

Frédéric PRZYBILLA



PROFESSIONAL ADDRESS

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CURRENT POSITION

Assistant Professor, Faculty of Pharmacy, University of Strasbourg (since September 1 2012)

EDUCATION

- 2024 **Habilitation à Diriger des Recherches**, University of Strasbourg, France.
Thesis entitled “Conversion ascendante de photons: caractérisation et applications en microscopie à molécule unique” defended February 13 2024 (garant Prof. Yves Mély).
- 2004 – 2008 **PhD in Physics**, Louis Pasteur University, Strasbourg, France.
Thesis entitled “Aspects fondamentaux de la transmission exaltée de la lumière à travers des ouvertures sub-longueurs d’onde” defended October 17 2008 (supervisor Prof. Thomas Ebbesen).
- 2003 – 2004 **MSc in Physical Chemistry**, Louis Pasteur University, Strasbourg, France.
- 2001 – 2003 **BSc in Physical Chemistry**, Louis Pasteur University, Strasbourg, France.
- 1999 – 2001 **French Preparatory Classes MPSI, MP**, equivalent of undergraduate studies specialized in Mathematics and Physics, Lycée Jean Moulin, Forbach, France.

EXPERIENCE

- 2011 – 2012 **Postdoctoral Researcher** (12 months), Laboratoire de Biophotonique et Pharmacologie, Université de Strasbourg - CNRS (UMR 7213), Illkirch, France. (Prof. Yves Mély)
- 2009 – 2010 **Postdoctoral Researcher** (20 months), groupe Nanophotonique, Centre de Physique Moléculaire Optique et Hertzienne, Université Bordeaux 1 - CNRS (UMR 5798), Talence, France. (Prof. Brahim Lounis)
- 2007 – 2008 **Research Engineer** (9 months), laboratoire des Nanostructures, Institut de Science et d’Ingénierie Supramoléculaires, Université Louis Pasteur - CNRS (UMR 7006), Strasbourg, France. (Prof. Thomas Ebbesen)
- 2004 – 2007 **Doctoral Student** (36 months), laboratoire des Nanostructures, Institut de Science et d’Ingénierie Supramoléculaires, Université Louis Pasteur - CNRS (UMR 7006), Strasbourg, France. (Prof. Thomas Ebbesen)

RESEARCH DIRECTIONS

My research activity focuses on the optical detection of single nano objects. Starting with the characterization of plasmonic effects in metallic nanostructures during my PhD thesis, my work continued with the development of a super-resolution fluorescence microscopy technique during a first post-doc. A second post-doc at the Biophotonics and Pharmacology Laboratory gave me the opportunity to gain an initial experience in biophysics. Currently assistant professor at the faculty of Pharmacy of University of Strasbourg, my research activities focus on the study of the interaction between biological objects at the single molecule scale and has led me to develop a new research theme centred on the photon up conversion phenomenon and its application in super resolution microscopy.

RESEARCH RESPONSIBILITIES

Co-responsible of 2/3 research thematic of the Biophotonics team of the Laboratory of Bioimaging and Pathology: "Structure and dynamics of cellular membranes and lipid nanoparticles" and "Technological and methodological developments".

Scientific responsible of PIQ-QuEST imaging platform part of the Alsace node of France Bio Imaging.

