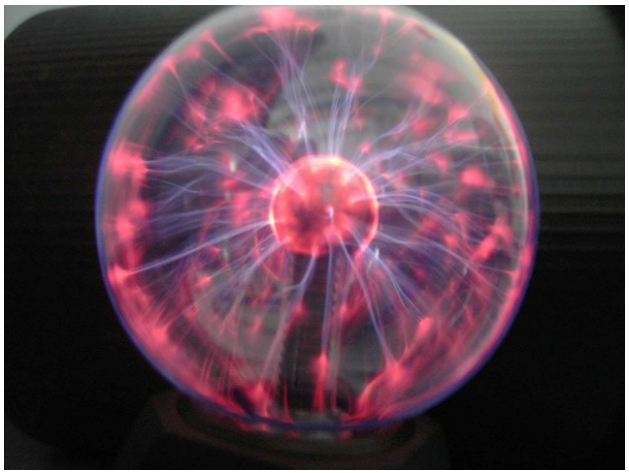
NOBLE GAS DISCHARGES



Christoph Ottenhues 07.05.2012

Outline

- Historical overview
- Build-up and function of a discharge tube
- Different types of discharges
- Noble gas discharges
- Influences of the gas pressure
- Applications

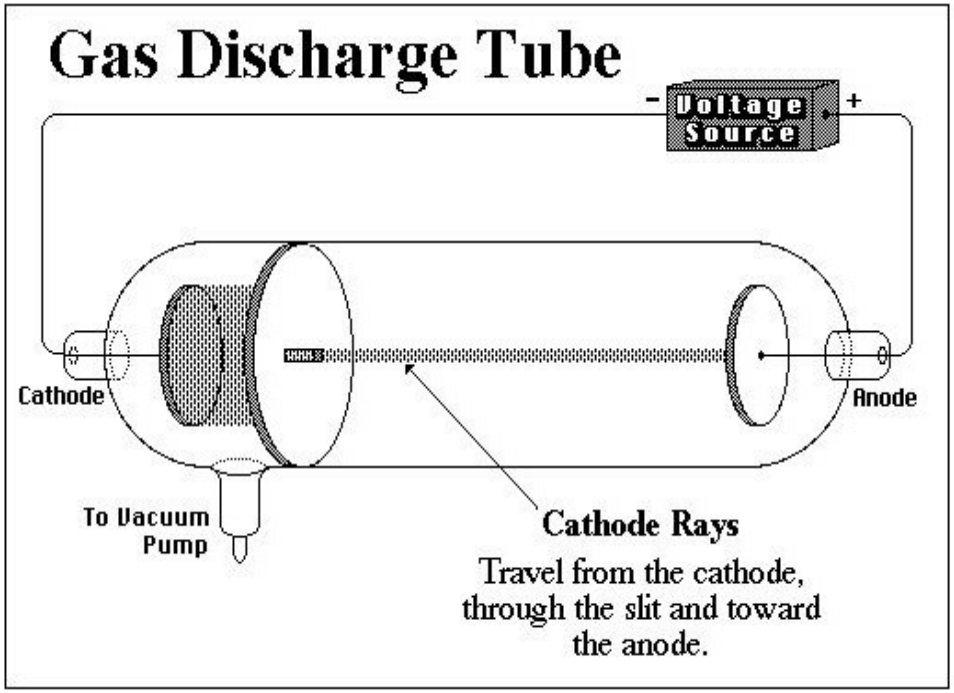
Historical Overview

- 1857: H. Geisler invented the „Geissler Tube“
- 1868: Helium was discovered by J. Janssen and N. Lockler
- 1895: Argon was verified by Lord Rayleigh and W. Ramsay
- 1898: Ramsay found krypton, xenon and neon in liquid air
- 1898: Radon was discovered by F. E. Dorn

Build-up and function of a discharge tube

Main components:

- Glas tube
- Voltage source
- Electron beam between cathode and anode
- Gas to excite(low or high pressure)



Build-up and function of a discharge tube

Function:

