

Charge and energy transport in time-dependently driven electron systems

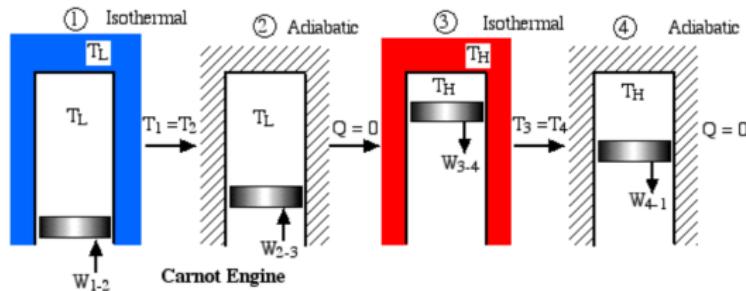
Janine Splettstößer

Applied Quantum Physics, MC2, Chalmers University of Technology

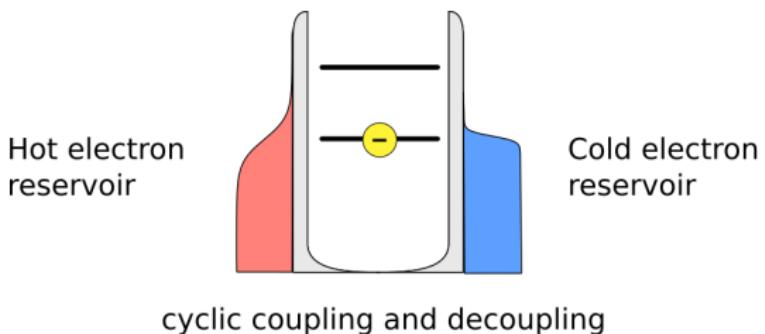


College on Energy Transport and Energy Conversion in the Quantum Regime
ICTP Trieste, August 2019

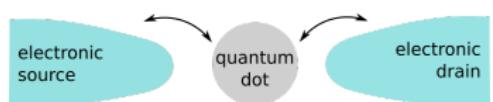
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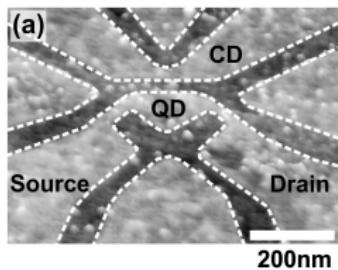
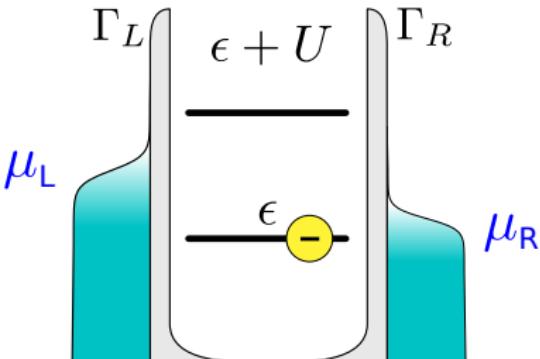
(ohio.edu)



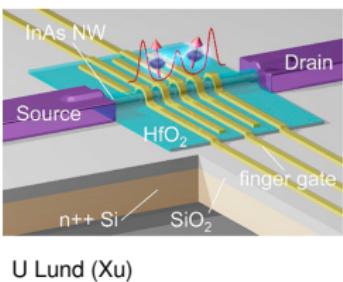
Quantum-dot systems



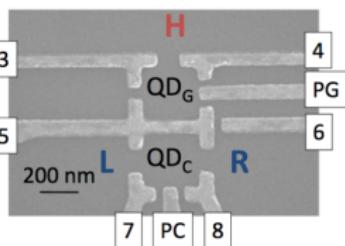
Discrete spectrum!



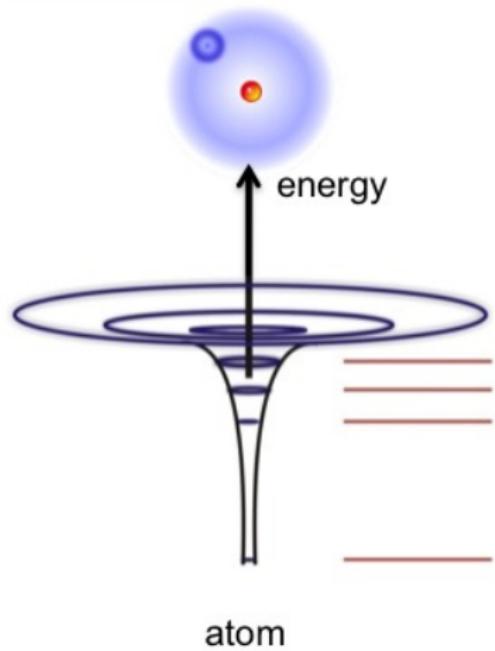
RWTH Aachen (Stampfer)



