Contribution ID: **136** Type: **Contributed poster**

# Non-linear and Ultrafast Circular Dichroism Measurements at FELs

*Monday, June 25, 2018 6:45 PM (15 minutes)*

The combination of polarization control with the unique properties of free-electron lasers in terms of high intensity and ultrashort pulse duration offer unique perspectives on non-linear and time-resolved insights in "handed"systems. Handedness, i.e. chirality, is of crucial interest for understanding the origination of life on earth but also in the spin properties of fundamental as well as complex systems.

A common technique to study chiral properties is to measure the absorption differences of opposing helicities of circularly polarized light, the so called circular dichroism (CD). For spin interactions with circularly polarized light, photoelectron spectroscopy can be used to determine dichroic yield differences in the dipole plane. For chiral molecular structures, the dichroism is also imprinted in the symmetry breaking of the electron emission beyond the dipole plane, i.e. the photoelectron circular dichroism (PECD). PECD is by far more sensitive to the molecular structure and therefore, a superior technique for chiral sensing.

Regarding the interaction between helical light and atomic systems, we present a highly non-linear study exploring electron yield and angular distribution imprinted CD in multi-photon two-color ionization in helium. This study reveals up to perfectly dichroic absorption and a helicity dependence on an optical laser induced Stark shift in ionic helium.

As first approach to establish FELs as tools for ultrafast, site-specific investigations of structurally chiral molecules, we furthermore present a variety of aspects from recent and present studies at LCLS, SSRL, FLASH and FERMI that are crucial to ultimately allow for time-resolved PECD studies on expanding molecular systems. Together with further studies of non-dichroic origins of symmetry breaking in multi-photon absorption, the complexity of PECD is discussed in the light of future, time-resolved FEL applications.

**Primary author:** Dr ILCHEN, Markus (University of Kassel)

**Co-authors:** Dr BOZHEVOLNOV, A. V. (Sankt Petersburg State University, Russia); Dr LUTMAN, Alberto (SLAC National Accelerator Laboratory, USA); Mr ACHNER, Alexander (European XFEL GmbH, Germany); Prof. GRUM-GRZHIMAILO, Alexei N. (Lomonosov Moscow State University, Russia); Mr BECKMANN, Andreas (X-Spectrum GmbH, Germany); Dr GALLER, Andreas (European XFEL GmbH, Germany); Prof. KAZANSKI, Andrey (Basque Foundation for Science, Spain); Dr KNIE, André (University of Kassel, Germany); Dr LINDAHL, Anton O. (Qamcom Research & Technology AB, Sweden); Prof. EHRESMANN, Arno (University of Kassel, Germany); Dr CALLEGARI, Carlo (Elettra-Sincrotrone Trieste SCpA, Italy); Dr GRAZIOLI, Cesare (Elettra-Sincrotrone Trieste SCpA, Italy); Dr RAY, Dipanwita (SLAC National Accelerator Laboratory, USA); Dr GRYZLOVA, Elena (Lomonosov Moscow State University, Russia); Dr ALLARIA, Enrico (Elettra-Sincrotrone Trieste SCpA, Italy); Dr FERRARI, Eugenio (Elettra-Sincrotrone Trieste SCpA, Italy); Mr SCHOLZ, Frank (Deutsches Elektronen Synchrotron, Germany); Dr HARTMANN, Gregor (University of Kassel, Germany); Dr NUHN, Heinz-Dieter (SLAC National Accelerator Laboratory, USA); Dr OHLDAG, Hendrik (SLAC National Accelerator Laboratory, USA); Dr OGASAWARA, Hirohito (SLAC National Accelerator Laboratory, USA); Mr SHEVCHUK, Ivan (Deutsches Elektronen Synchrotron, Germany); Dr MACARTHUR, James (SLAC National Accelerator Laboratory, USA); Dr BUCK, Jens (University of Kiel, Germany); Dr VIEFHAUS, Jens (Deutsches Elektronen Synchrotron, Germany); Mr SELTMANN, Joern (Deutsches Elektronen Synchrotron, Germany); Prof. PRINCE, Kevin C. (Elettra-Sincrotrone Trieste SCpA, Italy); Prof. UEDA, Kiyoshi (Tohoku University, Japan); Prof. BARTSCHAT, Klaus (Department of Physics and Astronomy, Drake University, USA); Dr GLASER, Leif (Deutsches Elektronen Synchrotron, Germany); Prof. AVALDI,

Lorenzo (CNR Istituto Struttura della Materia, Italy); Dr RAIMONDI, Lorenzo (Elettra-Sincrotrone Trieste SCpA, Italy); Dr INHESTER, Ludger (Center for Free-Electron Laser Science, Germany); Dr CORENO, Marcello (Elettra-Sincrotrone Trieste SCpA, Italy); Dr ZANGRANDO, Marco (Elettra-Sincrotrone Trieste SCpA); Dr BRAUNE, Markus (Deutsches Elektronen Synchrotron, Germany); Prof. LARSSON, Mats ( AlbaNova University Center, Stockholm University, Sweden); Dr MEYER, Michael (European XFEL GmbH, Germany); Dr DEVETTA, Michele (Elettra-Sincrotrone Trieste SCpA, Italy); Dr DI FRAIA, Michele (Elettra-Sincrotrone Trieste SCpA, Italy); Dr DOUGUET, Nicolas (Department of Physics and Astronomy, Drake University, USA); Prof. KABACHNIK, Nikolay (Lomonosov Moscow State University, Russia); Dr PLEKAN, Oksana (Elettra-Sincrotrone Trieste SCpA, Italy); Dr BOLOGNESI, Paola (CNR Istituto Struttura della Materia, Italy); Dr FINETTI, Paola (Elettra-Sincrotrone Trieste SCpA, Italy); Dr WALTER, Peter (SLAC National Accelerator Laboratory, USA); Prof. DEMEKHIN, Philip (University of Kassel, Germany); Mr SCHMIDT, Philipp (University of Kassel, Germany); Dr CUCINI, Riccardo (Elettra-Sincrotrone Trieste SCpA, Italy); Dr THOMAS, Richard D. (Stockholm University, Sweden); Mr PATRICK, Rupprecht (University of Heidelberg, Germany); Dr COFFEE, Ryan (SLAC National Accelerator Laboratory, USA); Dr BARI, Sadia (Deutsches Elektronen Synchrotron, Germany); Dr DUESTERER, Stefan (Deutsches Elektronen Synchrotron, Germany); Dr MOELLER, Stefan (SLAC National Accelerator Laboratory, USA); Dr WOLF, Thomas (PULSE at Stanford, USA); Dr MAXWELL, Timothy (SLAC National Accelerator Laboratory, USA); Dr OSIPOV, Timur (SLAC National Accelerator Laboratory, USA); Dr MAZZA, Tommaso (European XFEL GmbH, Germany); Dr ZHAUNERCHYK, Vitali (University of Gothenburg, Sweden); Dr OVCHARENKO, Yevheniy (European XFEL GmbH, Germany); Dr LI, Zheng (Center for Free-Electron Laser Science, Germany)

**Presenter:** Dr ILCHEN, Markus (University of Kassel)

**Session Classification:** Poster session