

# Niederdimensionale Halbleitersysteme – elektrische Eigenschaften

SS 2015



**Donat J. As**

Universität Paderborn, Department Physik

[d.as@uni-paderborn.de](mailto:d.as@uni-paderborn.de)

<http://physik.upb.de/ag/ag-as/>

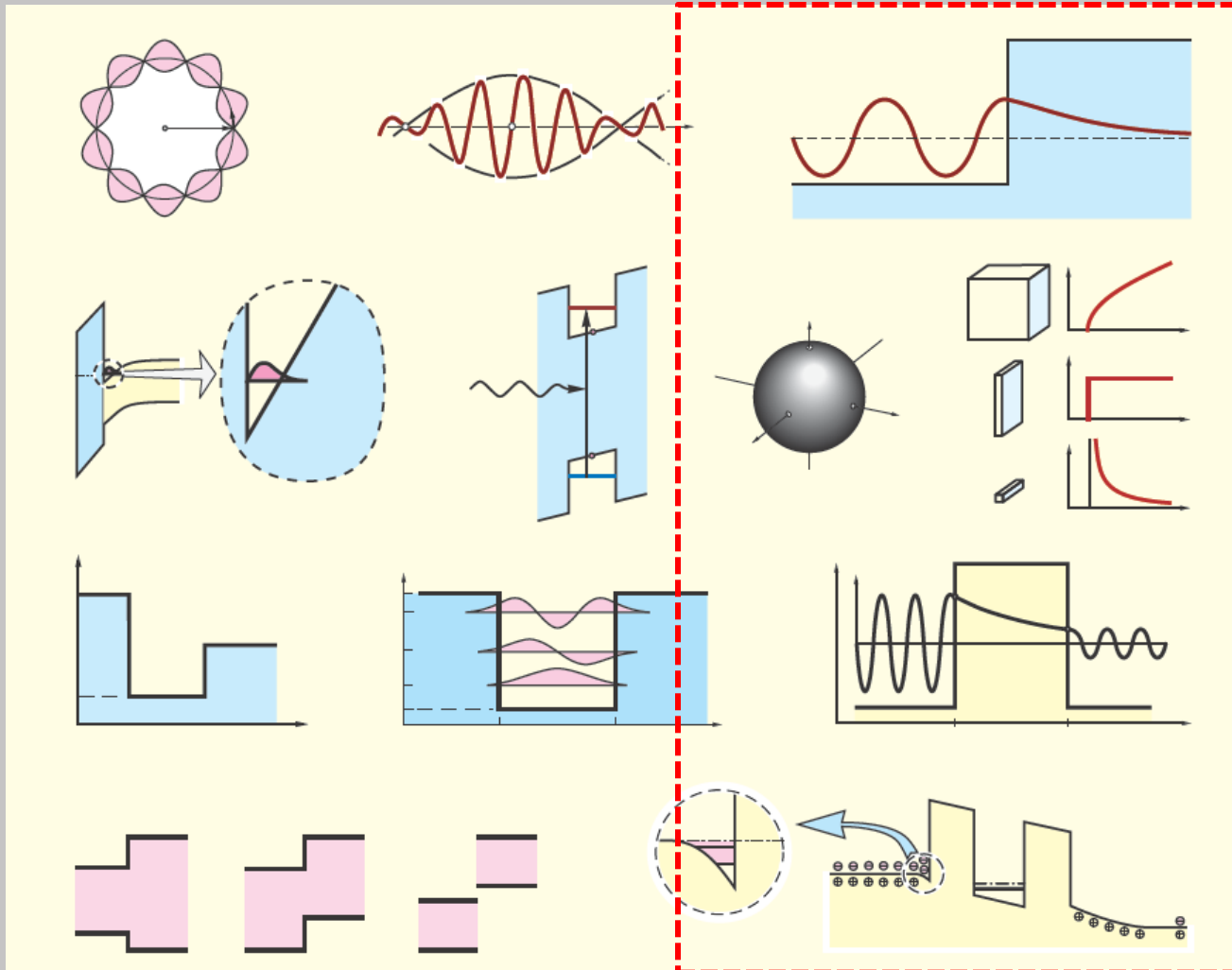
P8.2.10

Tel.: 05251-60-5838

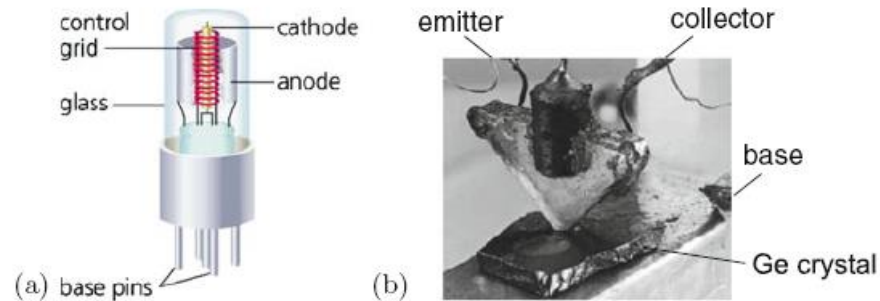
# Einleitung

- Niederdimensionale Halbleiterstrukturen - Nanostrukturen
- Physik von 3-, 2-, 1- und 0-dimensionalen Strukturen
- Elektrische und Transporteigenschaften
  - Quantum-Hall und Shubnikov-de Haas-Effekt
  - Streumechanismen in 3- und 2-dim. Systemen
  - Kohärenz und Mesoskopische Systeme
- elektrische Bauelemente
  - MESFET und HFET
  - Tunnelelektronentransistor (p-n Tunneldiode, RTD)
- Coulomb Blockade und Single Elektron Transistor
