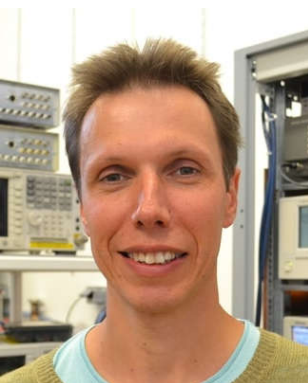


Topologically protected states in double nanowire superconductor hybrids

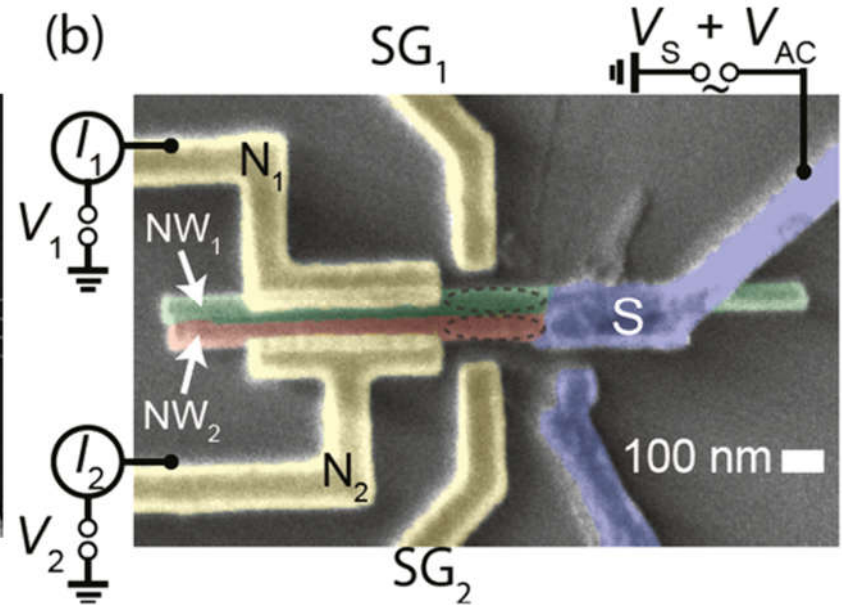
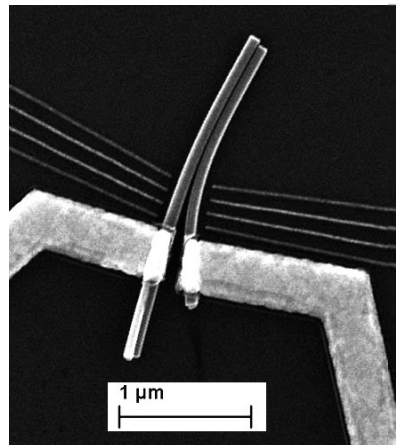
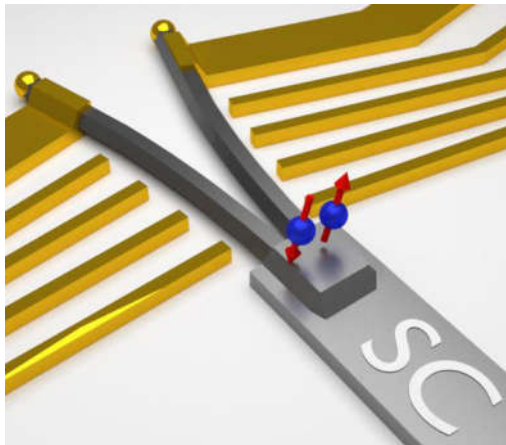


SuperTop Team



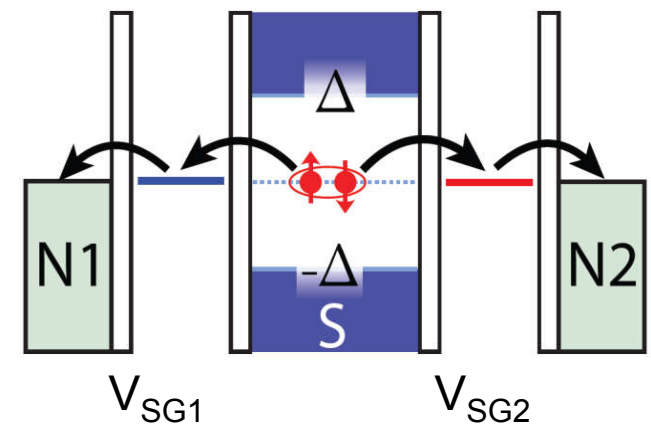
<i>Partner Number/ Acronym</i>	<i>Country</i>	<i>Institution/ Department</i>	<i>Name of the Principal Investigator (PI)³</i>
1 Coordinat. BME	HU	Budapest University of Technology & E.	Prof. Dr. Szabolcs Csonka
2 UBAS	CH	University of Basel	Prof. Dr. Christian Schönenberger
3 UCPH	DK	University of Copenhagen	Prof. Dr. Jesper Nygard
4 TU Delft	NL	Delft University of Technology	Dr. Attila Geresdi
5 CNRS	F	Ecole Normale Supérieure Paris	Prof. Dr. Takis Kontos
6 CNR Nano	I	Istituto Nanoscienze-CNR	Prof. Dr. Lucia Sorba

