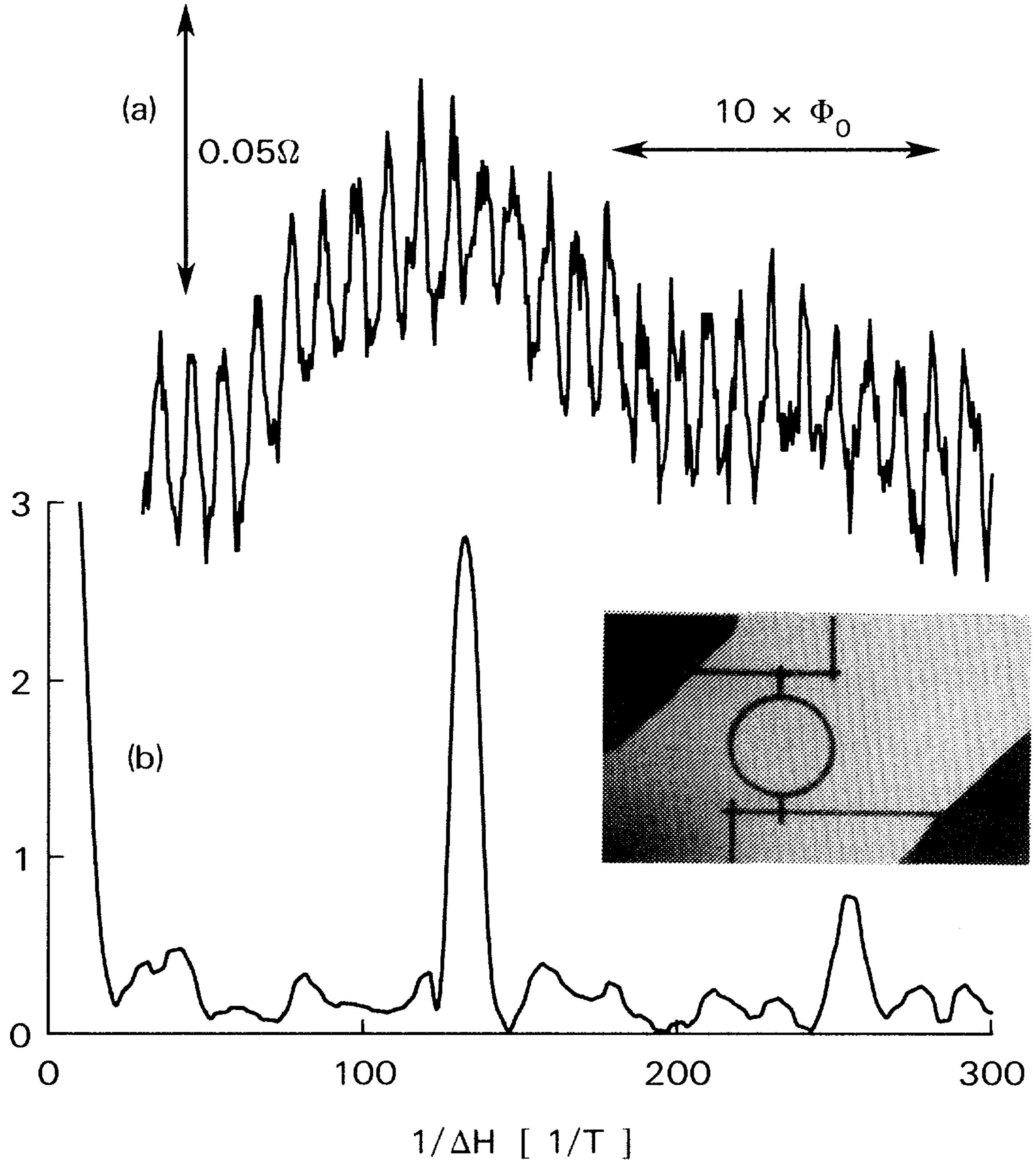
Aharonov-Bohm effect in a metallic ring



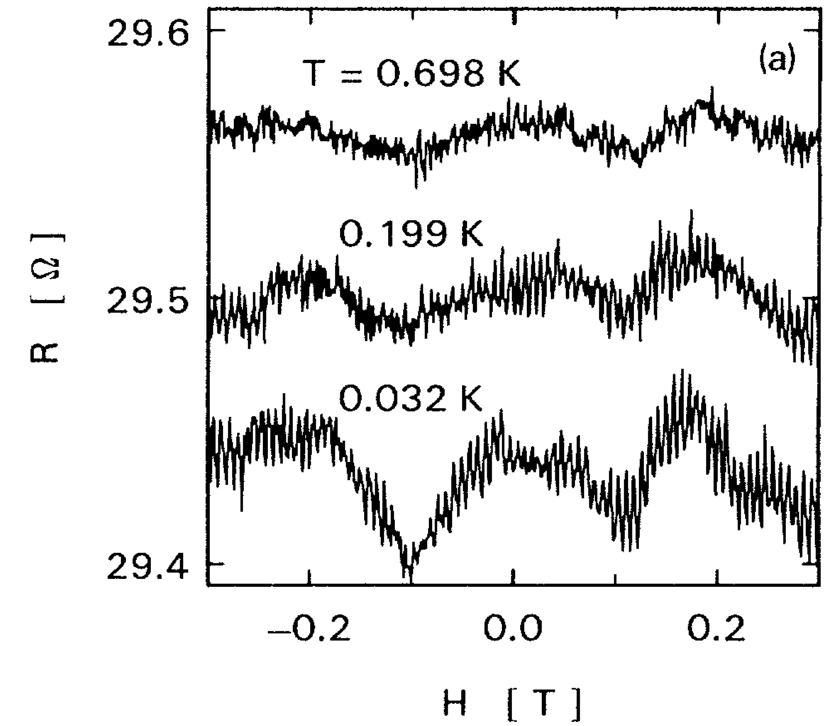


FIG. 1. (a) Magnetoresistance of the ring measured at $T = 0.01$ K. (b) Fourier power spectrum in arbitrary units containing peaks at h/e and $h/2e$. The inset is a photograph of the larger ring. The inside diameter of the loop is 784 nm, and the width of the wires is 41 nm.

Coherence length

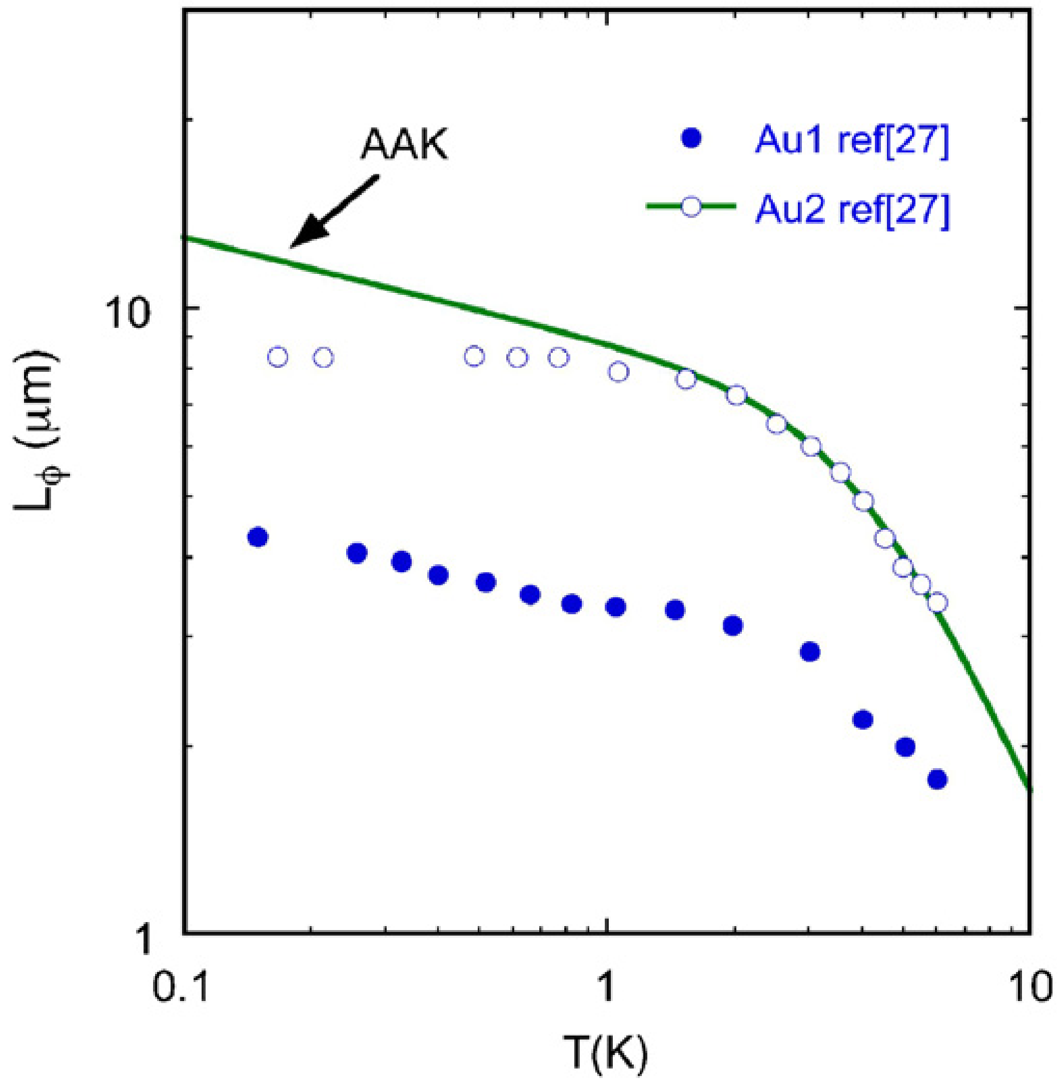


Fig. 1. Phase coherence length as a function of temperature for an ultra-pure gold sample before (•) and after (○) annealing. The solid line corresponds to the theoretical expectation within the AAK picture [30]. Data are taken from Ref. [26].

