Satellite Workshop

On

Scientific Instrument Proposals

for

Extreme Pressures and Temperatures Research

at PETRA IV

R. Farla, K. Glazyrin, I. Sergeev, H. P. Liermann

November 5-6th 2020

Abstract

This satellite workshop is dedicated to exploring the science cases and instrumentation for Extreme Conditions research using high pressure devices such as Diamond Anvil Cells (DAC) and Large Volume Presses (LVP) at PETRA IV. Scientific case studies will benefit from 1) the exceptional brightness and coherence from very small gap undulators with a maximum length of 10 m (signature beamlines) delivering high energy flux, enabling focused micro- to nano-sized beams on the sample, as well as 2) offering the chance to use an entire suite of coherent diffraction and imaging techniques that have so far not been possible at high energies. We will summarize and critical discuss the 5 key areas proposed in Scientific Instrumentation Proposals (SIP)drafts, offering the community the chance to view, comment and provide feedback before the submission deadline (1st December 2020):

- LVP Instruments (diffraction/imaging in the 6-ram LVP & dedicated imaging/diffraction in a PE-type press)
- High-P, high-T DAC X-ray diffraction and imaging microscope
- A high pressure PETRA IV endstation combining Spectroscopy and Diffraction
- A dynamic Compression X-ray Diffraction/Imaging Microscope
- Non-resonant Inelastic X-ray Scattering (NIXS) and Nuclear Resonance Scattering (NMR) in a DAC

Topics of discussion will be considered within the framework of the CDR chapters on Earth and Environment and Materials for Energy and Transport Technology. Discussions include high-pressure investigation of materials structure, physical properties and kinetics of transformational processes using X-ray diffraction, spectroscopy and imaging techniques. Particular consideration will be given to the emergence of new and advanced techniques, such as time-resolved microtomography, phase contrast, coherent Bragg diffraction imaging, ptychography, and synchrotron Mössbauer spectroscopy. Technological advances in high pressure generation in conjunction of with PETRA IV, processes the driving forces leading to novel phase discoveries and the study of complex geological materials to explore a wider (towards smaller) length and time scales than currently possible.

After the workshops, the SIPs will be finalized for submission with the aim to support new, dedicated, instruments for Extreme Conditions Research at PETRA IV in order to meet upcoming challenges and demand by the community in this rapidly growing field of research.

Final Schedule

30.10.2020, 15:00 hr

Thursday Nov. 5th		
8:30 – 9:00	Registration and Coffee	
9:00 – 9:05	Welcome	O. Seeck / H.-C. Wille
9:05 – 9:20	Introduction	H. P. Liermann
Session 1: Research at extreme pressure and temperatures in the LVP ***Chair: S. Bhat***		
9:20 – 9:40	**Towards advanced in situ X-ray diffraction experiments by combination of a multi-anvil press and high-density monochromatic X-ray beams (15 min + 5)**	T. Katsura (BGI)
9:40 – 10:00	**Opportunities at the PETRA IV LVP for deformation studies under extreme conditions (15 min + 5)**	N. Hilairet (Uni. of Lille, CNRS)
10:00 – 10:25	Coffee Break	
10:25 – 10:45	**How detailed in situ microstructure analysis at extreme conditions can be at PETRA IV? (15 min + 5)**	D. Rafaja (TU Freiberg)
10:45 – 11:10	**Summary Instrumentation (20 + 5 min)**	R. Farla (DESY)
11: 10 – 11:40	**Discussion (30 min)**	R. Farla (DESY)
11:40 – 13:20	Lunch Break	

