

Speech by

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It is a great honor indeed to be a co-recipient of this years' King Faisal Prize for the sciences.

When I noticed I would share the prize with Daniel Loss, I realized that the field of semiconductor spintronics has come a long way in the past twenty years. It all starts with the notion that the electrons in semiconducting devices not carry charge, they also carry a small magnetic moment called spin. In the mid-nineties, researchers started to think about what one could do with this spin, and how one could do this.

One of the most basic aspects of doing things in this field is that one has to be able to create currents in a semiconductor that are spin-polarized (magnetic). Late 90s I arrived at Würzburg in a lab that had access to, rather exotic, magnetic semiconductors. We directly started using these for injecting spin-polarized currents in non-magnetic semiconductors, with instant and overwhelming success. This work brought me first in contact with Daniel Loss, who was looking for a means to realize his spin qubits – but he will tell you all about that.

A further step in the development of the field was the realization that in some materials relativistic effects are of prime importance. Here again the material base in Würzburg could be put to very good use, because we can grow a material, HgTe, where these effects are exceptionally strong spin-orbit coupling. In the course of our experiments on this material, we discovered a totally novel phenomenon: because of the unusual topology (ordering) of the electronic states in HgTe, it is metallic on its surfaces, even though its bulk is insulating. HgTe is now usually referred to as a topological

insulator, and our discovery opened up a completely new field of research, that of topological materials.

So yes, spintronics came a long way. Let me not forget to thank my collaborators, both in Würzburg and around the globe, and last but not least my family, for allowing me to spend a large amount of time and attention focusing on this fascinating part of physics.