Weak localisation in magnetic field

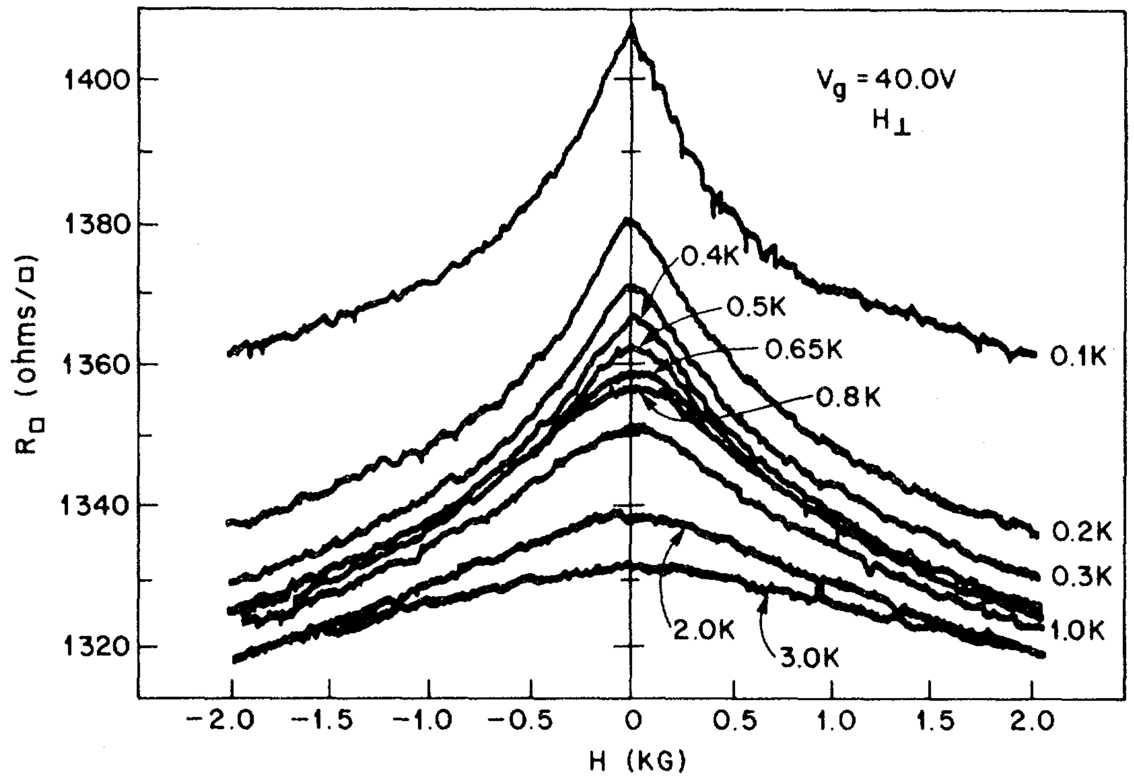
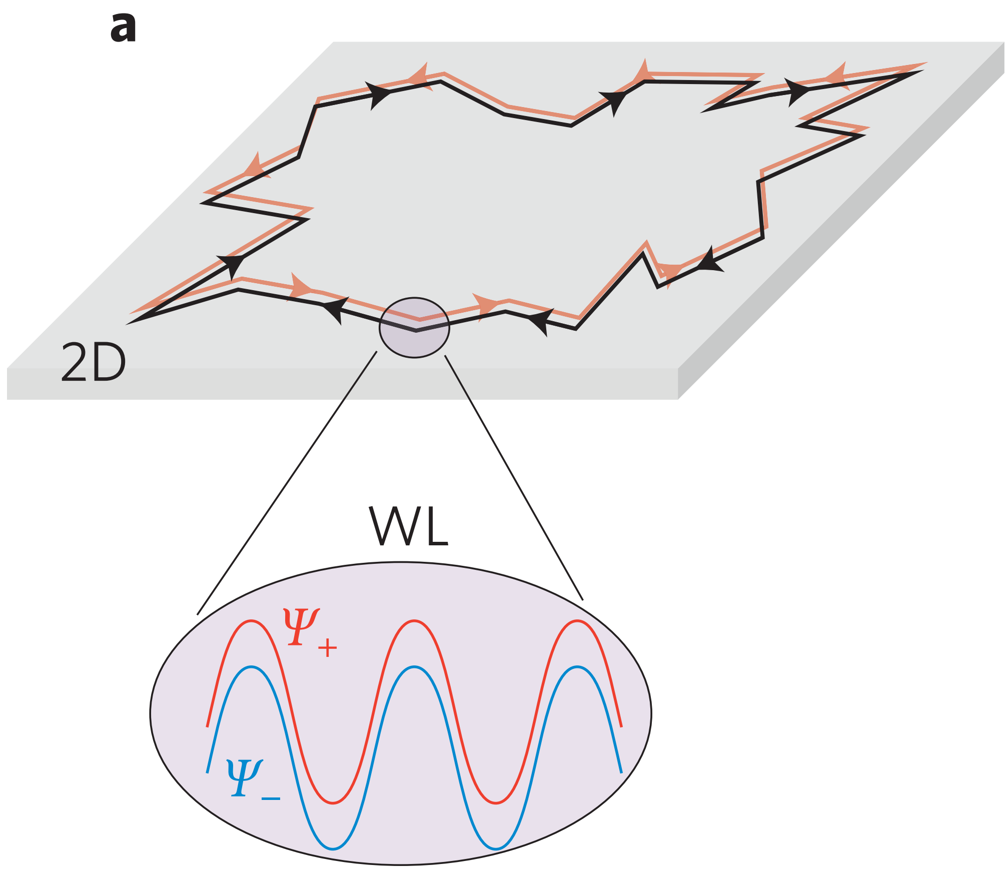
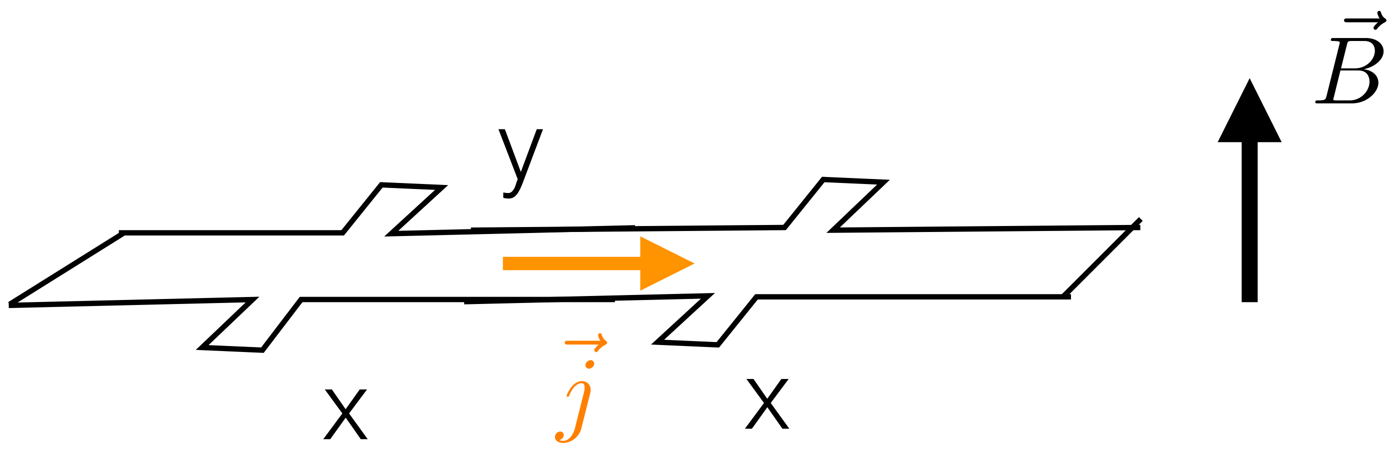
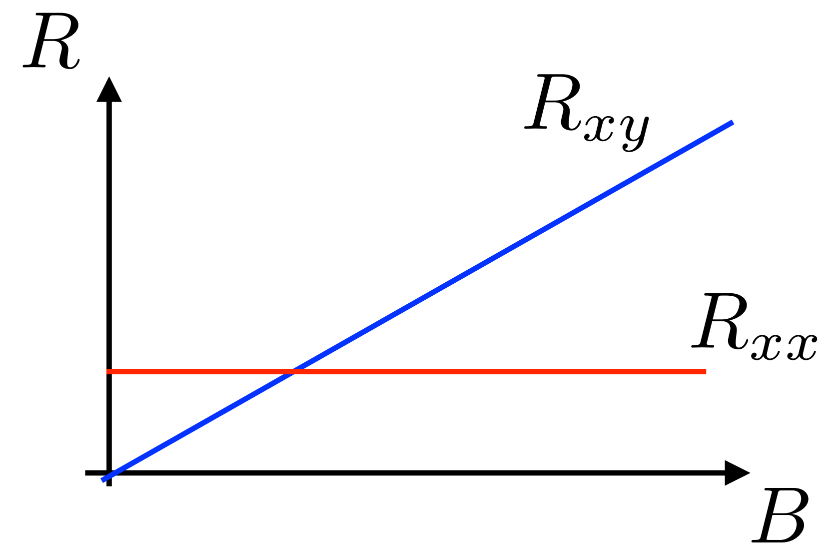


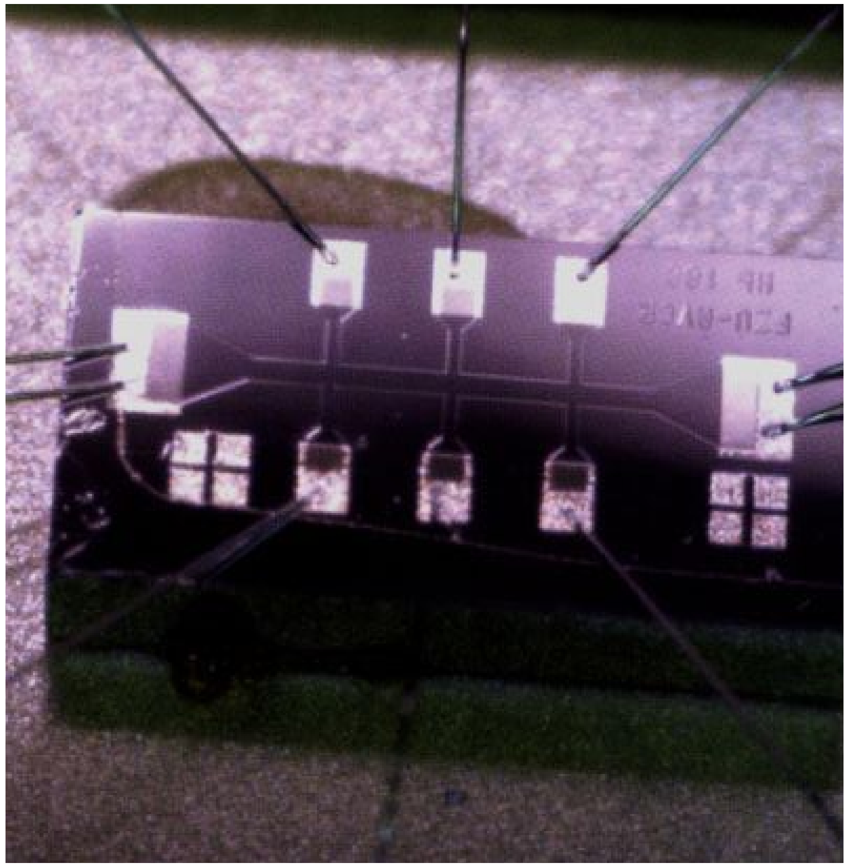
FIG. 2. Low-field magnetoresistance of a Si(111) MOSFET in a perpendicular field for various temperatures. Electron density is 4.52×10^{12} cm^{-2}.

