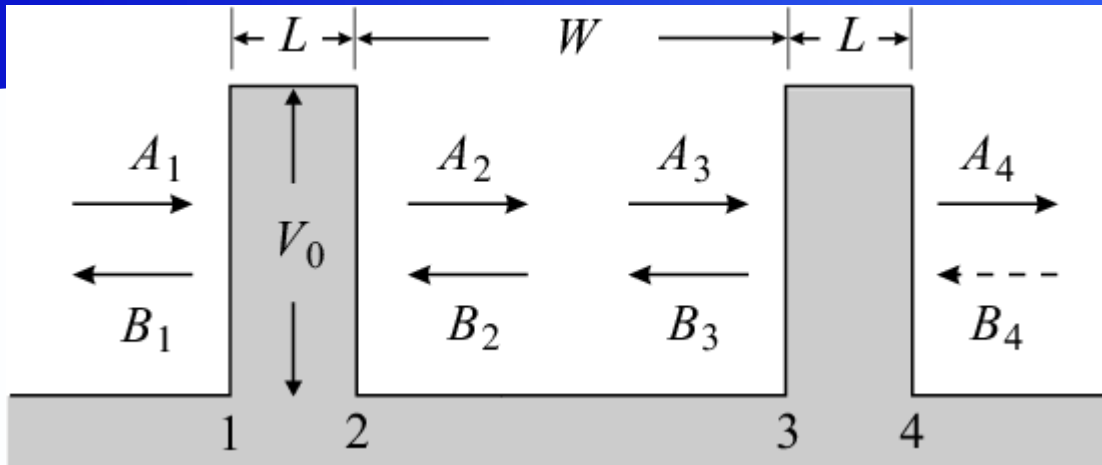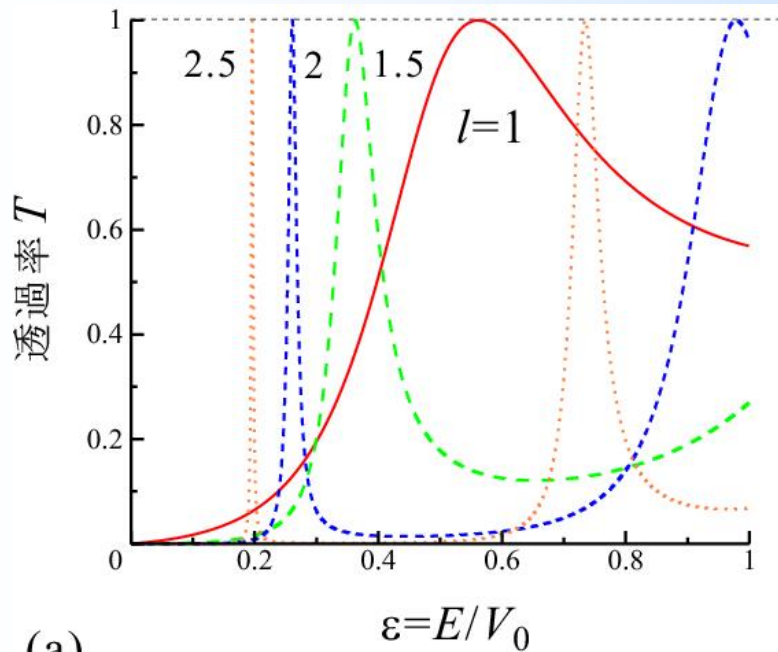# Physics of Semiconductors (11)

