

Current Research

My main research interests are theoretical and experimental soft matter, optics and photonics, with a special emphasis on the role of chirality in these fields. My PhD was more specifically focused on out-of-equilibrium phenomena in chiral liquid crystals (LC). With experimental and theoretical approaches, I studied the rotation of LC droplets driven by heat flux, similar to turbines submitted to wind. I was able to show the relevance of spontaneous symmetry breaking (PRL cover) and intriguing crossed-coupling effects (Liq. Cryst. cover+Liq. Cryst. Rev. review) in this interesting phenomena called the Lehmann effect, and designed a novel numerical method for the simulation of free-energy-minimizing metastable LC structures (first author PRE).

During my postdocs in Slovenia, I turned my focus on theoretical photonics and light propagation phenomena in chiral birefringent media. I designed and implemented novel and powerful ray-tracing/beam propagation methods (Soft Matter cover+Opt. Express, both first author) allowing to bridge the gap between experiments and theory by directly comparing simulated optical micrographs with experimental pictures obtained in the microscope; a straightforward application of these methods is the topological classification of metastable birefringent structures. I also was the recipient of a Marie Skłodowska Curie individual fellowship, which focused on the theoretical and numerical study of the interaction between spatial optical solitons and topological solitons in chiral soft birefringent media. Two major results were obtained during the fellowship: we showed that chirality can enhance non-linear effects in soft birefringent media, thus paving the way to low-power photonics devices (first author PRL), and we demonstrated the controlled lensing and deflection of laser beams on topological solitons, thus showing how soft materials are good candidates for tunable manipulation of laser beams in photonics devices (focus paper in PRX).

I am currently a CNRS researcher at the Laboratoire Charles Coulomb in Montpellier, where I am focusing on the transport properties of chiral guest objects in chiral host environments such as cholesteric liquid crystals or granular media with chiral boundary conditions. By using a combination of experiments and theoretical modelling, I will construct model systems demonstrating how fluctuations and chirality can be used to tune the transport properties of molecular, mesoscopic and macroscopic entities, with possible applications to chiral differentiation.

Professional experience

- 09/2021 – **Chargé de recherche CNRS**, *Laboratoire Charles Coulomb, Université de Montpellier*
Present Chiral soft matter, fluctuations, transport.
- 04/2021 – **Research associate**, *FMF, University of Ljubljana*
08/2021 Soft topological photonics and optomechanics, supervised by Slobodan Žumer
- 04/2019 – **Marie Skłodowska-Curie individual fellowship**, *FMF, University of Ljubljana*
03/2021 Interacting optical and topological solitons in frustrated cholesterics, supervised by Slobodan Žumer
- 01/2018 – **Research assistant**, *FMF, University of Ljubljana*
03/2019 Light deviation effect in cholesteric and nematic droplets, supervised by Slobodan Žumer

Education

- 09/2014 – **PhD in Physics**, *Laboratoire de Physique ENS de Lyon*
12/2017 Lehmann rotation of cholesteric and achiral nematic droplets driven by heat flux
Supervisor: Patrick Oswald
- 09/2011 – **Bachelor and Master in Physics**, *École Normale Supérieure de Lyon (France)*
07/2014 Specialisation in out-of-equilibrium physics, ranked 2/33.

Computer skills

- **Programming:** C/C++, OpenMP/MPI, Perl, Python, JS/D3, Matlab, Mathematica, Arduino, Latex/TikZ.
- **Applications:** Blender, GIMP, Inkscape, Labview, Office365/LibreOffice.

Active collaborations and networks

“Soft Matter Physics” group of Prof. Smalyukh (Boulder, Colorado, USA): 3 papers published.

“Liquid Crystals and Photonics” group of Prof. Neyts (Ghent, Belgium): 2 paper published.
I am a member of the Horizon 2020 COST action CA17139 (EUTOPIA).

Fundings

Marie Skłodowska-Curie Individual Fellowship (150 k€) at the Faculty of Mathematics and Physics (University of Ljubljana, Slovenia, from 01/04/2019 to 31/03/2021).

Activities as referee

I am a member of the reviewer board of Crystals, and I write reviews Soft Matter, Optical Materials Express, Fluids, Materials, Polymers and Crystals.

Responsibilities

I was a member of the organizing committee for the 18th Colloquium on self-organised anisotropic systems (Colloque sur les systèmes anisotropes auto-organisés, CFCL 2017).

Teaching

180h in 2015–2017: Numerical projects in python, Analytical mechanics, Laboratory work, Signal processing, Practical work in physics, Electromagnetism.