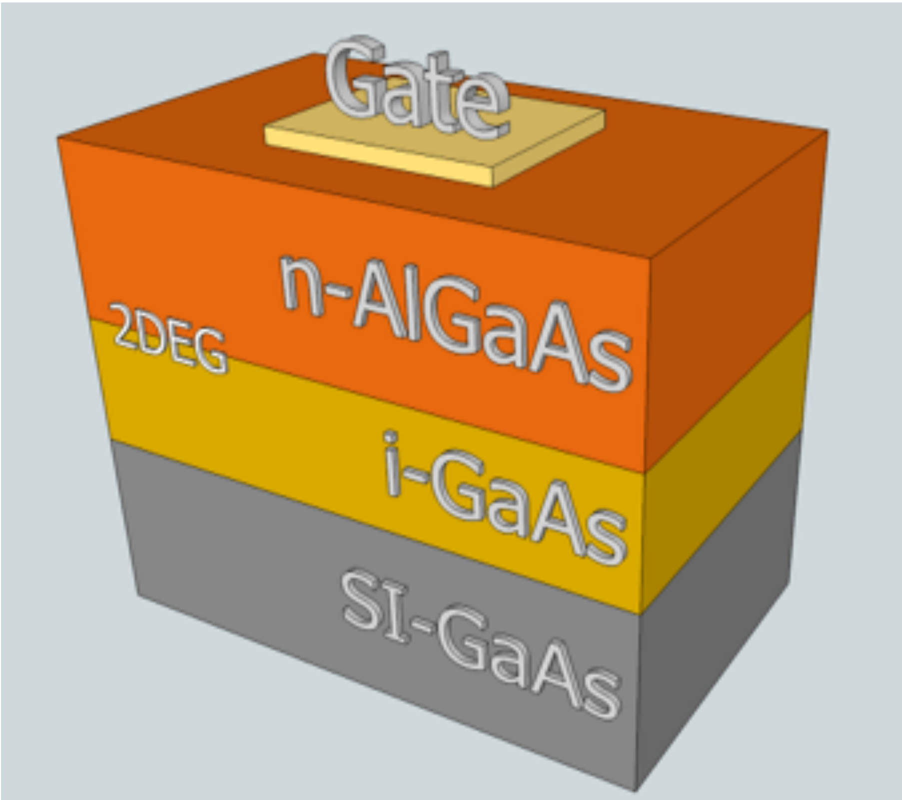


Magnetoresistance measurements - Hall bar









Integer Quantum Hall Effect

VOLUME 45, NUMBER 6 PHYSICAL REVIEW LETTERS 11 AUGUST 1980

New Method for High-Accuracy Determination of the Fine-Structure Constant Based on Quantized Hall Resistance

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and

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(Received 30 May 1980)

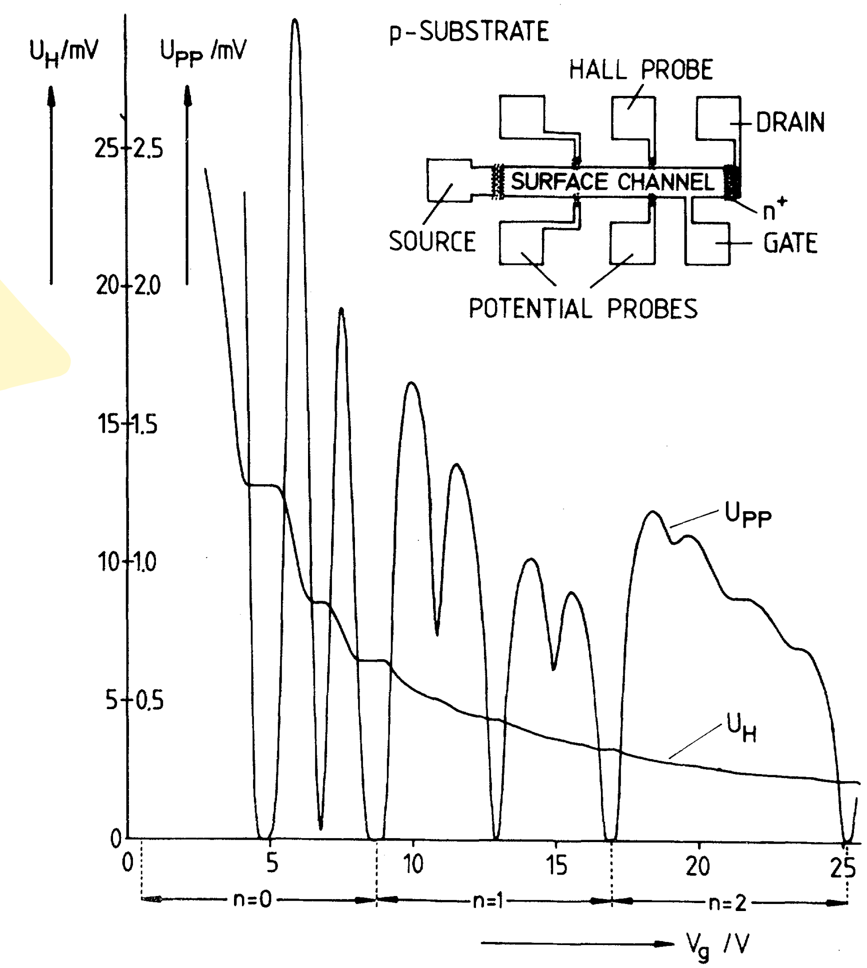
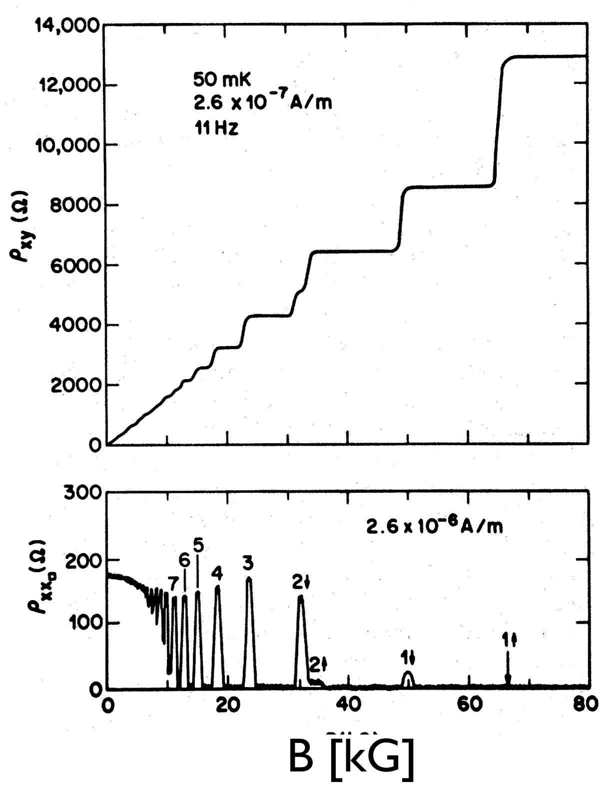
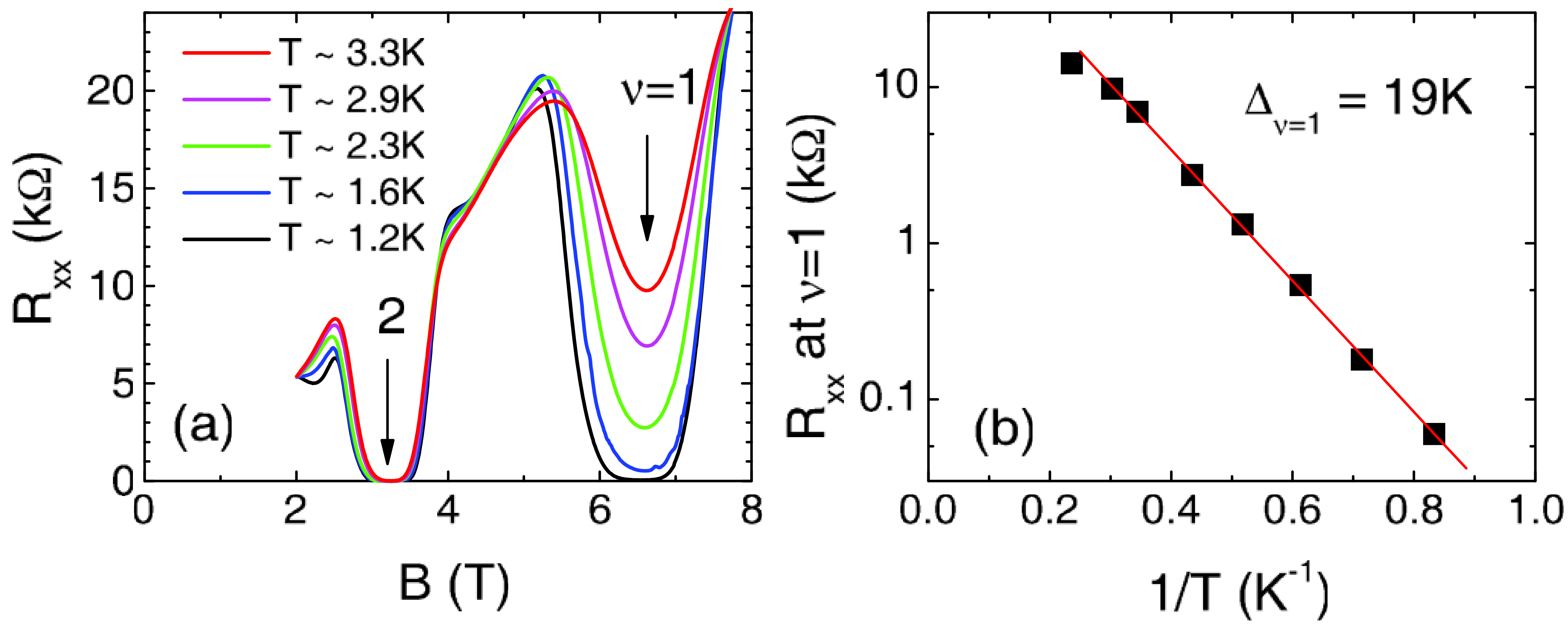


FIG. 1. Recordings of the Hall voltage U_H, and the voltage drop between the potential probes, U_{pp}, as a function of the gate voltage V_g at $T = 1.5$ K. The constant magnetic field (*B*) is 18 T and the source drain current, *I*, is 1 μA. The inset shows a top view of the device with a length of $L = 400$ μm, a width of $W = 50$ μm, and a distance between the potential probes of $L_{pp} = 130$ μm.

