Perovskite semiconductors have recently emerged as one of the most intensively studied materials. This is due to their unique properties, which make these materials very promising in photovoltaic applications as well as light emitters. In less than 10 years, perovskite based photovoltaic cells have achieved an efficiency comparable to conventional silicon based solar cells which have been continuously developed over the last 50 years. Crucially, perovskites can be synthesized using wet chemistry methods, which significantly reduces the cost of their production. Potentially perovskite solar cells can be much cheaper than the current photovoltaic technology. It is interesting that the practical use of these materials precedes the understanding of their basic physical properties. The physics behind the outstanding performance of perovskite based solar cells is currently not understood. The known electronic properties of perovskites seem to contradict everything we have learned about semiconductors in the last half-century. The current perovskite gold-rush has resulted in increased interested in different perovskite-derived materials such as two-dimensional perovskites. These materials are natural quantum wells whose properties can be controlled with extreme flexibility, making the spectrum of their applications extend even further than classical perovskites. Thanks to appropriate engineering, they can be used in photovoltaic cells, light emitting diodes and white light emitters.

The goal of this project is to understand what makes perovskites so unique and to establish methods to control and engineer their unique properties. A full understanding of the properties of these materials may mean that in the future they will change people's everyday lives in the same way as the invention of the Si transistor did.