Felix Büttner

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KEYWORDS **Topological materials (skyrmions), thin-film magnetic materials, coherent soft x-ray imaging, ultrafast science, x-ray free-electron lasers**

PROFESSIONAL CAREER

Helmholtz-Zentrum Berlin, Germany. Young Investigator Group Leader. Mar 2020 – present
Right to supervise and promote PhD students at University of Potsdam.

Massachusetts Institute of Technology, USA. Postdoc. Oct 2015 – Feb 2020
Department of Materials Science and Engineering. Advisor: Prof. G. Beach.

Daimler AG, Stuttgart, Germany. IT Engineer. Feb 2014 – Jul 2015
Rotational program “CAReer top talent program for future leader”

EDUCATION

University of Mainz, Germany. PhD in Physics. May 2010 – Nov 2013
Thesis: Topological mass of magnetic Skyrmions probed by ultrafast dynamic imaging. Supervision by Prof. M. Kläui and Prof. S. Eisebitt. Graduation with distinction.

University of Göttingen, Germany. Diplom (MS equivalent) in Physics. Oct 2005 – Feb 2010
Thesis: Thickness dependence of the magnetic properties of ripple-patterned Fe/MgO(001) films. Supervision by Prof. H. Hofsäss.

INVITED TALKS

Congress of the International Commission on Optics and International Conference on Optics in the Life Sciences, Dresden, Germany	Sep 2021
IEEE Conference on Advances in Magnetics (AIM), Moena, Italy	Jun 2021
MRS Spring Meeting, Seattle, WA, USA	Apr 2021
International Science@FELs Conference, Hamburg, Germany	Sep 2020
WEH Workshop on Magnetism, Bad Honnef, Germany	Jan 2020
SPIE Conference, San Diego, CA, USA	Aug 2019
Workshop on Skyrmion Imaging Techniques, Singapore	Jun 2019
International Surface X-ray and Neutron Scattering Conference (SXNS15), Pohang, South Korea	Jul 2018
IEEE International Magnetics Conference (Intermag), Singapore	Apr 2018
Spring Meeting of the German Physical Society (DPG), Berlin, Germany	Mar 2018
Spring Meeting of the American Physical Society (APS), Los Angeles, CA, USA	Mar 2018
IEEE Conference on Advances in Magnetics (AIM), Italy	Jan 2018
International Workshop on Topological Structures in Ferroic Materials, Leeds, UK	Aug 2017

AWARDS & SCHOLARSHIPS

Helmholtz Young Investigator Award	2020
NSLS-II Director’s Postdoc Fellowship	2018
Best Young Researcher Award of the IEEE Italy and IEEE Magnetics Society	2018
DFG Research Fellowship	2016

PROFESSIONAL ACTIVITIES

Reviewer Activities

Science, Nature Nanotechnology, Nature Communications, Nano Letters, NPG Asia Materials, Physical Review Letters, Scientific Reports, Applied Physics Letters, Journal of Applied Physics, Journal of Magnetism and Magnetic Materials, and others

Conference Organization

WEH Seminar “Magnetism at the Nanoscale: Imaging - Fabrication - Physics”, Jan 2021
Bad Honnef, Germany. Together with Dr. Jakob Walowski and Dr. Bastian Pfau.

TEACHING ACTIVITIES

As Instructor

"Emergent phenomena of interacting spins and charges I: Textures in real space and reciprocal spaces" (Graduate course, 6 ECTS). Together with Prof. Oliver Rader.
Department of Physics, University of Potsdam, Germany. Fall 2020

As Teaching Assistant

"Electrical, Optical, and Magnetic Properties of Materials" (Graduate course).
Department of Materials Science and Engineering, MIT. Fall 2017

"Graduate Physics Laboratory" ("Fortgeschrittenenpraktikum").
Department of Physics, TU Berlin, Germany. Spring 2013

"Recitation: Thermodynamics and Statistical Mechanics" (1-week spring break class).
Department of Physics, University of Göttingen, Germany. Spring 2010