Shingo Katsumoto

Institute for Solid State Physics,

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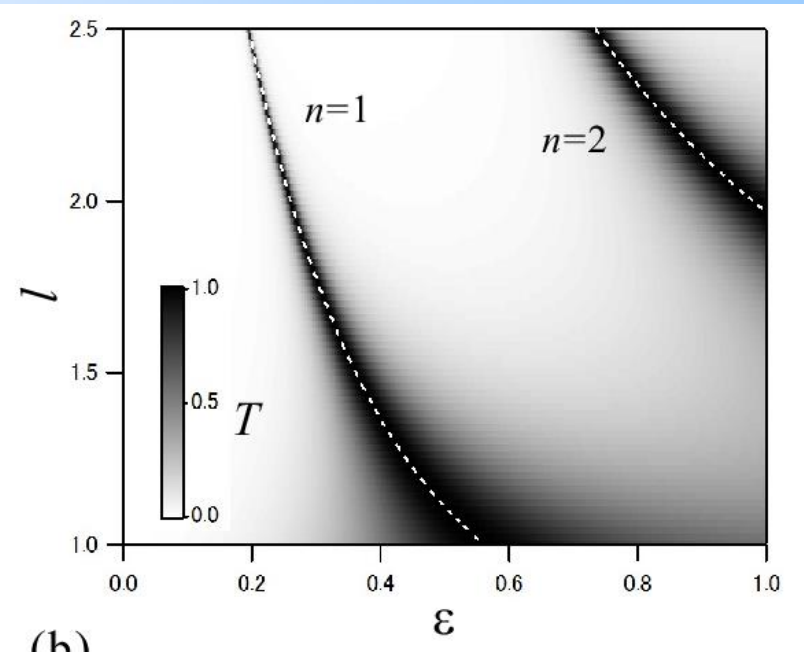
2013/6/25

Double barrier diode

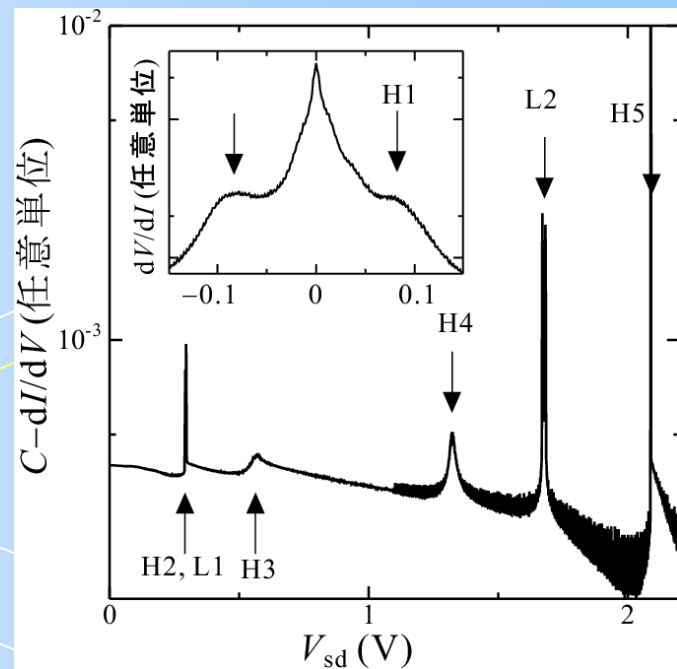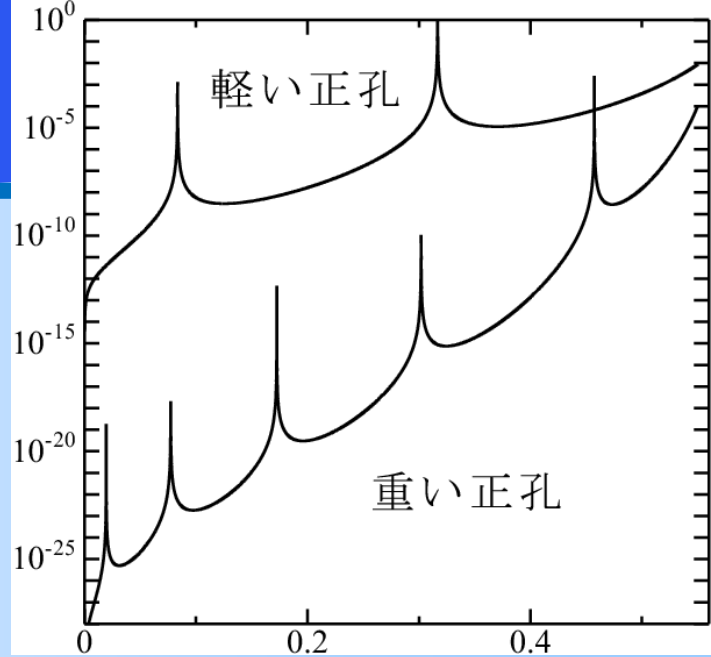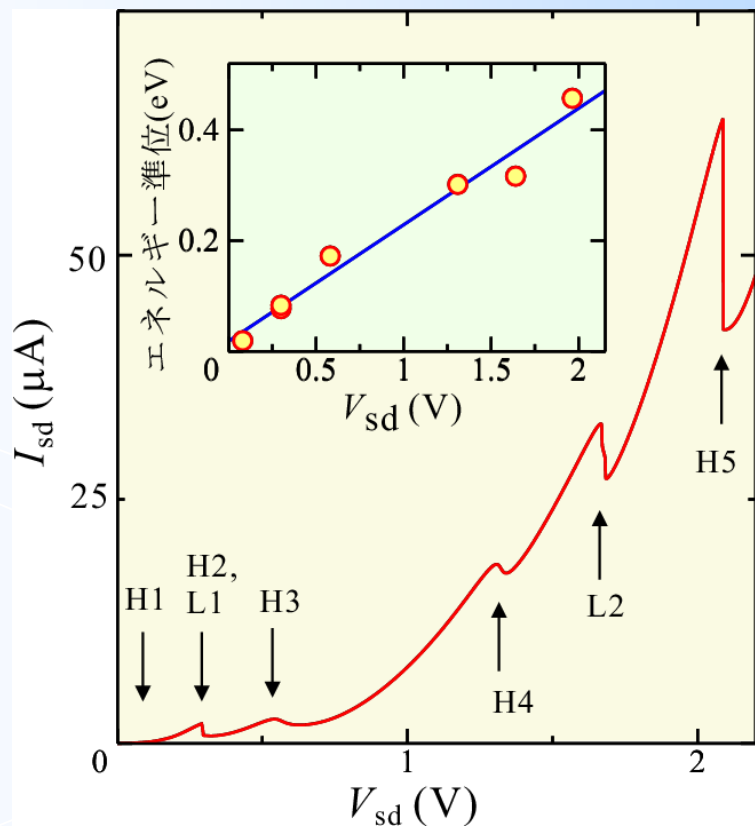$$l \equiv \frac{\sqrt{2mV_0}}{\hbar}L$$

