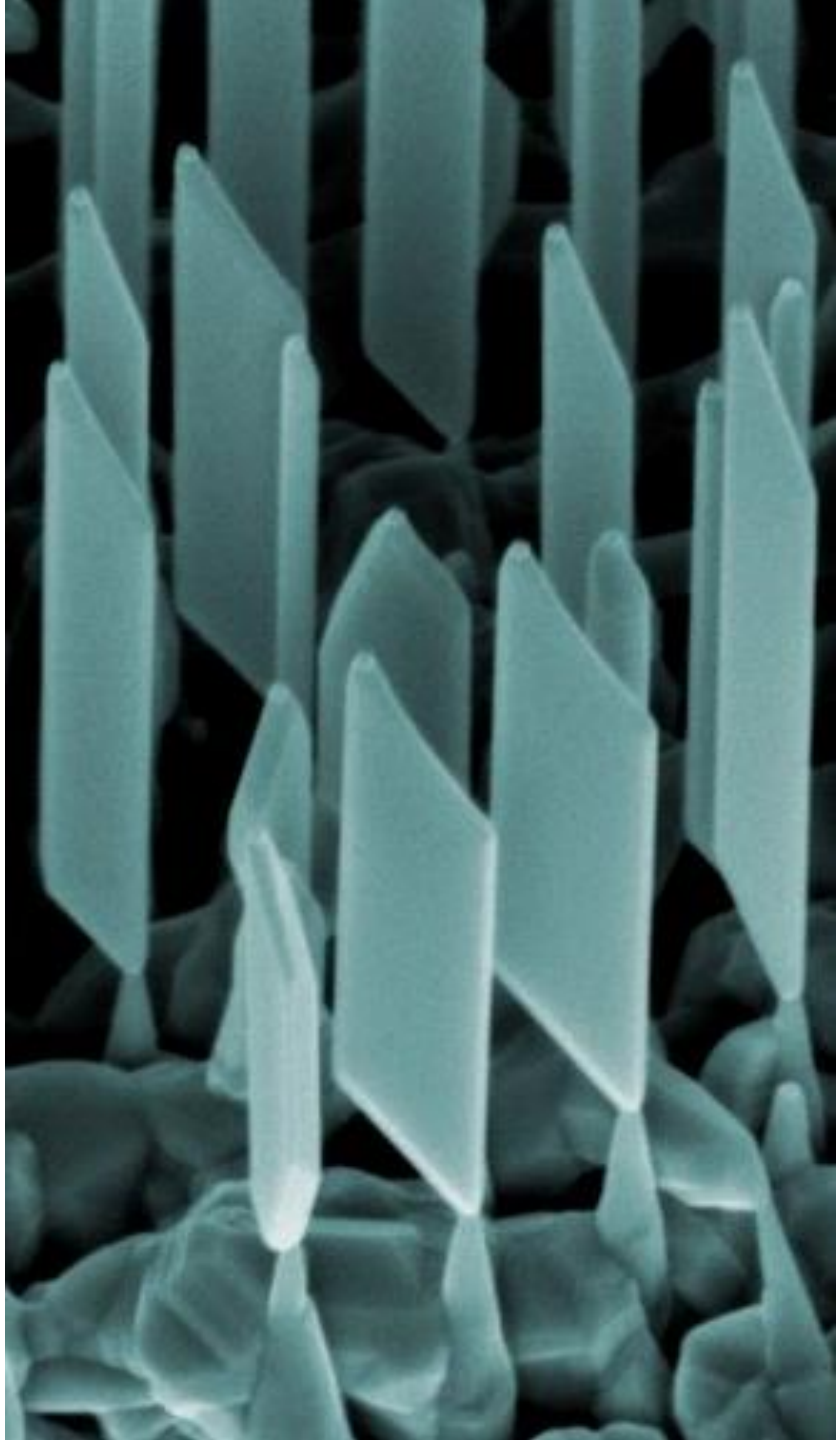
ICFO

Josephson Diode Effect in High-Mobility InSb Nanoflags

Bianca Turini

SCUOLA NORMALE SUPERIORE

CNR NANO PISA NEST



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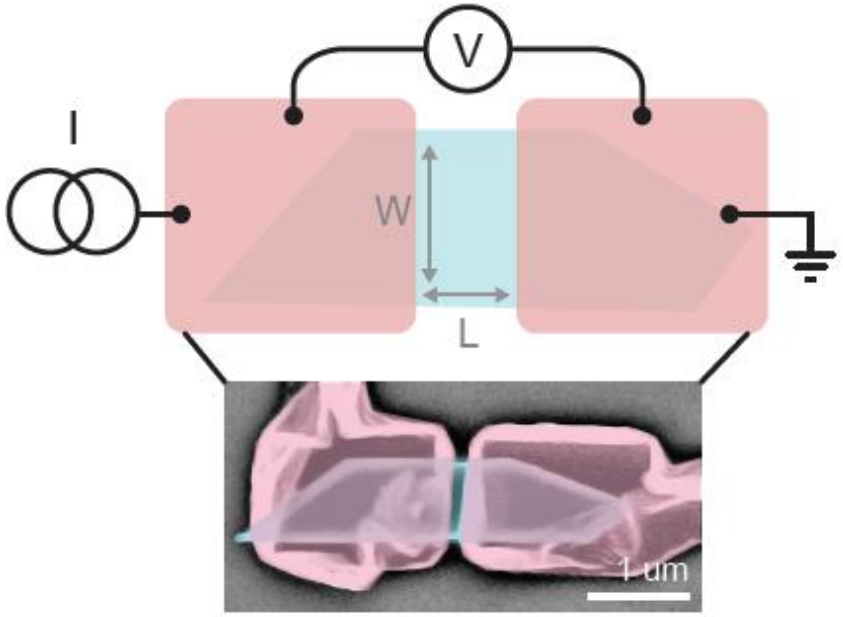

III-V semiconductor/superconductor hybrid system

Single-junction Josephson diode

SCUOLA NORMALE SUPERIORE

CNRNANO PISA NEST

Heun Lab

Sorba Lab

Giazotto Lab

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- InSb Nanoflags
- NF-based Josephson junctions
- Observation of the JDE