PUBLICATIONS

22. Dukhno, O.; Ghosh, S.; Greiner, V.; Bou, S.; Godet, J.; Muhr, V.; Buchner, M.; Hirsch, T.; Mély, Y.; **Przybilla, F.** Targeted Single-Particle Tracking with Upconverting Nanoparticles. *ACS Appl. Mater. Interfaces* **2024**, *16*, 11217–11227. <https://doi.org/10.1021/acsami.3c17116>
21. Märkl, S.; **Przybilla, F.**; Rachel, R.; Hirsch, T.; Keller, M.; Witzgall, R.; Mely, Y.; Wegener, J. Time-Resolved Analysis of Upconversion Nanoparticle Uptake and Cytotoxicity in Non-Cancerous Epithelial Cells. **Submitted to Scientific Reports.**
20. Soro, L. K.; Knighton, R. C.; Avecilla, F.; Thor, W.; **Przybilla, F.**; Jeannin, O.; Esteban-Gomez, D.; Platas-Iglesias, C.; Charbonnière, L. J. Solution-State Cooperative Luminescence Upconversion in Molecular Ytterbium Dimers. *Advanced Optical Materials* **2022**, 2202307. <https://doi.org/10.1002/adom.202202307>
19. Knighton, R. C.; Soro, L. K.; Thor, W.; Strub, J.-M.; Cianférani, S.; Mély, Y.; Lenertz, M.; Wong, K.-L.; Platas-Iglesias, C.; **Przybilla, F.**; Charbonnière, L. J. Upconversion in a d-f [RuYb₃] Supramolecular Assembly. *J. Am. Chem. Soc.* **2022**, *144* (29), 13356–13365. <https://doi.org/10.1021/jacs.2c05037>
18. Soro, L. K.; Charpentier, C.; **Przybilla, F.**; Mély, Y.; Nonat, A. M.; Charbonnière, L. J. Yb to Tb Cooperative Upconversion in Supramolecularly Assembled Complexes in a Solution. *Chemistry* **2021**, *3* (3), 1037–1046. <https://doi.org/10.3390/chemistry3030074>
17. Kavand, A.; Serra, C. A.; Blanck, C.; Lenertz, M.; Anton, N.; Vandamme, T. F.; Mély, Y.; **Przybilla, F.**; Chan-Seng, D. Controlled Synthesis of NaYF₄:Yb,Er Upconversion Nanocrystals as Potential Probe for Bioimaging: A Focus on Heat Treatment. *ACS Appl. Nano Mater.* **2021**, *4* (5), 5319–5329. <https://doi.org/10.1021/acsanm.1c00664>
16. Frenzel, F.; Würth, C.; Dukhno, O.; **Przybilla, F.**; Wiesholler, L. M.; Muhr, V.; Hirsch, T.; Mély, Y.; Resch-Genger, U. Multiband Emission from Single β-NaYF₄(Yb,Er) Nanoparticles at High Excitation Power Densities and Comparison to Ensemble Studies. *Nano Res.* **2021**. <https://doi.org/10.1007/s12274-021-3350-y>
15. Osz, J.; McEwen, A. G.; Bourguet, M.; **Przybilla, F.**; Peluso-Iltis, C.; Poussin-Courmontagne, P.; Mély, Y.; Cianférani, S.; Jeffries, C. M.; Svergun, D. I.; Rochel, N. Structural Basis for DNA Recognition and Allosteric Control of the Retinoic Acid Receptors RAR–RXR. *Nucleic Acids Research* **2020**, *48* (17), 9969–9985. <https://doi.org/10.1093/nar/gkaa697>
14. Kavand, A.; Blanck, C.; **Przybilla, F.**; Mély, Y.; Anton, N.; Vandamme, T.; Serra, C. A.; Chan-Seng, D. Investigating the Growth of Hyperbranched Polymers by Self-Condensing Vinyl RAFT Copolymerization from the Surface of Upconversion Nanoparticles. *Polym. Chem.* **2020**, *11* (26), 4313–4325. <https://doi.org/10.1039/DoPY00452A>
13. Nonat, A.; Bahamyirou, S.; Lecointre, A.; **Przybilla, F.**; Mély, Y.; Platas-Iglesias, C.; Camerel, F.; Jeannin, O.; Charbonnière, L. J. Molecular Upconversion in Water in Heteropolynuclear Supramolecular Tb/Yb Assemblies. *J. Am. Chem. Soc.* **2019**, *141* (4), 1568–1576. <https://doi.org/10.1021/jacs.8b10932>
12. Dukhno, O.; **Przybilla, F.**; Muhr, V.; Buchner, M.; Hirsch, T.; Mély, Y. Time-Dependent Luminescence Loss for Individual Upconversion Nanoparticles upon Dilution in Aqueous Solution. *Nanoscale* **2018**, *10* (34), 15904–15910. <https://doi.org/10.1039/C8NR03892A>
11. Dukhno, O.; **Przybilla, F.**; Collot, M.; Klymchenko, A.; Pivovarenko, V.; Buchner, M.; Muhr, V.; Hirsch, T.; Mély, Y. Quantitative Assessment of Energy Transfer in Upconverting Nanoparticles Grafted with Organic Dyes. *Nanoscale* **2017**, *9* (33), 11994–12004. <https://doi.org/10.1039/C6NR09706E>

