Manipulating Edge Channel Transport in Graphene

Master project and thesis

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12-8-2016

Structure

- Introduction
- Theory (SGM and backscattering)
- Results
- Conclusions
- Discussion

Structure

Not discussed

- Quantum Hall effect
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-
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Structure

Not discussed

- Quantum Hall effect
- Edge reconstruction
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-
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Not discussed

- Quantum Hall effect
- Edge reconstruction
- Fabrication
-
-

Structure

Not discussed

- Quantum Hall effect
- Edge reconstruction
- Fabrication
- Multi-ribbon devices (effect of ribbon width on transport)
-

Structure

Not discussed

- Quantum Hall effect
- Edge reconstruction
- Fabrication
- Multi-ribbon devices (effect of ribbon width on transport)
- Hysteresis

Introduction

Traineeship program

- To fabricate and characterize graphene nanoribbons by low temperature magneto-transport measurements
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Introduction

Traineeship program

- To fabricate and characterize graphene nanoribbons by low temperature magneto-transport measurements
- The quantum Hall regime will be explored, as part of the research program to develop understanding of edge channel physics in graphene
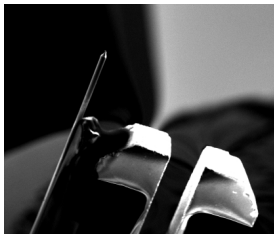
Introduction

Internship goal

- To manipulate edge channel transport with the Scanning Gate Microscope (SGM)
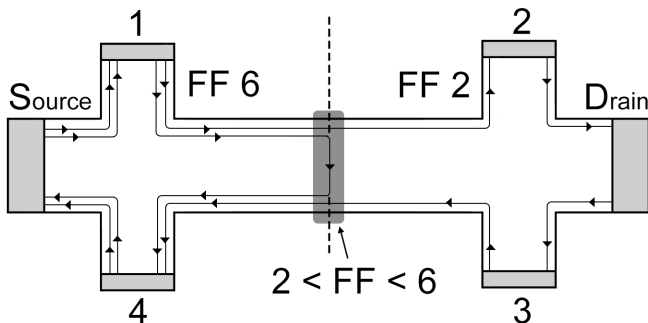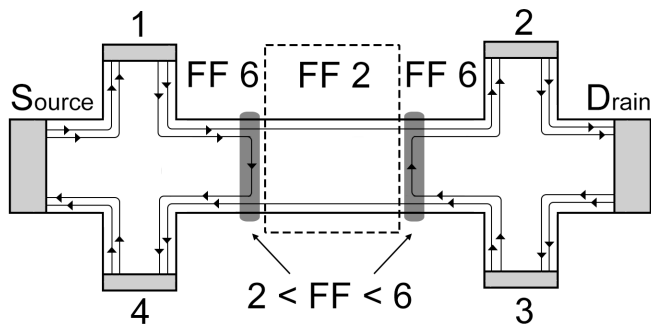
Scanning Gate Microscopy

- AFM
- 300 mK
- 8 T
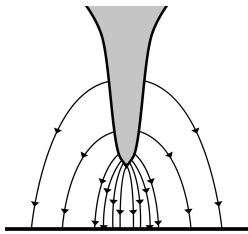
Theory

Backscattering edge channels

- $R_{xx} = 0 \text{ k}\Omega$
- $R_{14} = \frac{h}{e^2}\frac{1}{6} \approx 4.3 \text{ k}\Omega$ $\qquad\qquad$ $R_{23} = \frac{h}{e^2}\frac{1}{6} \approx 4.3 \text{ k}\Omega$
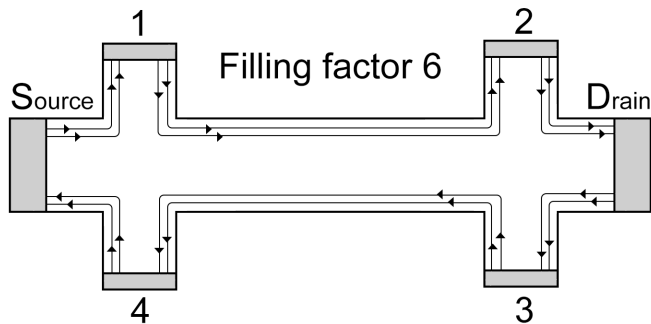
Theory

Backscattering edge channels

- $R_{xx} = 0 \text{ k}\Omega$
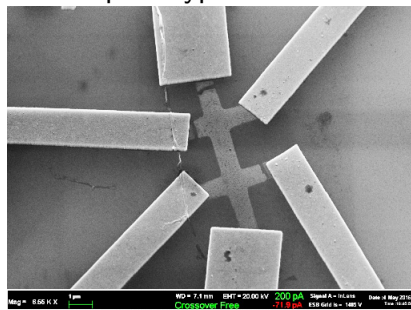- $R_{14} = \frac{h}{e^2} \frac{1}{6} \approx 4.3 \text{ k}\Omega$
$\qquad\qquad\qquad R_{23} = \frac{h}{e^2} \frac{1}{2} \approx 12.9 \text{ k}\Omega$

Theory

Backscattering edge channels

- $R_{xx} = 8.6 \text{ k}\Omega$
- $R_{14} = \frac{h}{e^2}\frac{1}{6} \approx 4.3 \text{ k}\Omega$ $R_{23} = \frac{h}{e^2}\frac{1}{6} \approx 4.3 \text{ k}\Omega$
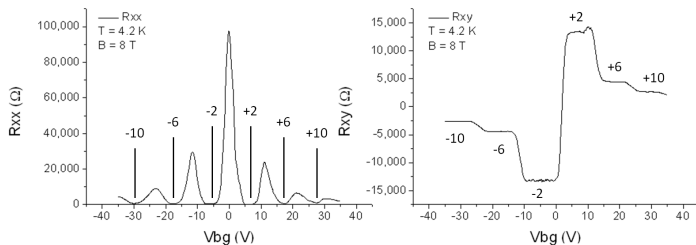
Results