Realized Double NW Setups



- Deposition of NWs separately
- Crossed Andreev reflection $\sim 20\%$
- Significant capacitive coupling of NWs

But: evaporated Al contacts are not
ideal, soft gap

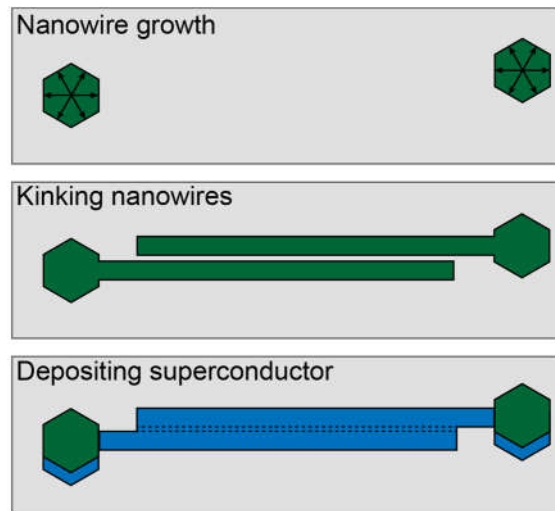
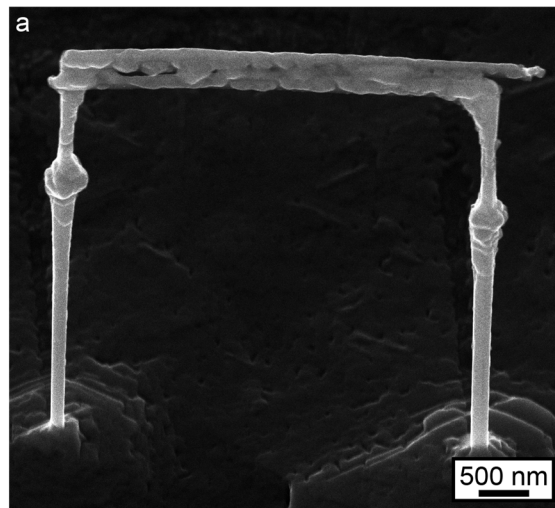


New J. Phys. 20, 063021 (2018)