(a)
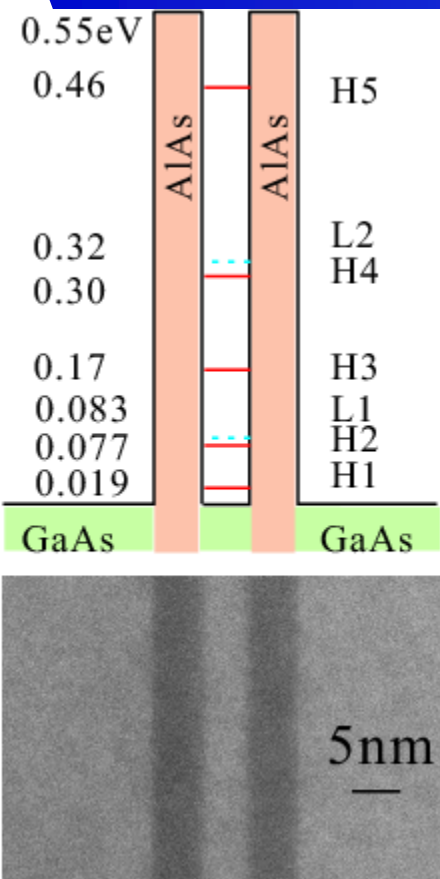
(b)

Double barrier diode:
an exepeiment

0.55eV
0.46 — H5
0.32 — L2
0.30 — H4
0.17 — H3
0.083 — L1
0.077 — H2
0.019 — H1

AlAs AlAs

GaAs GaAs

5nm

軽い正孔

重い正孔

I_{sd} (μA)

エネルギー準位(eV)

V_{sd} (V)

H1 H2, L1 H3 H4 L2 H5

V_{sd} (V)

$C-dI/dV$ (任意単位)

dV/dI (任意単位)