U Lund (Xu)

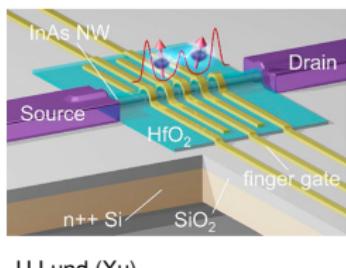
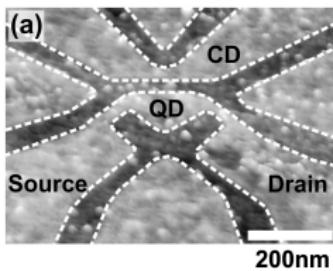
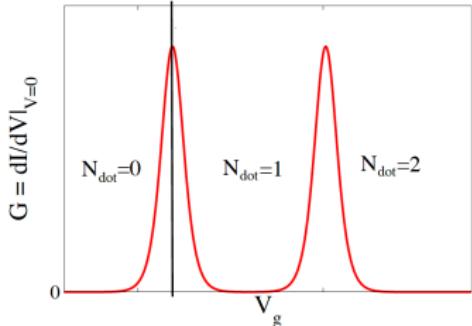
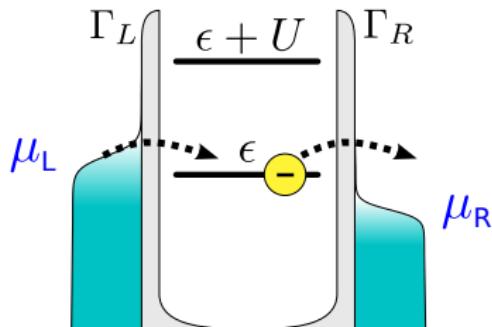


U Würzburg (Molenkamp)

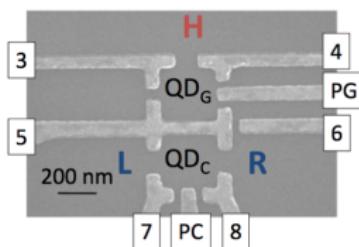


Quantum-dot systems

Transport spectroscopy — single-electron transistor



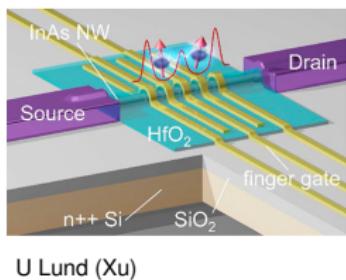
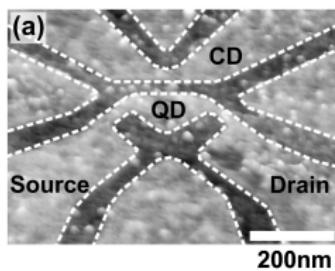
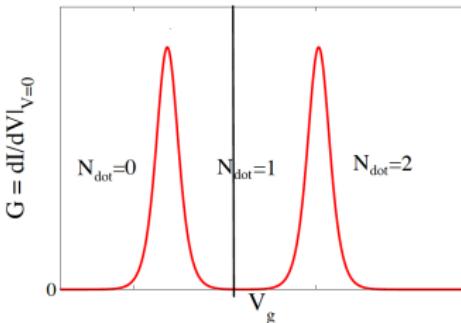
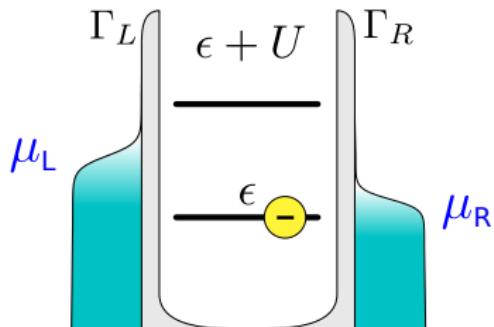
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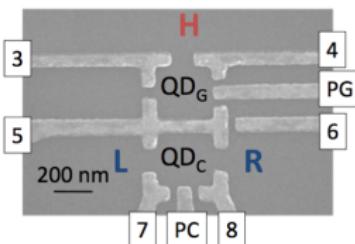
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Quantum-dot systems

