Non-local transport in multi-terminal nanostructure patterned of a 3-dimensional topological crystalline insulator SnTe

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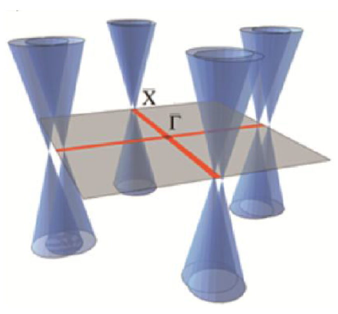
Motivation



SnTe - 3D Topological Crystalline Insulator
- surface states protected by crystal symmetry
- *surface transport hindered by p-type bulk*

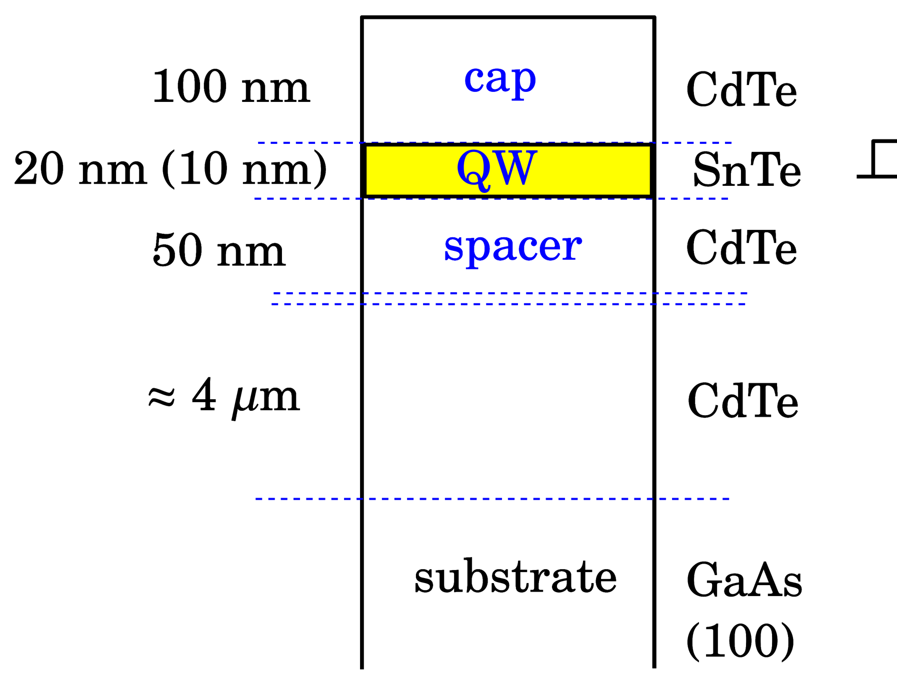
Separation of surface from bulk
- sub-micron samples
- non-local measurements
- ballistic effects

Results

- weak antilocalization (WAL) for quasi 1D topological states
- magnetic focusing and quenching of Hall effect in ballistic transport
- 1D quantization of high mobility surface states