H1

L2 H5

H4

H2, L1 H3

V_{sd} (V)

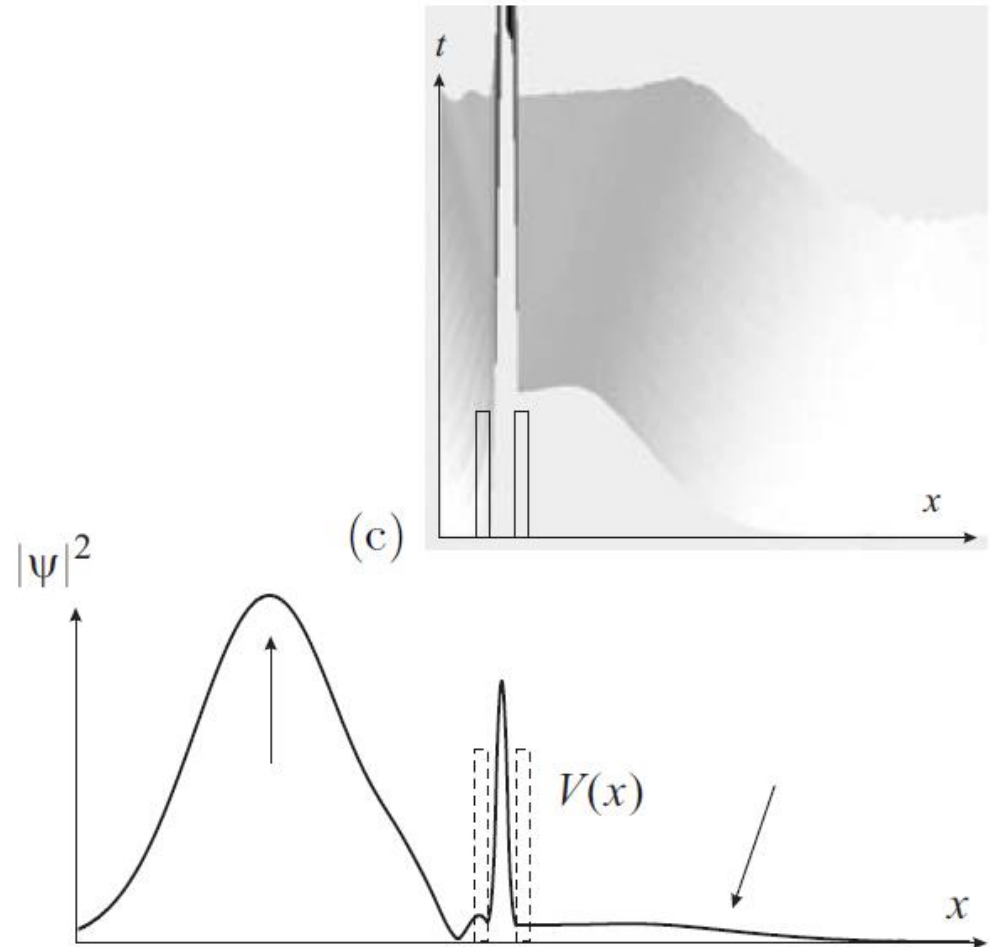# Collision of a wave packet to a potential barrier