Session 2: Research at extreme pressure and temperatures at the high-p and high-T microscope ***Chair: K. Glazyrin (DESY)***		
13:20 – 13:40	**Insight into material synthesis in the DAC via X-ray diffraction and imaging (15 + 5 min)**	N. Dubrovinskaia (Uni. Bayreuth)
13:40 – 14:00	**Exploring the role of volatiles in the Earth using x-ray diffraction and imaging in the DAC (15 + 5 min)**	C. S. Valle (Uni. Münster)
14:00 – 14:20	Using x-ray scattering and imaging to explore the density distribution of planetary interiors (15 + 5 min)	S. Pettitgirad (ETH)
14:20– 14:40	**Understanding the interior of planetary bodies using tDAC & dsDAC in conjunction with X-ray diffraction and imaging" (15 + 5 min)**	L. Dubrovinsky (BGI, Uni. Bayreuth)
14: 40 – 15:05	**Proposal for High-P and High-T DAC x-ray Diffraction/Imaging Microscope** (20 + 5 min)	C. Prescher (DESY)
15:05 – 15:35	**Discussion (30 min)**	K. Glazyrin (DESY)
15:35 – 15:45	Coffee Break	
Session 3: Dynamic compression microscope for research at extreme pressure, temperatures and time resolution ***Chair: K. Appel***		
15:45 – 16:05	**Simulating the interior of giant planets using dynamic compression (15 + 5 min)**	D. Kraus (Uni. Rostock, HZDR)
16:05 – 16:25	**Material properties under dynamic compression (15 + 5 min)**	M. McMahon (Uni. Edinburgh)
16:25 – 16:45	**Simulating Asteroid and Meteorite Impacts with shock and dDAC drivers (15 + 5 min)**	F. Langenhorst (Uni. Jena)
16:45 – 17:05	**Studying earth material properties using time-resolved x-ray diffraction (15 + 5 min)**	H. Marquardt (Uni. of Oxford)
17: 05 – 17:30	**Proposal for Dynamic Compression X-ray Diffraction/Imaging Microscope (20 + 5 min)**	H. P. Liermann (DESY)
17: 30 – 18:00	**Discussion (30 min)**	K. Appel (EuXFEL)
Session 4:* Discussion and close out** ***Chair: R. Farla, K. Glazyrin, I. Sergeev, H. P. Liermann		
18:00 – 18:30	**Discussion and close out 1st day (20 min)**	TBD

Friday Nov. 6th		
Session 5: Research at extreme pressure and temperatures at the diffraction spectroscopy instrument ***Chair: H. P. Liermann***		
8:40 – 9:00	**Room-temperature superconductivity in the system C-S-H**	A. Salamat (UNLV)
9:00 – 9:20	**X-ray emission spectroscopy at extreme conditions: Perspectives for PETRAIV (15 + 5 min)**	Ch. Sternemann (Uni. Dortmund)
9:20 – 9:40	**Investigating chemical properties of magmas under pressure using XAS and XRF (15 + 5 min)**	C. Sanloup (Uni. Paris)
9:40 – 10:00	**Advanced Imaging techniques for high pressure samples: the prospects of now and the PETRA-IV (15 + 5 min)**	S. Petitgirard (ETH)
10:00 – 10:20	**Towards a PETRA-IV instrument merging the access to spectroscopy, diffraction and imaging for high pressure science (15 + 5 min)**	D. Laniel (BGI)
10:20 – 10:40	**Technical aspects of an instrument merging the access to spectroscopy, diffraction and imaging for high pressure science (15 + 5 min)**	K. Glazyrin (DESY)
10:40 – 11:10	Discussion	H. P. Liermann
11:10 – 11:30	Coffee Break	

Session 6: Research at extreme pressure and temperatures at the inelastic scattering instrument ***Chair: Ch. Sternemann***		
11:15 - 11:35	**Hydrothermal fluids: Insights from X-ray Raman scattering and X-ray emission (15 + 5 min)**	M. Wilke (Uni. Potsdam)
11:35 - 11:55	**Valence-to-core XES and X-ray Raman scattering of compressed glasses (15 + 5 min)**	G. Spiekermann (ETH)
11:55 - 12:15	**Nuclear Resonance Spectroscopy at extreme conditions - from magnetism in the mantle to chemical reactions at the core-mantle boundary (15 + 5 min)**	I. Kupenko (Uni. Münster)
12:15 - 12:35	**Low-temperature high-pressure phonon spectroscopy in backscattering geometry (15 + 5 min)**	R. Hermann (ORNL)
12:35 - 12:55	**Instrumentation requirements and perspectives at PETRAIV for inelastic and nuclear resonance scattering (15 + 5 min)**	I. Sergeev (DESY)
12:55 - 13:25	**Discussion**	
Session 7:* Discussion and close out** ***Chair: R. Farla, K. Glazyrin, I. Sergeev, H. P. Liermann		
13:25 – 13:30	**Final Discussion and close out**	R. Farla, K. Glazyrin, I. Sergeev, H. P. Liermann