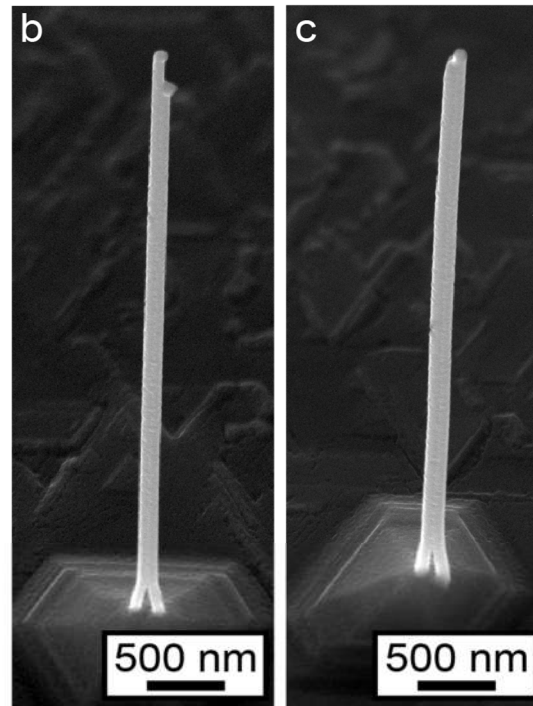
Novel nanostructures as a platform

Growth of Double NW with in-situ deposition of Al shell

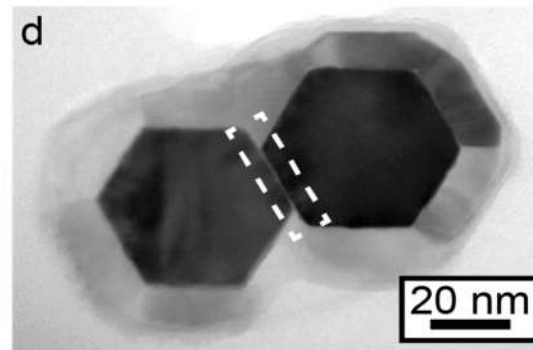
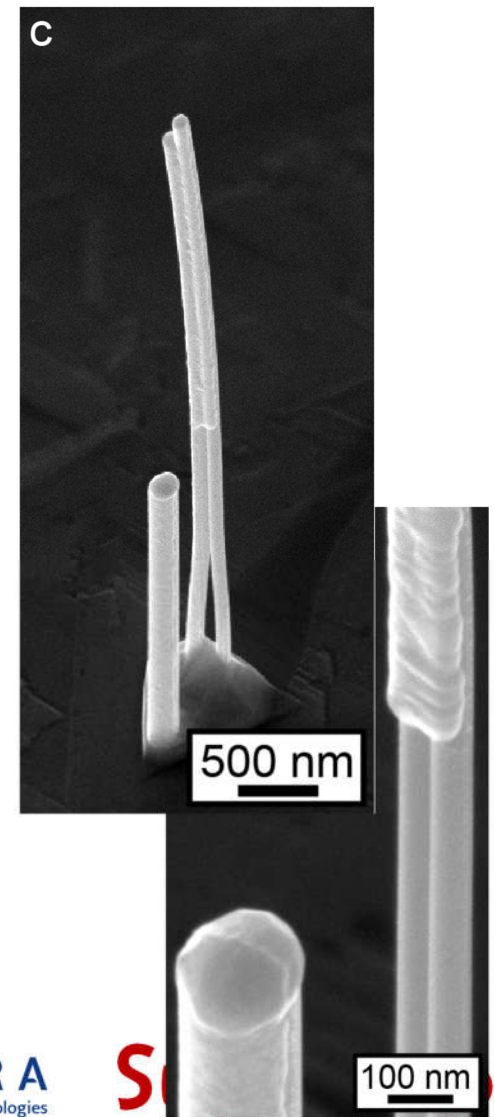
Parallel kinked NWs



Growth next by

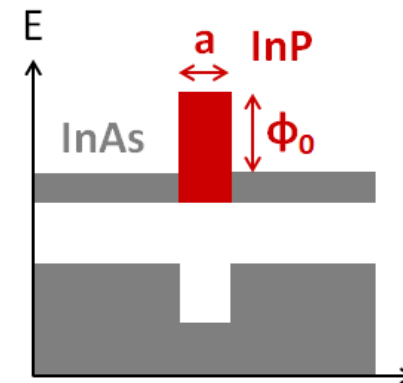
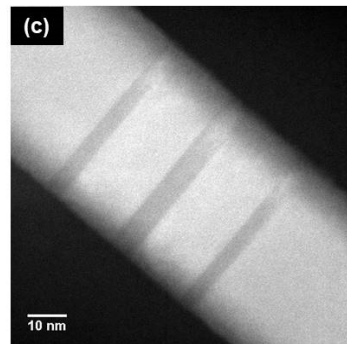
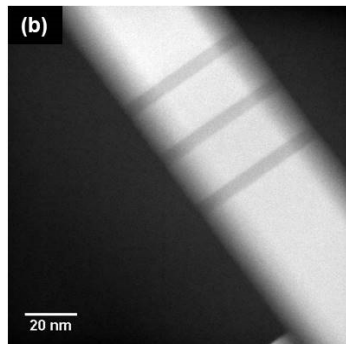
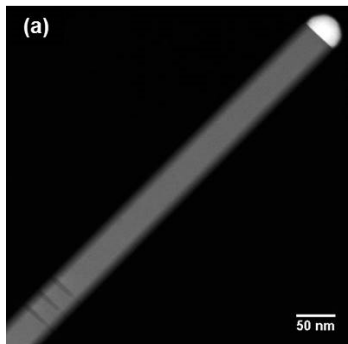
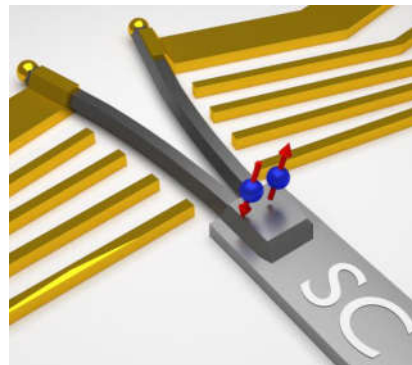
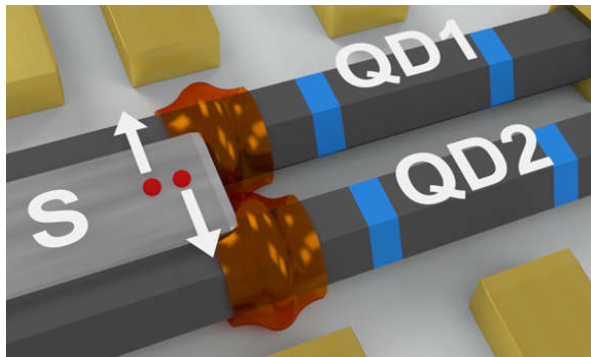