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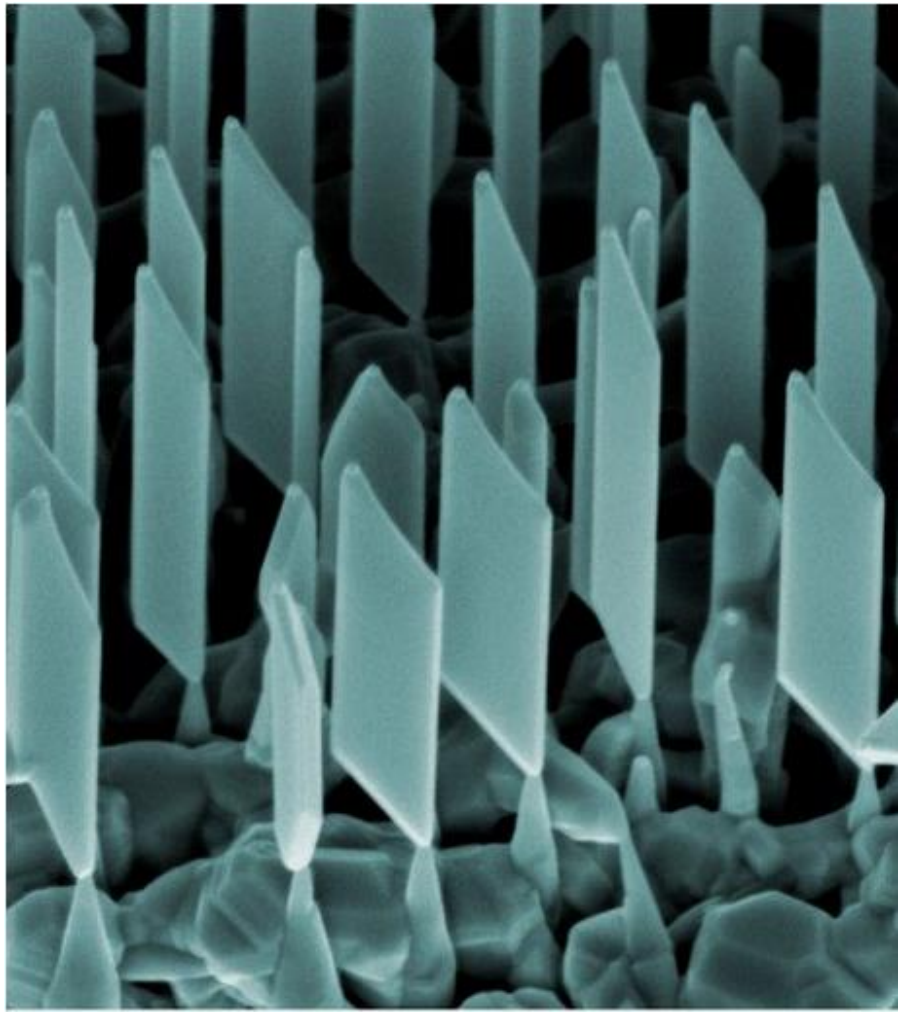
InSb is appealing for spintronics but challenging to grow 2D