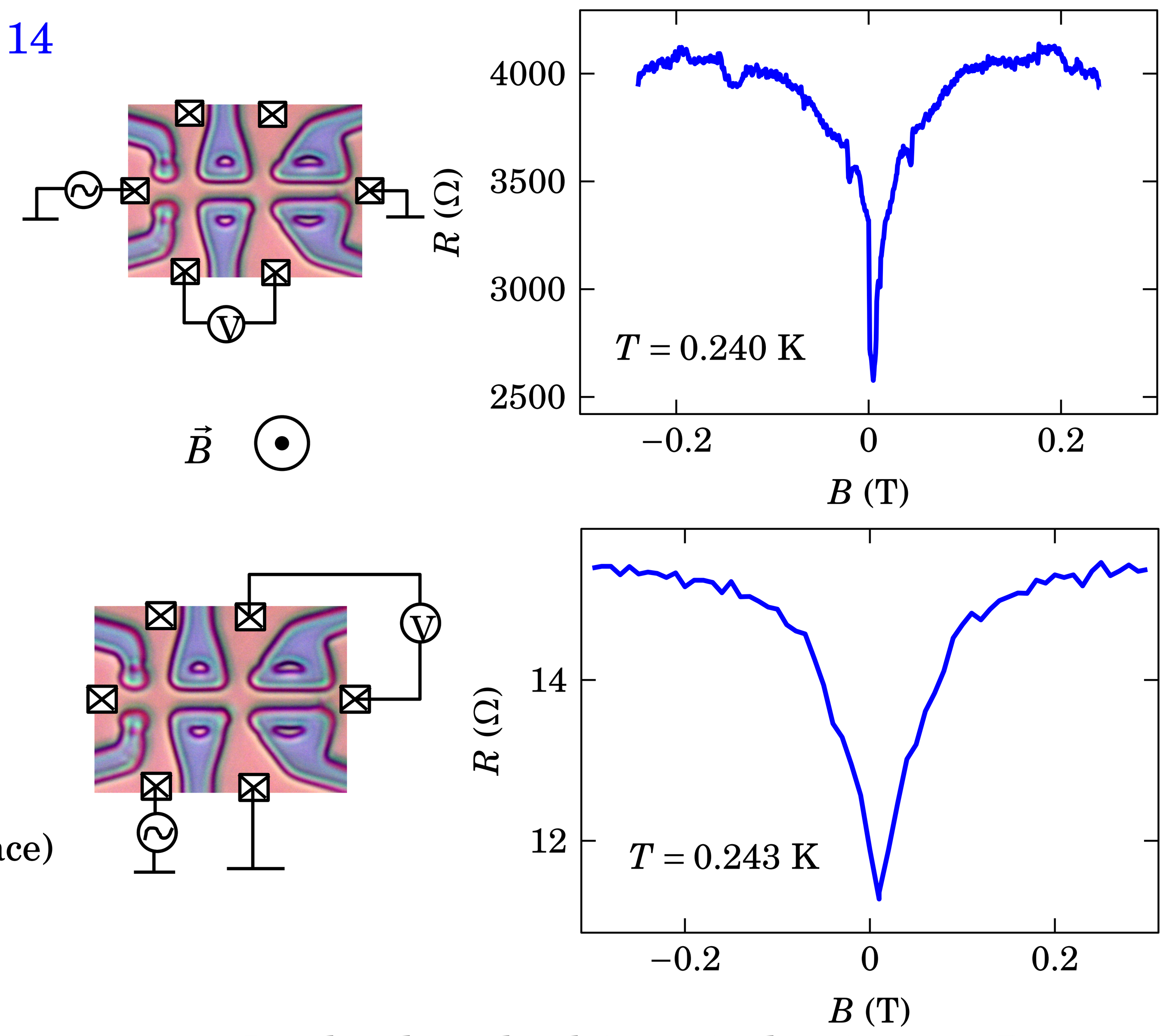
SnTe/CdTe quantum well

Substrate no: 131 - 15 & 135 - 14



Estimated values of mobility μ and hole concentration p for macroscopic sample:
$p_{3D} = 10^{13}$ cm^{-2} , $\mu = 1000$ cm^2/Vs (bulk)
$p_{2D} = 3 \times 10^{11}$ cm^{-2}, $\mu = 10000$ cm^2/Vs (surface)

