



Members of the FINON network at the final meeting held at EPFL (Lausanne, Switzerland, Sept. 2017).

## Training PhD Students to Become Experts in Nonlinear Optical Technologies

The growing interest in pushing imaging resolution beyond the diffraction limit to the nanoscale in the applied sciences is proven by the commercialization and increasing spread of super-resolution microscopy despite the highly specialized technology involved. The scientific aim of the FINON-ITN was to parallel the nonlinear nanoscopy development on new grounds to achieve chemical and structural characterization at the molecular level without labeling or extensive sample preparation.

FINON has taken nonlinear optical microscopy techniques into the nano-dimension, allowing for label-free three-dimensional, dynamic imaging of (macro) molecular arrangements and nanostructures by probing inherent higher-order electronic and molecular vibrations with novel detection concepts. The consortium has focused on

(A) exploring the use of nano-sized scanning probes, polarization- or phase-resolved detection schemes to enable nano-scale imaging

(B) benchmarking the capabilities of the newly developed methods by fundamental studies of molecular suprastructures and metallic nanostructures

(C) applying the novel nanoscopy concepts to live-cell and fuel cell studies, in this way introducing them as attractive instruments for the pharmaceutical, nanotechnology, and biosciences industries.

Twelve excellent international Early Stage Researchers (ESRs) were recruited to conduct research projects with the above goals. With the guidance of six expert female principle investigators and nine experienced industrial and academic associated partners, the ESRs have been embedded in an interdisciplinary and intersectorial research environment to receive the best possible training for a successful scientific career. Within the framework of the four year project duration, the FINON ESRs have developed into well-rounded young researchers by obtaining state-of-the-art academic, entrepreneurial and industrial training through scientific conferences, soft-skill workshops and cross-sectorial secondments.

## Outreach and Broader Impact

FINON is a unique compilation of six expert female principal investigators who repeatedly have been identified for their scientific excellence in a research field traditionally heavily dominated by men. Hence, the FINON consortium is an important contribution to the gender balance policy, both as a support to the career development of the partners, and even more importantly to encourage young female students to start

and complete a PhD in the natural sciences and pursue a career toward a full professor or a leadership position in industry.

The instrumentation and analysis methods developed in the first half of the project have been applied to biophysical and chemical research questions. The excellent success of the FINON project is mirrored in the to date 24 publications in internationally

# FINON

Female Investigators in  
Nonlinear Optical  
Nanoscopy

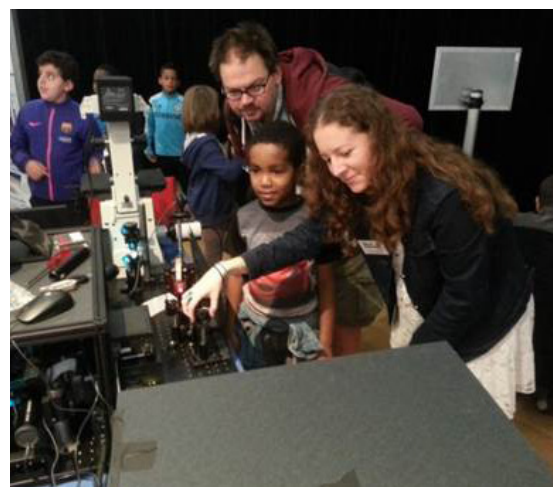


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### OUR BENEFICIARIES:



ESR Carolina Rendón Barraza demonstrates an experiment at Fête de la science in Marseille, France.

recognized, high-impact journals of the different research fields connected by the interdisciplinary consortium approach (plus further manuscripts submitted or in preparation). Public visibility and an interest in the FINON research activities has been generated by eight outreach activities at public science events at various European locations, for example, at the International Science Festival in Sweden, the Fête de la Science in France or the Girls' Day in Germany. Furthermore, FINON researchers presented

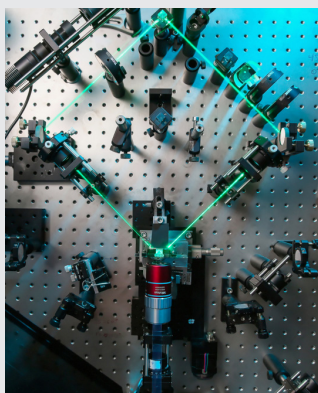
their results with posters and presentations at over 50 conferences and workshops across the world. Special recognition of FINON activities was received through two of our ESRs, Marie Didier and Carolina Rendón Barraza, who have been featured in promotional scientific videos (<https://www.youtube.com/watch?v=nm2ZTZ1LCnc>), and through PI Sophie Brasselet being awarded the Silver Medal of the Centre de Recherche National Scientifique in France (<http://www.fresnel.fr/spip/spip.php?article1261>).



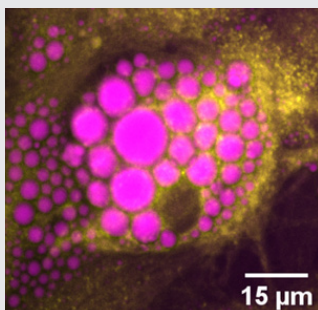
FINON ESR Marie Didier, as featured in promotional video.

## Scientific Highlights

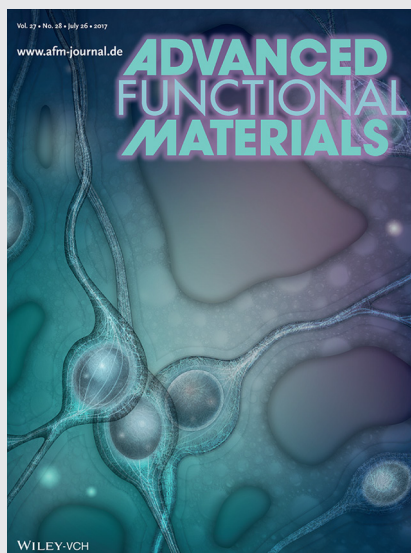
- Development and implementation of novel nanoscopy tools unique in the European scientific landscape: interface-sensitive wide-field SHG microscope, electrochemical tip-enhanced Raman spectroscope, FWM heterodyne interferometer, polarization resolved nonlinear microscope
- Fundamental studies of (bio)molecular suprastructures: visualization of lipids in amyloid plaque in brain tissue, micro-molding of proteins to create tissue-mimicking architectures, unraveling amyloid formation paths relevant for Parkinson's disease
- Applications of advanced nanoscopy tools: 3D tracking of individual nanoparticles with 20 nm spatial and 1 ms temporal resolution, spectrally resolving enhanced water transport in nm-confined Nafion pores; nanometric scale structural imaging in metal and dielectric nanoparticles



A wide field SH microscope was constructed at EPFL.



Differentiated adipose-derived stem cell illuminated label-free with nonlinear microscopy—magenta: cellular lipid depots in adipocyte, yellow: intrinsic cellular fluorescence. (Scale bar: 15 μm) (Photo: © Alexandra Paul)



Left: "Covalently Adaptable Elastin-Like Protein-Hyaluronic Acid (ELP-HA) Hybrid Hydrogels with Secondary Thermoresponsive Crosslinking for Injectable Stem Cell Delivery" published in Advanced Functional Materials, May 2017.



Middle school visit to MPIP lab in June, 2016.

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