Coulomb Blockade in an Open Quantum Dot

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We report the observation of Coulomb blockade in a quantum dot contacted by two quantum point contacts each with a single fully transmitting mode, a system thought to be well described without invoking Coulomb interactions. Below 50 mK we observe a periodic oscillation in the conductance of the dot with gate voltage, corresponding to a residual quantization of charge. From the temperature and magnetic field dependence, we infer the oscillations are mesoscopic Coulomb blockade, a type of Coulomb blockade caused by electron interference in an otherwise open system.

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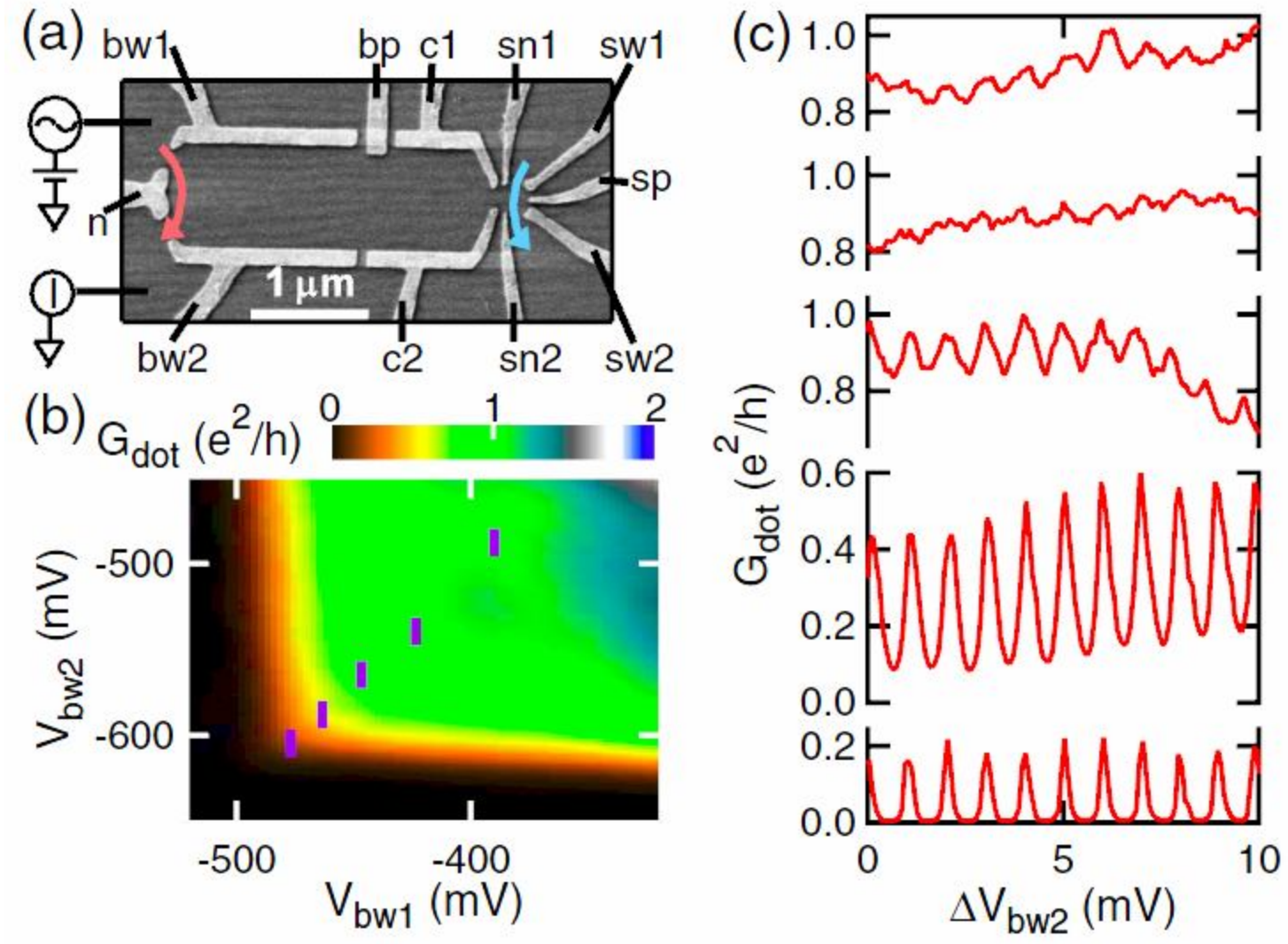
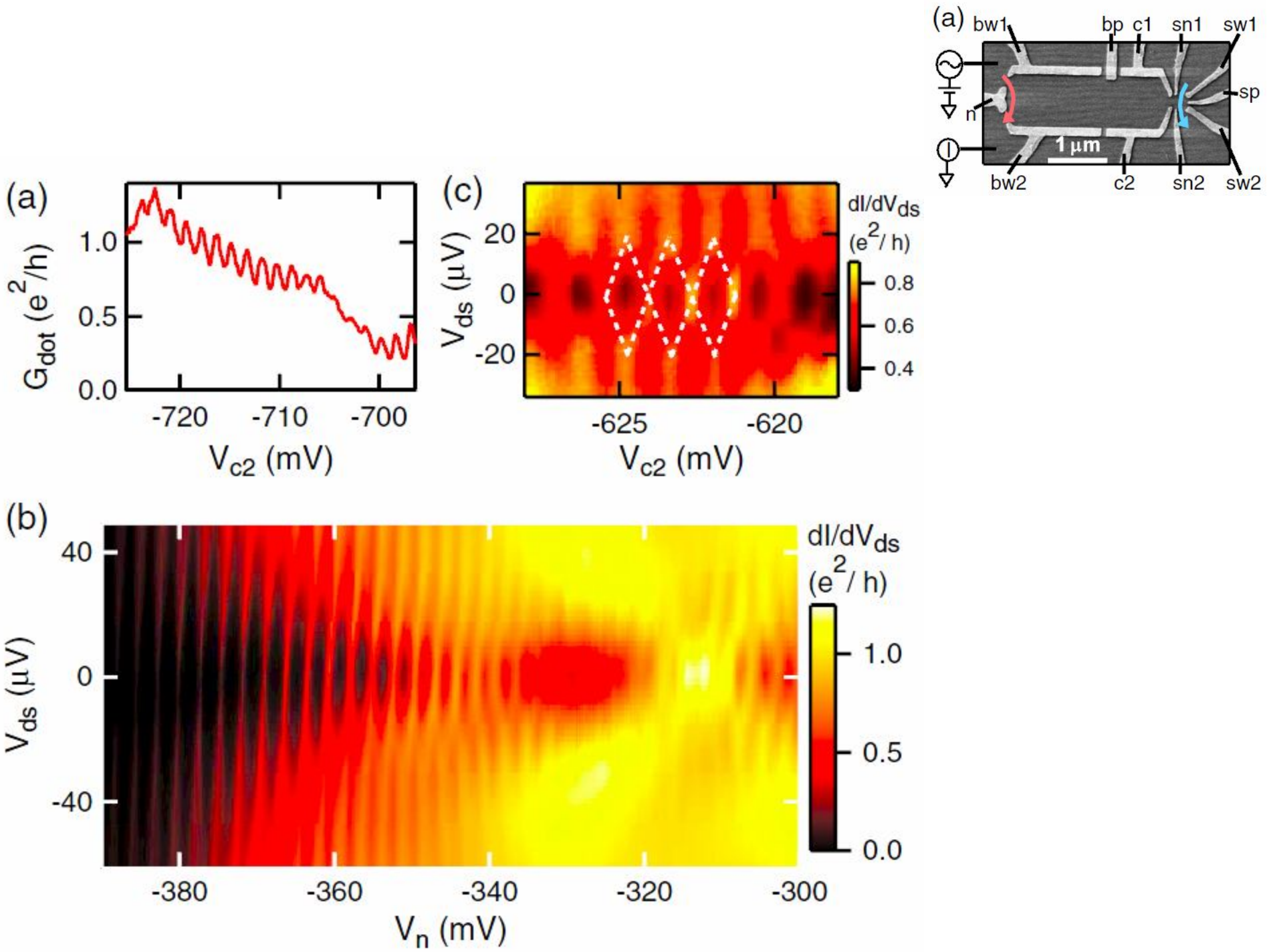
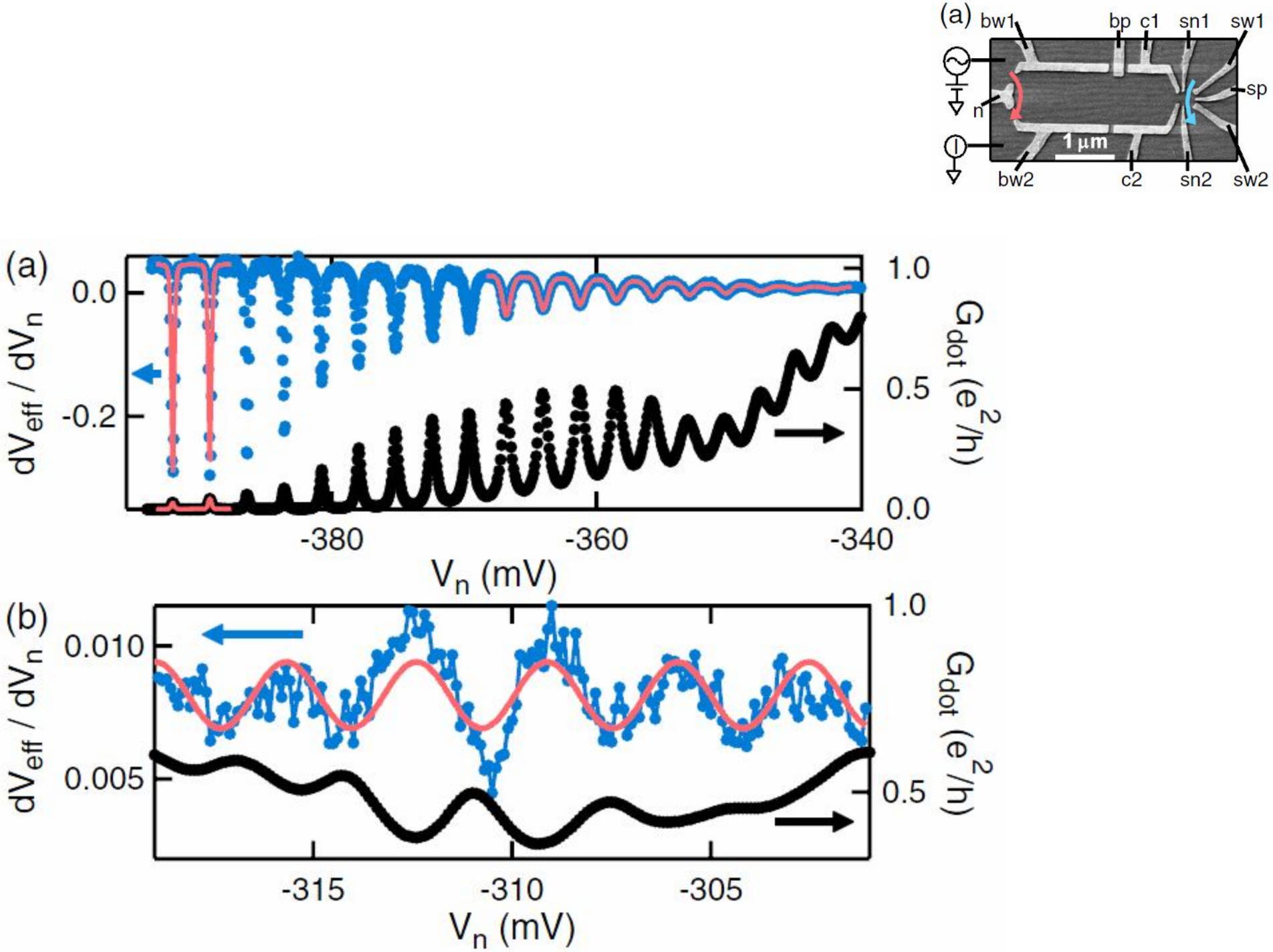
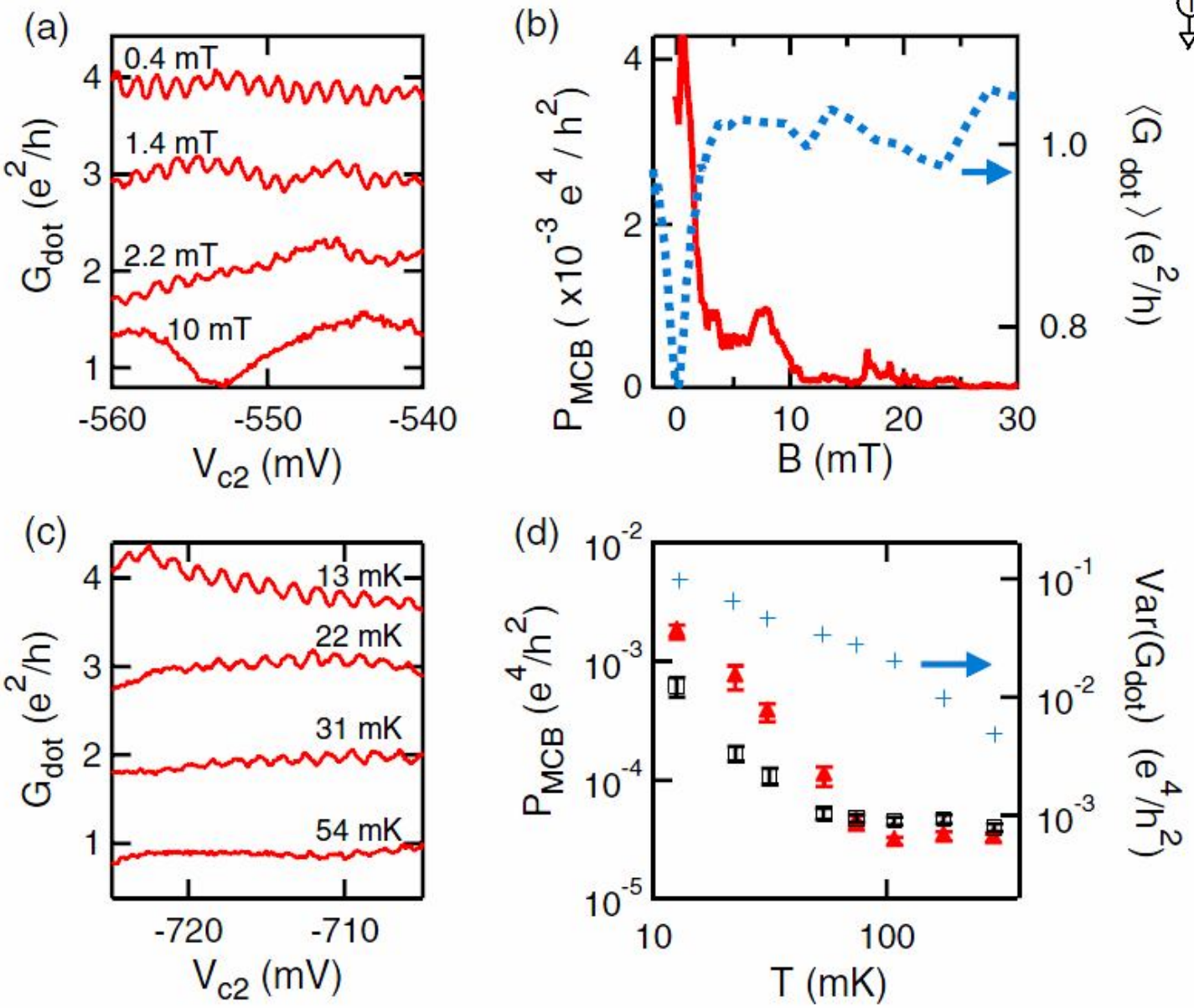
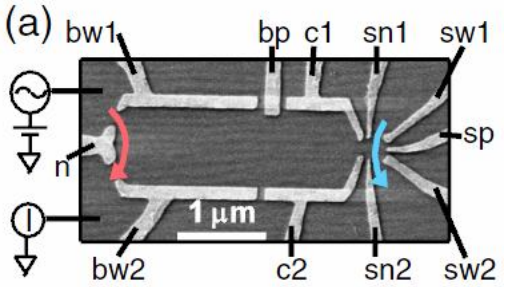