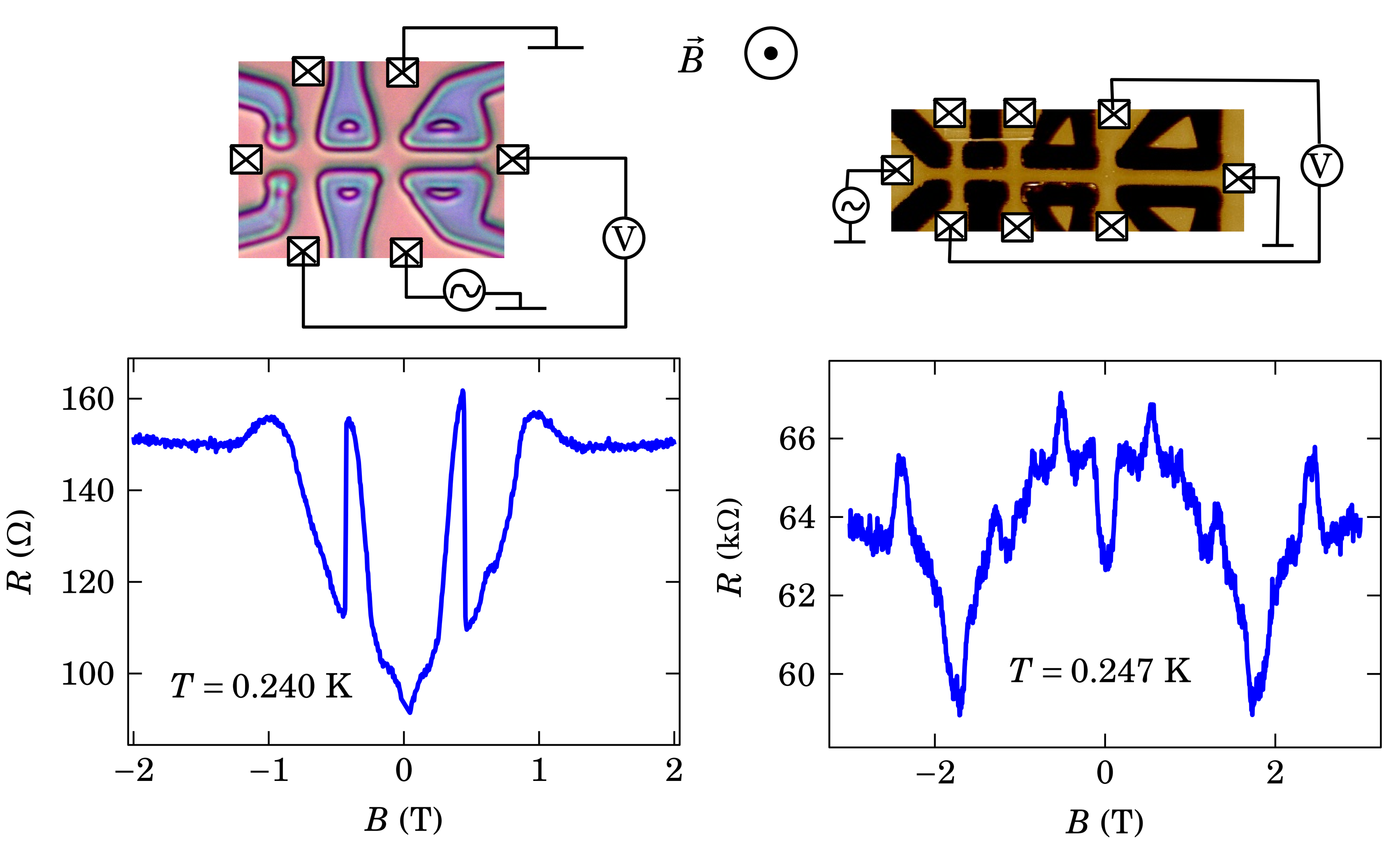
Sub-micron samples



Local and non-local 4-terminal resistances R versus magnetic field B. Weak anti-localization (WAL) is visible as narrow and deep minimum. Temperature T indicated on figures. The configuration of voltage and current probes s shown on the left