van der Waals clamping



Spectroscopy tools to analyze

Sharp tunnel barriers

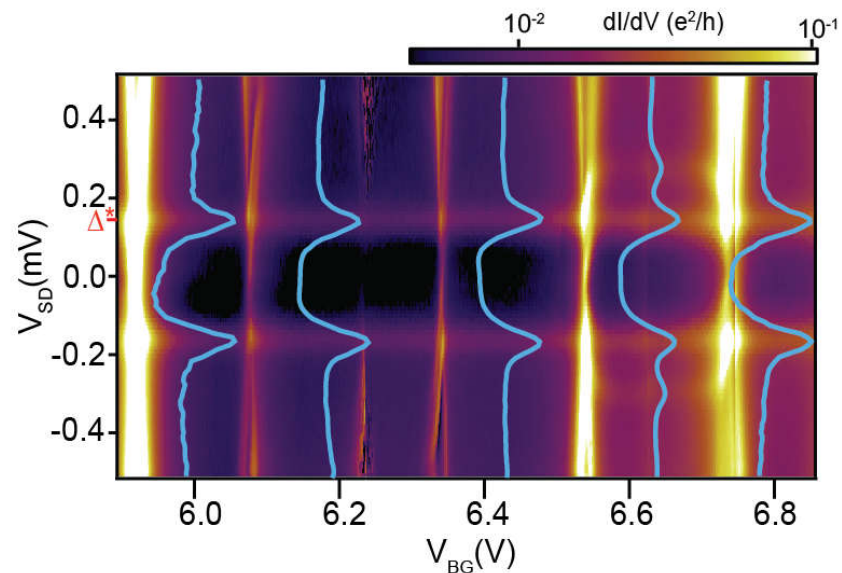
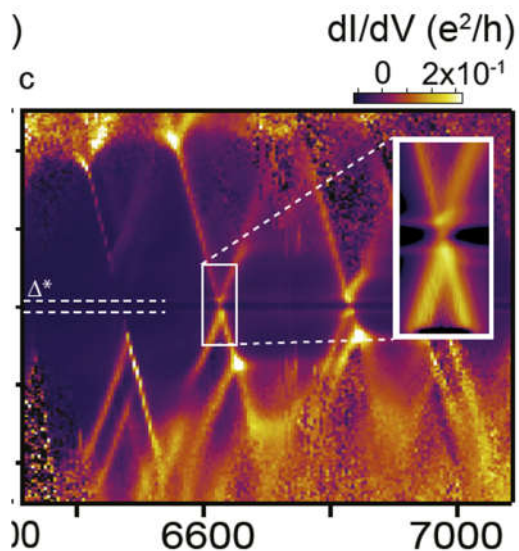
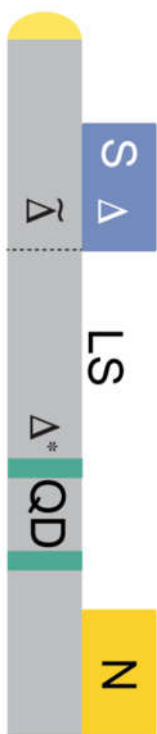
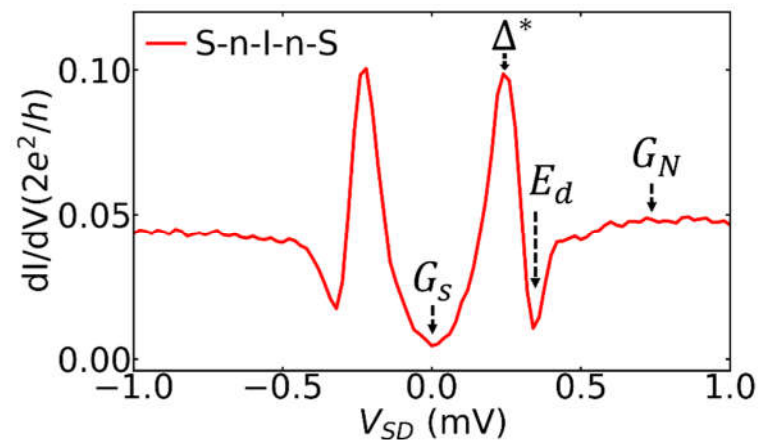
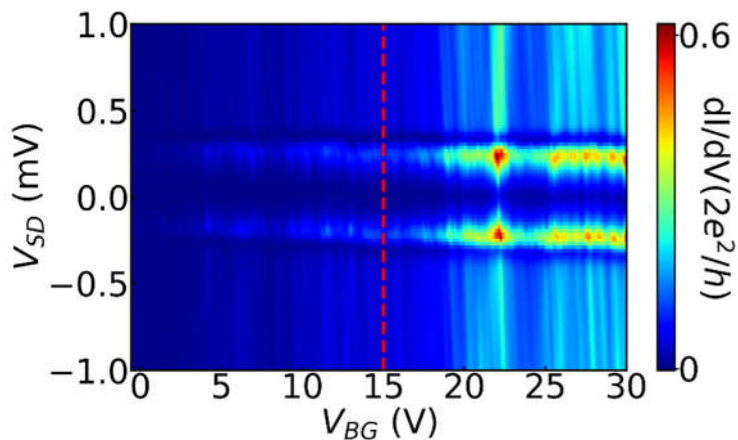
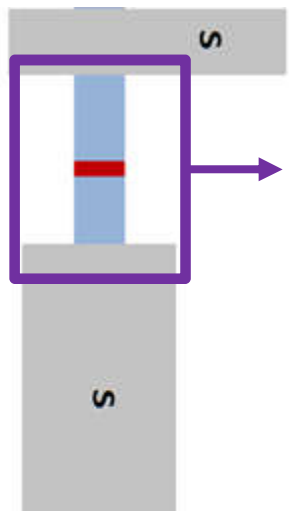