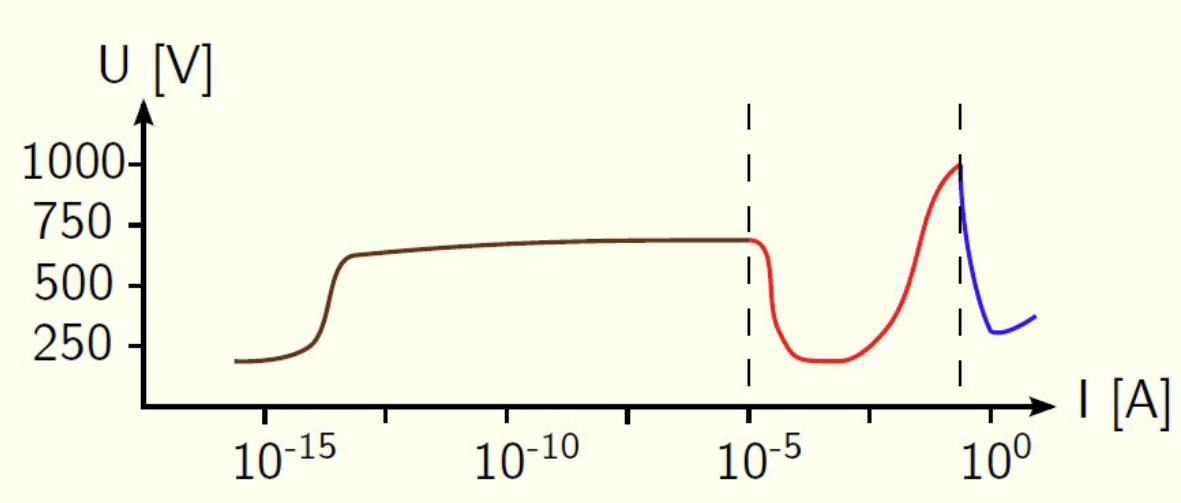
- Two possibilities of photon radiation
  - Free electron excites a gas atom $e^- + A \rightarrow A^* \rightarrow A + h \bullet \nu$
  - Free electron ionizes a gas atom $e^- + A \rightarrow A^+ \rightarrow A + h \bullet \nu$
- Ionization also creates new electrons
  - Leads to a avalanche multiplication of electrons
  - Increase of current flow
  - Need of a current limiter

Build-up and function of a discharge tube

Influences on the gas discharge:

- A single gas or a gas mixture
- Pressure of the gas
- Applied voltage and distance between cathode and anode
  - Leads to higher electron energies

Different types of discharges

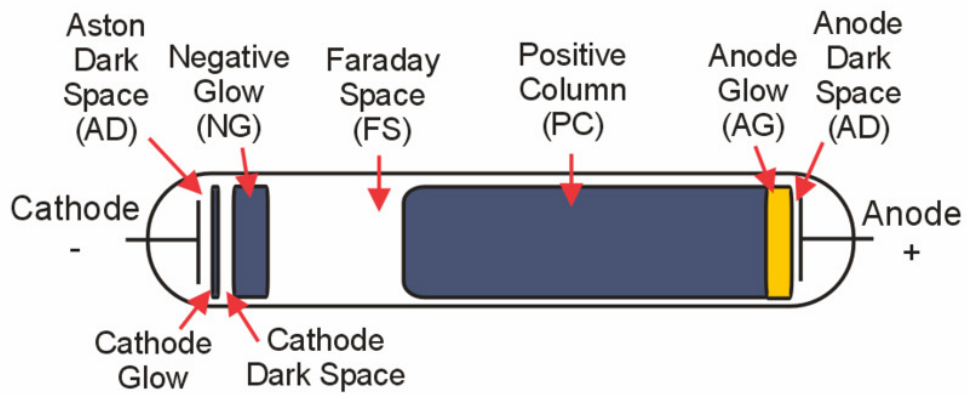


Devide in three types of discharges:

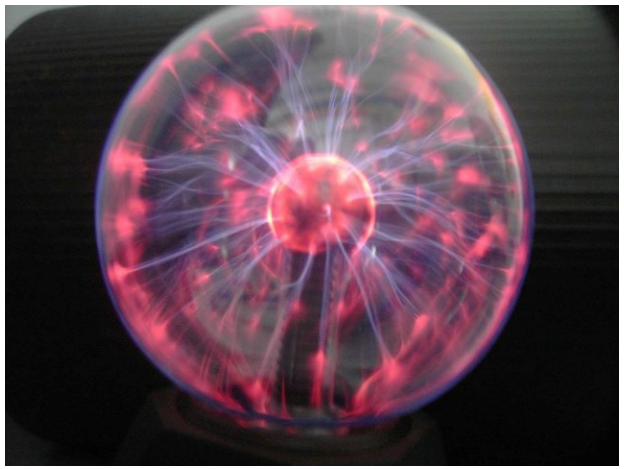
- Townsend discharge
- Electric glow discharge
- Arc Discharge