(a)
bw1
bp
c1
sn1
sw1
sp
n
1 μm
bw2
c2
sn2
sw2
(b)
G_dot (e^2/h)
0
1
2
V_bw2 (mV)
-500
-600
-500
-400
V_bw1 (mV)
(c)
1.0
0.8
1.0
0.8
1.0
0.8
0.6
0.4
0.2
0.0
0.2
0.0
G_dot (e^2/h)
0
5
10
ΔV_bw2 (mV)


(a)
bw1
bp
c1
sn1
sw1
sp
n
1 µm
bw2
c2
sn2
sw2
(a)
G_{dot} (e^2/h)
1.0
0.5
0.0
-720
-710
-700
V_{c2} (mV)
(c)
V_{ds} (µV)
20
0
-20
-625
-620
V_{c2} (mV)
dI/dV_{ds}
(e^2/ h)
0.8
0.6
0.4
(b)
V_{ds} (µV)
40
0
-40
-380
-360
-340
-320
-300
V_n (mV)
dI/dV_{ds}
(e^2/ h)
1.0
0.5
0.0


(a)
bw1
bp
c1
sn1
sw1
sp
n
1 µm
bw2
c2
sn2
sw2
(a)
0.0
-0.2
dV_eff / dV_n
1.0
0.5
0.0
G_dot (e^2/h)
-380
-360
-340
V_n (mV)
(b)
0.010
0.005
dV_eff / dV_n
1.0
0.5
G_dot (e^2/h)
-315
-310
-305
V_n (mV)


(a)
0.4 mT
1.4 mT
2.2 mT
10 mT
G_{dot} (e^2/h)
V_{c2} (mV)
(b)
P_{MCB} (x10^{-3} e^4/h^2)
$\langle G_{dot} \rangle$ (e^2/h)
B (mT)
(c)
13 mK
22 mK
31 mK
54 mK
G_{dot} (e^2/h)
V_{c2} (mV)
(d)
P_{MCB} (e^4/h^2)
Var(G_{dot}) (e^4/h^2)
T (mK)


(a)
bw1
bp
c1
sn1
sw1
sp
n
1 µm
bw2
c2
sn2
sw2