

# Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter



IMPRS UFAST Call for PhD applications 2025/2026

PM3 – Quench control of quantum materials



<b>Title of PhD Project</b>	<b>Quench control of quantum materials</b>
<b>Type</b>	2 Experimental
<b>Supervisor(s)</b>	Prof. Philip Moll
<b>Affiliation(s):</b>	Max Planck Institute for the Structure and Dynamics of Matter
<b>Number of positions:</b>	2
<b>Abstract:</b>	<p>Quenching denotes the rapid removal of heat from an object, and it forms a cornerstone of material science. Iron is a rather soft material, unless it is quenched into its hard (martensitic) state by dropping hot iron into water. Here we plan to explore the same phenomenon in the world of quantum materials, by manipulating the electronic states formed at ultra-low temperatures via variation of the cooling protocol of a sample. Using state-of-the-art nanofabrication, you will fabricate crystalline nanocircuits from which heat is removed at extreme rates owing to its negligible thermal mass (<math>&gt;10^6</math>K/s). This will allow you to modify the domain patterns and possibly access supercooled phases of electronic instabilities, such as charge- and spin-density-waves. In materials with coupled orders, such modifications always imprint boundary conditions on secondary phases; for example, one can change superconductivity by tailoring the domains of a coexisting magnetic phase. Specifically, these questions will be explored in iron-based high temperature superconductors, charge-ordering Kagome metals, and the “hidden order” state of <math>URu_2Si_2</math>. Experiments will be performed in house as low-temperature (300K-10mK) and high magnetic field (20T) electric transport measurements. Further, you will engage in the global network of high-magnetic field science, which gives you access to the strongest magnetic fields on earth in specialized user facilities.</p>
<b>Contact person for scientific questions about the project:</b>	Prof. Philip Moll: <a href="mailto:philip.moll@mpsd.mpg.de">philip.moll@mpsd.mpg.de</a>
<b>Research Group Website:</b>	<a href="https://www.mpsd.mpg.de/research/microstructured-quantum-matter">https://www.mpsd.mpg.de/research/microstructured-quantum-matter</a>