Different types of discharges

Electric glow discharge:

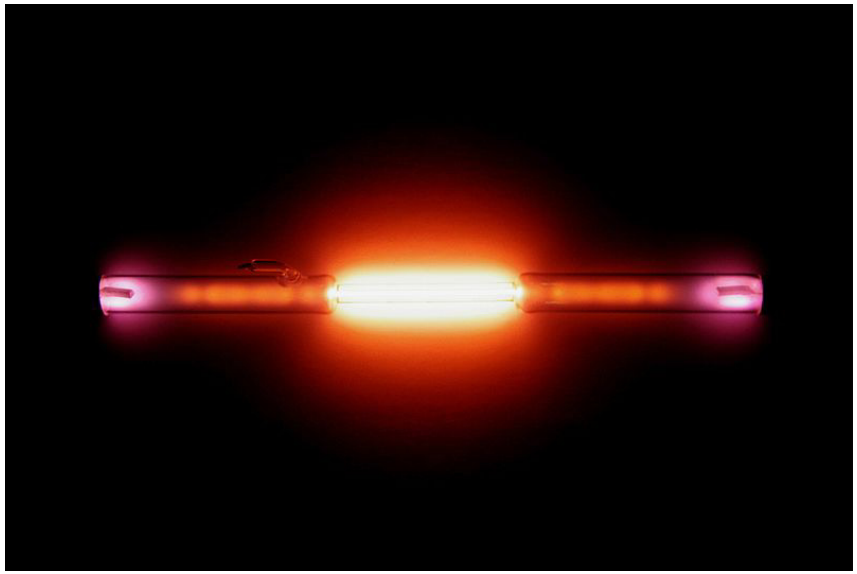


Arc Discharge:



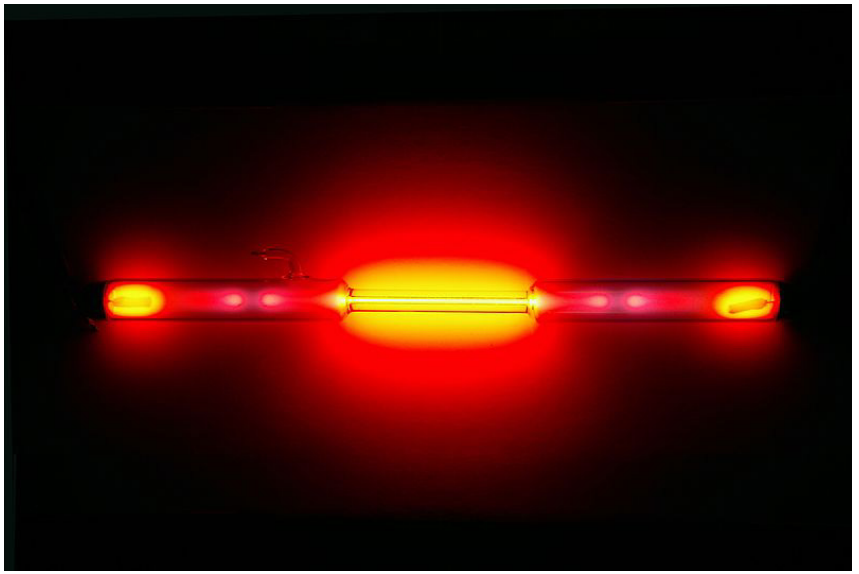
Noble gas discharges

Helium discharge



white to orange spectrum

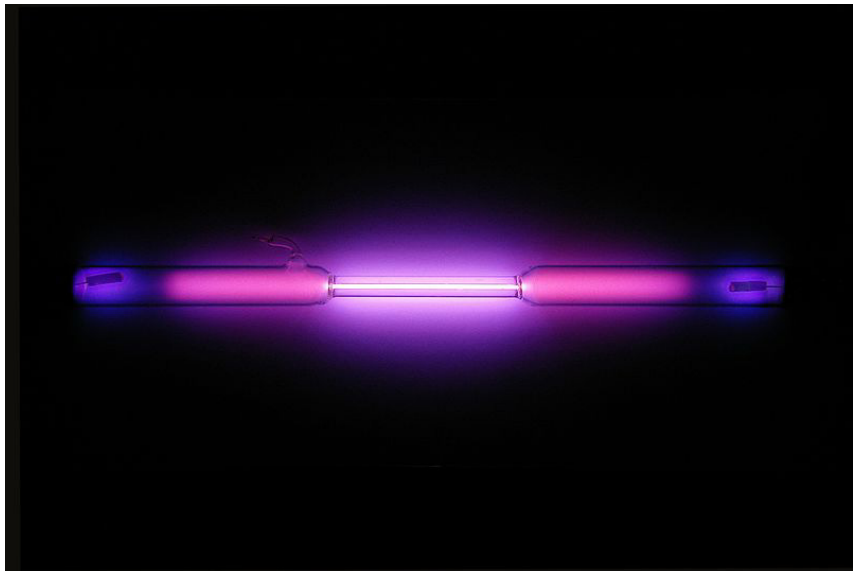
Neon discharge



red-orange spectrum

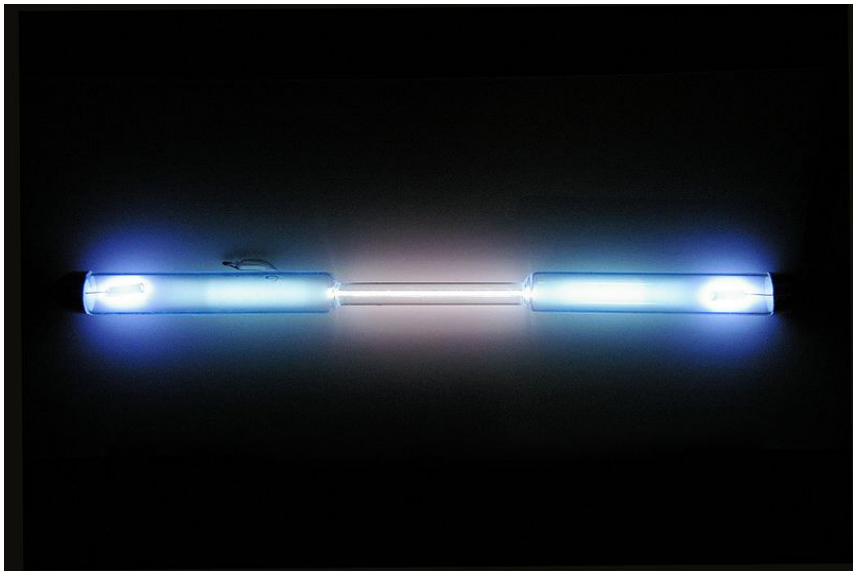
Noble gas discharges

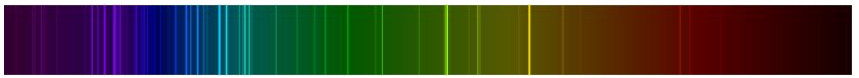
Argon discharge



violet to blue spectrum

Krypton discharge

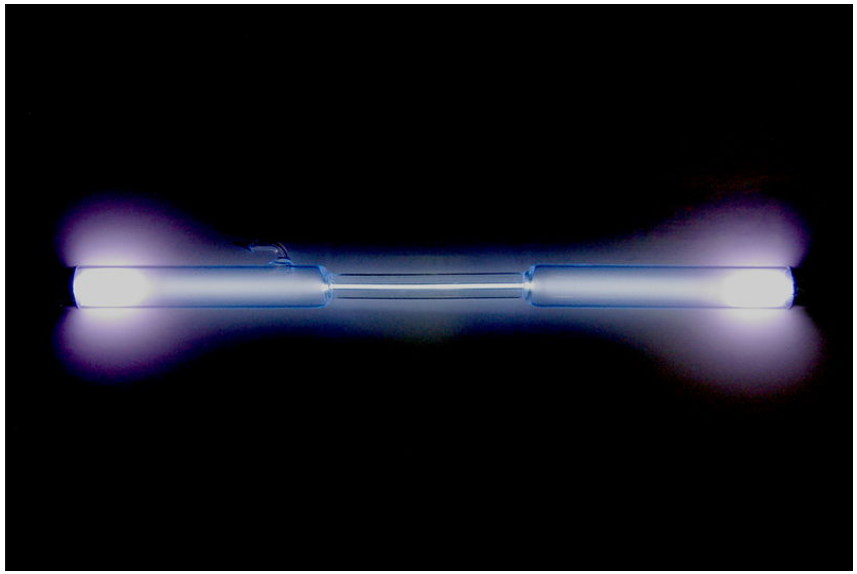




gray to green spectrum

Noble gas discharges

Xenon discharge



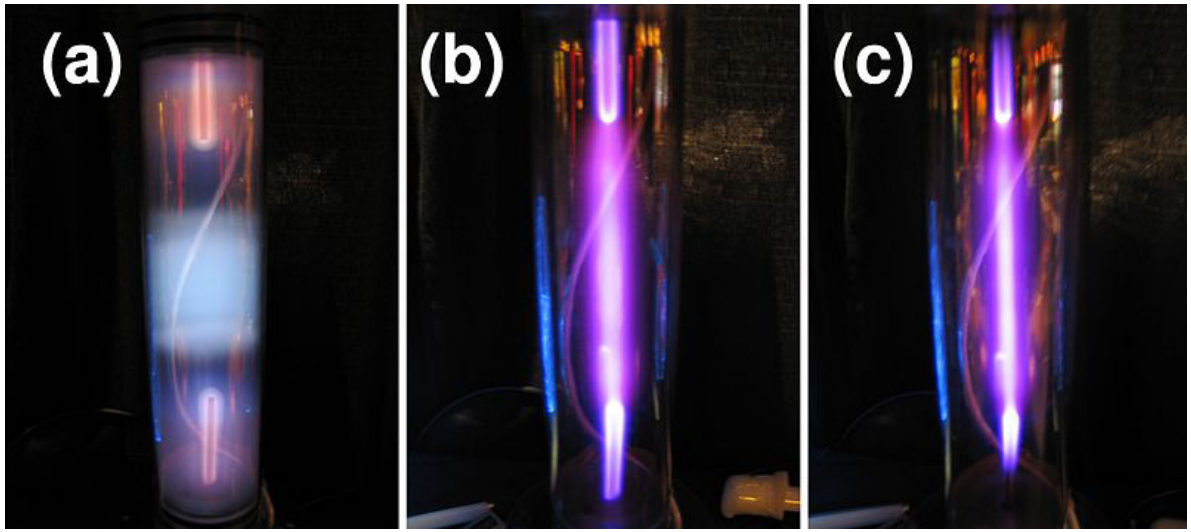
blue-gray spectrum

Advantages of noble gases:

- Stabel
- No chemical reaction with glas
- Incombustible

Influences of the gas pressure

- Increasing the pressure
  - Broadening of the emitted light spectrum
  - Decrease the current flow
  - Arc discharge



Argon discharge

Applications

In the past:

- Neon glow discharge lamps

NE-34 General-electric

Broadway 1920s

Applications

Nowadays:

- Ultra high pressure xenon discharge lamp
  - Starting voltages up to 50kV
  - Non operating pressure: 7bar
  - Operating pressure up to 70bar
  - Colour temperature of 6000K (sunlight 6500K)
  - Efficiency: 60lm/W
- Used as:
  - Floodlight, effect light

Illumination of the night sky with FALCON® 6000 CMY (with Osram xstage lightsource)

Sources

- *C.F. Gallo*
  Coronas and Gas Discharges in Electrophotography: A Review
  IEEE Transactions on Industry Applications, 1975, Vol.IA-11,
  No. 6, S. 739 – 748
- http://www.pasewalker-spektrum.de/rundblick/plasmatext.html
- http://www.techniklexikon.net/d/xenon-h%C3%B6chstdrucklampe/xenon-h%C3%B6chstdrucklampe.htm
- http://www.seilnacht.com/Lexikon/54Xenon.htm
- http://www.tech-faq.com/gas-discharge-tube.html
- http://www.ao-technology.com/ao/index.php?lang=1&idcatside=4&8category=43,44,45,46,47,48&8cf1=alpha-one&8cf7=Entertainment
- http://en.wikipedia.org/wiki/Electric_discharge_in_gases
- http://en.wikipedia.org/wiki/Electric_glow_discharge
- http://en.wikipedia.org/wiki/Neon_lighting
- http://en.wikipedia.org/wiki/Neon_lamp
- http://en.wikipedia.org/wiki/Noble_gas
- http://de.wikipedia.org/wiki/Xenon-Gasentladungslampe
- http://de.wikipedia.org/wiki/Gasentladungsr%C3%B6hre
- http://en.wikipedia.org/wiki/Geissler_tube
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Thank you for your attention