Gate defined tunnel barriers are not ideal

→ Growth of thin InP segments into InAs nanowires

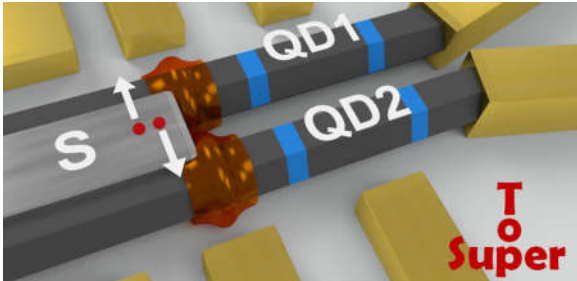
Tunnel barrier, Quantum dot etc.

Spectroscopy with InP barriers and QDots



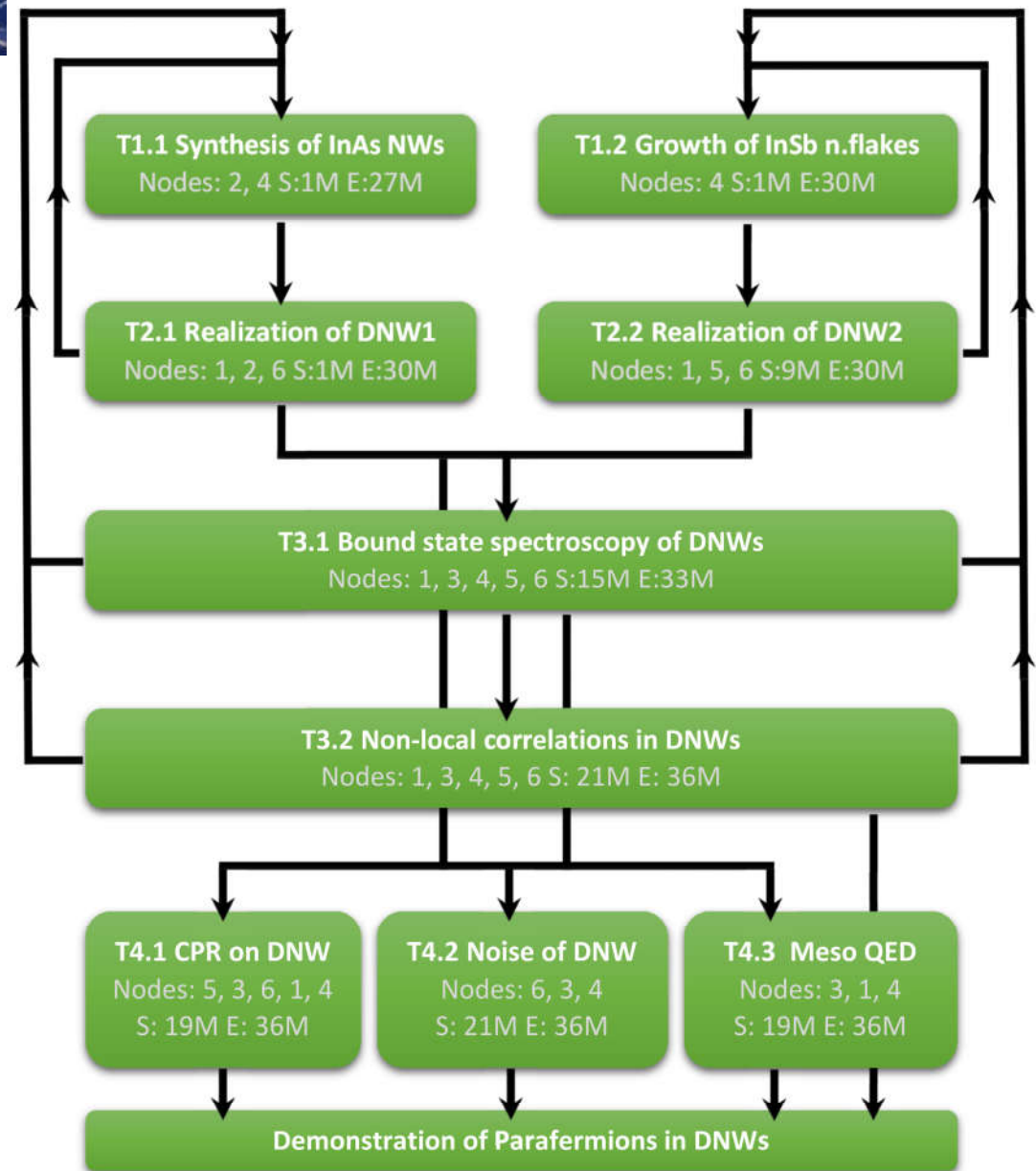
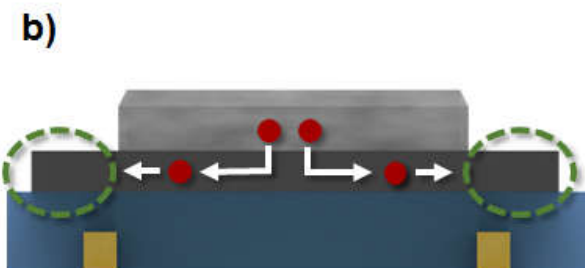