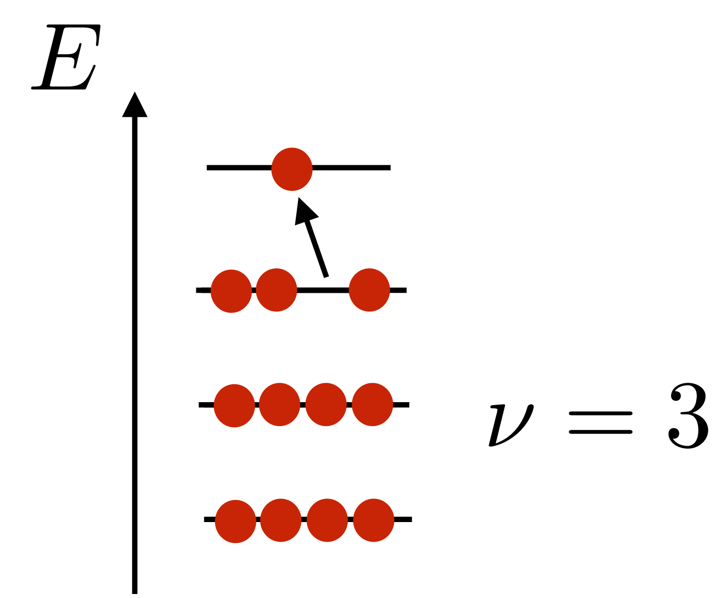


Activated transport (IQHE)



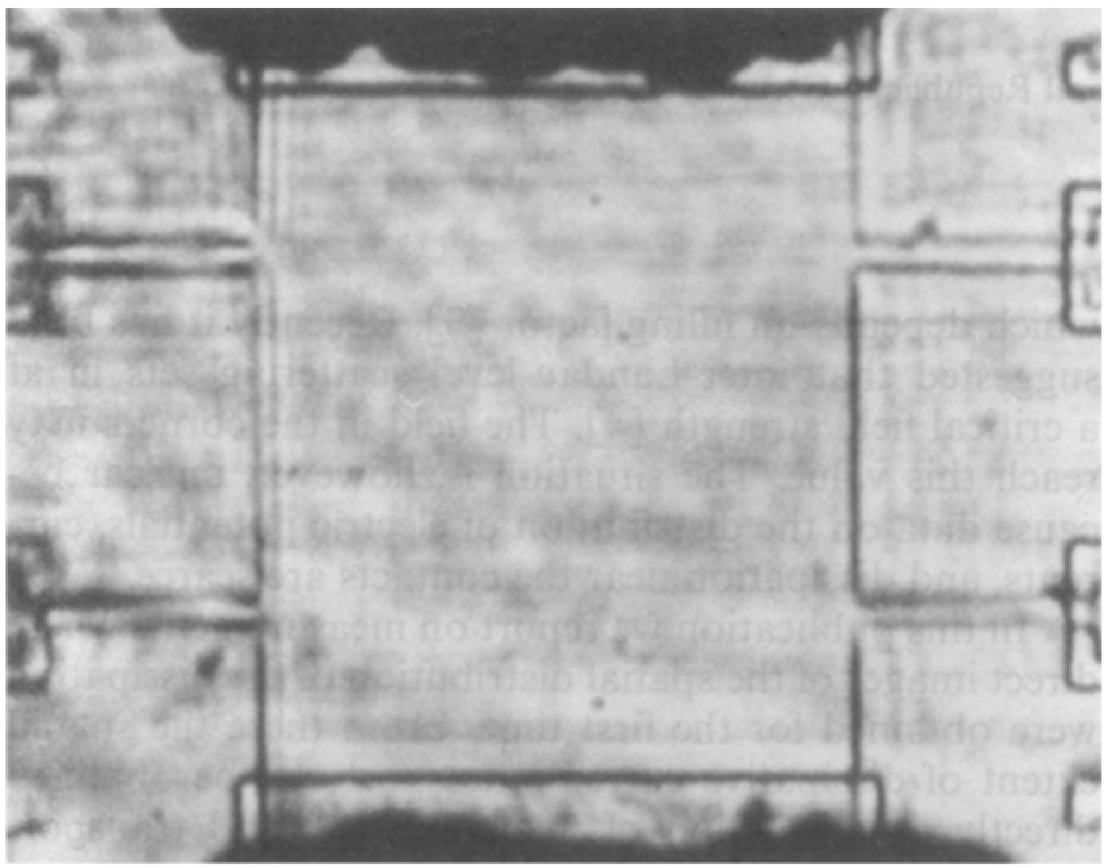
- in quantum Hall regime, $\sigma \propto \rho$
- conductivity proportional to number of carriers

$$\propto \exp(-E_g/2kT)$$

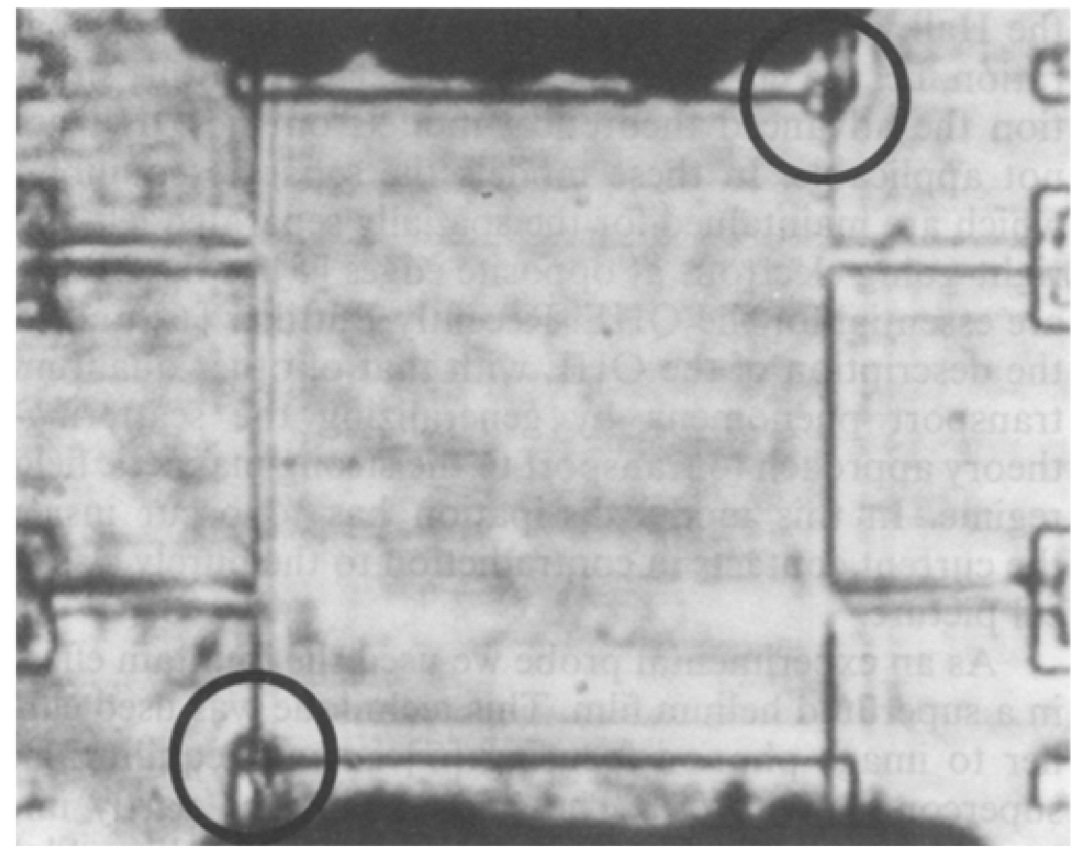


Dissipation of energy in a Hall bar (IQHE)

