Curriculum Vitae

Prof. Marco Stampanoni

Assistant Professor Tenure Track for X-ray Microscopy
Institute for Biomedical Engineering (IBT) and Paul Scherrer Institut (PSI)
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Degrees/Higher Education

2002	PhD, Physics, ETH Zurich
2000	MAS ETH in Medical Physics
1998	Diploma, Physics, ETH Zurich

Professional Career

2008 - present	Assistant Professor Tenure Track at the Institute for Biomedical Engineering of ETH Zurich
2005 - present	Head of the X-Ray Tomographic Microscopy Group, Swiss Light Source, Paul Scherrer Institut, Villigen, Switzerland
2004-2005	Beamline Scientist at Swiss Light Source, Paul Scherrer Institut, Villigen, Switzerland
2003-2004	Instrument Scientist at Swiss Light Source, Paul Scherrer Institut, Villigen, Switzerland

Academic Commitments

Since 2010	Director of the Master of Advanced Studies in Medical Physics at the ETH, Zürich

Major Committee Assignments

Since 2011	Chair of ESRF-PRC-MD Panel, the European Synchrotron Radiation Facility Program Review Committee, Medical Applications Panel
Since 2011	Member of the International Advisory Committee of MASR, Medical Application of Synchrotron Radiation
Since 2010	Member of the Werner Meyer-Ilse Award Committee, X-ray Microscopy Conference
Since 2009	Member of ESRF-PRC-MD Panel, the European Synchrotron Radiation Facility Program Review Committee, Medical Applications Panel
Since 2008	Member of the steering committee of CIMST, the Zürich Center for Imaging Science and Technology
2005-2010	Member of ACNI, the Advisory Committee on Neutron Imaging at Paul Scherrer Institut

Major Honors and Awards

2003	ETH-Medal for outstanding PhD thesis

Teaching

Lecture 227-0390-00L	“Elements of Microscopy”
Lecture 227-0965-00L	“Micro and Nano-Tomography of Biological Tissues”
Lecture 227-0970-00L	“Research Topics in Biomedical Engineering “

Publications

- 130+ refereed publications, h-index 19
- 3 patents

Achievements

- Development of cutting-edge instrumentation for synchrotron-based X-ray tomographic microscopy
- Pioneering work in clinical phase contrast imaging

Facilities and Major Equipment

- TOMCAT: a beamline for tomographic microscopy and coherent radiology experiment at the Swiss Light Source of the Paul Scherrer Institut
- X-ray laboratory with multiple table top sources

Membership in Societies

SPS, SPIE, IEEE

Personnel

Scientific coworkers	2
Non-scientific. coworkers	1
Post-doctoral students	5
Doctoral students	6

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Prof. Marco Stampanoni - Research Highlights

X-ray imaging and microscopy

Keywords

- X-ray tomographic microscopy
- Phase contrast X-ray imaging
- Synchrotron-based imaging methods

Future priority areas

- Clinical application of phase contrast imaging
- Methods development for the 3D visualization of evolving structures at the micron- and nano-scale

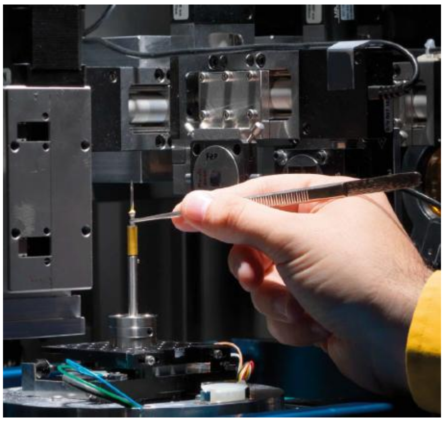
Focus

Since their discovery more than a century ago, X-rays have been a fundamental tool for the non-destructive characterization of materials. Thanks to the advent of modern synchrotron radiation facilities, X-ray diffraction, absorption and imaging methods have been tremendously developed during the recent years. In particular, soft and hard X-ray microscopy reaches now a spatial resolution of a few tens of nanometers.

Our group contributes to this pioneering work by introducing novel imaging modalities. Specifically, we focus our efforts on the development of tomographic instruments and methods for non-invasive 3D investigations of biosamples at the micron- and nano-scale.