10. Sharma, K. K.; **Przybilla, F.**; Restle, T.; Godet, J.; Mély, Y. FRET-Based Assay to Screen Inhibitors of HIV-1 Reverse Transcriptase and Nucleocapsid Protein. *Nucleic Acids Res* **2016**, 44 (8), e74. <https://doi.org/10.1093/nar/gkv1532>
9. Sharma, K. K.; **Przybilla, F.**; Restle, T.; Boudier, C.; Godet, J.; Mély, Y. Reverse Transcriptase in Action: FRET-Based Assay for Monitoring Flipping and Polymerase Activity in Real Time. *Anal. Chem.* **2015**, 87 (15), 7690–7697. <https://doi.org/10.1021/acs.analchem.5b01126>
8. Yang, B.; **Przybilla, F.**; Mestre, M.; Trebbia, J.-B.; Lounis, B. Large Parallelization of STED Nanoscopy Using Optical Lattices. *Opt. Express, OE* **2014**, 22 (5), 5581–5589. <https://doi.org/10.1364/OE.22.005581>
7. Godet, J.; Kenfack, C.; **Przybilla, F.**; Richert, L.; Duportail, G.; Mély, Y. Site-Selective Probing of CTAR Destabilization Highlights the Necessary Plasticity of the HIV-1 Nucleocapsid Protein to Chaperone the First Strand Transfer. *Nucleic Acids Res* **2013**, 41 (9), 5036–5048. <https://doi.org/10.1093/nar/gkt164>
6. **Przybilla, F.**; Genet, C.; Ebbesen, T. W. Long vs. Short-Range Orders in Random Subwavelength Hole Arrays. *Opt Express* **2012**, 20 (4), 4697–4709. <https://doi.org/10.1364/OE.20.004697>
5. Drezet, A.; **Przybilla, F.**; Laux, E.; Mahboub, O.; Genet, C.; Ebbesen, T. W.; Bouillard, J. S.; Zayats, A.; Spevak, I. S.; Zayats, A. V.; Nikitin, A. Y.; Martín-Moreno, L. Opening the Light Extraction Cone of High Index Substrates with Plasmonic Gratings: Light Emitting Diode Applications. *Appl. Phys. Lett.* **2009**, 95 (2), 021101. <https://doi.org/10.1063/1.3176435>
4. **Przybilla, F.**; Degiron, A.; Genet, C.; Ebbesen, T. W.; Léon-Pérez, F. de; Bravo-Abad, J.; García-Vidal, F. J.; Martín-Moreno, L. Efficiency and Finite Size Effects in Enhanced Transmission through Subwavelength Apertures. *Opt. Express, OE* **2008**, 16 (13), 9571–9579. <https://doi.org/10.1364/OE.16.009571>
3. **Przybilla, F.**; Genet, C.; Ebbesen, T. W. Enhanced Transmission through Penrose Subwavelength Hole Arrays. *Appl. Phys. Lett.* **2006**, 89 (12), 121115. <https://doi.org/10.1063/1.2355450>
2. **Przybilla, F.**; Degiron, A.; Laluet, J.-Y.; Genet, C.; Ebbesen, T. W. Optical Transmission in Perforated Noble and Transition Metal Films. *J. Opt. A: Pure Appl. Opt.* **2006**, 8 (5), 458–463. <https://doi.org/10.1088/1464-4258/8/5/015>
1. Bravo-Abad, J.; Degiron, A.; **Przybilla, F.**; Genet, C.; García-Vidal, F. J.; Martín-Moreno, L.; Ebbesen, T. W. How Light Emerges from an Illuminated Array of Subwavelength Holes. *Nature Physics* **2006**, 2 (2), 120–123. <https://doi.org/10.1038/nphys213>