"Undergraduate Physics Laboratory" ("Anfängerpraktikum").
Department of Physics, University of Göttingen, Germany. Spring 2007 & Spring 2009

"Quantum mechanics".
Department of Physics, University of Göttingen, Germany. Spring 2007

"Mathematics for Physicists".
Department of Physics, University of Göttingen, Germany. Fall 2006

PUBLICATIONS

Metrics

Peer-reviewed articles: >35, citations: >2000, h-index: 18 (Google Scholar)

Key Publications

† indicates equal contributors

1. Ultrafast all-optical topological switching observed in real time using a free-electron laser.
   F. Büttner†, B. Pfau†, M. Böttcher, M. Schneider, G. Mercurio, C. M. Günther, P. Hessing, C. Klose, A. Wittmann, K. Gerlinger, L.-M. Kern, C. Strüber, C. von Korff Schmising, J. Fuchs, D. Engel, A. Churikova, S. Huang, D. Suzuki, I. Lemesh, M. Huang, L. Caretta, D. Weder, S. Zayko, K. Bagschik, R. Carley, L. Mercadier, J. Schlappa, A. Yaroslavtsev, L. Le Guyarder, N. Gerasimova, A. Scherz, C. Deiter, R. Gort, D. Hickin, J. Zhu, M. Turcato, D. Lomidze, F. Erdinger, A. Castoldi, S. Maffessanti, M. Porro, A. Samartsev, C. Ropers, J. Sinova, J. H. Mentink, B. Dupé, G. S. D. Beach, and S. Eisebitt.
   Nature Materials **20**, 30 (2021).

2. Fast current-driven domain walls and small skyrmions in a compensated ferrimagnet.
   L. Caretta†, M. Mann†, F. Büttner†, K. Ueda, B. Pfau, C. M. Günther, P. Hessing, A. Churikova, C. Klose, M. Schneider, D. Engel, C. Markus, D. Bono, K. Bagschik, S. Eisebitt, and G. S. D. Beach.
   Nature Nanotechnology **13**, 1154 (2018).

3. Theory of isolated magnetic skyrmions: From fundamentals to room temperature applications.
   F. Büttner, I. Lemesh, and G. S. D. Beach.
   Scientific Reports **8**, 4464 (2018).

4. Field-free deterministic ultrafast creation of skyrmions by spin–orbit torques.
   F. Büttner†, I. Lemesh†, M. Schneider, B. Pfau, C. M. Günther, P. Hessing, J. Geilhufe, L. Caretta, D. Engel, B. Krüger, J. Viefhaus, S. Eisebitt, and G. S. D. Beach.
   Nature Nanotechnology **12**, 1040 (2017).

5. Dynamics and inertia of skyrmionic spin structures.
   F. Büttner†, C. Moutafis†, M. Schneider, B. Krüger, C. M. Günther, J. Geilhufe, C. v. Korff Schmising, J. Mohanty, B. Pfau, S. Schaffert, A. Bisig, M. Foerster, T. Schulz, C. A. F. Vaz, J. H. Franken, H. J. M. Swagten, M. Kläui, and S. Eisebitt.
   Nature Physics **11**, 225 (2015).

Other Publications

6. Interfacial Dzyaloshinskii-Moriya interaction arising from rare-earth orbital magnetism in insulating magnetic oxides.
   L. Caretta, E. Rosenberg, F. Büttner, T. Fakhrul, P. Gargiani, M. Valvidares, P. Reddy, C. A. Ross, G. S. D. Beach.
   Nature Communications **11**, 1090 (2020).

7. Thermal nucleation and high-resolution imaging of sub-micrometer bubbles in ultrathin thulium iron garnet films.
   F. Büttner†, M. A. Mawass†, J. Bauer, E. Rosenberg, L. Caretta, C. O. Avci, J. Gräfe, S. Finizio, C. A. F. Vaz, N. Novakovic, M. Weigand, K. Litzius, J. Förster, N. A. Träger, F. Groß, D. Suzuki, M. Huang, J. Bartell, F. Kronast, G. Schütz, C. A. Ross, and G. S. D. Beach.
   Physical Review Materials **4**, 011401(R) (2020) (editor's selection).

