanOsc (SE) Thales (FR) Università di Pisa (IT)



We will develop the conceptually new paradigm for ultra dense and ultra fast magnetic storage that will exceed the current technology by two orders of magnitude in storage density and by about four orders of magnitude in operation speed.

FUTURE AND EMERGING TECHNOLOGIES







The increasing need for more data storage is evident with the use of high bandwidth and in the widespread use of the mobile devices. We are set to directly impact the expanding worldwide market for nonvolatile ultra low energy memory.

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### More info:

https://www.physics.gu.se/english/research/femtoterabyte

http://www.fetfx.eu/project/femtoterabyte/

https://cordis.europa.eu/project/id/737093

