Ribbon dimensions: $L \approx 6 \ \mu\mathrm{m}, W \approx 800 \ \mathrm{nm}$
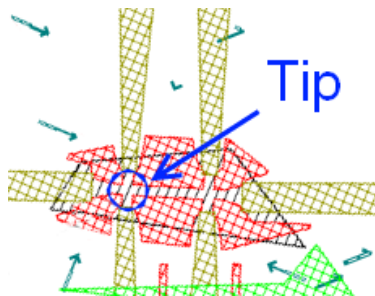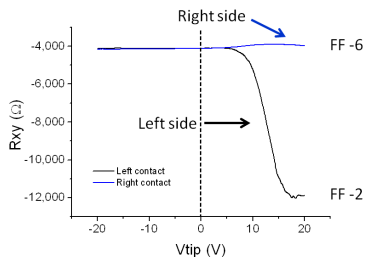
prototype device

Results

Quantum Hall effect

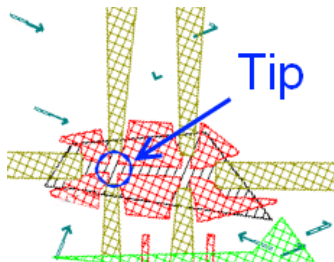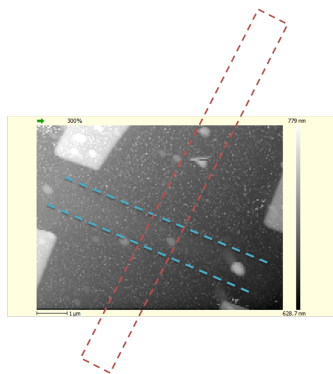## Tip position (static)
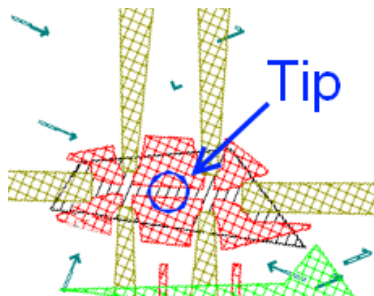
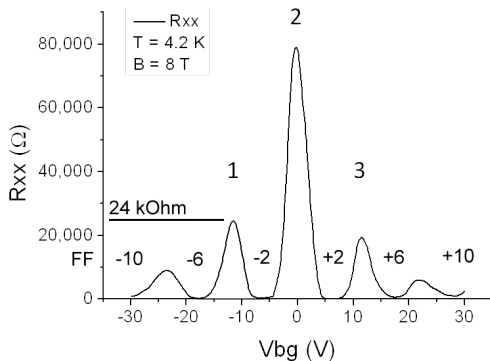# Results

Local control over the filling factor
T = 4.2 K, B = 8 T

Scanning the tip
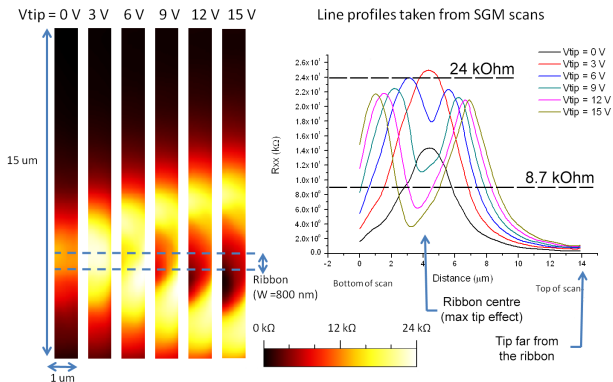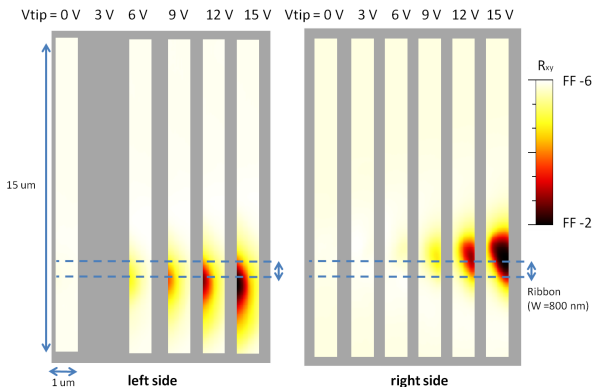
Results

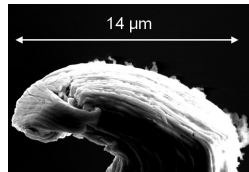## Scanning the tip

Results

Scanning the tip: R_{xx}
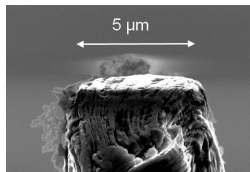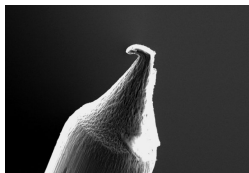
Results

Scanning the tip: R_{xy}

Tip shape

Conclusion

- A local control over the filling factor achieved
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Conclusion

- A local control over the filling factor achieved
- Tip was to large to determine edge channel structure

Discussion

- Discussion