8. Voltage-gated optics and plasmonics enabled by solid-state proton pumping.
   M. Huang, A. J. Tan, F. Büttner, H. Liu, Q. Ruan, W. Hu, C. Mazzoli, S. Wilkins, C. Duan, J. K. W. Yang, and G. S. D. Beach.
   Nature Communications **10**, 5030 (2019).

9. Measurement of interfacial Dzyaloshinskii-Moriya interaction from static domain imaging.
   P. Agrawal, F. Büttner, I. Lemesh, S. Schlotter, and G. S. D. Beach.
   Physical Review B **100**, 104430 (2019).

10. Generation and stability of structurally imprinted target skyrmions in magnetic multilayers.
    N. Kent, R. Streubel, C.-H. Lambert, A. Ceballos, S.-G. Je, S. Dhuey, M.-Y. Im, F. Büttner, F. Hellman, S. Salahuddin, and P. Fischer.
    Applied Physics Letters **115**, 112404 (2019).

11. Hydration of gadolinium oxide (GdO_x) and its effect on voltage-induced Co oxidation in a Pt/Co/GdO_x/Au heterostructure.
    A. J. Tan, M. Huang, S. Sheffels, F. Büttner, S. Kim, A. H. Hunt, I. Waluyo, H. L. Tuller, and G. S. D. Beach.
    Physical Review Materials **3**, 064408 (2019).

12. Interface-Driven Chiral Magnetism and Current-Driven Domain Walls in Insulating Magnetic Garnets.
    C. O. Avci, E. Rosenberg, L. M. Caretta, F. Büttner, M. Mann, C. Marcus, D. Bono, C. A. Ross, and G. S. D. Beach.
    Nature Nanotechnology **14**, 561 (2019).

13. Magneto-ionic control of magnetism using a solid-state proton pump.
    A. J. Tan, M. Huang, C. O. Avci, F. Büttner, M. Mann, W. Hu, C. Mazzoli, S. Wilkins, H. L. Tuller, and G. S. D. Beach.
    Nature Materials **18**, 35 (2019).

14. Current-Induced Skyrmion Generation through Morphological Thermal Transitions in Chiral Ferromagnetic Heterostructures.
    I. Lemesh, K. Litzius, M. Böttcher, P. Bassirian, N. Kerber, D. Heinze, J. Zázvorka, F. Büttner, L. Caretta, M. Mann, M. Weigand, S. Finizio, J. Raabe, M.-Y. Im, H. Stoll, G. Schütz, B. Dupé, M. Kläui, and G. S. D. Beach.
    Advanced Materials **30**, 1805461 (2018).

15. Magnetostatic twists in room-temperature skyrmions explored by nitrogen-vacancy center spin texture reconstruction.
    Y. Dovzhenko, F. Casola, S. Schlotter, T. X. Zhou, F. Büttner, R. L. Walsworth, G. S. D. Beach, and A. Yacoby.
    Nature Communications **9**, 2712 (2018).

16. A Logic-in-Memory Design with 3-Terminal Magnetic Tunnel Junction Function Evaluators for Convolutional Neural Networks.
    S. Dutta, S. A. Siddiqui, F. Büttner, L. Liu, C. A. Ross, M. A. Baldo.
    Proc. IEEE/ACM NANOARCH p. 83 (2017).

17. Investigation of the Dzyaloshinskii-Moriya interaction and room temperature skyrmions in W/CoFeB/MgO thin films and microwires.
S. Jaiswal, K. Litzius, I. Lemesh, F. Büttner, S. Finizio, J. Raabe, M. Weigand, K. Lee, J. Langer, B. Ocker, G. Jakob, G. S. D. Beach, M. Kläui.
Applied Physics Letters **111**, 022409 (2017).