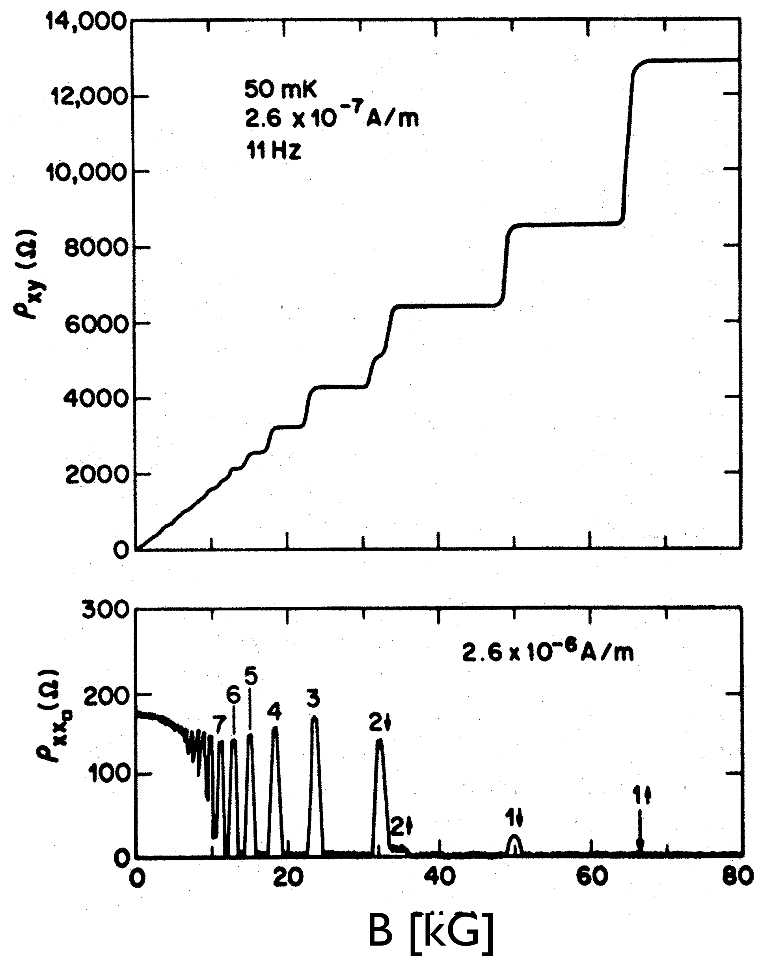
current off

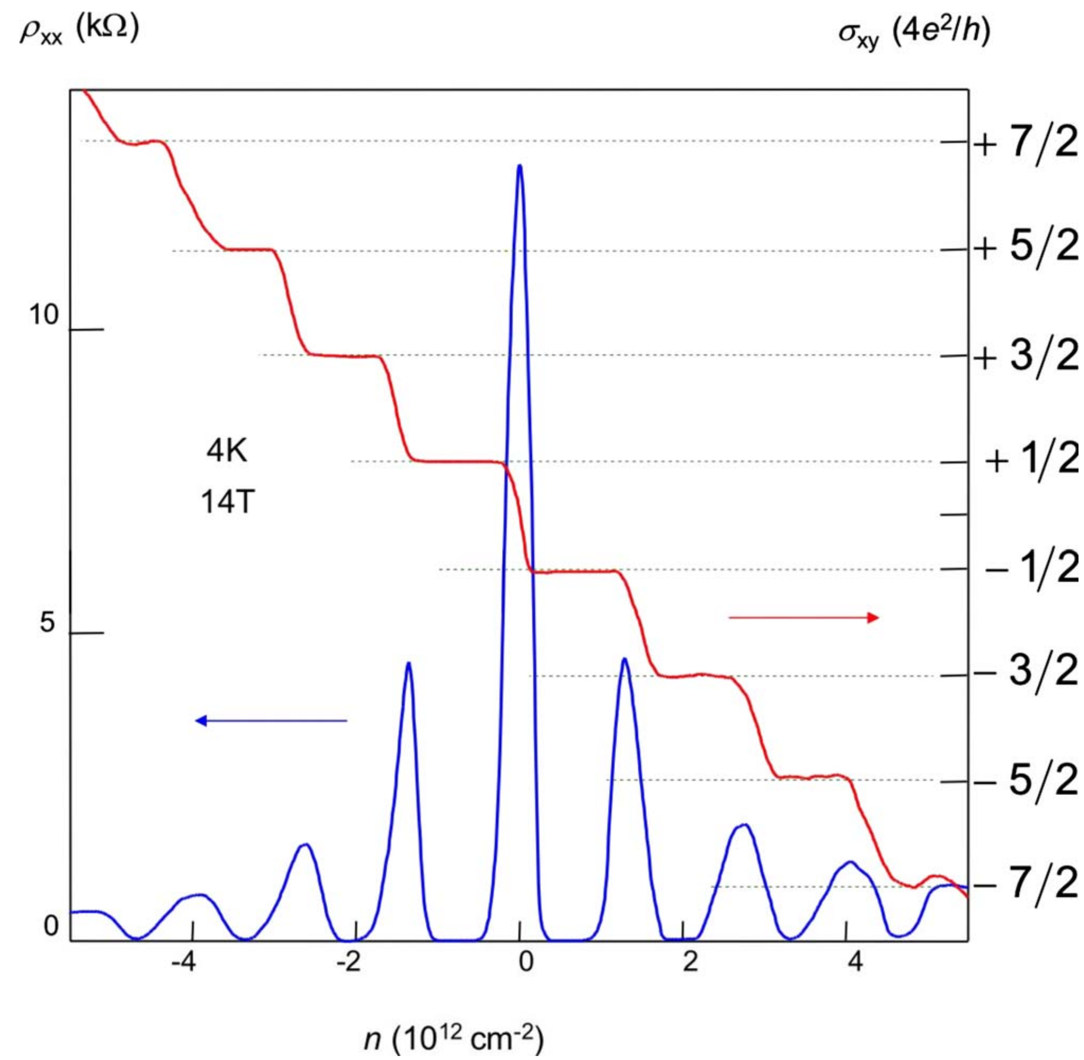


current on



IQHE in 2DEG and in graphene





$$E = \hbar^2 k^2 / 2m$$

$$E = \frac{\hbar e B}{m}(n + \frac{1}{2})$$

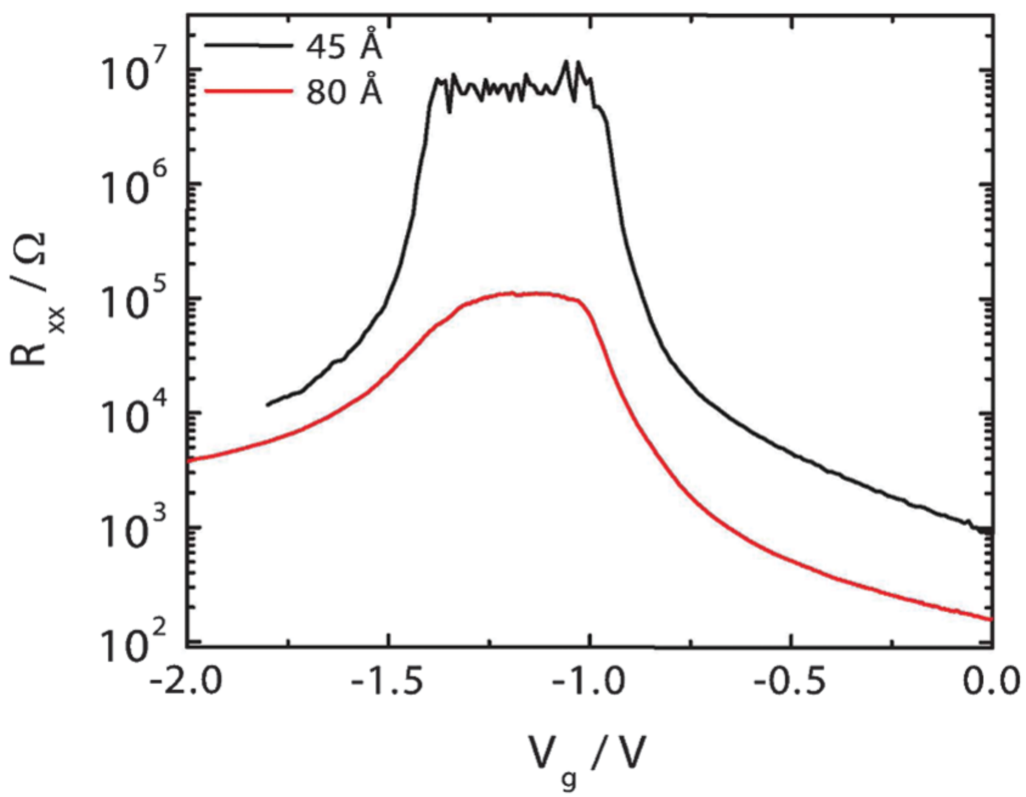
$$E = \pm \hbar v_F k$$

$$E = \pm\sqrt{2e\hbar v_F B(|n| + 0)}$$

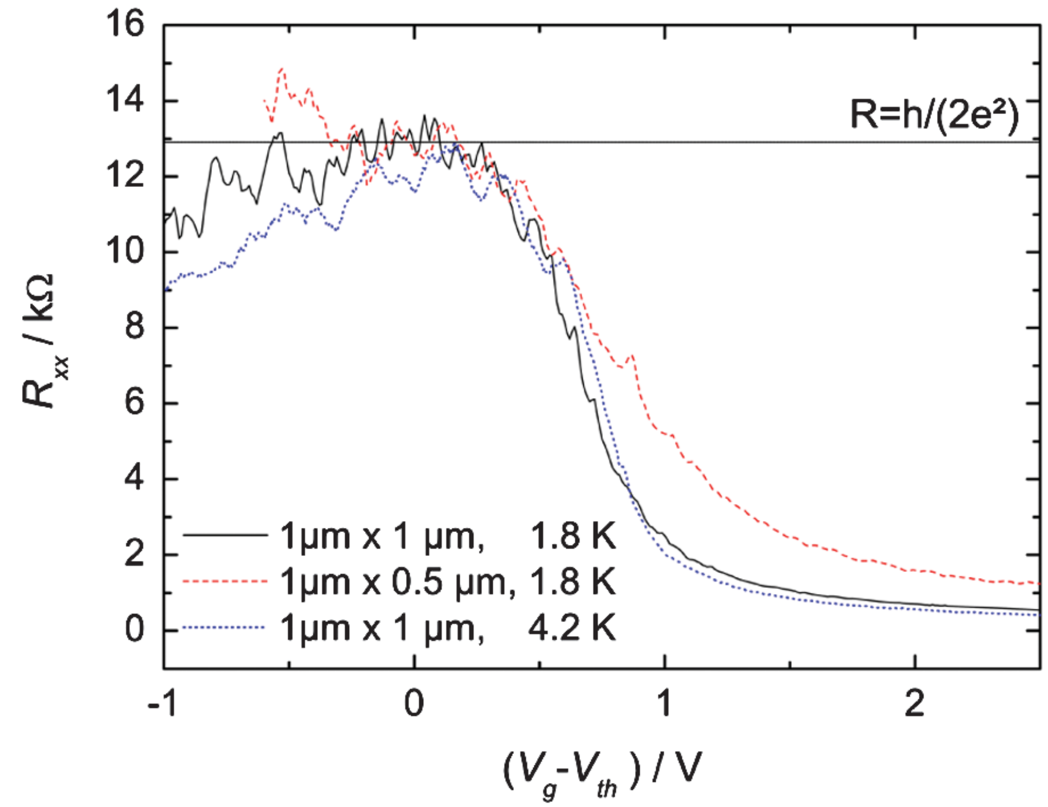
… information on Berry phase upon completing cyclotron orbit

