



PRESS RELEASE – APRIL 10, 2019

ChroMS – the brain as never seen before

Developed by researchers from École Polytechnique, Sorbonne Université, Inserm and the CNRS, ChroMS is a new microscopy technique bringing together color, 3D and high-resolution imaging, and is nothing short of a revolution in vertebrate brain imaging. The ChroMS technique is described in detail in a recently published article in Nature Communications.

Until now, researchers have had to choose between resolution and volume when performing vertebrate brain imaging. They could either obtain very high resolution over small volumes using three-dimensional electron microscopy or an image of the whole brain at resolutions that are far too low to understand the details.

The main advantage of the ChroMS (*Chromatic Multiphoton Serial imaging*) technique is that it provides a truly high-resolution virtual view (at the cellular level) of certain parts of the brain that are essential for understanding the development of neuronal circuits. Although the visit is virtual, the data are real. They are obtained from the brains of transgenic mice whose neurons produce fluorescent markers originating from jellyfish or coral. When stimulated by an infrared laser, these markers show up as colors.

“This instrument is ideal for making extremely precise, 3D reconstructions of regions of the brain with a volume of a few cubic millimeters, which is a breakthrough with this image quality, and this is the appropriate scale for what we want to observe”, explains Emmanuel Beaurepaire, researcher from the Laboratory for Optics and Biosciences (LOB – a joint research lab between École Polytechnique, the CNRS and Inserm). *“Using the current version of our instrument, we can also reconstitute a complete mouse brain, albeit at a lower level of precision”.*

“We are particularly interested in cell lineage,” states Jean Livet, researcher from the Institut de la Vision (Sorbonne Université, Inserm, CNRS). *“In other words, the manner in which the brain develops from neural stem cells: what are the daughter cells from a given stem cell, how can a stem cell mutation influence their development, and how are groups of cells generated by different stem cells organized in relation to one another? The high-volume, color-coded images produced by ChroMS reveal the developmental history of an individual region of the brain”.*

ChroMS should enable us to answer questions that neuroscientists have been asking for a long time, such as whether neurons arising from the same stem cell connect to each other preferentially to fulfil a given function, and whether pathologies such as epilepsy could be linked to localized problems affecting certain neural stem cells.

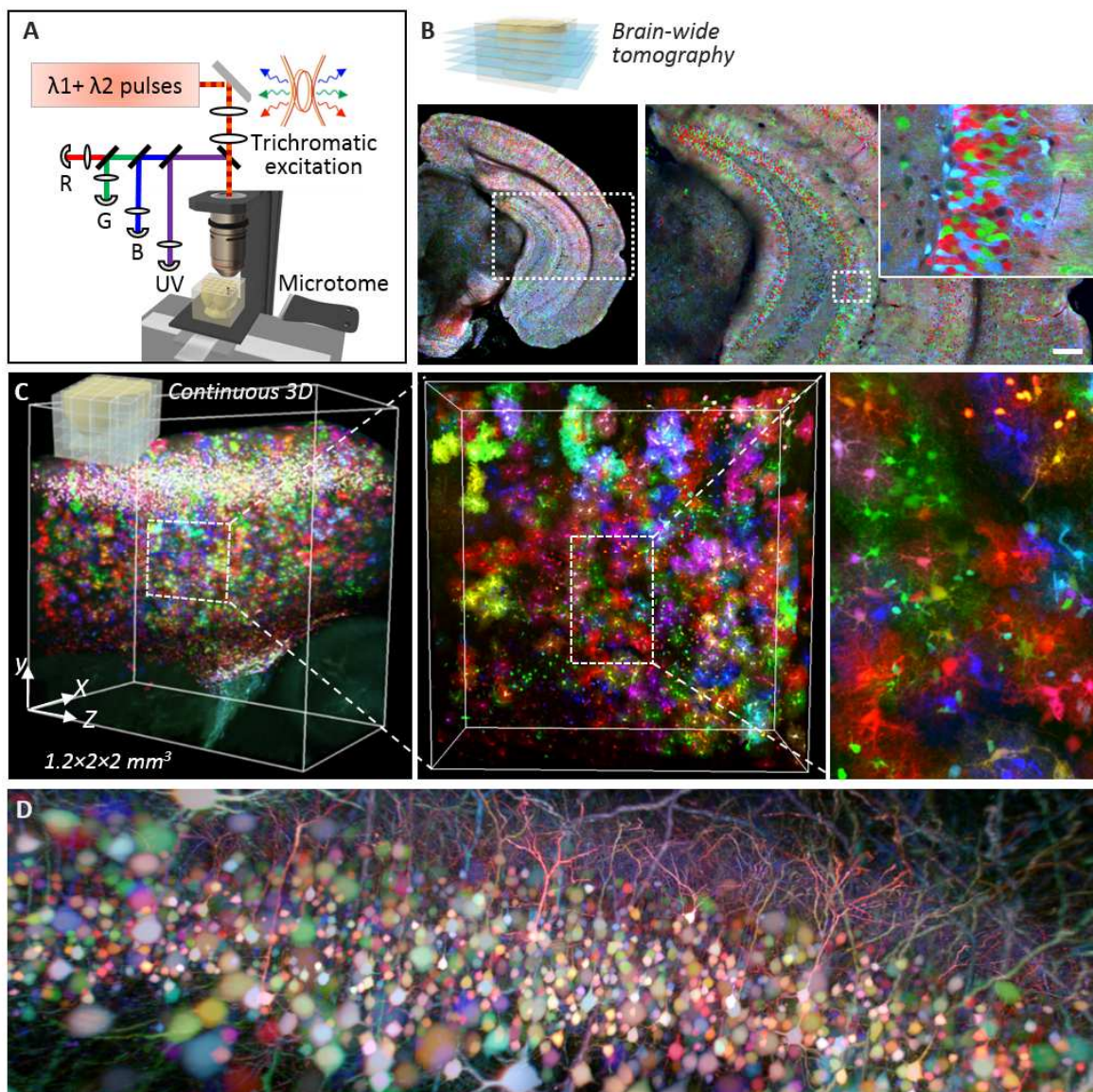
Although the ChroMS technique is ideally suited to the study of highly complex organs such as the brain, it can be used on all organs and should also prove a very effective tool for embryogenesis studies.

