Contribution ID: **69** Type: **not specified**

Evidence of large polarons in photoemission band mapping of the perovskite semiconductor CsPbBr3

Tuesday, 29 October 2019 14:00 (30 minutes)

Lead-halide perovskite (LHP) semiconductors rival conventional semiconductors in multiple optoelectronic applications. The origin of such outstanding transport propeties are howerer not yet fully understood. We find signatures of large polaron formation in the electronic structure of the inorganic LHP $CsPbBr_3$ by means of angle-resolved photoelectron spectroscopy. The experimental valence band dispersion shows a hole effective mass 0.26±0.02 m_e, 50% heavier than the bare mass m_0=0.17 m_e predicted by density functional theory. Calculations of electron-phonon coupling indicate that phonon dressing of the carriers mainly occurs via distortions of the Pb-Br bond with a Fröhlich coupling parameter α=1.82. A good agreement with our experimental data is obtained within the Feynmann polaron model, validating a viable theorical method to predict the carrier effective mass of LHPs $ab\,initio$.

Position

Postdoc

Primary authors: COLONNA, Nicola (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland); PUPPIN, Michele (Laboratoire de Spectroscopie Ultrarapide and Lausanne Centre for Ultrafast Science (LACUS), Ecole Polytechnique Federale de Lausanne, ISIC, Station 6, CH-1015 Lausanne, Switzerland); POLISHCHUCK, Serhii (Laboratoire de Spectroscopie Ultrarapide and Lausanne Centre for Ultrafast Science (LACUS), Ecole Polytechnique Federale de Lausanne, ISIC, Station 6, CH-1015 Lausanne, Switzerland); CREPALDI, Andrea (Institute of Physics and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland); DIRIN, Dmitry (Laboratory of Inorganic Chemistry, Department of Chemistry and Applied Biosciences, ETH Z{\"u}rich, CH-8093 Z{\"u}rich, Switzerland}, and Laboratory for Thin Films and Photovoltaics, EMPA –Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, CH-8600 D{\"u}bendorf, Switzerland); NAZARENKO, Olga (Laboratory of Inorganic Chemistry, Department of Chemistry and Applied Biosciences, ETH Z{\"u}rich, CH-8093 Z{\"u}rich, Switzerland}, and Laboratory for Thin Films and Photovoltaics, EMPA –Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, CH-8600 D{\"u}bendorf, Switzerland); DE GENNARO, Riccardo (Theory and Simulations of Materials (THEOS), and National Centre for Computational Design and Discovery of Novel Materials (MARVEL), École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland); GATTI, Gianmarco (Institute of Physics and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland); ROTH, Silvan (Institute of Physics and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland); BARILLOT, Thomas Roland (Laboratoire de Spectroscopie Ultrarapide and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, ISIC, Station 6, CH-1015 Lausanne, Switzerland); POLETTO, Luca (National Research Council of Italy - Institute of Photonics and Nanotechnologies (CNR-IFN), via Trasea 7, 35131 Padova, Italy); XIAN, Rui Patrick (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany); RETTING, Laurenz (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany); WALF, Maximilian (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany); ERNSTORFER, Ralph (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany); KOVALENKO, Maksym (Laboratory of Inorganic Chemistry, Department of Chemistry and Applied Biosciences, ETH Z{\"u}rich, CH-8093 Z{\"u}rich, Switzerland, and Laboratory for Thin Films and Photovoltaics, EMPA –Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, CH-8600 D{\"u}bendorf, Switzerland); NICOLA, Marzari (Theory and Simulations of Materials (THEOS), and National Centre for Computational Design and Discovery of Novel Materials (MARVEL), École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland); MARCO, Grioni (Institute of Physics and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland); CHERGUI, Majed (Laboratoire de Spectroscopie

Ultrarapide and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, ISIC, Station 6, CH-1015 Lausanne, Switzerland)

Presenter: COLONNA, Nicola (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland)

Session Classification: Poster session

Track Classification: Poster