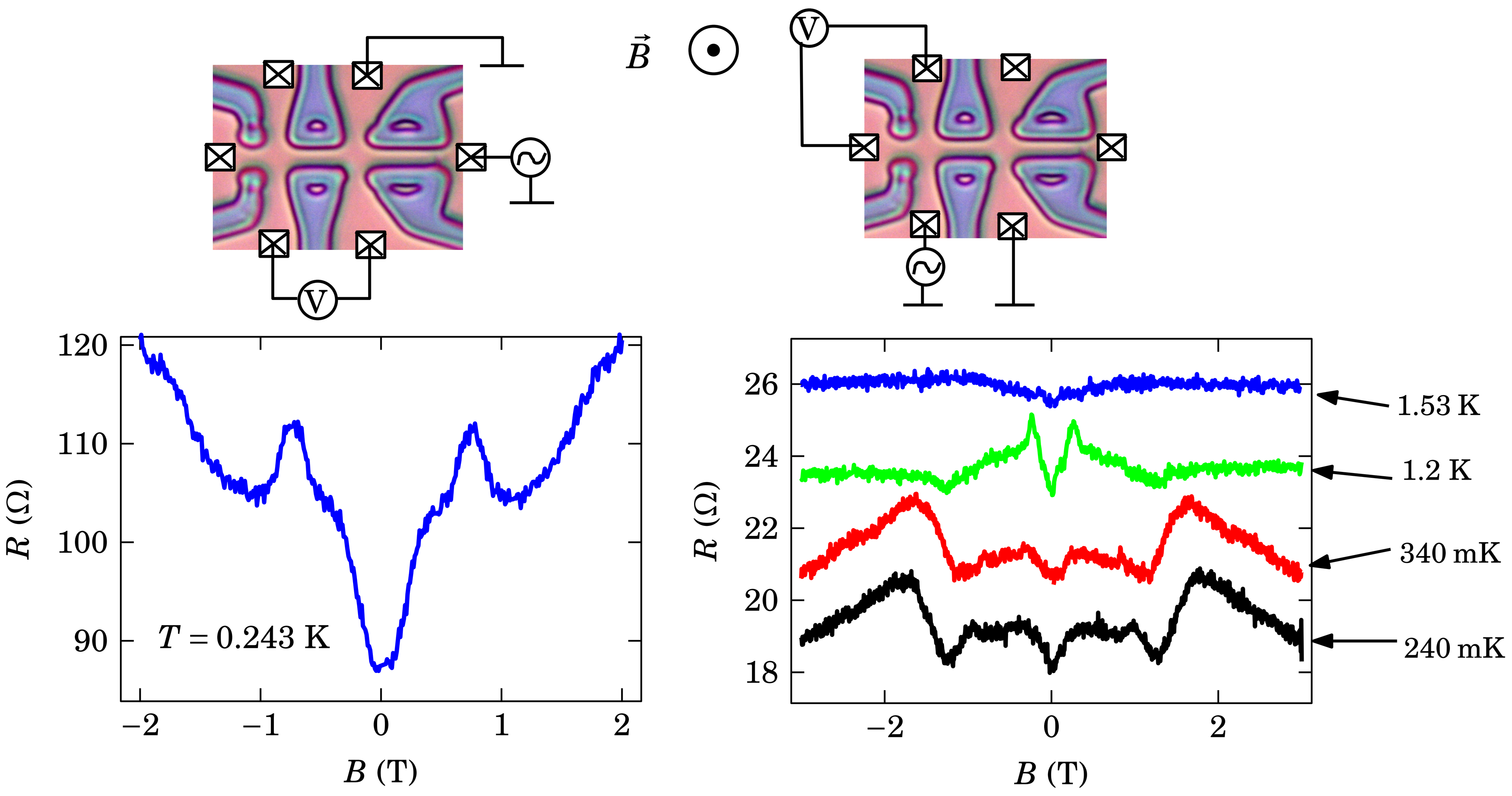
Ballistic effects

Local measurements



4-terminal resistances R measured at higher magnetic fields with voltage probes on the opposite sides of the sample (Hall configuration). Symmetric maxima attributed to magnetic focusing. Note the quenching of the Hall effect