Small bandgap E_g=0.23 eV

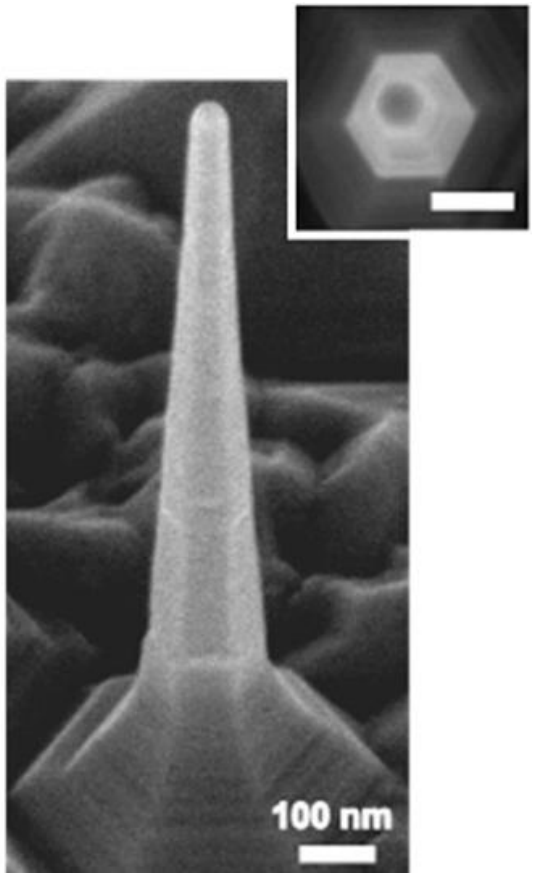
Low effective mass m/m_0 = 0.018

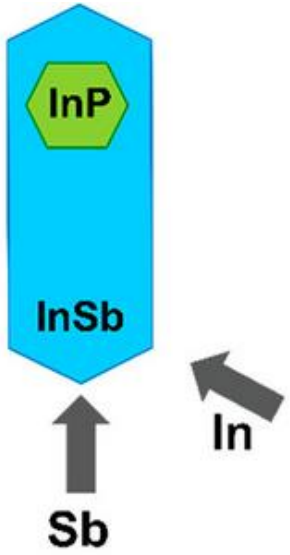
Strong SOC $E_{SOC} \sim 200\ \mu eV$

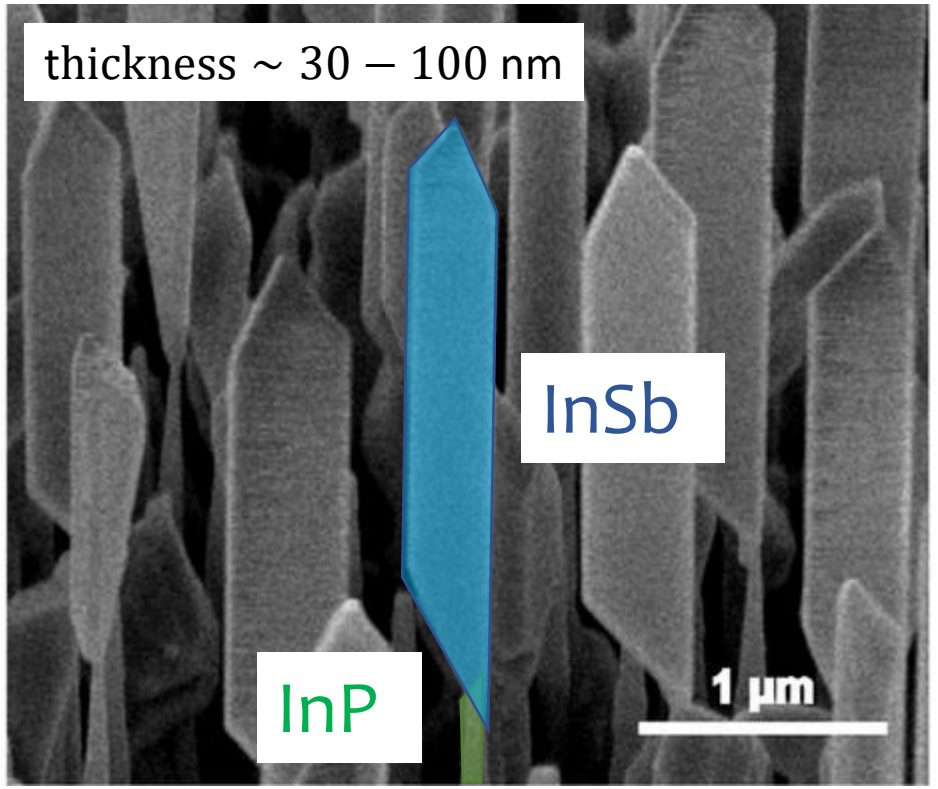


Nanoflags are grown via Chemical Beam Epitaxy

Dr. I. Verma





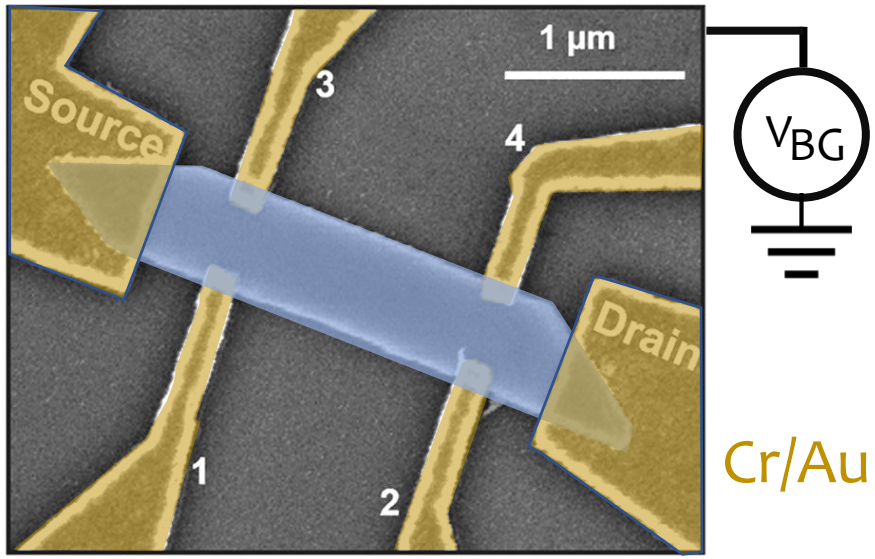


NFs show high mobility

Dr. S. Salimian

@ T = 4.2 K

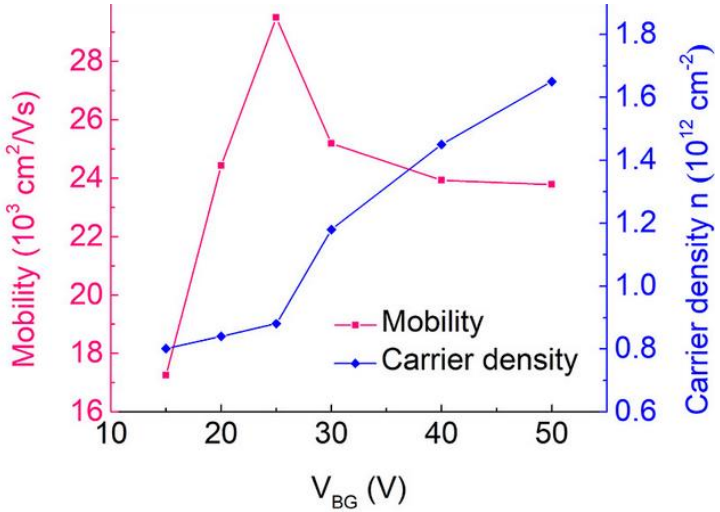
Cr/Au



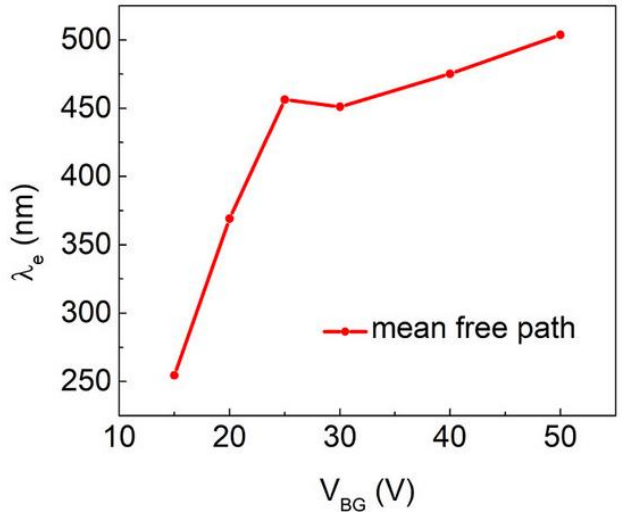
Cr/Au

@ T = 250 mK

$g^* \sim 44$



$\mu_e \sim 29500\ cm^2/Vs$