- QWIP und QDIP
- Quantum-Kaskadenlaser und Fountain-Laser

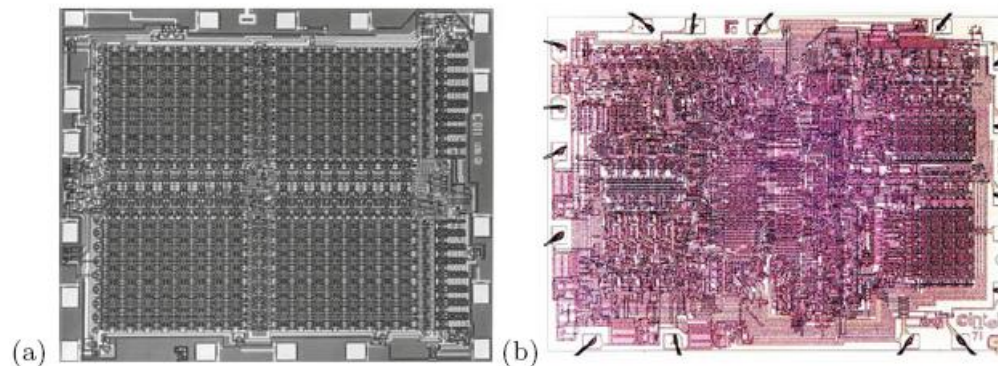
# Niederdimensionale Systeme



# Transistor



**Fig. 23.1.** (a) Schematic image of a vacuum triode. The electron current flows from the heated cathode to the anode when the latter is at a positive potential. The flow of electrons is controlled with the grid voltage. (b) Bell Laboratories' first (experimental) transistor, 1947



**Fig. 23.29.** (a) Intel™ 1103 1 KByte (1024 memory cells) dynamic random access memory (RAM), arranged in four grids with 32 rows and columns (1970), chip size:  $2.9 \times 3.5 \text{ mm}^2$ . (b) Intel™ 4004 microprocessor (1971), chip size:  $2.8 \times 3.8 \text{ mm}^2$ , circuit lines:  $10 \mu\text{m}$ , 2,300 MOS transistors, clock speed: 108 kHz