COLLABORATION

During the development of my research activities, I set up and maintained local or international cooperative research projects with the following collaborators:

- Dr. Natacha Rochel, IGBMC, Unistra, since 2011.
- Dr. Thomas Hirsch, Regensburg University, since 2013.
- Dr. Ute Resch-Genger, BAM, Berlin, since 2017.
- Dr. Aline Nonat et Dr. Loïc Charbonnière, Institut Pluridisciplinaire Hubert Curien, Unistra, since 2017.
- Dr. Delphine Chan-Seng et Pr Christophe Serra, Institut Charles Sadron, Unistra, since 2017.
- Dr. Helgo Schmidt, IGBMC, Unistra, since 2019.
- Dr. Antoine Kichler et Dr. Alexandre Specht, CAMB, Unistra, since 2023.

FUNDING

2022 – 2025 Project : Upconverting particles coated with phospholipids for long-term single-molecule tracking and application to study the dynamics of living cell lipid domains.

Funding agency : 50% Région Grand Est (Compétences Recherche Action 15 SESRI – Volet 2) and 50% ITI QMat (Unistra).

Role : Co-leader, project leader is Prof. Yves Mély.

Ressources : 120k€ for 3 years of PhD salary.

- 2019 – 2024 Project : LUCAS - Light UpConverting ASsemblies.
 Funding agency : ANR (AAPG 2019).
 Role : Partner and scientific leader, coordinator is Dr. Loïc Charbonnière from IPHC and Prof. Raphael Tripier from UBO is the second partner.
Ressources : 90k€ out of 360k€ for 1 year of Postdoc salary, small instruments and consumables costs.
- 2015 – 2016 Project : Single molecule FRET microscopy with upconverting nanoparticles.
 Funding agency : LabEx Nanostructures in Interaction with their Environment (Unistra).
 Role : Co-leader, project leader is Prof. Yves Mély.
Ressources : 130k€ for the purchase of a microscope and consumables costs.

SUPERVISING AND MENTORING ACTIVITIES

Currently I am supervising 1 Postdoc. In the past, I co-supervised 3 postdocs, co-supervised 1 PhD student and supervised 10 Master 2 students.

- 04/2024 – ongoing **Ruifang Su, Postdoctoral project** “Upconverting particles coated with phospholipids for long-term single-molecule tracking and application to study the dynamics of living cell lipid domains”. **Supervisor (100%).**
- 02/2023 – 01/2024 **Ali Kassir, Postdoctoral project** “Imaging of Light UpConverting Assemblies”. **Supervisor (100%).**
- 07/2018 – 12/2019 **Vanille Greiner, Postdoctoral project** “Application des UCNPs en microscopie de molécule unique et suivi site-sélectif de modifications locales d'acides nucléiques”. **Co-supervisor (50%),** supervisor is Prof. Yves Mély.
- 10/2015 – 10/2018 **Oleksii Dukhno, PhD thesis** “Microscopie de molécules uniques avec des nanoparticules à conversion ascendante” defended november 13 2018. **Co-supervisor (50%),** supervisor is Prof. Yves Mély.
- 10/2014 – 06/2016 **Kamal K. Sharma, Postdoctoral project** “Etude de l'interaction entre les protéines RT et NCp7 de VIH-1 et des acides nucléiques dérivés du génome viral”. **Co-supervisor (50%),** supervisor is Prof. Yves Mély.

TEACHING RESPONSABILITIES

My teaching activities focus on statistics and physics (≈ 230 h per year) in the following subjects: Mathematics/Statistics/Physics (L1), Instrumentation practical work (L2, co-responsible), Clinical research methodology (L3), Experimental Statistics (M1, co-responsible), Methodologies and statistics (M2), Biophotonics (M2).