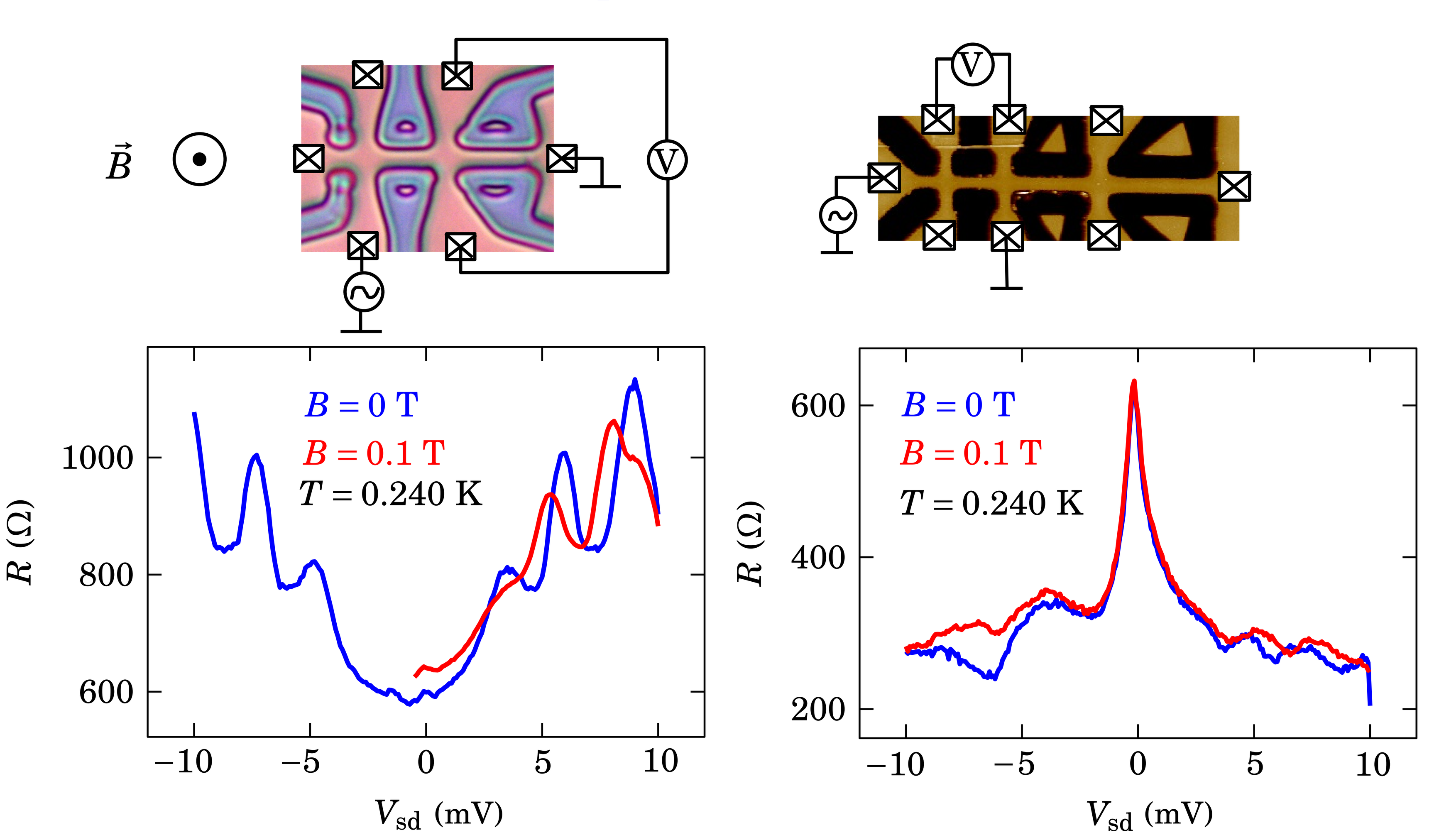
Non-local measurements



Resistances R in non-local configurations. Note the disappearance of magnetic focusing peaks at higher temperatures T (indicated on the right). At $T = 1.53$ K only WAL is visible.

