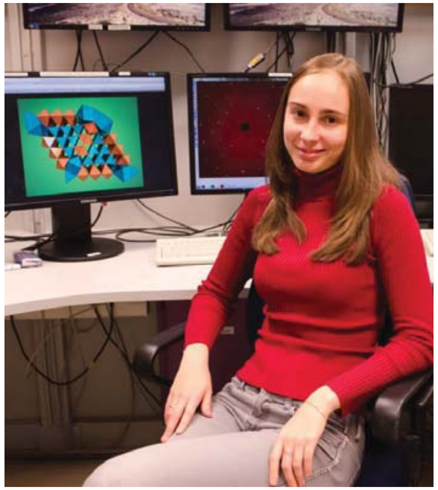
LAUDATIO ANLÄSSLICH DER VERLEIHUNG DES

MAX-VON-LAUE-PREISES 2018 AN ELENA BYKOVA

FÜR IHRE HERAUSRAGENDEN METHODISCHEN BEITRÄGE ZUR STRUKTURAUFKLÄRUNG UNTER EXTREMEN BEDINGUNGEN UND FÜR DIE ENTDECKUNG UND STRUKTURAUFKLÄRUNG NEUER HOCHDRUCKPOLYMORPHE VON EISENVERBINDUNGEN



Dear Elena,

we are happy to congratulate you on the Max von Laue Prize 2018 of the Deutsche Gesellschaft für Kristallographie *"for your exceptional contribution to the development of the methodology of ultra-high pressure crystallography and for discovery and structure solution of new polymorphs of iron compounds"*. We are also happy to introduce you and your research to our colleagues in the crystallographic community.

Elena was born in 1988 in Amursk, Russia. In 2010 she got the M.Sc. degree in inorganic chemistry from Novosibirsk State University, Russia; in 2015 defended her Dissertation entitled *"Single-crystal X-ray diffraction at extreme conditions in mineral physics and material sciences"* and received the title *Dr. rer. nat.* from the Bayreuth Graduate School of Mathematical and Natural Sciences (BayNAT) of the University of Bayreuth, Germany. After two years of Post-doctoral research at the Bavarian Research Institute of Experimental Geochemistry and Geophysics, University of Bayreuth, in 2017 Elena moved to Deutsches Elektronen-Synchrotron, Hamburg, Germany to work at the Extreme Conditions Beamline (P02.2) at PETRA III.

Whereas powder X-ray diffraction studies stepped over a megabar in pressure already in the 1970s, single-crystal experiments remained much rarer and covered until recently a very limited pressure range: In 2011, when Elena started her work in Bayreuth, the upper limit of single-crystal diffraction studies barely stepped over 15 GPa. Moreover, high-temperature experiments were limited to temperatures of about 1000 K (with external electrical heating) that is too low for chemistry and geosciences, which are usual driving forces in the high-pressure research. The last several years brought significant progress in the field and Elena contributed decisively in all aspects of technical development – methodology of crystals selection and loading, strategy of data collection, construction of laser-heating systems for single-crystal studies, adaptation and installation of portable laser-heating setups at ID09 and ID27 at the ESRF, and at P02 at PETRA III. Elena's (and colleagues) work demonstrates that portable (movable) laser heating setups for diamond anvil cells (DACs) coupled with synchrotron radiation facilities allow single-crystal diffraction experiments at thousands of degrees.

Technological advances resulted in a revolutionary breakthrough in the high-pressure crystallography. Single-crystal synchrotron XRD data, compared to powder data, provide a possibility for unambiguous indexing of diffraction patterns and determination of a space group of crystals subjected to extreme conditions. Moreover, by solving and refining crystal structures *in situ*, at pressures over 170 GPa (more than ten times higher than just a few years ago!) and variable temperatures (in works of Elena ranging from 30 K to over 3000 K), it has become possible to determine chemical compositions of the compounds synthesized at extreme conditions that realized a dream of generations of mineral physicists, geoscientists, high-pressure chemists, and material scientists.

Elena's work was decisive in refutation of the old paradigm that multiple phase transitions under pressurization and/or laser heating have to result in destruction of crystal's quality, thus making single-crystal diffraction studies at extreme conditions (above 10-15 GPa) impossible. In numerous experiments, Elena demonstrated that following a proper experimental protocol, it is possible to preserve crystals, regardless of how many phase transformations they undergo at extreme conditions and even study those synthesized directly in a DAC. The methodology of HPHT crystallography, to which Elena considerably contributed, enables to get XRD data at extreme conditions comparable in quality to those collected at ambient conditions. Elena contributed to the discoveries of numerous chemical and physical phenomena observed in solid matter at extreme conditions on numerous examples – iron oxides with different stoichiometry, silicates, oxychlorides, titanium phosphate, boron allotropes, and borides.

Elena Bykova's own research interests are focused on studies of iron bearing compounds at extreme conditions. She discovered several high-pressure novel iron borides, iron carbides, demonstrated hydrogen bonding symmetrization in FeOOH, investigated iron-rich silicates and carbonates at extreme conditions. Especially important are the results of Elena's work on iron oxides: She discovered nine (!) new oxides with unusual structures and unexpected chemical compositions, demonstrated their homologous relations, and placed new findings in the context of the global Earth's history and dynamics.

Leonid Dubrovinsky and Natalia Dubrovinskaia, Bayreuth