Become part of the Cluster of Excellence **ct**.*qmat*. Established in 2019, the Würzburg-Dresden Cluster **ct**.*qmat* is a leading international center for research on topological and complex quantum matter. Our aim is to develop a deep understanding of quantum phenomena in general and to identify materials in which those phenomena are observed in the laboratory. The chair "Experimentelle Physik 4" at the **Julius-Maximilians University (JMU) Würzburg, Germany,** is offering from the next possible date on

2 PhD positions

in the field of **"Designer Quantum Materials"**.

Introduction:
With the advent of advanced thin film technology allowing for atomic-layer precise deposition the epitaxial compatibility of many metal oxides can be harnessed to create designer quantum materials in the form of layered structures and ultrathin films with novel functional properties, not present in the bulk constituents. This is made possible by finely tuning the various competing many-body interactions and hence the materials' properties, employing, e.g., strain, band engineering, confinement, and doping.

The projects:
Metal oxides, in particular those containing 3d- and 5d-transition metals, are well known for their emergent phases and novel electronic properties evolving from the various competing many-body interactions through spontaneous symmetry-breaking. Additionally, the topological nature of band structures, often induced by strong spin-orbit coupling, can give rise to new states of matter.
In one project, you will use the possibilities of heterointerfacing to create and tune composite oxide materials with topological electronic states, typically in the presence of or assisted by electron correlations. Realization thereof are predicted to be found in the rich phase diagram of pyrochlore and perovskite iridates that encompasses spin-orbit driven Mott insulators, topological superconductivity as well as Weyl and Dirac semimetals.
In the other project, you will pursue a similar approach, designing the electronic properties of bismuthates which display by virtue of their structural variants an interesting playground for electric-field tunable phases, all the way from ferroelectric insulators to Rashba systems to Weyl and Dirac semimetals.
The experimental research program (sample growth by pulsed laser deposition, study of the chemical and electronic structure by state-of-the-art photoelectron spectroscopy) will benefit from close, established collaborations with theory.

What to expect:
When you do research at the JMU you will enjoy an inspiring and international environment at one of the worldwide hotspots for topological and correlated quantum matter. Embedded in the Würzburg-Dresden Cluster of Excellence (ct.qmat) and the Würzburg Collaborative Research Center (TocoTronics), you work in a creative, open-minded team that is committed to gain new insight in the design of oxide quantum materials and their potential for applications in future quantum technology. As part of these projects, you will perform experiments at national and international synchrotron radiation facilities.

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Stand: 21.06.2020