Master's thesis:
Topological Insulators based on InAs/GaSb quantum well heterostructures

Technische Physik

We offer a master's thesis in the research group *nanoelectronics* at the chair **Technische Physik**.

Topological insulators based on InAs/GaSb quantum well heterostructures are a key topic of the nanoelectronics group. They are especially appealing due to the possibility of switching between their normal insulating (**NI**) and topological insulating phase (**TI**) [1]. This switching is either achieved by a dual gating approach or optically induced [2]. Due to this switching opportunity between the two phases (similar to "*on*"/"*off*") they are interesting for potential devices such as a field effect transistor. Also, the topological insulating gap is rather temperature insensitive in these structures which is interesting for room temperature applications [3].

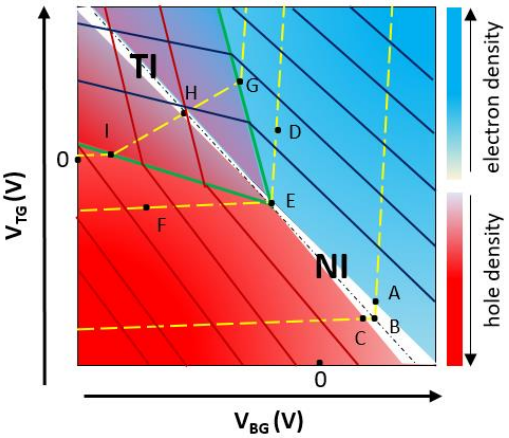

Fig.1 *Phase diagram of InAs/GaSb bilayer quantum wells. Dual gating enables the switching between the normal insulating (**NI**) and topological insulating (**TI**) phase.*

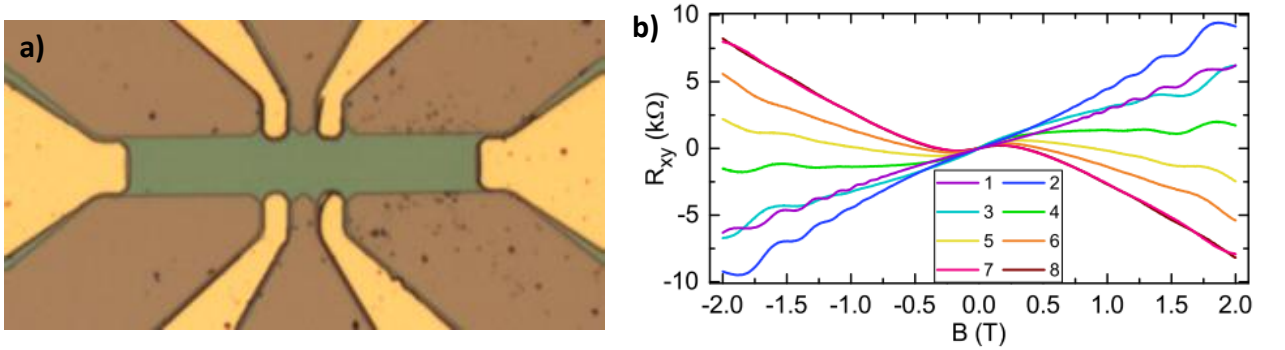

Fig.2 a) *Typical six terminal Hall bar.* ***b)*** *Optical switching from the normal regime (1) into the topological regime (8). In the normal regime the slope of the hall resistance is linear whereas for the topological regime a kink for small magnetic fields due to the coexistence of electrons and holes is observable.*

Your tasks will include the design and fabrication of topological insulators based on InAs/GaSb quantum well heterostructures and to characterize these samples with combined electrical and optical gating methods using newly designed Hall bar layouts.

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References:

[1] F. Qu et al., Electric and Magnetic Tuning between the Trivial and Topological Phases in InAs/GaSb Double Quantum wells, PRL **115**, 036803 (2015)
[2] G. Knebl et al., Optical tuning of the charge carrier type in the topological regime of InAs/GaSb quantum wells, PRB **98**, 041301(R) (2018)
[3] M. Meyer et al., Topological band structure in InAs/GaSb/InAs triple quantum wells, PRB **104**, 085301 (2021)