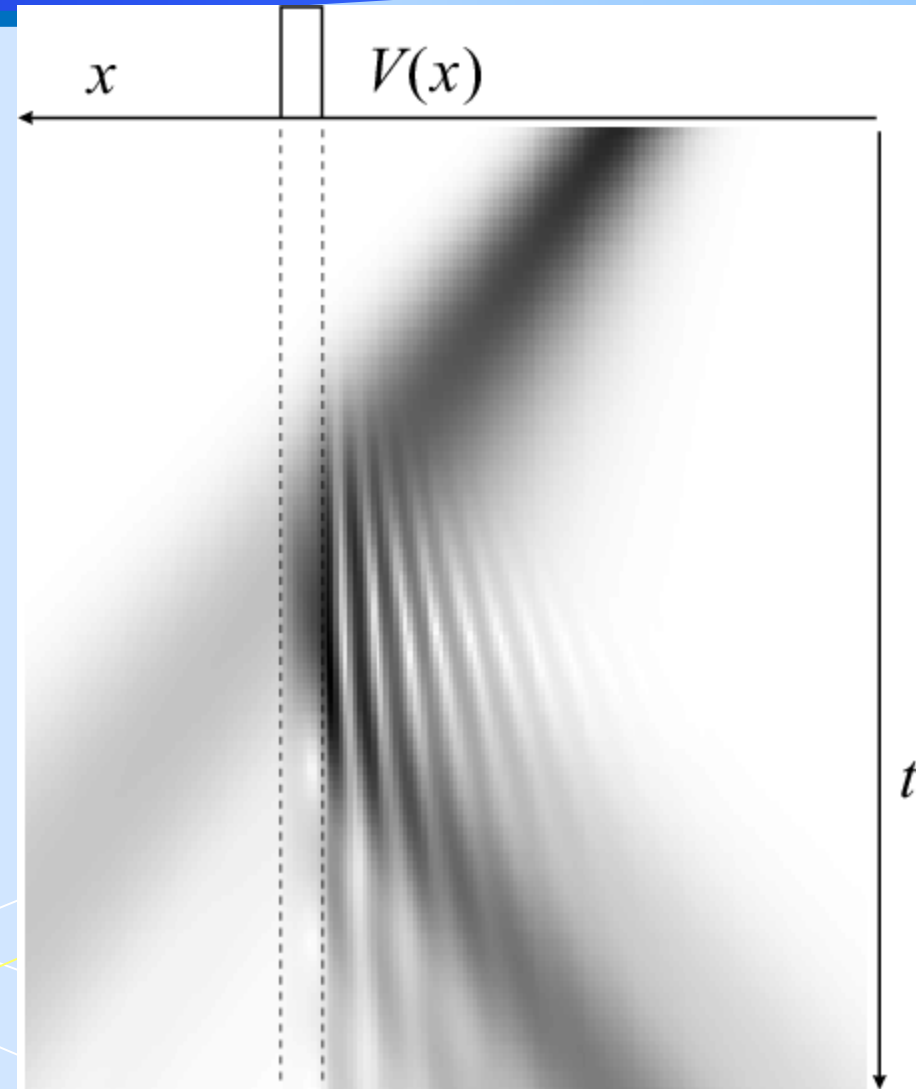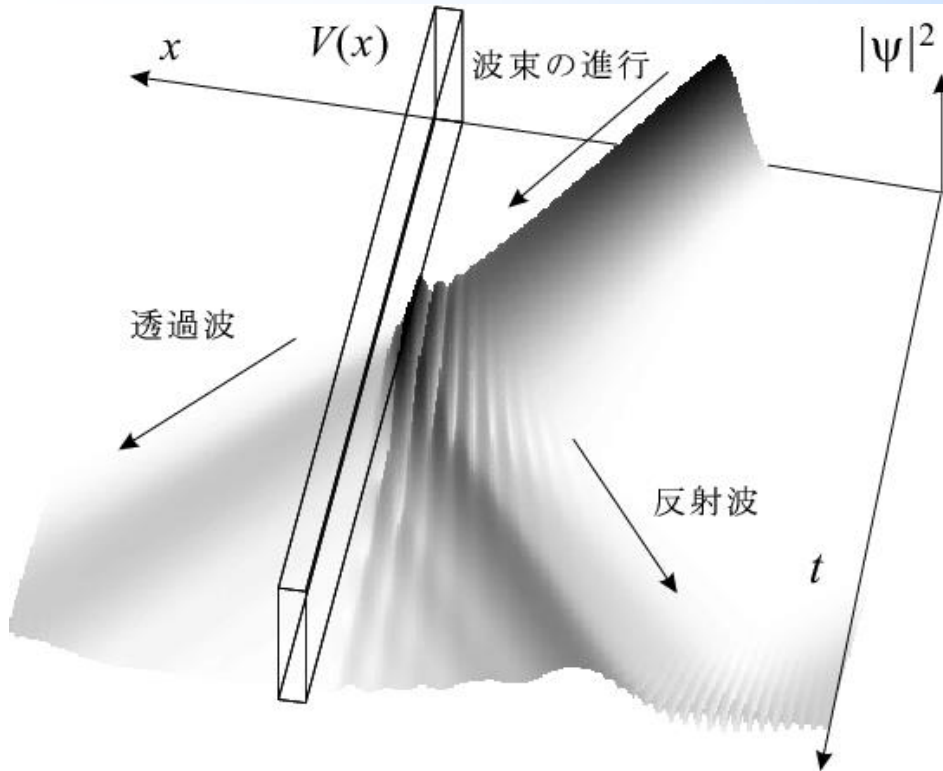
Collision of a wave packet to a double barrier