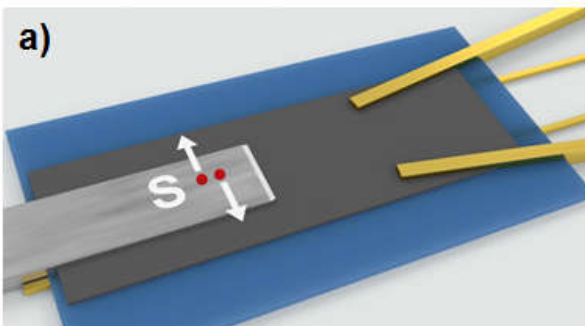
Structure of SuperTop

1D platform nanowires



2D platform

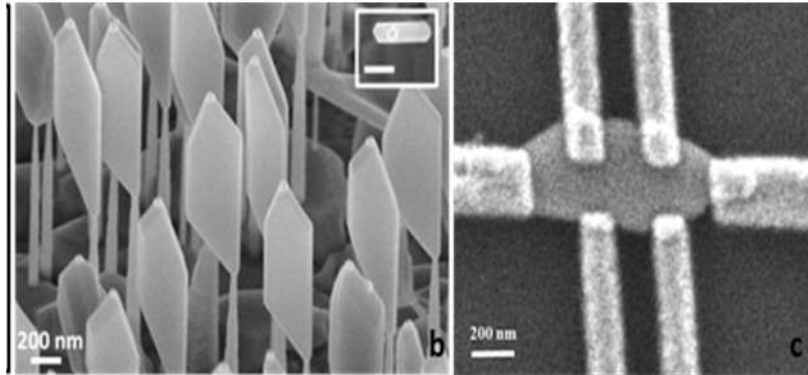
InSb nanoflakes, ...



J. Klinovaja, D. Loss PRB **90**, 045118 (2014)

2DEGs to engineer Double NW setup

InSb nanoflakes



Au assisted CBE with methalorganic precursors.