$\lambda_{mfp} \sim 500\ nm$

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- InSb Nanoflags

  I. Verma *et al.*, *ACS ANM* (2021)

  gate-tunability
  high-mobility
  giant g*-factor

- NF-based Josephson junctions

- Observation of the JDE

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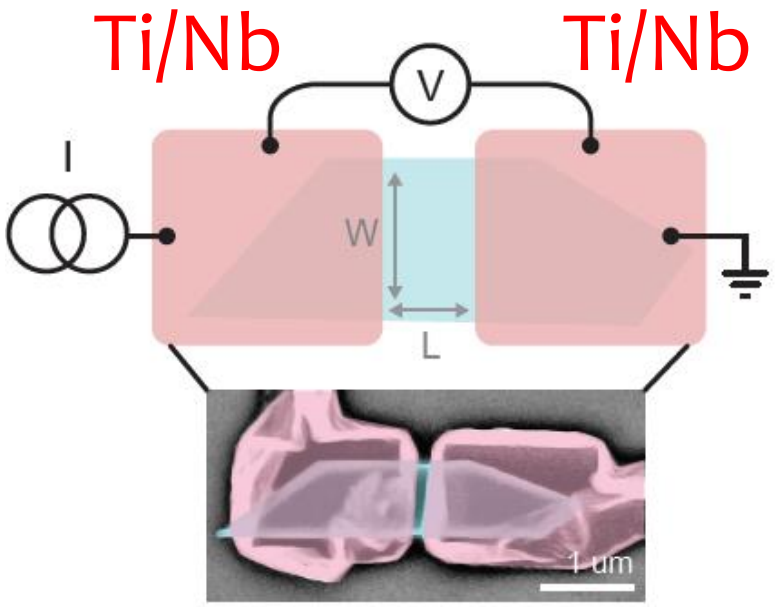
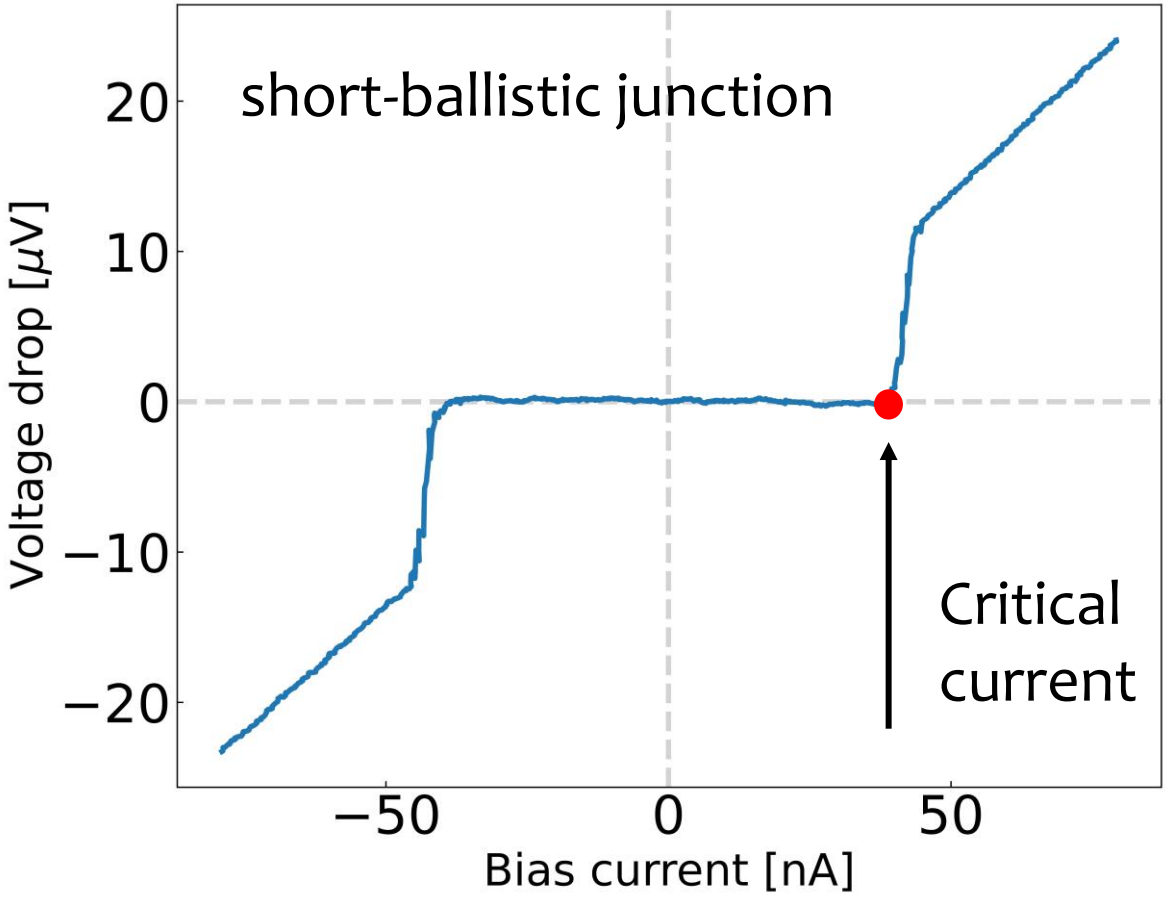
The device shows supercurrent

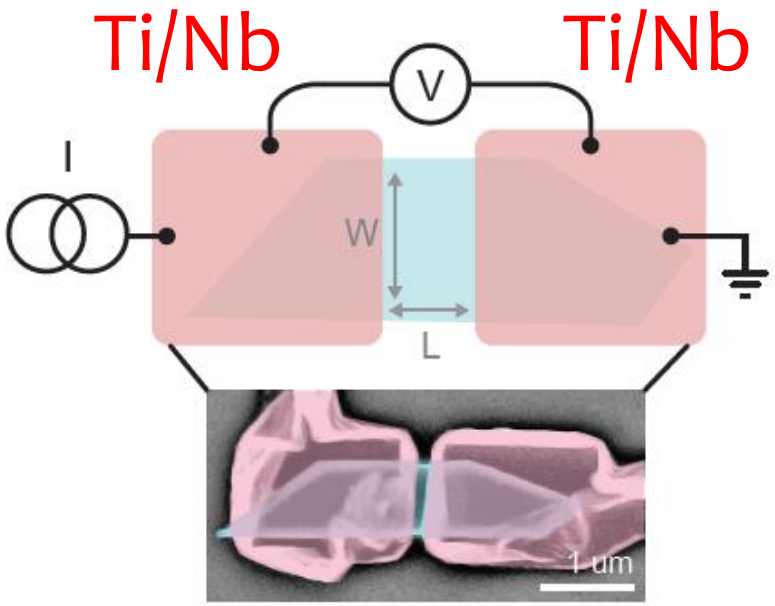


λ_{mfp}	500 nm
L	200 nm
ξ_S	750 nm



The device shows gate-tunable supercurrent

(Golubov & Kupriyanov, 2005)