Topological insulator - HgTe/CdTe heterostructure

long device

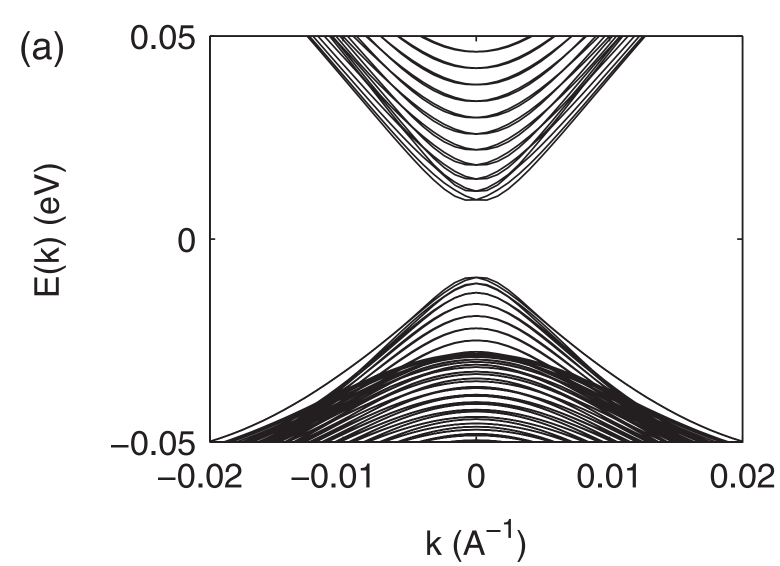


short device

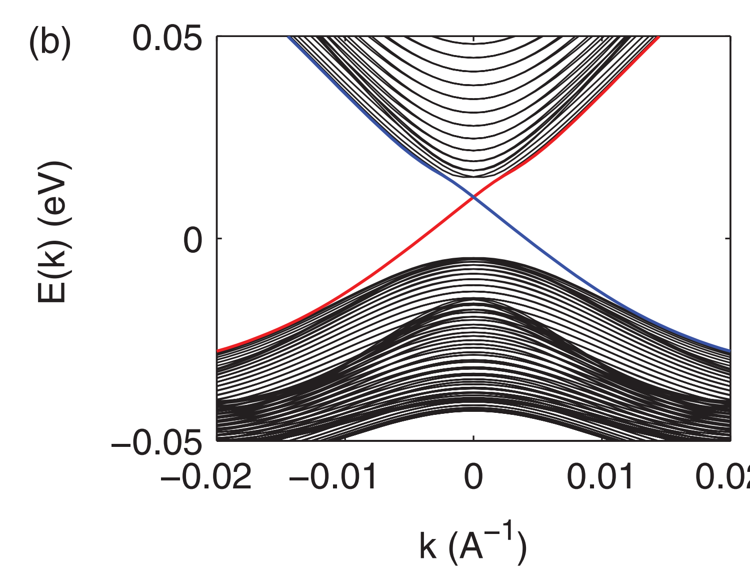


- quantum wells with different thickness of HgTe
- topologically distinct systems

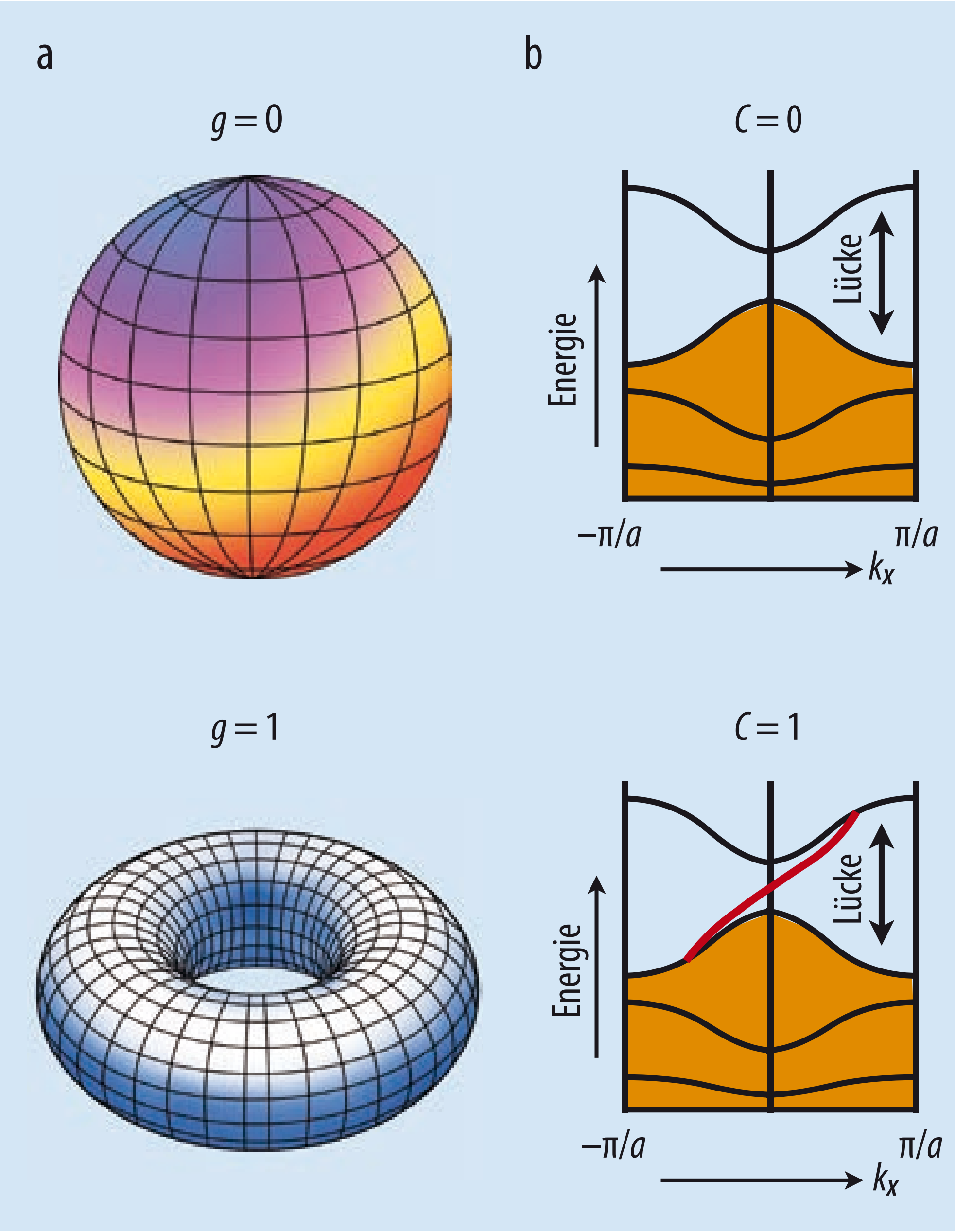
narrow QW



wide QW



Topological invariants



- g related to Gauss curvature
- c related to Berry curvature

HgTe and CdTe

bulk

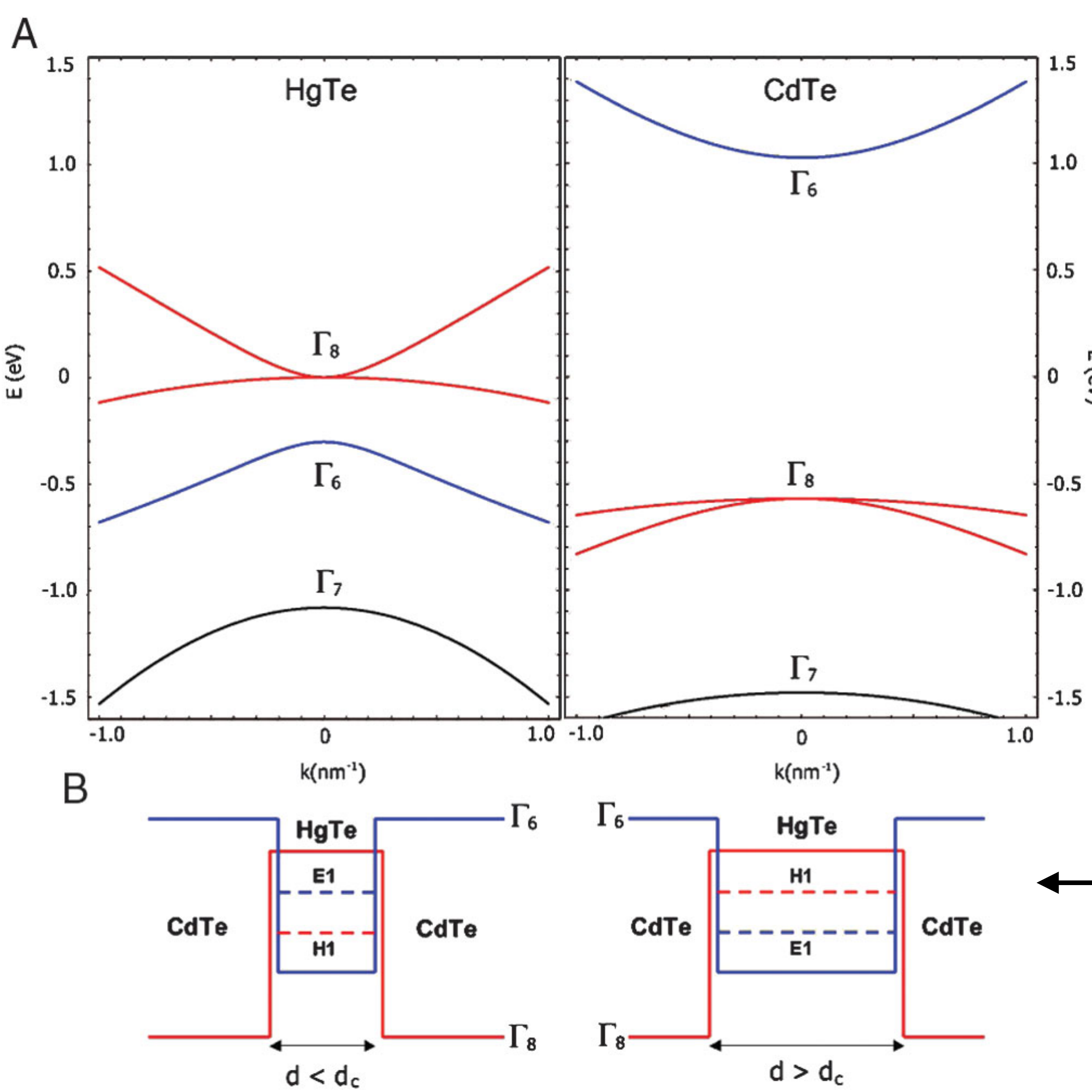
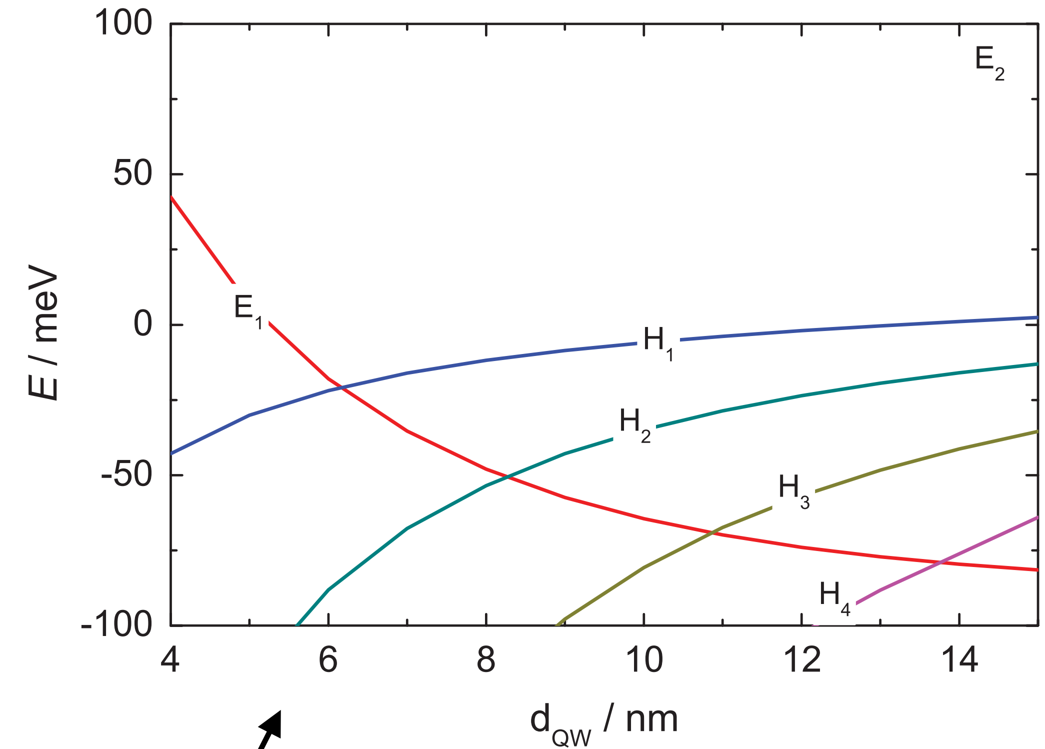
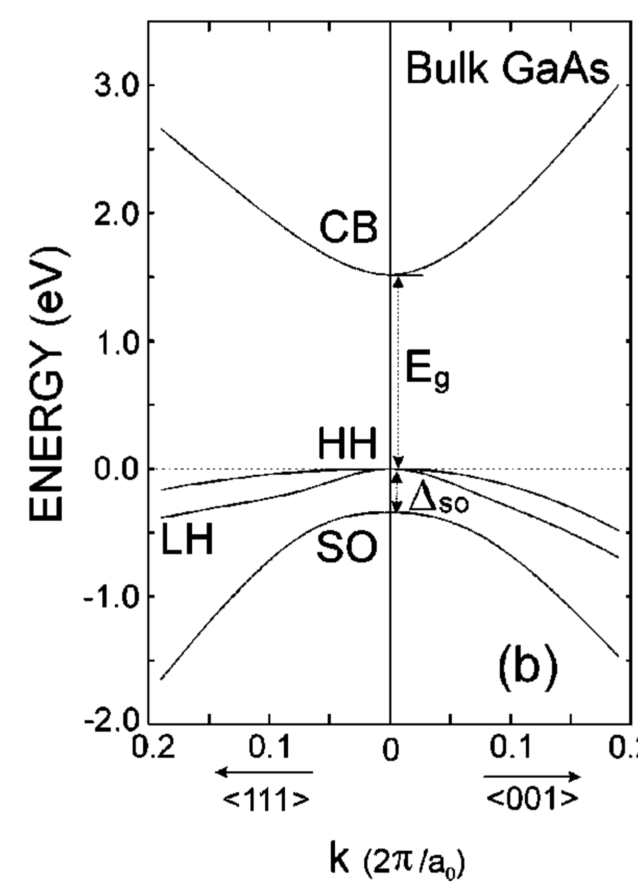