18. Accurate model of the stripe domain phase of perpendicularly magnetized multilayers.
I. Lemesh†, F. Büttner†, and G. S. D. Beach.
Physical Review B **95**, 174423 (2017).

19. Skyrmion Hall Effect Revealed by Direct Time-Resolved X-Ray Microscopy.
K. Litzius, I. Lemesh, B. Krüger, L. Caretta, K. Richter, F. Büttner, P. Bassirian, J. Förster, R. M. Reeve, M. Weigand, I. Bykova, H. Stoll, G. Schütz, G. S. D. Beach, and M. Kläui.
Nature Physics **13**, 170 (2017).

20. Magnetic Skyrmions: From Fundamental to Applications.
G. Finocchio, F. Büttner, R. Tomasello, M. Carpentieri, and M. Kläui.
Journal of Physics D: Applied Physics **49**, 423001 (2016) (Review Article).

21. Modification of magnetic anisotropy in Ni thin films by poling of (011) PMN-PT piezosubstrates.
A. Tkach, A. Kehlberger, F. Büttner, G. Jakob, S. Eisebitt, and M. Kläui.
Ferroelectrics **499**, 135 (2016).

22. Quantitative analysis of magnetization reversal in Ni thin films on unpoled and poled (011)$[PbMg_{1/3}\ Nb_{2/3}O_3]_{0.68}$–$[PbTiO_3]_{0.32}$ piezoelectric substrates.
A. Tkach, A. Kehlberger, F. Büttner, G. Jakob, S. Eisebitt, and M. Kläui.
Journal of Physics D: Applied Physics **49**, 335004 (2016).

23. Accurate calculation of the transverse anisotropy in perpendicularly magnetized multilayers.
F. Büttner†, B. Krüger†, S. Eisebitt, and M. Kläui.
Physical Review B **92**, 054408 (2015).

24. Electric field modification of magnetotransport in Ni thin films on (011) PMN-PT piezosubstrates.
A. Tkach, A. Kehlberger, F. Büttner, G. Jakob, S. Eisebitt, and M. Kläui.
Applied Physics Letters **106**, 062404 (2015).

25. Magnetoelectric properties of epitaxial Fe_3O_4 thin films on (011) PMN-PT piezosubstrates.
A. Tkach, M. Baghaie Yazdi, M. Foerster, F. Büttner, M. Vafaee, M. Fries, and M. Kläui.
Physical Review B **91**, 024405 (2015).

26. Domain wall transformations and hopping in $La_{0.7}Sr_{0.3}MnO_3$ nanostructures imaged with high resolution x-ray magnetic microscopy.
S. Finizio, M. Foerster, B. Krüger, C. A. F. Vaz, T. Miyawaki, M. A. Mawass, L. Peña, L. Méchin, S. Hühn, V. Moshnyaga, F. Büttner, A. Bisig, L. Le Guyader, S. El Moussaoui, S. Valencia, F. Kronast, S. Eisebitt, and M. Kläui.
Journal of Physics: Condensed Matter **26**, 456003 (2014).

27. Efficient spin transfer torque in $La_{2/3}Sr_{1/3}\ MnO_3$ nanostructures.
M. Foerster, L. Pena, C. A. F. Vaz, J. Heinen, S. Finizio, T. Schulz, A. Bisig, F. Büttner, S. Eisebitt, L. Mechin, V. Moshnyaga, and M. Kläui.
Applied Physics Letters **104**, 072410 (2014).

28. Monolithic focused reference beam X-ray holography.
J. Geilhufe, B. Pfau, M. Schneider, C. M. Günther, S. Werner, S. Schaffert, E. Guehrs, F. Büttner, S. Frömmel, M. Kläui, and S. Eisebitt.
Nature Communications **5**, 3008 (2014).

29. Synchronous precessional motion of multiple domain walls in a ferromagnetic nanowire by perpendicular field pulses.
J.-S. Kim, M.-A. Mawass, A. Bisig, B. Krüger, R. Reeve, T. Schulz, F. Büttner, M. Weigand, H. Stoll, J. Yoon, C.-Y. You, S. Eisebitt, H. J. M. Swagten, B. Koopmans, and M Kläui.
Nature Communications **5**, 3429 (2014).