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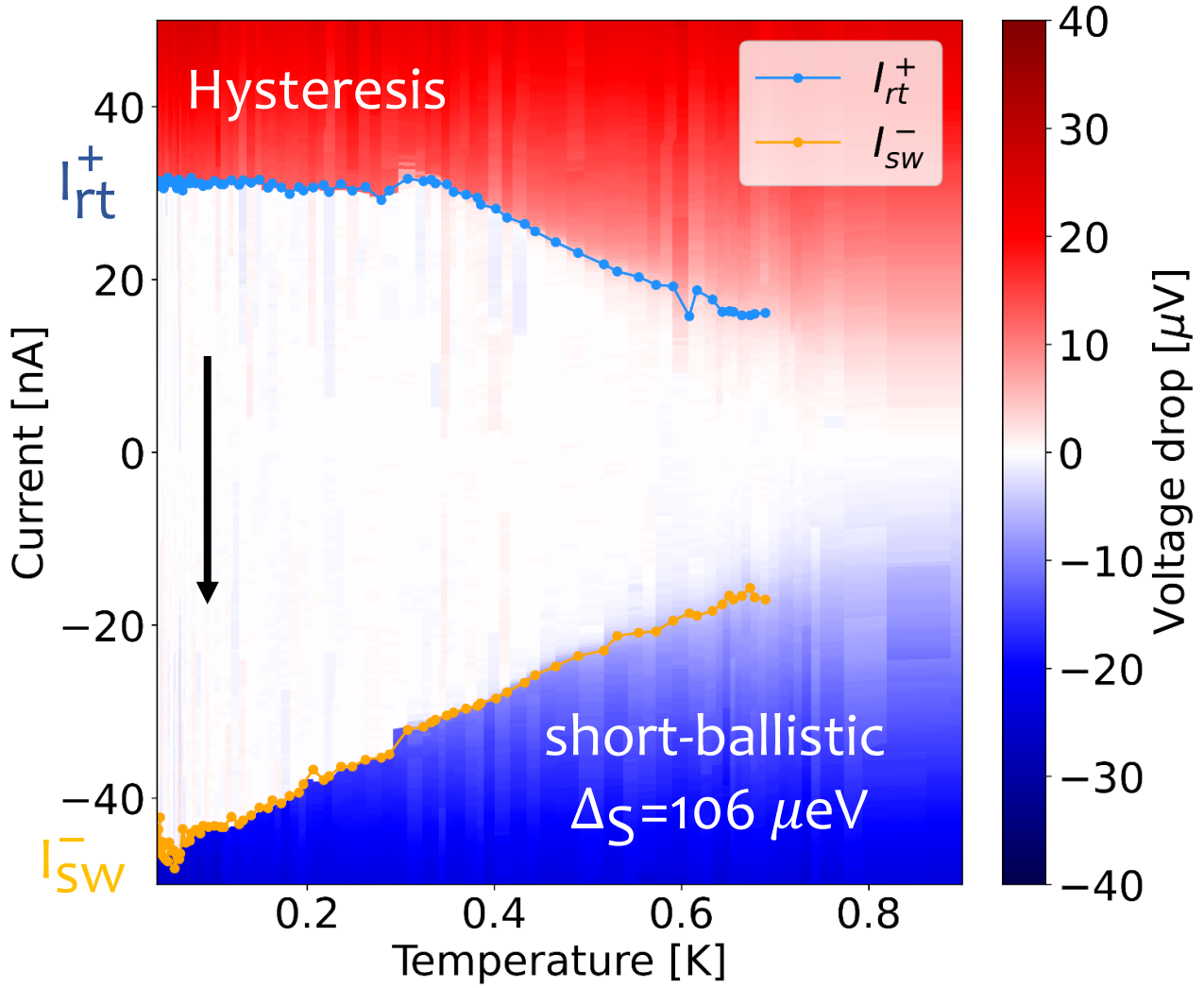

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InSb Nanoflags

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high-mobility
giant g*-factor

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S. Salimian *et al.*, APL (2021)

