

Remembering Olivier Guillot-Noël

Olivier Guillot-Noël was a bright scientist as well as a man who liked life, appreciated by all for his kindness and dynamism.

He graduated in 1994 from the “Ecole Nationale Supérieure de Chimie de Paris” (ENSCP) a chemical engineer school (French equivalent to technical university) and, right from the beginning, was interested more by quantum mechanics and spectroscopy than by chemistry. Accordingly, he started a thesis entitled “Transition probabilities and absorption linewidths in the laser host $\text{YVO}_4:\text{Nd}$: Nd-Nd, Nd-host interactions, crystal field effects and chemical bond.” in the Condensed Matter Chemistry Laboratory of ENSCP. During these years, he became interested in magnetic effects in rare earth (RE) ions through the use of Electron Paramagnetic Resonance (EPR) spectroscopy, a technique which can reveal the fine details of RE energy levels energy structure and wavefunctions. In particular, he was able to model the energy level structure of RE pairs and identify them in satellite lines of Nd doped YVO_4 , a widely used laser host.¹ This was much easier than using optical spectroscopy because the optical inhomogeneous linewidth normally hides these weak interactions. He defended his thesis in 1997 and moved to Delft technical university to study Ce doped crystals for scintillation. He published there the first paper on $\text{LaCl}_3:\text{Ce}$ which is one of the most efficient crystals known today.² After two years in the Netherlands, he came back to ENSCP and obtained a position as a junior researcher at CNRS in 2000. Relying on his knowledge of RE interactions and his taste for theory, he studied intrinsic optical bistability in interacting atomic systems. At the time, the physics of the phenomenon was not well understood and several models and analysis had been published with opposite conclusions. Olivier was finally able to resolve the problems with a description which could cover previous ones depending on approximations and relative interactions times.³ Experimental work followed with the start of an independent group in the laboratory devoted to materials for optical information processing in 2002. Soon, contacts were established with the groups of Stefan Kröll (Lund, Sweden) and Jean-Louis Le Gouët (Orsay, France) to work on a project where RE ions could be used as quantum bits. This was very appropriate since magnetic interactions were central to the use of RE ions in the quantum computing schemes. Especially, the use of an external magnetic field can be necessary to ensure proper transition branching ratios. Olivier immersed in the theory of RE atomic structure, including Zeeman and hyperfine effects. This is especially complex as much as the corresponding literature which contains a lot of mistakes in formula and matrix elements. Nevertheless, after establishing correct expressions, application of the theory to $\text{Tm}:\text{YAG}$ was very successful as it predicted the optimal magnetic field to obtain a Λ -system in this material.⁴ Afterwards, these calculations were repeated in other materials with very good agreement with experiments. Material synthesis and characterization was also part of the group activity and a high resolution optical experiment was set up to test new crystals. Among them $\text{Pr}:\text{La}_2(\text{WO}_4)_3$ exhibits a low inhomogeneous linewidth and long coherence lifetimes despite the high magnetic moment of lanthanum. This compound is one of the very few solids in which narrow electromagnetically induced transparency has been observed.⁵ This result was part of new projects on solid state quantum memories in collaboration within a small network of European groups (J.L. Le Gouët, Orsay, S. Kröll, Lund, N. Gisin, Geneva, T. Halfmann, Darmstadt, D. Süter, Dortmund). Olivier also wanted to use EPR pulsed spectroscopy as a tool to characterize and manipulate RE ions.⁶ Ivan Lorgère and himself had found schemes in RE crystals to use multiple resonances (optical, RF, microwave) in order to build quantum gates. Their tragic travel to Brazil was part of this project.

During his short career, Olivier was the author or co-author of more than 60 papers and 40 oral communications. He presented 11 invited talks. He was awarded in 2006 the Aimé Cotton prize of the French physical society. He supervised four PhD students.

Olivier was a man of extraordinary energy and dedication to physics. He was bright, ready to take challenges and was the main source of motion in the group. His cheerfulness was valued by colleagues as well as his sometimes provoking attitude. He was a fair person and did not like compromises. He was 37 years old.

He is missed by many friends and coworkers throughout the rare earth community. His disappearance is a tragic loss for his family and especially his young daughter.

¹ Evidence of ferromagnetically coupled Nd³⁺ ions pairs in weakly doped Nd :LiYF₄ and Nd :YVO₄ crystals, as revealed by high resolution optical and electron paramagnetic resonance spectroscopies *O. Guillot-Noël, V. Mehta, B. Viana, D. Gourier, M. Boukhris, S. Jandl. Phys. Rev. B 61, 15338 (2000).*

² Optical and scintillation properties of cerium-doped LaCl₃, LuBr₃ and LuCl₃ *O. Guillot-Noël, J. T. M. de Haas, P. Dorenbos, C. W. E van Eijk, K. W. Krämer, H. U. Güdel. J. Lumin. 85, 21 (1999).*

³ General conditions for intrinsic optical bistability at atomic and molecular scale : an effective spin-Hamiltonian approach *O. Guillot-Noël, L. Binet, D. Gourier. Phys. Rev. B 65, 245101 (2002).*

⁴ Analysis of magnetic interaction in rare earth doped crystals for quantum manipulation *O. Guillot-Noël, Ph. Goldner, E. Antic-Fidancev, J. L. Le Gouët. Phys. Rev. B 71, 174409 (2005).*

⁵ Long Coherence Lifetime in a Highly Spin Concentrated Solid Ph. Goldner, *O. Guillot-Noël, F. Beaudoux, Y. Le Du, J. Lejay, T. Chanelière, J.-L. Le Gouët, L. Rippe, A. Amari, A. Walther, and S. Kröll*

⁶ Direct observation of rare-earth-host interactions in Er:Y₂SiO₅ *O. Guillot-Noël, Ph. Goldner, F. Beaudoux, J. Vincent, J. Lejay, H. Vezin. Phys. Rev. B 76, 180408 (2007).*