FIG. 2 (color). (a) Bulk band structure of HgTe and CdTe; (b) schematic picture of quantum well geometry and lowest subbands for two different thicknesses. From Bernevig *et al.*, 2006.



quantum well (heterostr.)



Quantum Hall Effect (fractional)

VOLUME 48, NUMBER 22 PHYSICAL REVIEW LETTERS 31 MAY 1982

Two-Dimensional Magnetotransport in the Extreme Quantum Limit

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Bell Laboratories, Murray Hill, New Jersey 07974
(Received 5 March 1982)

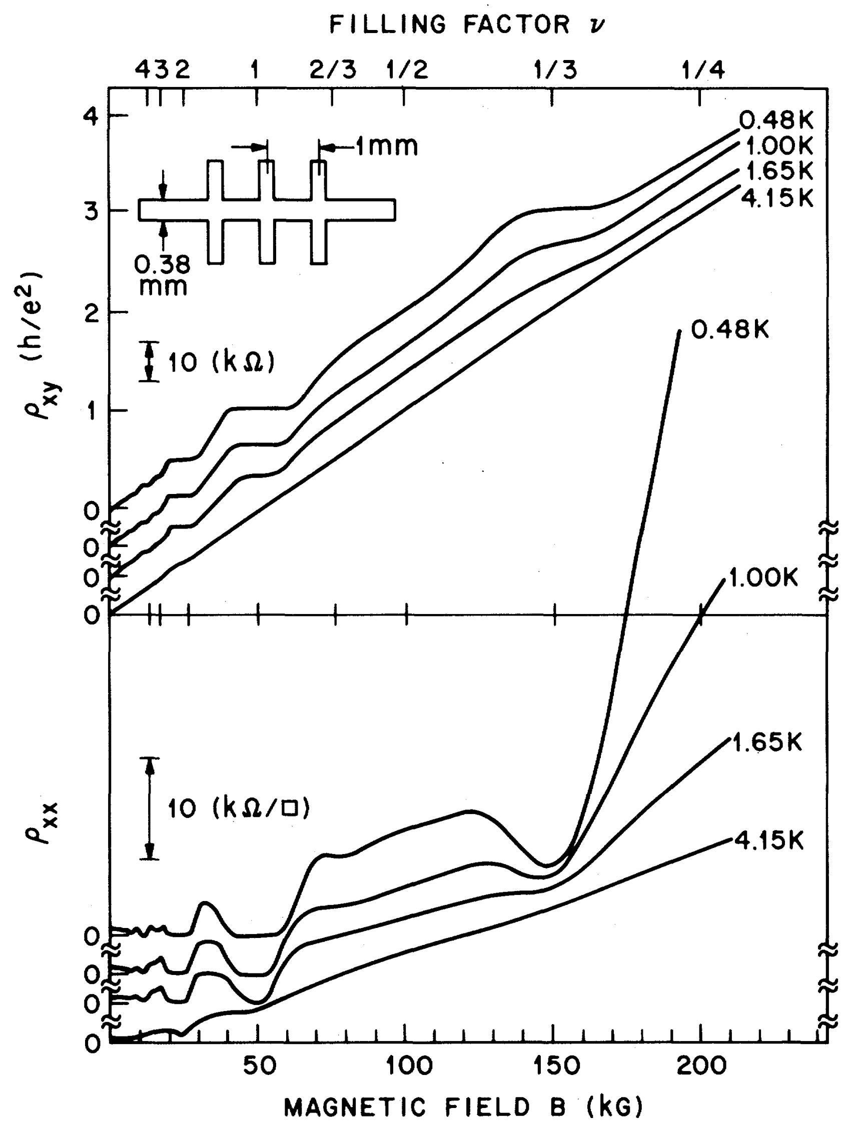
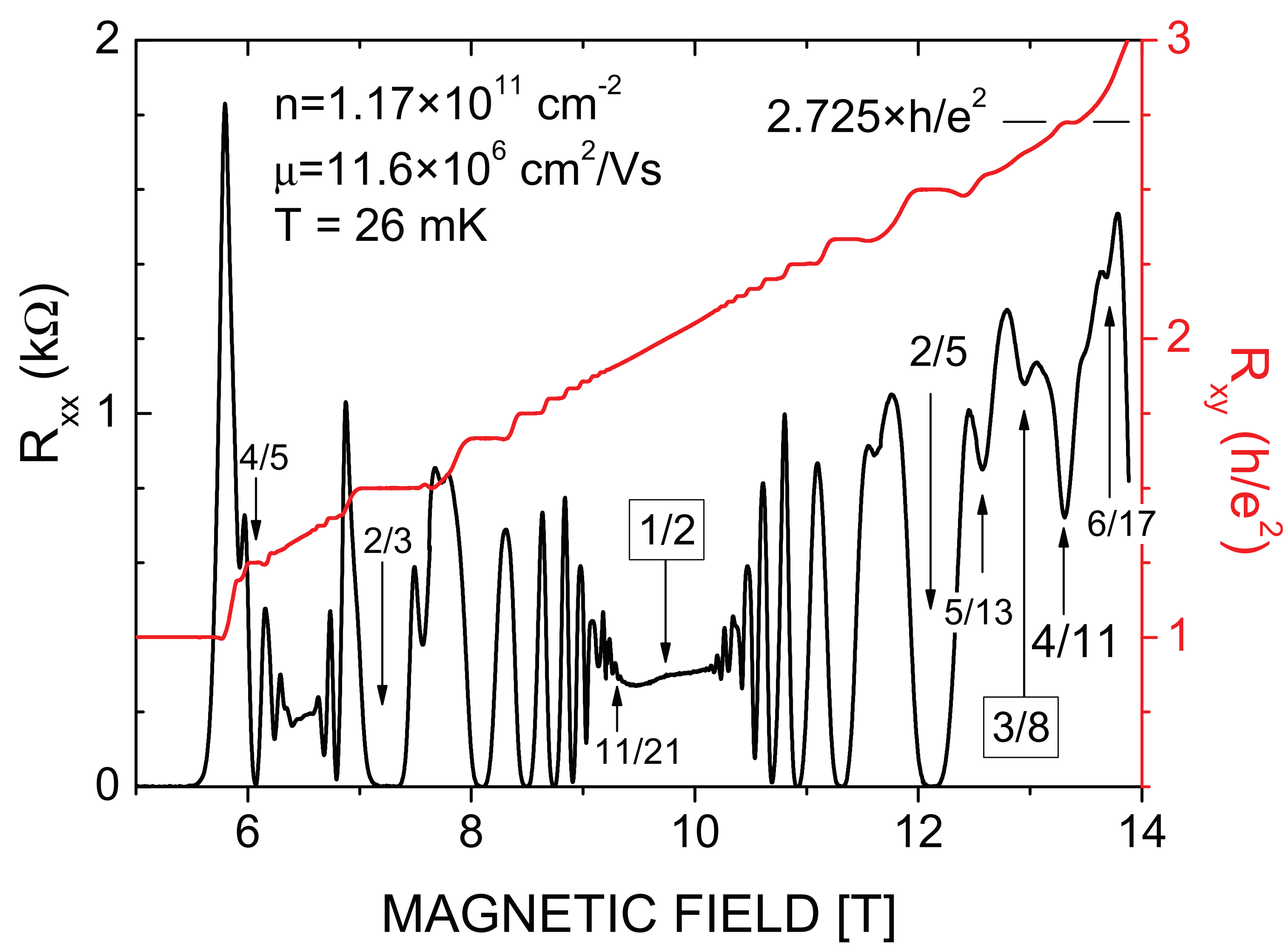


FIG. 1. ρ_{xy} and ρ_{xx} vs B, taken from a GaAs-$Al_{0.3}$-$Ga_{0.7}As$ sample with $n = 1.23\times 10^{11}/cm^2$, $\mu = 90\,000$ cm^2/V sec, using $I = 1$ μA. The Landau level filling factor is defined by $\nu = nh/eB$.