short-ballistic
$\Delta_s \sim E_{soc}$

Observation of the JDE

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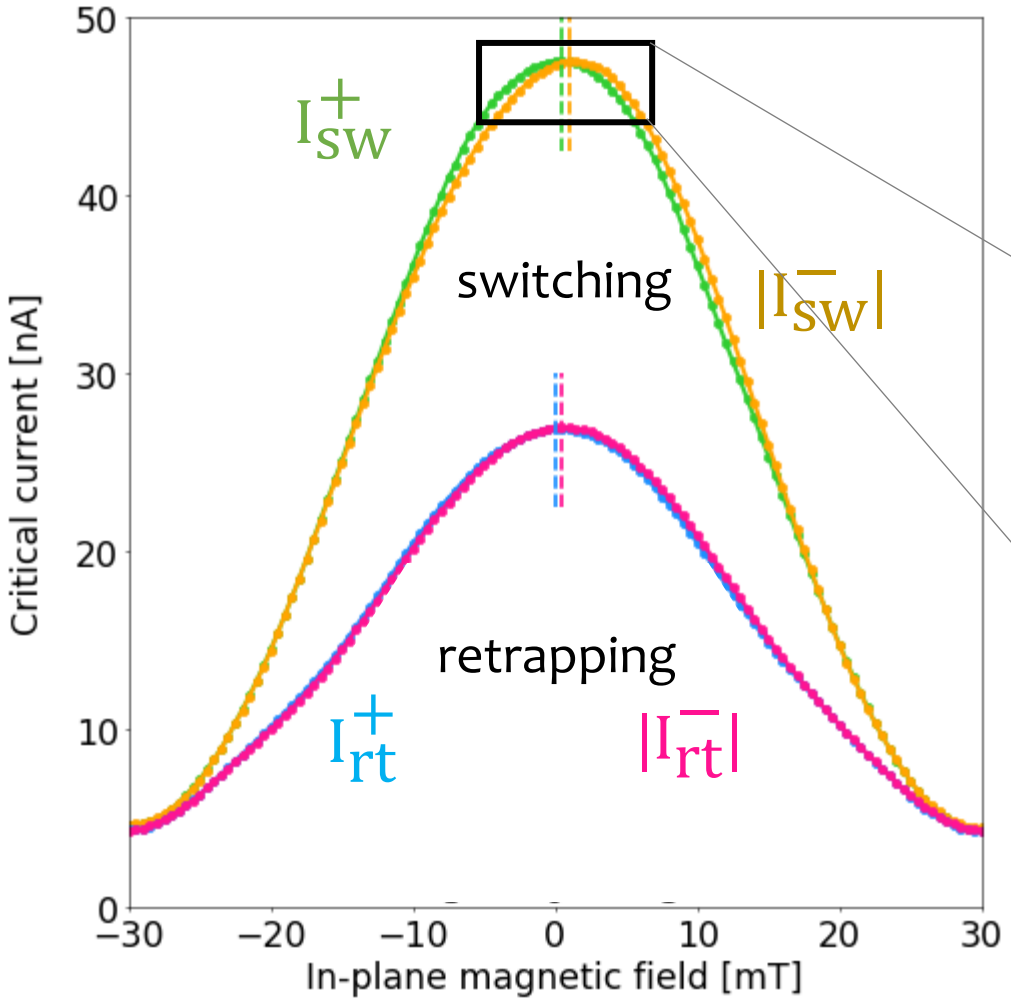
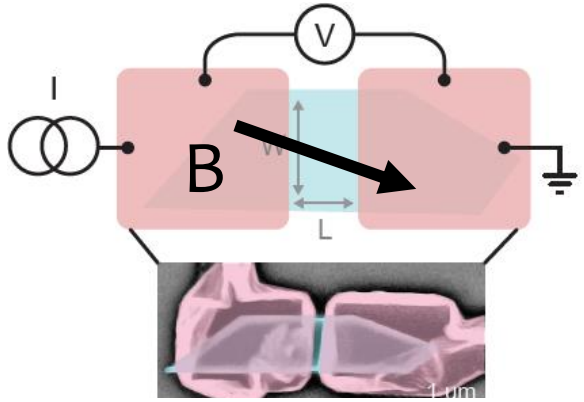
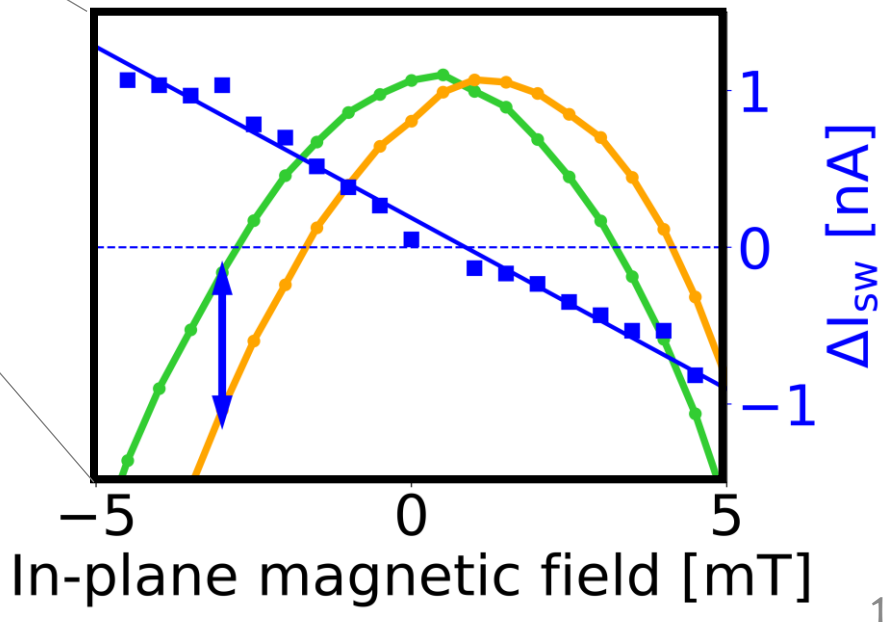
Observation of the JDE