# Integrated Circuit

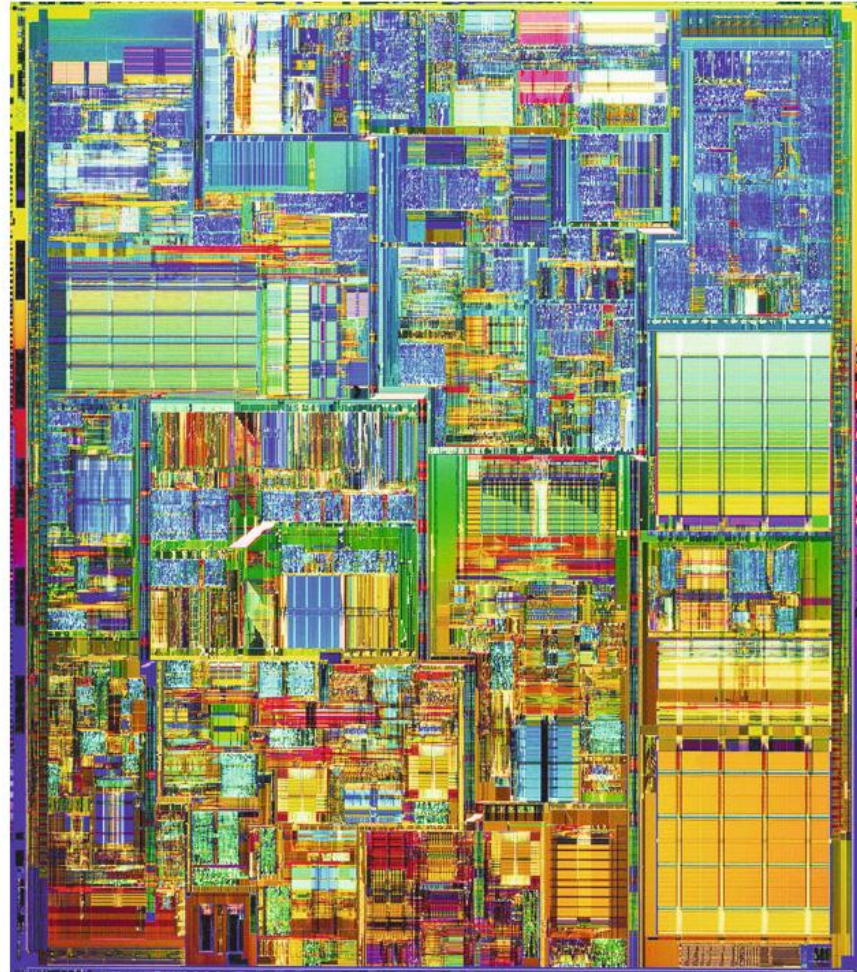


Fig. 23.30. The Intel™ Pentium 4 microprocessor (2000), circuit lines:  $0.18\ \mu\text{m}$ , 42 million transistors, clock speed: 1.5 GHz

# Literatur

## Nanostructures:

J.H. Davies,	„The Physics of Low-Dimensional Semiconductors: an introduction“
M.J. Kelly,	„Low-dimensional Semiconductors – materials, physics, technology, devices“
O. Manasreh:	„Introduction to Nanomaterials and Devices“
M. Grundmann:	„The Physics of Semiconductors“
E.F. Schubert:	„Physics Foundations of Solid-State Devices“
F. Henneberger et al.:	„Optics of Semiconductor nanostructures“
K.H. Ploog:	„III-V quantum system research“
T. Ihn:	„Semiconductor Nanostructures“

## Allgemeine Halbleiterphysik:

S.M. Sze,	„Physics of Semiconductor Devices“
J. Singh,	„Physics of Semiconductors and their Heterostructures“
J. Singh,	„Semiconductor Devices – An Introduction“
O. Manasreh	„Semiconductor Heterojunctions and Nanostructures“
R. Waser:	„Nanoelectronics and Information Technology“

## Laserdioden:

S.L.Chuang,	„Physics of Optoelectronic Devices“
J. Singh,	„Optoelectronics – An Introduction to Materials and Devices“