Excitation spectrum in the 1/3 Laughlin state

$$H = \frac{1}{2m}\sum_{i=1}^{N_e}\left(\vec{p}_i - q\vec{A}(\vec{r}_i)\right)^2 + \frac{e^2}{4\pi\varepsilon}\sum_{i<j}\frac{1}{|\vec{r}_i - \vec{r}_j|}$$

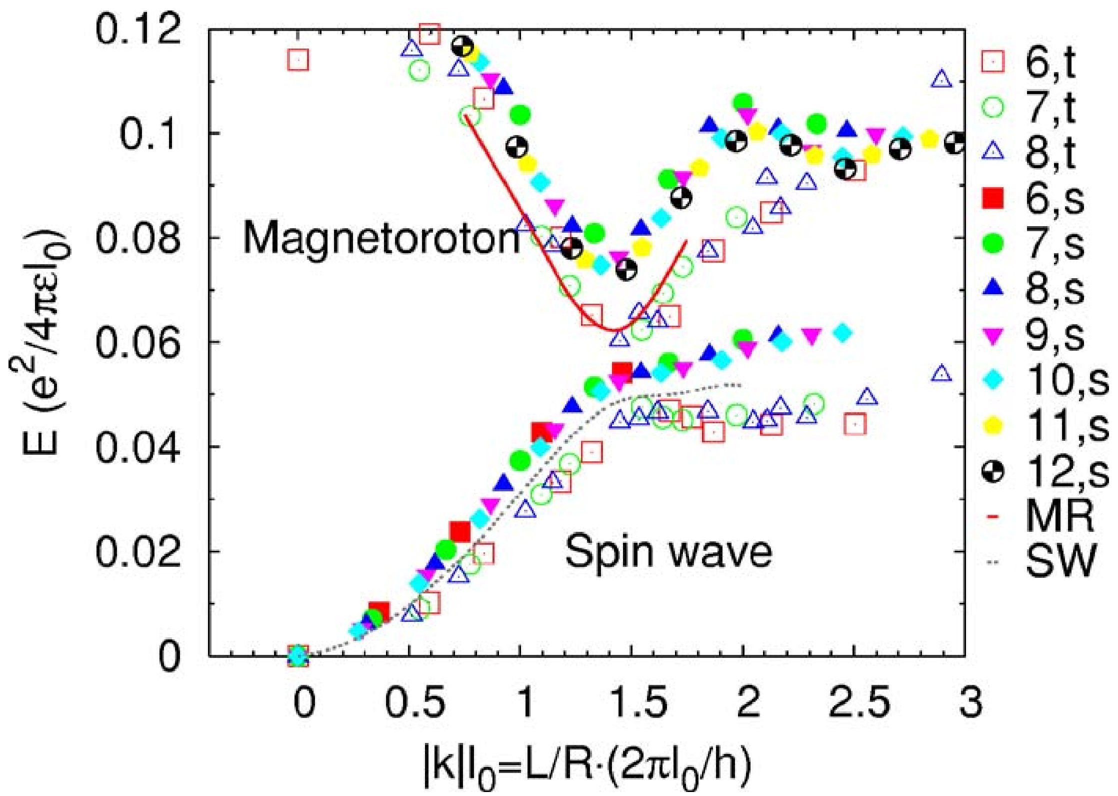
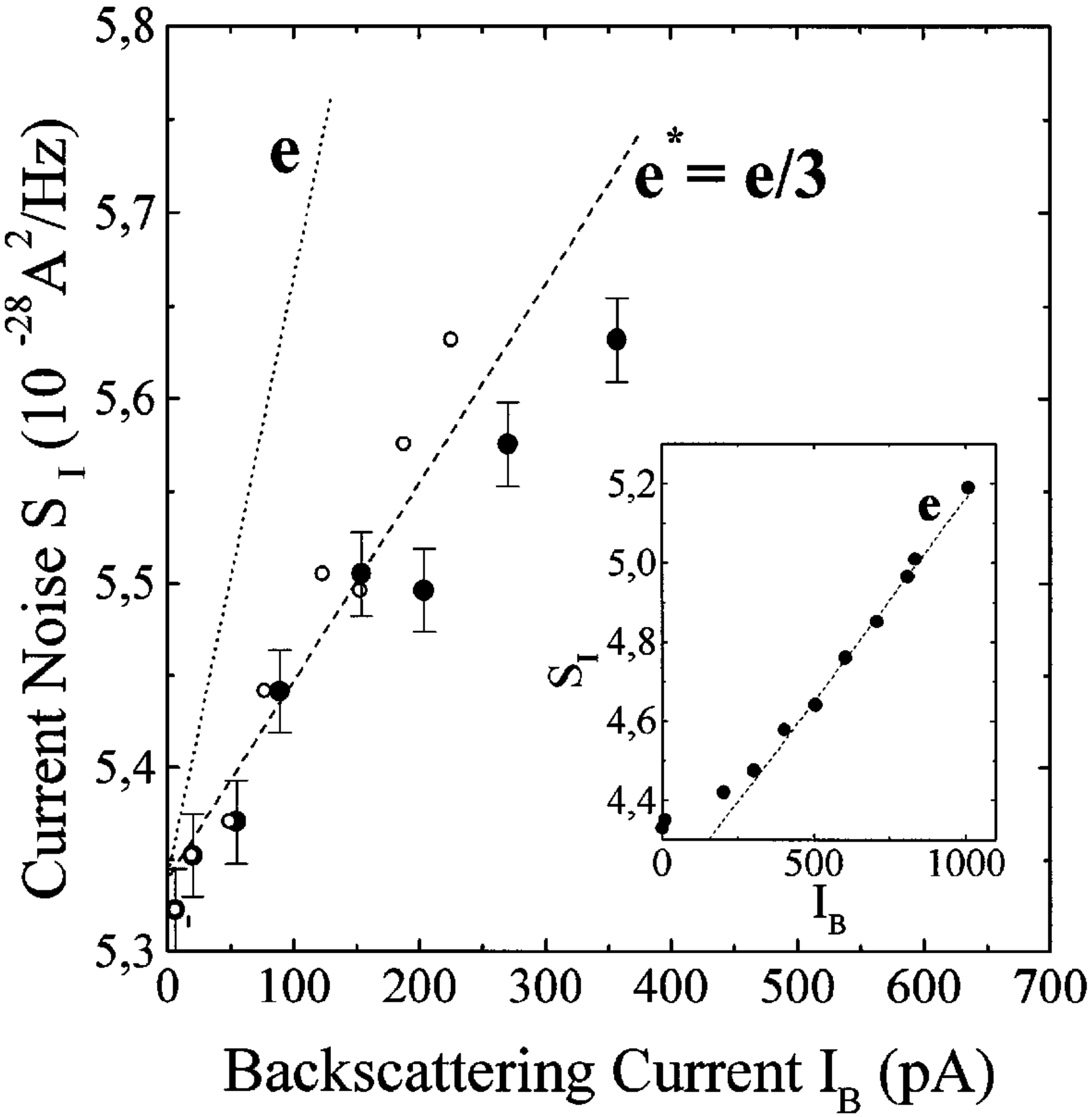


FIG. 5. (Color online) The spin wave (SW) and the magnetoroton branch (MR) seen in the ED spectra of ideal $\nu=1/3$ systems of different sizes and geometries. In the legend, *t* stands for torus, *s* for sphere, and the number indicates the number of electrons. The lines (solid and dotted) were obtained from the $1/N \to 0$ extrapolation of the data (MR and SW) on the sphere.

Shot noise in the 1/3 FQHE state



$$S = 2e \cdot I$$

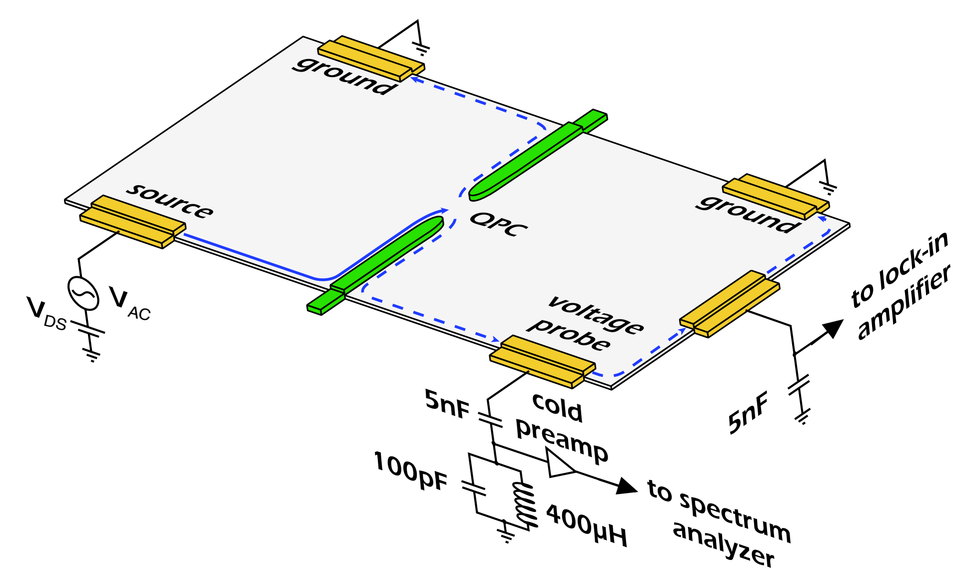


FIG. 1 (color online). Schematic of the noise measurement setup (see text for details).