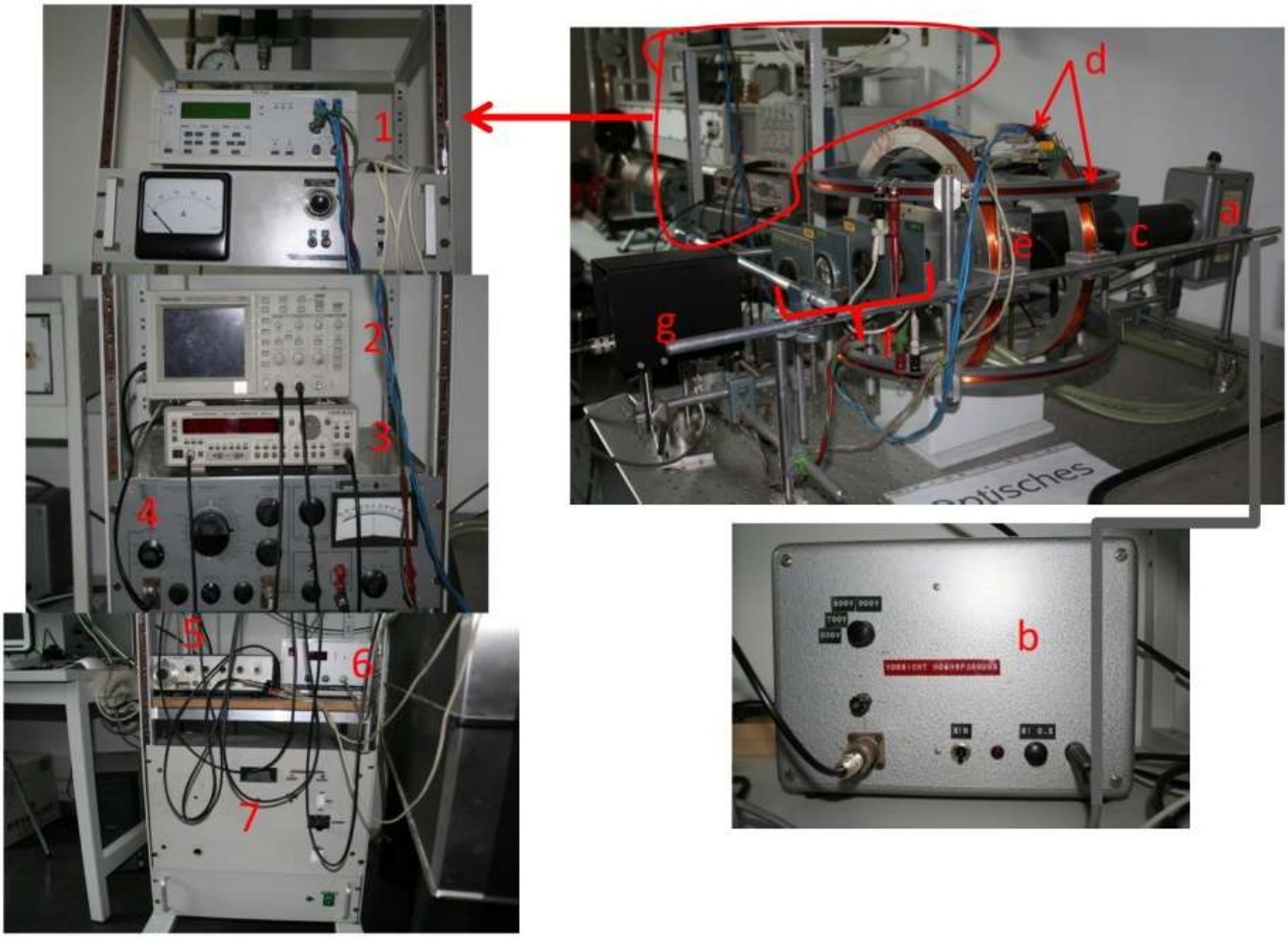
# Optical-pumping Setup




1. Current Power supply
2. Oscilloscope
3. Programmable function generator
4. Lock-in-amplifier
5. RF generator
6. Power supply of Rb lamp
7. Heating system for Rb absorption cell

a. Detector
b. Voltage gain for PM
c. Focusing lens
d. 2 pairs of Helmholtz coil
e. Rb absorption cell
f. Optics(Interference filter+lens+linear polarizer+$\lambda$/4 plate)
g. Rb lamp

## Tasks:

1 . Investigate optical pumping of Zeeman states, measure the relaxation time and optical pumping time.

Hint: compensate earth magnetic field of the two directions ($B_V$=44μT, $B_h$=20 μT).

$$B = (\frac{4}{5})^{\frac{3}{2}} \frac{\mu_0 nI}{R}$$

n=number of windings in Helmholtz coil.

R= is radius of Helmholtz coil system.

$\mu_0 = 4\pi \times 10^{-7}$ N/A$^2$

2 . Measure the resonance frequencies of Zeeman energy states, calculate Lande factor and compare with the theoretical value.

$$E = hv$$

$$E = g_F (\frac{e\hbar}{2m}) \mathrm{B}\, m_F$$

3. Observe quadratic Zeeman Effect. (use of lock-in-amplifier)

Note ( just for introduction)

**Prepare the following questions:**

1. what is Zeeman effect?

2. draw the S, P energy states diagram of Rb. (including Zeeman states)

3. what is the angular momentum of photon?

4. what are the electron transition selection rules between S and P states?

5. what is stimulated emission?