Supervision of students

- 2016, 2017 **Bibliographical projects**, *École Normale Supérieure de Lyon*
Landauer principle, information motors, Maxwell daemon.
- 2016 **L3 Internship (2 months)**, *Laboratoire de Physique ENS de Lyon*, Felix Bunel
Soft matter modelling for LC
- 2022 **M1 Internship (2 months)**, *Laboratoire Charles Coulomb*, Aude Amari
Material and optical properties of cholesteric Bragg-Berry lenses

Public events and talks

- 09/2019 **European researchers’ night**, *Ljubljana*
Presentation of postdoc activities and discussions with high-school Slovene students
- 05/2019 **Experience of a successful MSCA applicant**, *Ljubljana*
MSCA IF Masterclass workshop organized by the University of Ljubljana

Publications

An updated list of publications and talks can also be found on my [\[Personal webpage\]](#) or on [\[Google Scholar\]](#)

- [1] G. Poy, A. J. Hess, A. K. Seracuse, M. Paul, S. Žumer, and I. I. Smalyukh, “Interaction and co-assembly of optical and topological solitons”, [Nature Photonics](#) **16**, 454 (2022).
- [2] I. Nys, B. Berteloot, and G. Poy, “Surface stabilized topological solitons in nematic liquid crystals”, [Crystals](#) **10**, 840 (2020).

- [3] A. J. Hess, G. Poy, J.-S. B. Tai, S. Žumer, and I. I. Smalyukh, “Control of light by topological solitons in soft chiral birefringent media”, *Physical Review X* **10**, 031042 (2020).
- [4] G. Poy, A. J. Hess, I. I. Smalyukh, and S. Žumer, “Chirality-enhanced periodic self-focusing of light in soft birefringent media”, *Physical Review Letters* **125**, 077801 (2020).
- [5] G. Poy and S. Žumer, “Physics-based multistep beam propagation in inhomogeneous birefringent media”, *Optics Express* **28**, 24327–24342 (2020).
- [6] J. A. Richards, B. M. Guy, E. Blanco, M. Hermes, G. Poy, and W. C. Poon, “The role of friction in the yielding of adhesive non-brownian suspensions”, *Journal of Rheology* **64**, 405–412 (2020).
- [7] B. Berteloot, I. Nys, G. Poy, J. Beekman, and K. Neyts, “Ring-shaped liquid crystal structures through patterned planar photo-alignment”, *Soft Matter* **16**, 4999–5008 (2020).
- [8] P. Oswald, A. Dequidt, and G. Poy, “Lehmann effect in nematic and cholesteric liquid crystals: a review”, *Liquid Crystals Reviews* **7**, 142–166 (2019).
- [9] G. Poy and S. Žumer, “Ray-based optical visualisation of complex birefringent structures including energy transport”, *Soft Matter* **15**, 3659–3670 (2019).
- [10] P. Oswald and G. Poy, “Role of impurities in the Lehmann effect of cholesteric liquid crystals: Towards an alternative model”, *Physical Review E* **98**, 032704 (2018).
- [11] P. Oswald and G. Poy, “Dislocations dynamics during the nonlinear creep of a homeotropic sample of smectic-a liquid crystal”, *The European Physical Journal E* **41**, 73 (2018).
- [12] G. Poy and P. Oswald, “On the existence of the thermomechanical terms of akopyan and zel’dovich in cholesteric liquid crystals”, *Liquid Crystals* **45**, 1428–1442 (2018).
- [13] G. Poy, F. Bunel, and P. Oswald, “Role of anchoring energy on the texture of cholesteric droplets: Finite-element simulations and experiments”, *Physical Review E* **96**, 012705 (2017).
- [14] P. Oswald, G. Poy, and F. Vittoz, “Fréedericksz transition under electric and rotating magnetic field: application to nematics with negative dielectric and magnetic anisotropies”, *Liquid Crystals* **44**, 1223–1230 (2017).
- [15] P. Oswald, G. Poy, and A. Dequidt, “Lehmann rotation of twisted bipolar cholesteric droplets: role of Leslie, Akopyan and Zel’dovich thermomechanical coupling terms of nematodynamics”, *Liquid Crystals* **44**, 969–988 (2016).
- [16] M. Hermes, B. M. Guy, W. C. K. Poon, G. Poy, M. E. Cates, and M. Wyart, “Unsteady flow and particle migration in dense, non-brownian suspensions”, *Journal of Rheology* **60**, 905–916 (2016).
- [17] A. Dequidt, G. Poy, and P. Oswald, “Generalized drift velocity of a cholesteric texture in a temperature gradient”, *Soft Matter* **12**, 7529–7538 (2016).
- [18] J. Ignés-Mullol, G. Poy, and P. Oswald, “Continuous rotation of achiral nematic liquid crystal droplets driven by heat flux”, *Physical Review Letters* **117**, 057801 (2016).
- [19] G. Poy and P. Oswald, “Do lehmann cholesteric droplets subjected to a temperature gradient rotate as rigid bodies?”, *Soft Matter* **12**, 2604–2611 (2016).
- [20] P. Oswald and G. Poy, “Droplet relaxation in hele-shaw geometry: application to the measurement of the nematic-isotropic surface tension”, *Physical Review E* **92**, 062512 (2015).
- [21] P. Oswald and G. Poy, “Lehmann rotation of cholesteric droplets: role of the sample thickness and of the concentration of chiral molecules”, *Physical Review E* **91**, 032502 (2015).