1D quantization of 2D surface states

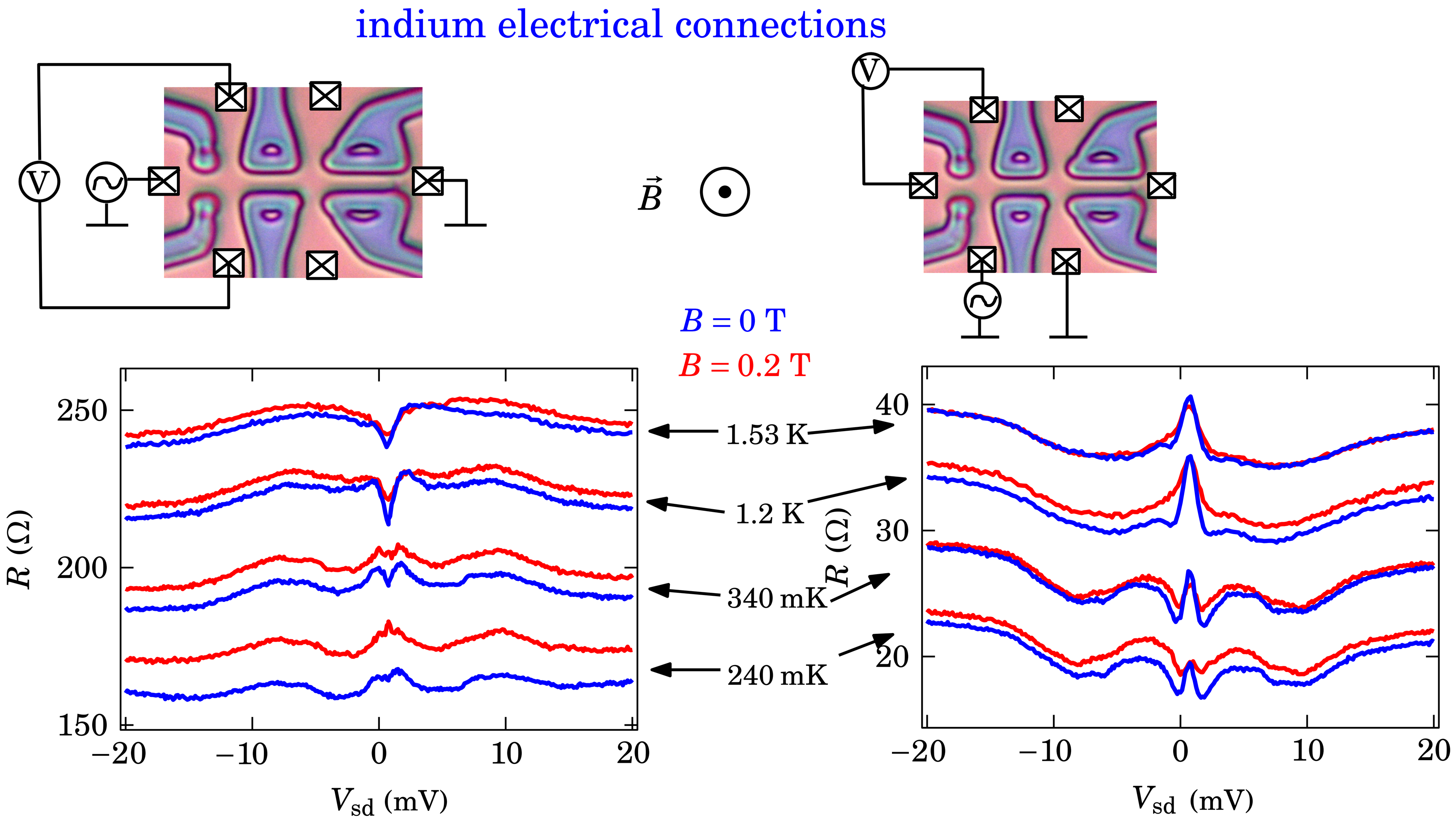
silver paint electrical connections



Hall and local resistances R measured as a function of source-drain voltage V_{sd} at zero magnetic field and at $B = 0.1$ T. Regular oscillations attributed to subsequent population of 1D quantized states.

Contact resistances ~ 10 kΩ

indium electrical connections



Hall and non-local resistances R vs source-drain voltage V_{sd} as a function of temperature measured at $B = 0$ T and $B = 0.2$ T. Resistance peaks are shifted with field (compare also left figure) and disappearance at $T = 1.53$ K.

Contact resistances ~ 10 Ω