We are interested in developing and optimizing imaging modalities (absorption, phase and dark-field contrast), tomographic reconstruction algorithms as well as imaging devices.

A fundamental pillar of our work is the transfer of the technology developed at the synchrotron to applications based on conventional X-ray sources. Our advanced methods will be accessible to a broader community ranging from medical to non-destructive and homeland security professionals.



(© Scanderberg Sauer Photography)

X-ray tomographic (3D) microscopy at the micron- and nano-scale can be carried out in a few minutes at third generation synchrotron facilities.

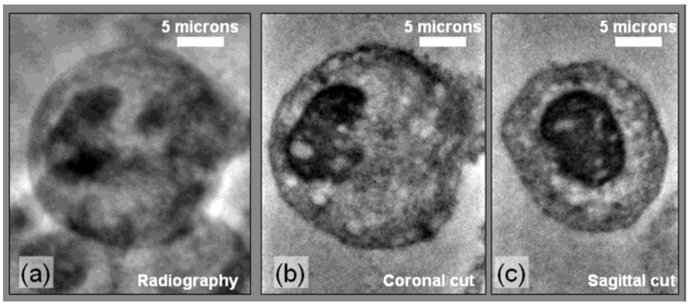
Working with hard X-rays allows for high penetration power, larger depth of focus and easy sample manipulation

Phase contrast X-ray imaging: making the invisible visible.

When travelling through an opaque sample, X-rays are not only simply absorbed but they undergo refraction and diffraction processes as well, depending on the internal structure of the sample. At the Swiss Light Source of the Paul Scherrer Institut, our group develops hardware and software instrumentation to record these additional signals and to convert them into visible, understandable images. Our technology allows recording such information at a spatial resolution ranging over four orders of magnitude, i.e. from a few tens of nanometers up to a few tens of microns. This gives insight to structural information starting from the single cell level up to the whole organ.

Single cell tomographic imaging

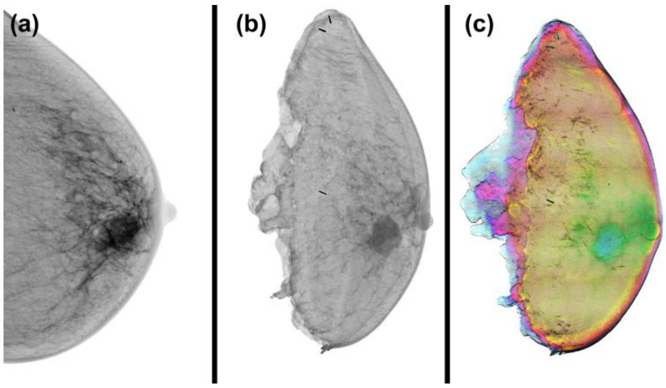
Hard X-ray images of low-absorbing and tiny samples like cells can be generated by Zernike phase contrast, obtained with dedicated X-ray optics machined with cutting-edge micro- and nanotechnology.



Hard X-ray n*anotomography* of an unstained MC3 pre-osteoblast cell. Radiographic projection (a), coronal (b) and sagittal (c) cuts of the cell. Clearly visible are the nucleus (dark) with several intracellular structures. Measurements have been carried out at the TOMCAT beamline of the Swiss Light Source of the PSI.

Phase contrast mammography

Phase contrast and scattering-based (dark-field) X-ray imaging can potentially revolutionize the radiological approach to breast imaging because of their intrinsic capability of detecting subtle differences in the electron density of a material and of measuring the effective integrated local small-angle scattering power generated by the microscopic density fluctuations in the specimen.



Conventional mammography (a) shows a suspicious node, a few micro-calcifications but *only indirect signs* of tumor infiltration of the skin. Phase contrast mammography (c) unequivocally proves tumor-invasion close to the skin whereas conventional sample mammography (b) does not predict any skin involvement. Measurements have been done on a conventional X-ray source.

Our group intensively works with hospitals and worldwide leaders companies to introduce phase contrast imaging into clinics. We have shown that phase- and dark-field-enhanced mammography provides additional, diagnostically relevant information.

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