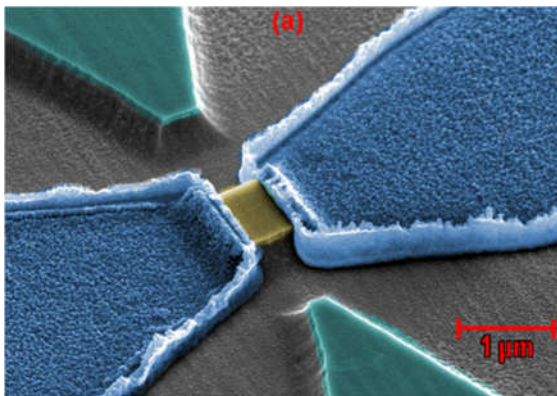
Length = $1.3\mu\text{m}$, width = 290 nm and thickness=100nm.

→ No proper size was achieved

Selective Area Epitaxy

SiO₂ hard mask on growth wafer. Still parameters need to be optimized

InAs quantum wells in 2DEGs



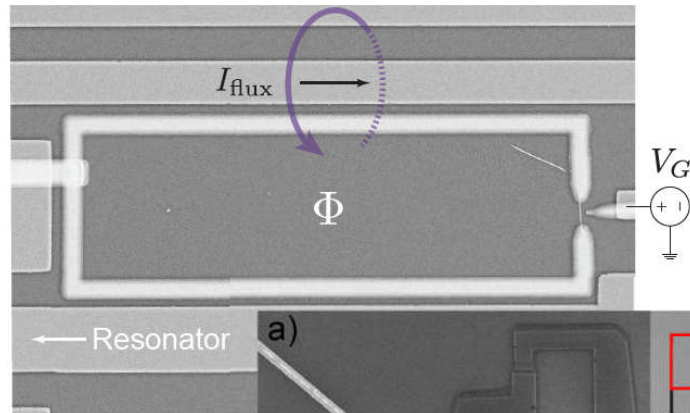
60nm under the surface,

$\mu \approx 2-3 \cdot 10^5 \text{cm}^2/\text{Vs}$

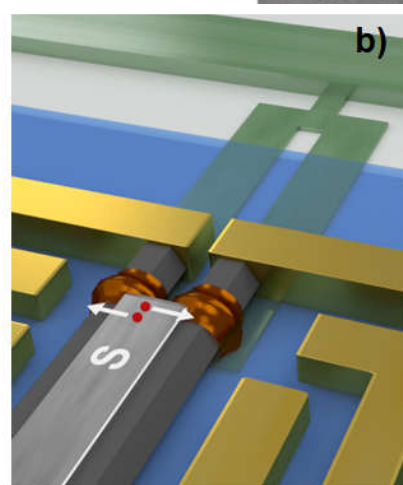
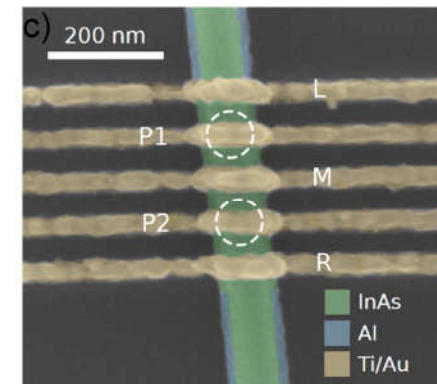
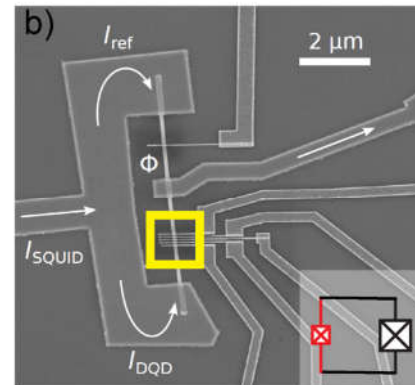
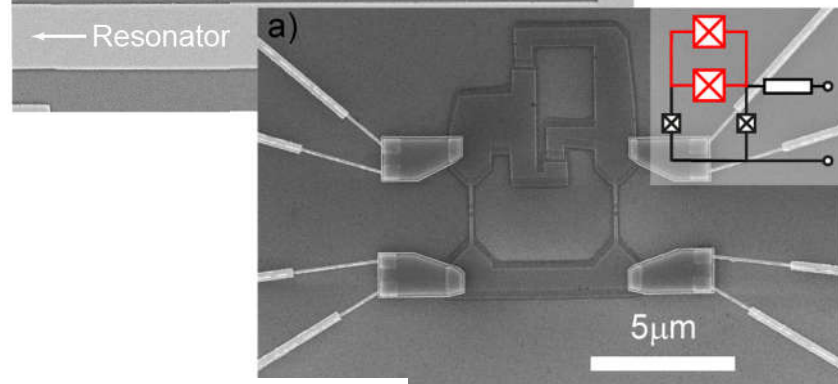
lack of a Schottky barrier → large transparency with Al and Nb SC films.