To read the full publication in Nature Communications:

<https://www.nature.com/articles/s41467-019-09552-9>

Références :

- Article: “Multicolor multiscale brain imaging with chromatic multiphoton serial microscopy” Lamiae Abdeladim, Katherine S. Matho, Solène Clavreul, Pierre Mahou, Jean-Marc Sintès, Xavier Solinas, Ignacio Arganda-Carreras, Stephen G. Turney, Jeff W. Lichtman, Anatole Chessel, Alexis-Pierre Bemelmans, Karine Loulier, Willy Supatto, Jean Livet, Emmanuel Beaurepaire. Nature Communications (2019). <https://doi.org/10.1038/s41467-019-09552-9>



(A) Principle of ChroMS microscopy, combining color two-photon excitation by frequency mixing and automated serial slicing of brain tissue. (B) Image acquired with the "whole brain tomography" mode showing the cortex and hippocampus of a Brainbow mouse. (C) 3D reconstruction and view at different scales of a 4.8 mm³ volume of mouse cortex in which astrocytes are marked with fluorescent proteins of different colors. (D) 3D view of color-marked neurons in the mouse cortex. Adapted from: Abdeladim et al, Nat Commun 2019.



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École Polytechnique offers an exceptional education to prepare bright men and women to excel in top-level key positions and lead complex and innovative projects which meet the challenges of 21st century society, all while maintaining a keen sense of their civil and social responsibilities. With its 23 laboratories, 22 of which are joint research units with the French National Center for Scientific Research (CNRS), the École Polytechnique Research Center explores the frontiers of interdisciplinary knowledge to provide major contributions to science, technology, and society. École Polytechnique is a founding member of Institut Polytechnique de Paris.

www.polytechnique.edu

ABOUT THE CNRS / The French National Center for Scientific Research (CNRS) is Europe's largest public research institution. It produces knowledge for the benefit of society. With 31,612 employees, a budget exceeding 3.5 billion euros in 2017 (including a self-generated income of 787 million euros), the CNRS is present in all scientific fields through its 1100 laboratories in France and around the world. With 21 Nobel laureates and 12 Fields Medal winners, the organization has a long tradition of excellence. It carries out research in mathematics, physics, information sciences and technologies, nuclear and particle physics, Earth sciences and astronomy, chemistry, biological sciences, the humanities and social sciences, engineering and the environment.

www.cnrs.fr

ABOUT SORBONNE UNIVERSITÉ / By joining two leading universities^[1] at the center of Paris, an exceptional center of knowledge has been recreated under the world-renowned Sorbonne name.

Sorbonne University is a world-class research university, presenting the comprehensive disciplinary range of arts, humanities, social natural sciences, engineering and medicine. The University offers its 55,600 students the best educational opportunities for success, through mono-disciplinary, bi-disciplinary and interdisciplinary programs. With its three main faculties, it offers varied and original opportunities across disciplines. Sorbonne University research draws on more than 3,400 professor-researchers and another 3,000 researcher partners from the major French research organizations. In addition to Nobel Prizes and other awards, the university has exceptional trans-disciplinary institutes and is the headquarters for the European Marine Biological Research Centre. International co-operation at Sorbonne University enables its students, academic staff and researchers to increase their exchanges with the rest of the world.

www.sorbonne-universite.fr

ABOUT INSERM / Founded in 1964, Inserm is a public scientific and technological institute which operates under the joint authority of the French Ministries of Health and Research. The institute is dedicated to biomedical research and human health, and is involved in the entire range of activities from the laboratory to the patient's bedside. It also partners with the most prestigious research institutions in the world that are committed to scientific challenges and progress in these fields.

www.inserm.fr

^[1] Paris-Sorbonne and Pierre & Marie Curie Universities