(a)

反射波

進行波

準定在波

$V(x)$

t

x

(b)

$|\psi|^2$

$V(x)$

x

(c)

t

x
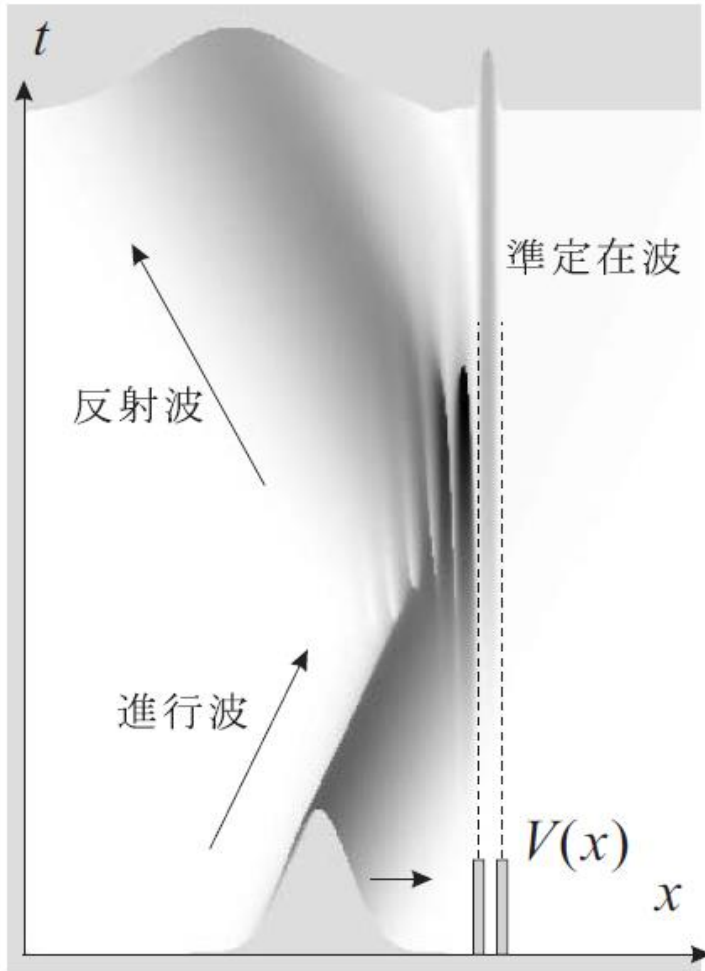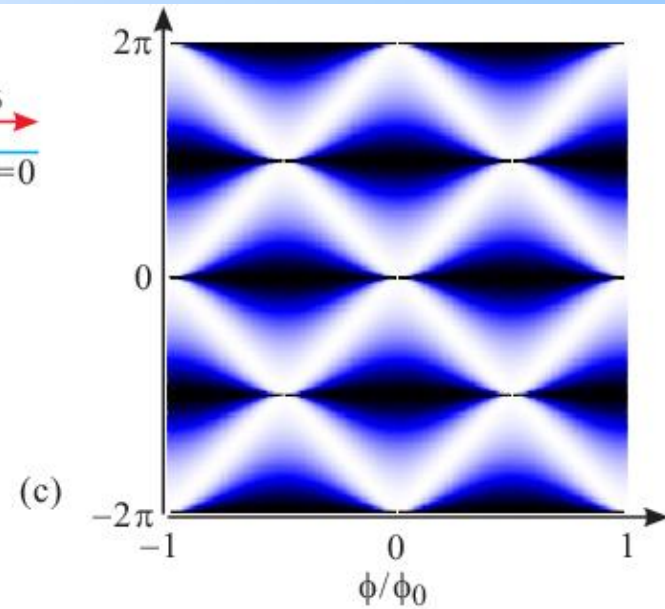
Aharonov-Bohm ring and phase rigidity
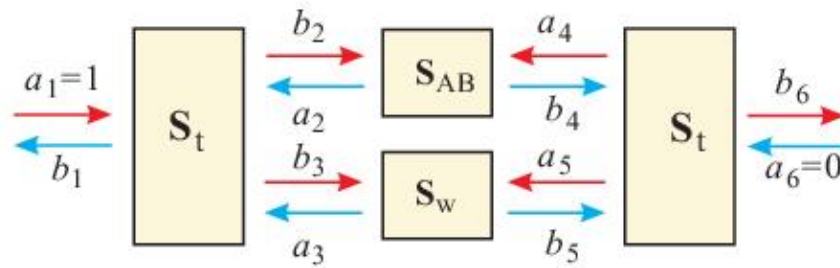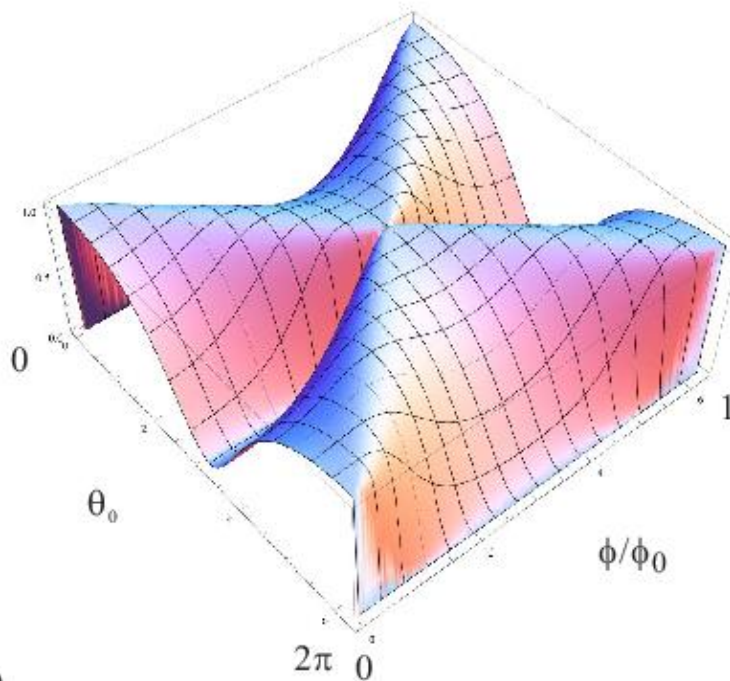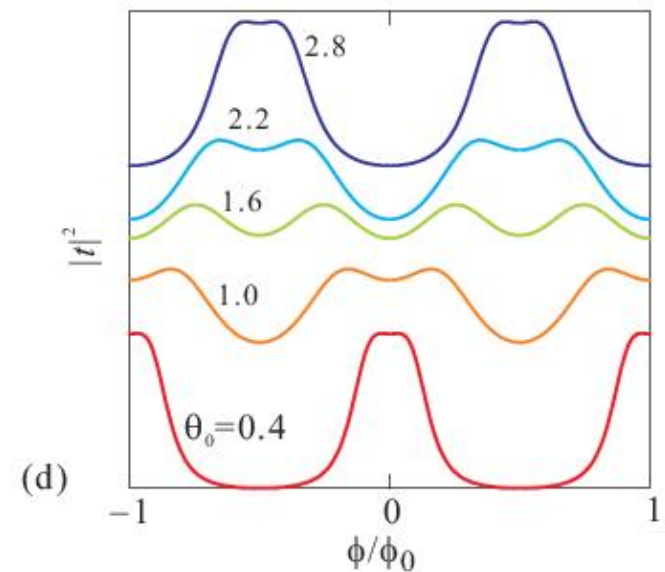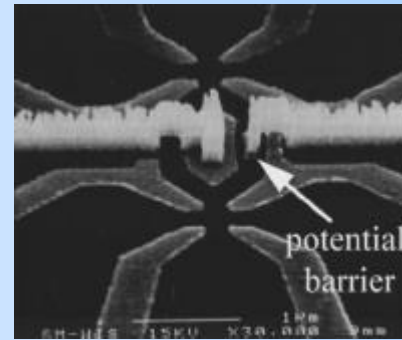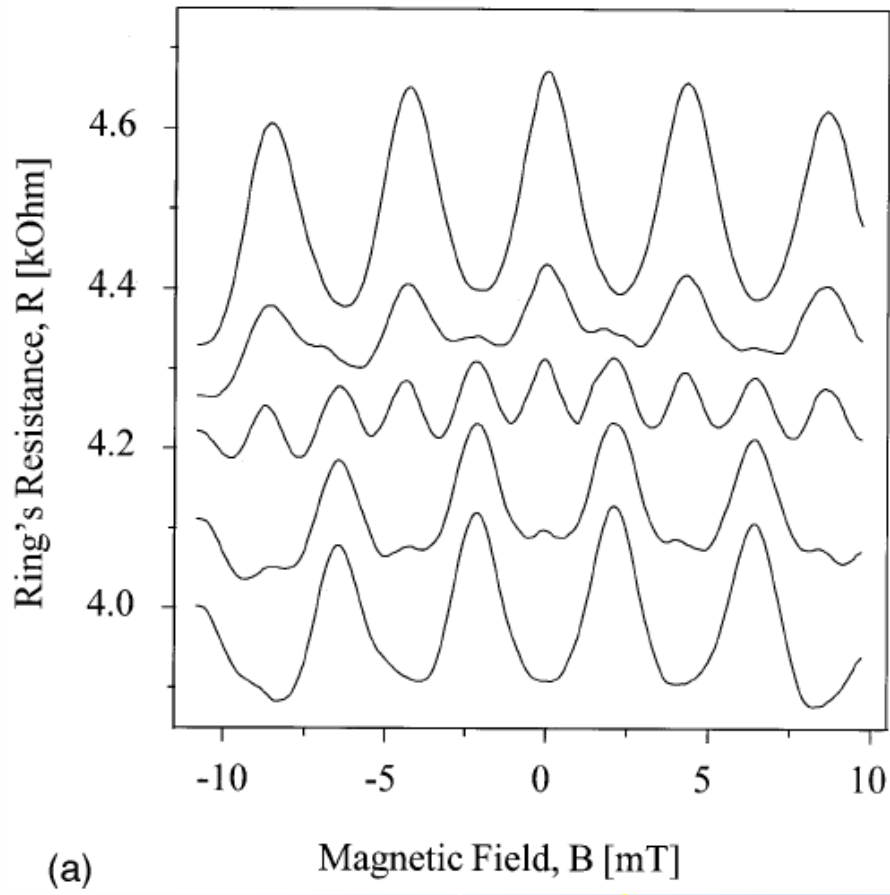
Experiment on phase rigidity

A. Yacoby et al.
PRB **53**, 9583 ('96).

Exercise

1. Let M_T be a transfer matrix of a potential barrier with a complex transmission coefficient t and a complex reflection coefficient r. Show that MT can be expressed as follows.

$$M_T = \begin{pmatrix} 1/t^* & -r^*/t^* \\ -r/t & 1/t \end{pmatrix}.$$

2. If an AB ring is a double slit system, the probability amplitude of outgoing wavefunction is written as

$$|\psi|^2 = |\psi_1|^2 + |\psi_2|^2 + 2|\psi_1||\psi_2|\cos\theta,$$

which gives if we put $|\psi_1| = |\psi_2|$ and $\theta = -\pi$, zero. The result is apparently against the requirement of unitarity. Also in $\theta = \dfrac{e\Phi}{\hbar} + \theta_0$, if $\theta_0 \neq 0$, Onsager reciprocity is also broken (Φ is magnetic flux piercing through the ring). Discuss what is wrong in the above "double slit model".