JDE is driven by the magnetic field

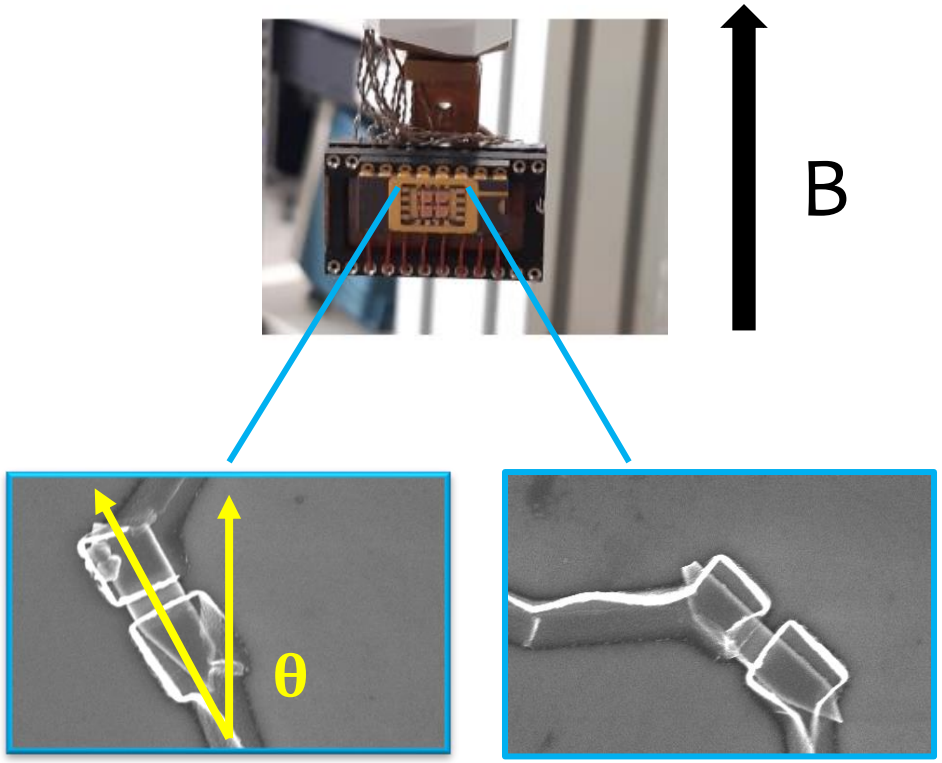


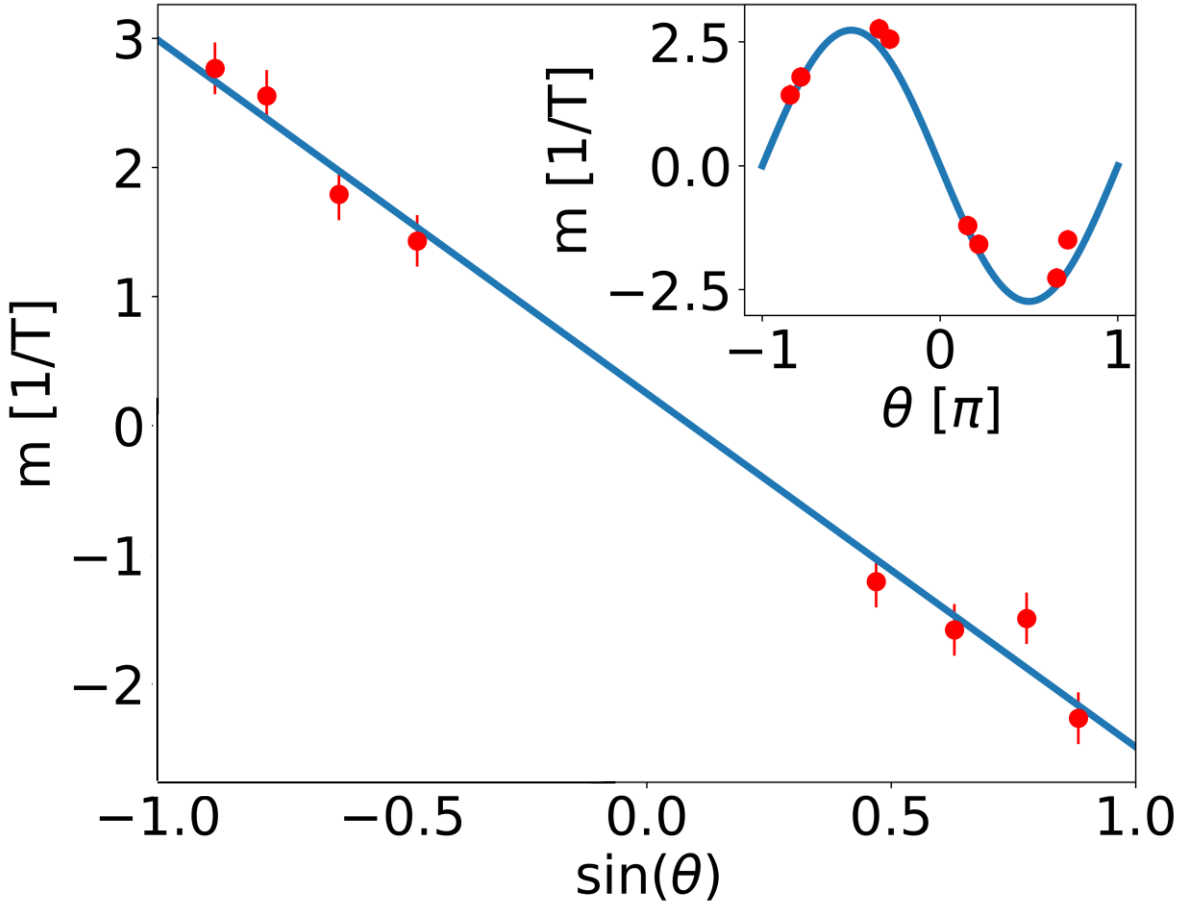




JDE depends on the in-plane angle

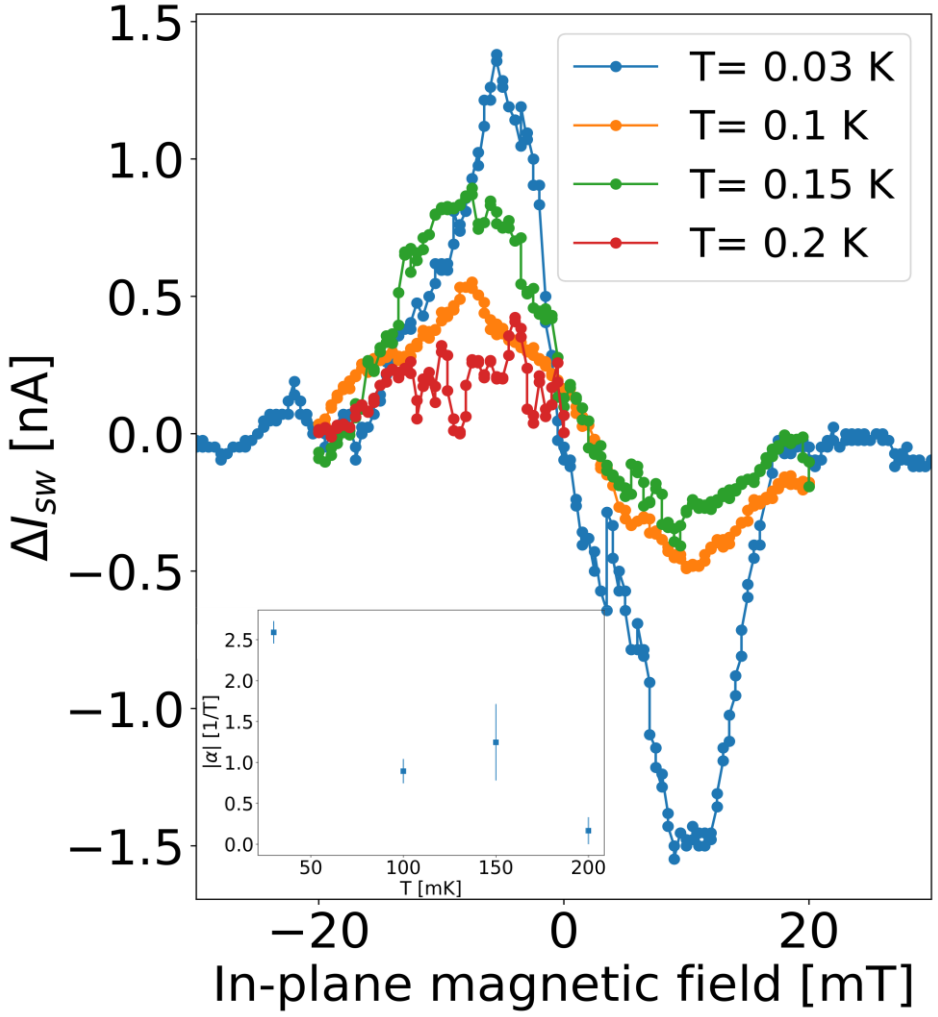
Rasmussen *et al.*, PRB (2016)

