

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].

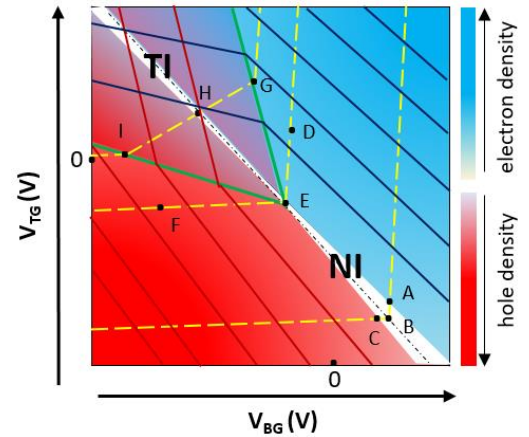


Fig.1 Phase diagram of InAs/GaSb bilayer quantum wells. Dual gating enables the switching between the normal insulating (NI) and topological insulating (TI) phase.

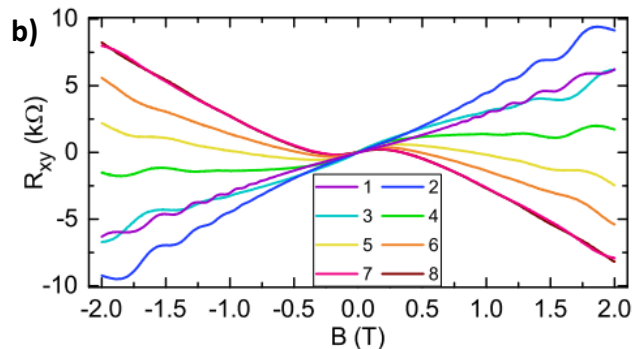
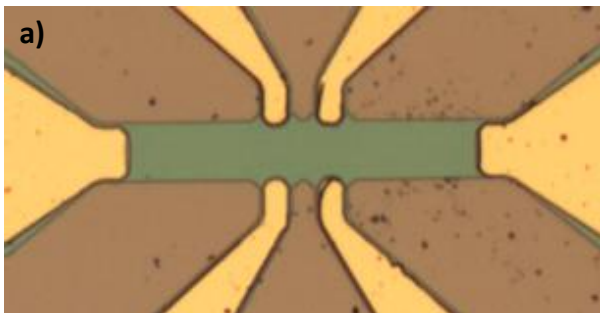


Fig.2 a) Typical six terminal Hall bar. **b)** Optical switching from the normal regime (1) into the topological regime (8). In the normal regime the slope of the hall resistance is linear whereas for the topological regime a kink for small magnetic fields due to the coexistence of electrons and holes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

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- [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)