30. Automatable sample fabrication process for pump-probe x-ray holographic imaging.
F. Büttner, M. Schneider, C. M. Günther, C. A. F. Vaz, B. Lägel, D. Berger, S. Selve, M. Kläui, and S. Eisebitt.
Optics Express **21**, 30563 (2013).

31. Breakdown of the X-Ray Resonant Magnetic Scattering Signal during Intense Pulses of Extreme Ultraviolet Free-Electron-Laser Radiation.
L. Müller, C. Gutt, B. Pfau, S. Schaffert, J. Geilhufe, F. Büttner, J. Mohanty, S. Flewett, R. Treusch, S. Düsterer, H. Redlin, A. Al-Shemmary, M. Hille, A. Kobs, R. Frömter, H. P. Oepen, B. Ziaja, N. Medvedev, S.-K. Son, R. Thiele, R. Santra, B. Vodungbo, J. Lüning, S. Eisebitt, and G. Grübel.
Physical Review Letters **110**, 234801 (2013).

32. Correlated velocity and domain wall spin structure oscillations.
A. Bisig, M. Stärk, M.-A. Mawass, C. Moutafis, J. Rhensius, J. Heidler, F. Büttner, M. Noske, M. Weigand, S. Eisebitt, T. Tyliszczak, B. v. Waeyenberge, H. Stoll, G. Schütz, and M. Kläui.
Nature Communications **4**, 2328 (2013).

33. Endstation for ultrafast magnetic scattering experiments at the free-electron laser in Hamburg.
L. Müller, C. Gutt, S. Streit-Nierobisch, M. Walther, S. Schaffert, B. Pfau, J. Geilhufe, F. Büttner, S. Flewett, C. M. Günther, S. Eisebitt, A. Kobs, M. Hille, D. Stickler, R. Frömter, H. P. Oepen, J. Lüning, and G. Grübel.
Review of Scientific Instruments **84**, 013906 (2013).

34. Magnetic states in low-pinning high-anisotropy material nanostructures suitable for dynamic imaging.
F. Büttner, C. Moutafis, A. Bisig, P. Wohlhüter, C. M. Günther, J. Mohanty, J. Geilhufe, M. Schneider, C. v. Korff Schmising, S. Schaffert, B. Pfau, M. Hantschmann, M. Riemeier, M. Emmel, S. Finizio, G. Jakob, M. Weigand, J. Rhensius, J. H. Franken, R. Lavrijsen, H. J. M. Swagten, H. Stoll, S. Eisebitt, and M. Kläui.
Physical Review B **87**, 134422 (2013).

35. Holographically aided iterative phase retrieval.
S. Flewett, C. M. Günther, C. v. Korff Schmising, B. Pfau, J. Mohanty, F. Büttner, M. Riemeier, M. Hantschmann, M. Kläui, and S. Eisebitt.
Optics Express **20**, 29210 (2012).

36. Ultrafast optical demagnetization manipulates nanoscale spin structure in domain walls.
B. Pfau, S. Schaffert, L. Müller, C. Gutt, A. Al-Shemmary, F. Büttner, R. Delaunay, S. Düsterer, S. Flewett, R. Frömter, J. Geilhufe, E. Guehrs, C. M. Günther, R. Hawaldar, M. Hille, N. Jaouen, A. Kobs, K. Li, J. Mohanty, H. Redlin, W. F. Schlotter, D. Stickler, R. Treusch, B. Vodungbo, M. Kläui, H. P. Oepen, J. Lüning, G. Grübel, and S. Eisebitt.
Nature Communications **3**, 1100 (2012).

37. Thickness dependence of the magnetic properties of ripple-patterned Fe/MgO(001) films.
F. Büttner, K. Zhang, S. Seyffarth, T. Liese, H.-U. Krebs, C. A. F. Vaz, and H. Hofsäss.
Physical Review B **84**, 064427 (2011).