- [22] P. Oswald, G. Poy, F. Vittoz, and V. Popa-Nita, “Experimental relationship between surface and bulk rotational viscosities in nematic liquid crystals”, *Liquid Crystals* **40**, 734–744 (2013).

Seminar & Colloquia

- [1] G. Poy, “Guiding principles of light in frustrated birefringent systems”, Soft Matter seminar, online weekly seminar organized by the FMF, Invited seminar (2021).
- [2] G. Poy, “Guiding principles of light in frustrated birefringent systems”, Faculty of Mathematics and Physics, Ljubljana, Slovenia, Colloquium (2021).
- [3] G. Poy, “Chirality in soft matter: from out-of-equilibrium physics to non-linear optics”, L2C, Montpellier, France, Invited seminar (2020).
- [4] G. Poy, “Chirality in soft matter: from out-of-equilibrium physics to non-linear optics”, Laboratoire Onde et Matière d’Aquitaine, Bordeaux, France, Invited seminar (2019).

Invited talks

- [1] G. Poy and S. Zumer, “Scattering-based microscope imaging of light beams in soft birefringent media with orientational fluctuations”, Proc. SPIE liquid Crystals XXVI, Invited paper and talk (2022).
- [2] G. Poy and S. Žumer, “Optical solitons and chirality-enhanced nonlinear optical response in frustrated liquid crystals”, Optics in Liquid Crystals, virtual conference, Invited talk (2021).
- [3] G. Poy, “Light simulation approaches in birefringent materials”, FWO-ARRS project meeting, Ljubljana, Slovenia, Invited talk (2021).
- [4] G. Poy and S. Zumer, “Chirality-enhanced nonlinear optical response of frustrated liquid crystals”, *Proc. SPIE liquid Crystals XXV*, Vol. 11807, Invited paper and talk (2021), p. 1180708.
- [5] G. Poy and S. Žumer, “Control of the flow of light with soft topological solitons”, EUTOPIA’s third meeting, virtual conference, Invited talk (2021).
- [6] G. Poy, A. J. Hess, J.-S. B. Tai, S. Žumer, and I. I. Smalyukh, “Lensing and deflection of light with soft topological solitons”, N.I.C.E. conference - Optics and Photonics symposia, Nice, France, Invited talk (2020).
- [7] G. Poy, J. Ignés-Mullol, and P. Oswald, “Lehmann effect: the end of the leslie paradigm”, International Liquid Crystal Conference, Kent, Ohio, Invited talk (2016).

Contributed talks & posters

- [1] G. Poy, “Hidden traces of chirality in the fluctuation modes of fully unwound frustrated cholesterics”, International Liquid Crystal Conference, Lisbonne, Portugal, Contributed talk (2022).
- [2] G. Poy and S. Žumer, “Optical solitons and chirality-enhanced nonlinear optical response in frustrated liquid crystals”, 18th International Conference on Ferroelectric Liquid Crystals, Ljubljana, Slovenia, Contributed talk (2021).
- [3] G. Poy and S. Žumer, “A new operator-splitted beam propagation method with application to non-linear optics in liquid crystals”, Optics of Liquid Crystals, Quebec city, Canada, Contributed talk (2019).
- [4] G. Poy and A. Petelin, “Nemaktis: a numerical platform for light propagation in liquid crystals”, European Conference on Liquid Crystals, Wrocław, Poland, Contributed talk (2019).

- [5] G. Poy, “Simulation of polarized optical micrographs including light-deviation effects in slowly-varying birefringent structures”, Workshop on Liquid Crystals for Photonics, Jas-trzebia Góra, Poland, Contributed talk (2018).
- [6] G. Poy, “Improved ray-tracing for slowly varying director field: simulation of optical micrographs of nematic and cholesteric droplets”, International Liquid Crystal Conference, Kyoto, Japan, Contributed talk (2018).
- [7] G. Poy, F. Bunel, J. Ignés-Mullol, and P. Oswald, “Heat-flux-driven rotation of nematic and cholesteric twisted bipolar droplets”, StatPhys, Lyon, France, Poster (2016).
- [8] G. Poy, J. Ignés-Mullol, and P. Oswald, “Du nouveau sur l’effet lehmann thermique dans des gouttes cholestériques”, 17ème Colloque sur les systèmes anisotropes auto-organisés, Autrans, France, Contributed talk (2015).