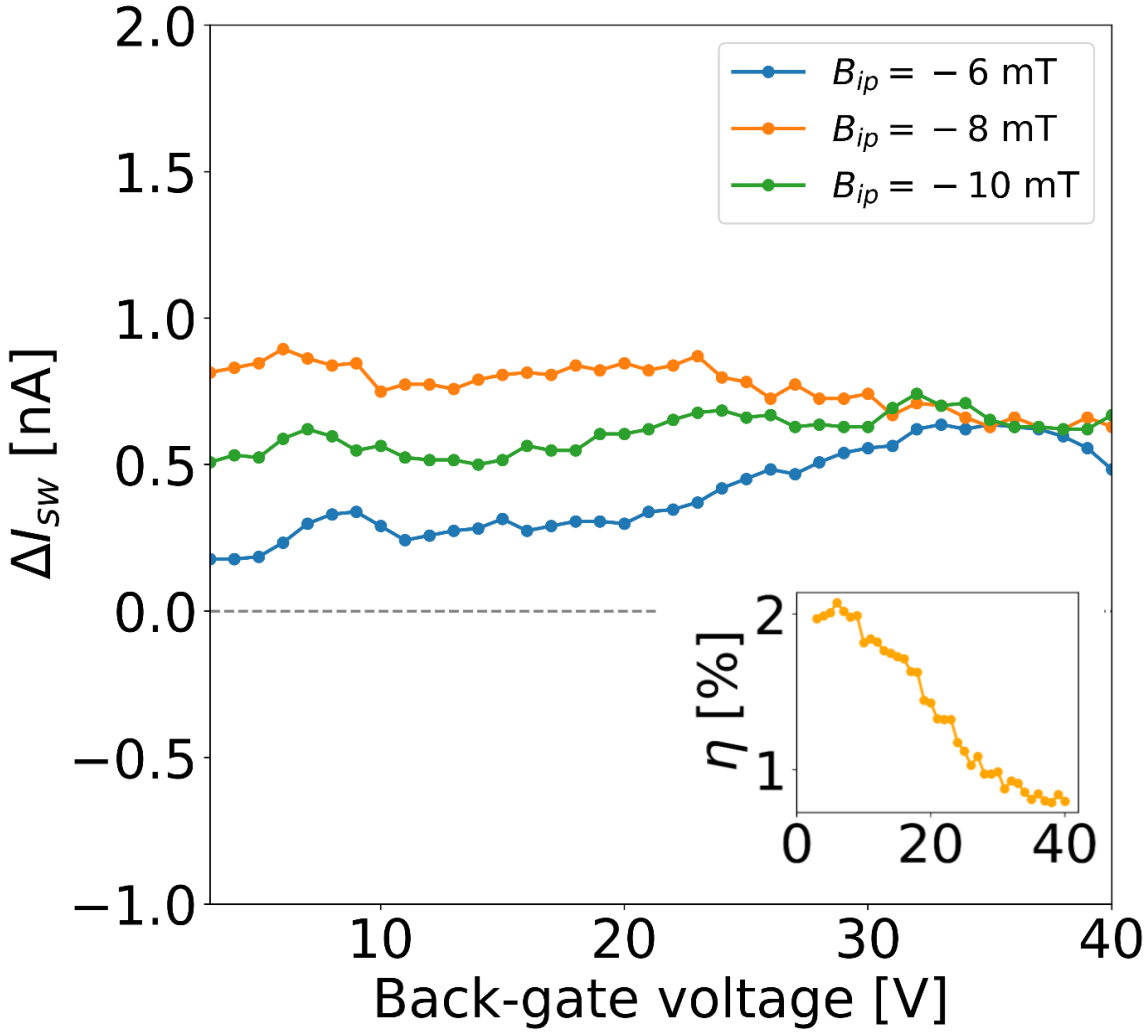




JDE depends on temperature and back-gate voltage

$\eta = \Delta I_{sw} / (I_c^+ + I_c^-)$





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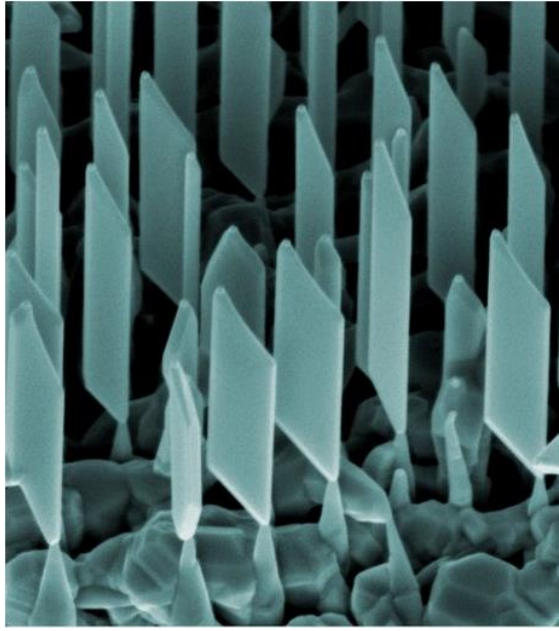

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$\Delta_S \sim E_{SOC}$

Observation of the JDE

B. Turini *et al.*, Nano Lett. (2021)

field-induced JDE
Rashba-type system
gate-dependent η

Josephson Diode Effect in High-Mobility InSb Nanoflags

AndQC

SUPERTED

SUPER GATE

Growth

V. Zannier

I. Verma

L. Sorba

Fab

S. Salimian

Theory

M. Carrega

NF growth
ACS ANM
(2021)

NF-based JJs
APL
(2021)

Transport

F. Paolucci

A. Iorio

E. Strambini

F. Giazotto

S. Heun

JDE in InSb Nanoflags
Nano Lett. (2022)