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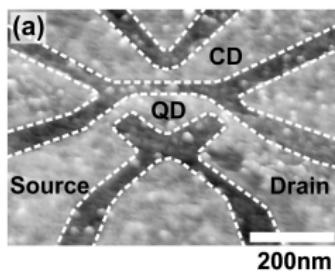
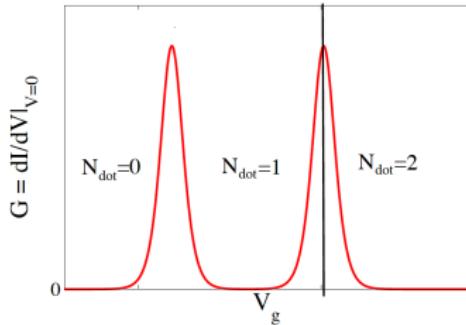
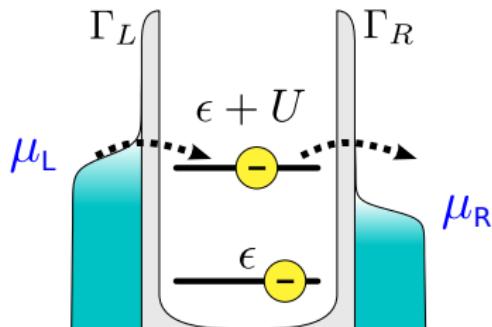
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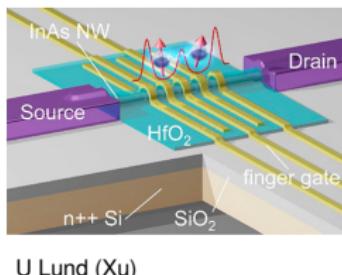
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Quantum-dot systems

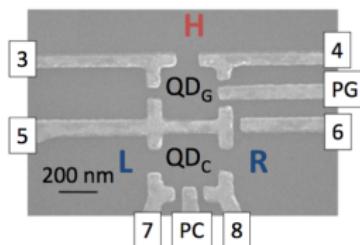
Transport spectroscopy — single-electron transistor



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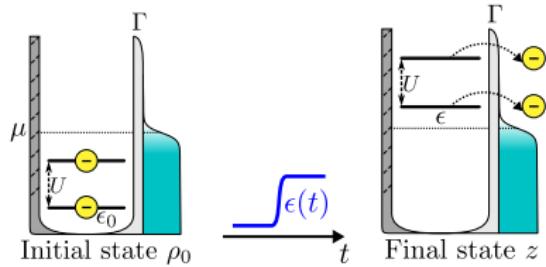


U Lund (Xu)



U Würzburg (Molenkamp)

Decay of charge and energy from a dot after a (potential) switch (Example 2)



How is energy transferred/dissipated in time-dependent systems?



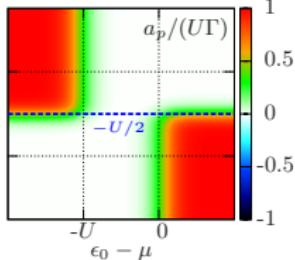
see, e.g., N. Ubbelohde, et al.: Nat. Nanotechnol. 10, 46 (2015);

- ▶ Heat current \rightarrow two modes, second can **dominate** the heat decay:

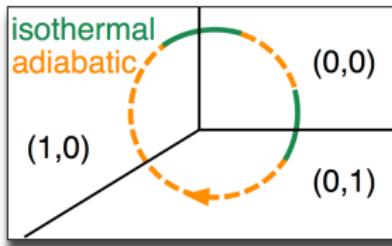
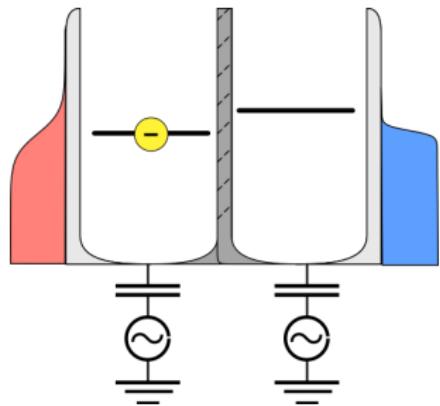
$$I_Q = a_c e^{-\gamma_c t} + a_p e^{-\gamma_p t}$$

- ▶ γ_p depends on bare coupling only and is the biggest rate

Signatures of **attractive**
Coulomb interaction



Double dot pump - Carnot heat engine (Example 1)



- ▶ Working principle of the double-dot cyclic heat engine
time-dependent coupling and decoupling to heat baths
- ▶ Similarities and differences with the classical counterpart