High frequency techniques to analyze

RF SQUID approach



Toolset for CPR measurements



Coupling to cavity QED.

Common effort of SuperTop and Dissemination

Team work: 18 meetings, 2 workshops

Mobility of human resources: >9 months!

Publications: >20, PRL, Nano Lett, 2 Nature Comm. Phys., Sci. Rep.

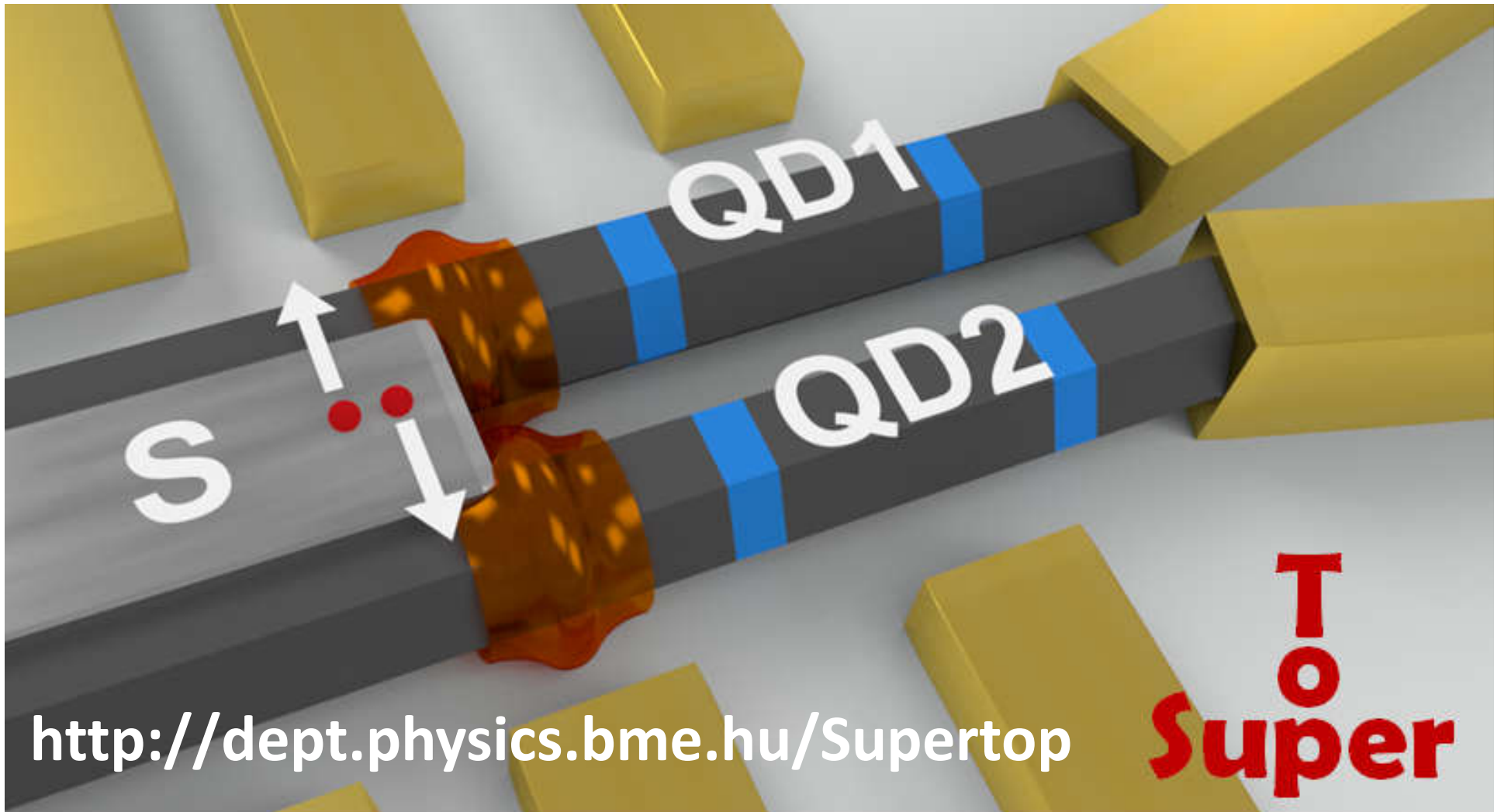
Presentations: Talks >34, Posters >20

Delivery Reports: 4

Various outreach activities: talks for general audience, science camps, lab visits, phd summer schools, ...

<http://dept.physics.bme.hu/Supertop>

Thank you for your attention!



<http://dept.physics.bme.hu/Supertop>

**T
o
Super**