ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

PAUL SCHERRER INSTITUT
PSI

Prof. Dr. Marco Stampanoni
ETH Zentrum, ETZ F85
Gloriastrasse 35
CH-8092 Zurich
Switzerland
Tel. +41 44 632 86 50
stampanoni@biomed.ee.ethz.ch
www.biomed.ee.ethz.ch

Villigen, December 5th, 2013

Dear Editor,

Please find enclosed our manuscript entitled **"X-ray phase-contrast imaging at 100 keV on a conventional source"** that we wish to be considered for publication as a Research Report in the Proceedings of the National Academy of Sciences USA.

Phase sensitive X-ray imaging techniques provide access to new and invaluable information compared to traditional absorption-based radiography and tomography. In our work, we show a Talbot-Lau grating interferometer based on a novel optical design, enabling imaging at X-ray energies of 100keV and above with a large field of view as well as a very compact and efficient geometry.
Our results demonstrate, for the first time, that phase contrast X-ray imaging can be successfully performed at di- agnostically relevant energies using a conventional X-ray tube, with potential applications spanning from medical imaging to nondestructive testing or homeland security.

Our method is based on a novel gratings design and arrangement approach for a Talbot-Lau (TL) type interferometer. The method introduces the "edge-on illumination" geometry of circularly aligned grating structures. "Edge-on illumination", as opposed to "face-on illumination" which is the standard approach, enables the fabrication of grating with high aspect-ratios, which are necessary for imaging at high energies. The fabrication of high aspect ratios is challenging in standard "face-on illumination" and currently the showstopper for the TL method. In addition to the "edge-on illumination" approach, our grating design involves circularly aligned grating structures, which are necessary to enable a large field of view in the horizontal direction. Without circular alignment, the extreme aspect ratios would significantly reduce the field of view.
In this work, we report about the design of the new gratings used for the "edge-on illumination". A laboratory arrangement has been set up for the proof of principle of the method, consisting of a high energy X-ray tube (160 kV voltage) and a caesium iodide scintillator-based detector. First imaging results at 100 keV design energy in absorption, phase and dark-field contrast are presented, showing the potential applications of this new technique.

We are convinced of the importance of our results and of the impact that such a work will have in the field of X-ray imaging, in particular medical diagnostics, non-destructive testing and homeland security.

We hope you find our manuscript worth to be reviewed by external peers, and, in this case, we would like to suggest you the following list of potential referees as well as, due to the pre-competitive level of the developments related to our work – involving imminent industrial applications – a list of scientists that are not supposed to be contacted as reviewer.

We would like to recommend the following researchers as potential reviewers for this paper:

1. Prof. Dr. Janos Kirz, Advanced Light Source, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, MS 80R0114, Berkeley, CA 94720 USA Email: jkirz@lbl.gov, Phone: +1-510-486-5423, Fax: +1-510-486-4960

2. Prof. Dr. Giorgio Margaritondo, Ecole Polytechnique Federale de Lausanne, Laboratoire de Physique des Rayons X, Rte de la Sorge, CH-1015 Lausanne, Switzerland E-mail: giorgio.margaritondo@epfl.ch, Phone : +41-21-6934471, Fax : +41-21- 6930443

3. Dr. Peiping Zhu, Beijing Synchrotron Radiation Facility, Beijing, China E-mail: zhupp@ihep.ac.cn, Phone: +86-10-88235990

4. Prof. Dr. David Attwood, Electrical Engineering and Computer Science College of Engineering, University of California, Berkeley, CA 94720 USA E-mail: attwood@berkeley.edu, Phone: +1-510-486-4463, Fax: +1-510-643-6103

5. Prof. Erik L Ritman MD PhD, Professor of Physiology and Medicine, Ralph B and Ruth K Abrams Professor, Dept Physiology & Biophysics, Alfred Bldg 2-409 Mayo Clinic College of Medicine, Rochester MN 55905 USA, Email: elran@mayo.edu, Tel: +1 507 255 1939

We kindly ask the following researchers to be excluded as reviewers because of strong conflicts of interest:

1. Prof. Dr. Franz Pfeiffer, Fakultät für Physik, Technische Universität München, James-Frank-Str. 1, D-85748 München, Germany, E-Mail: franz.pfeiffer@tum.de

2. Prof. Dr. Atsushi Momose, Department of Advanced Materials Science, University of Tokyo, Japan, E-Mail: momose@exp.t.u-tokyo.ac.jp

3. Prof. Dr. Alessandro Olivo, Department of Medical Physics and Bioengineering, University College London, England, E-Mail: a.olivo@medphys.ucl.ac.uk

We look forward to hearing from you at your earliest convenience and, for any additional information or clarification you might need, please do not hesitate to contact me.

Yours faithfully,

Prof. Dr. M. Stampanoni
Associate Professor for X-ray Imaging, ETH-Zürich, Zürich, Switzerland
Head of X-ray Tomography Group, Paul Scherrer Institut, Villigen, Switzerland