Setting up and running the photoluminescence laboratory at ISOLDE

Giannis Savva

Supervisor: Karl Johnston

CERN Summer Student 2016
10 Aug. 2016

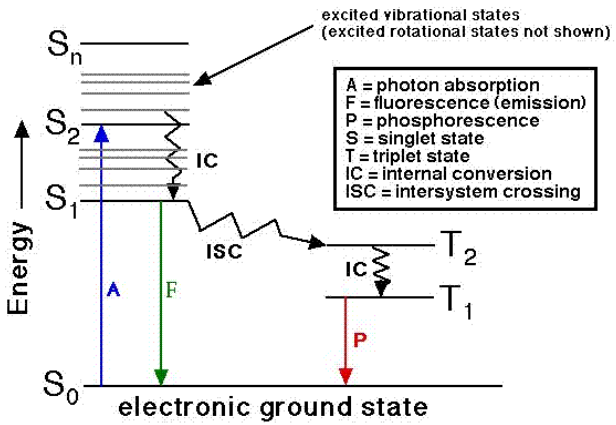
National Technical University of Athens

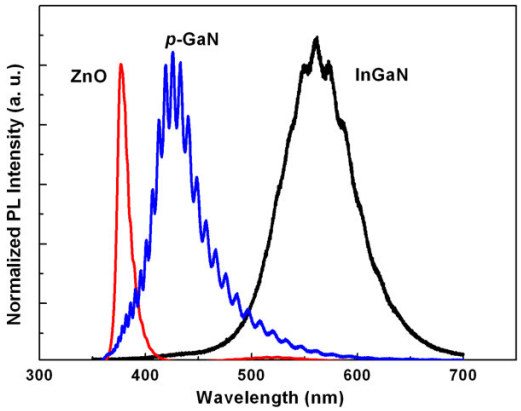
Outline

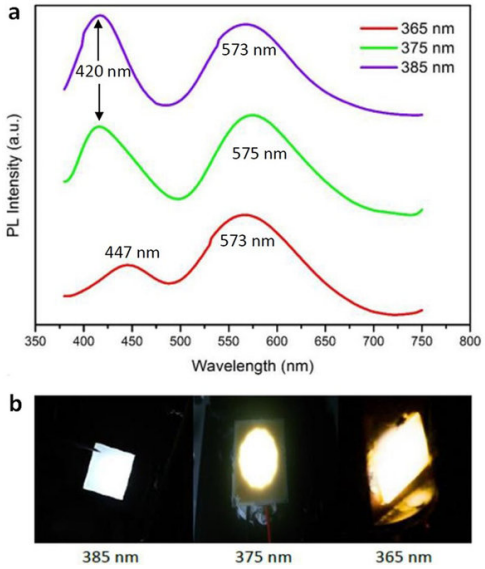
- What is photoluminescence (PL)?
- Setting up the lab
- Experimental setup
- Results
- Why PL at CERN?

Photoluminescence

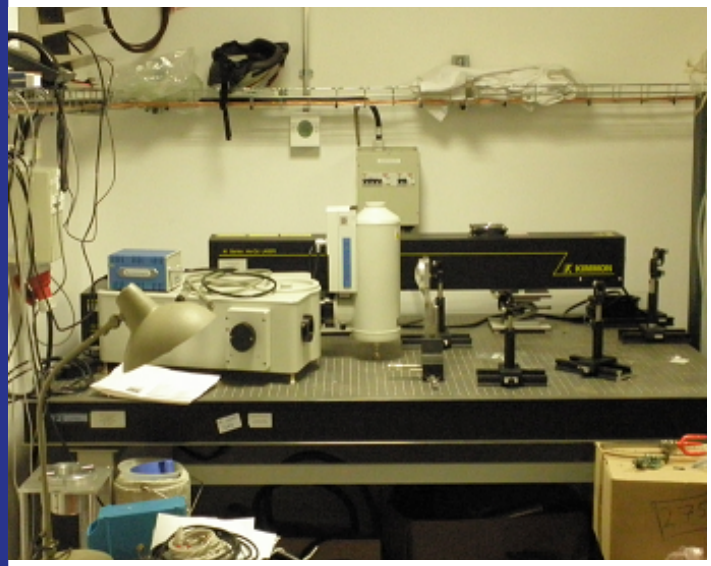
- Emission of light from a material under optical excitation
- Each material has its own excitation and emission spectra
- Extremely sensitive technique of electronic states
- No chemical identification of the source of the emitted light
  - Solution: implantation of radioactive isotopes





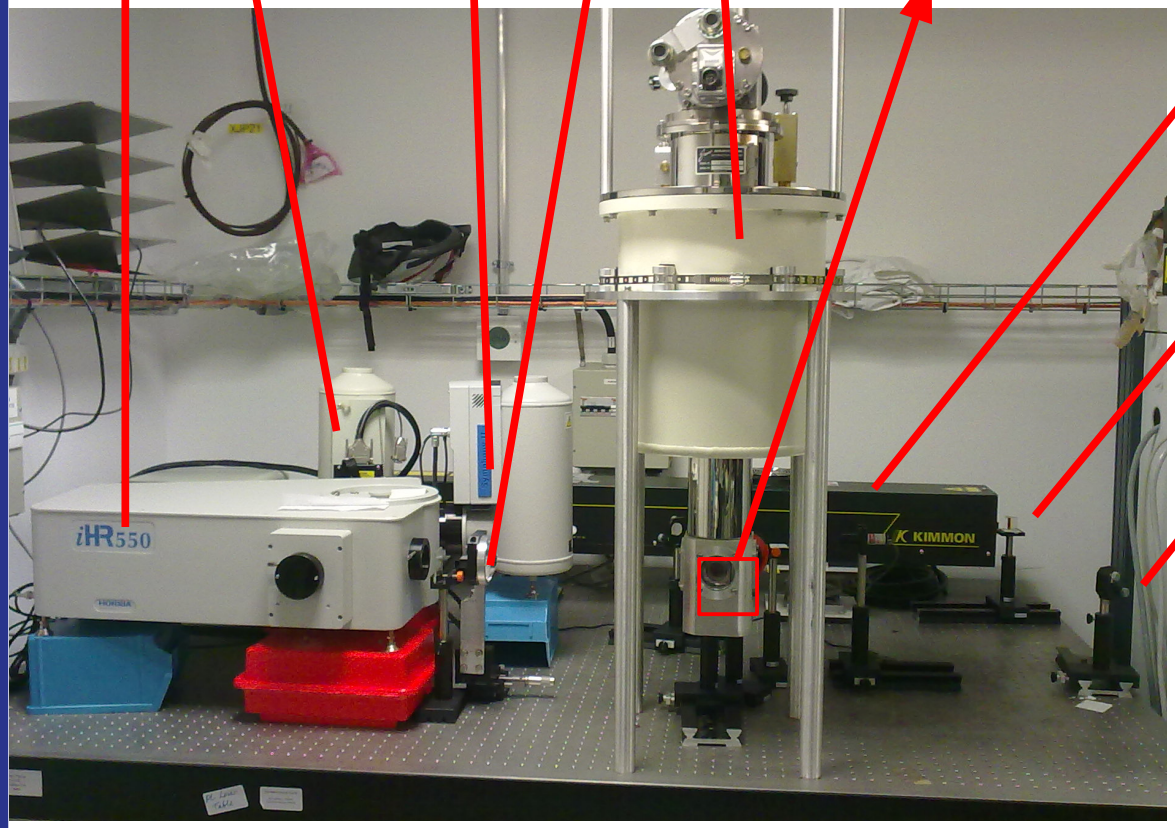


Before and after!

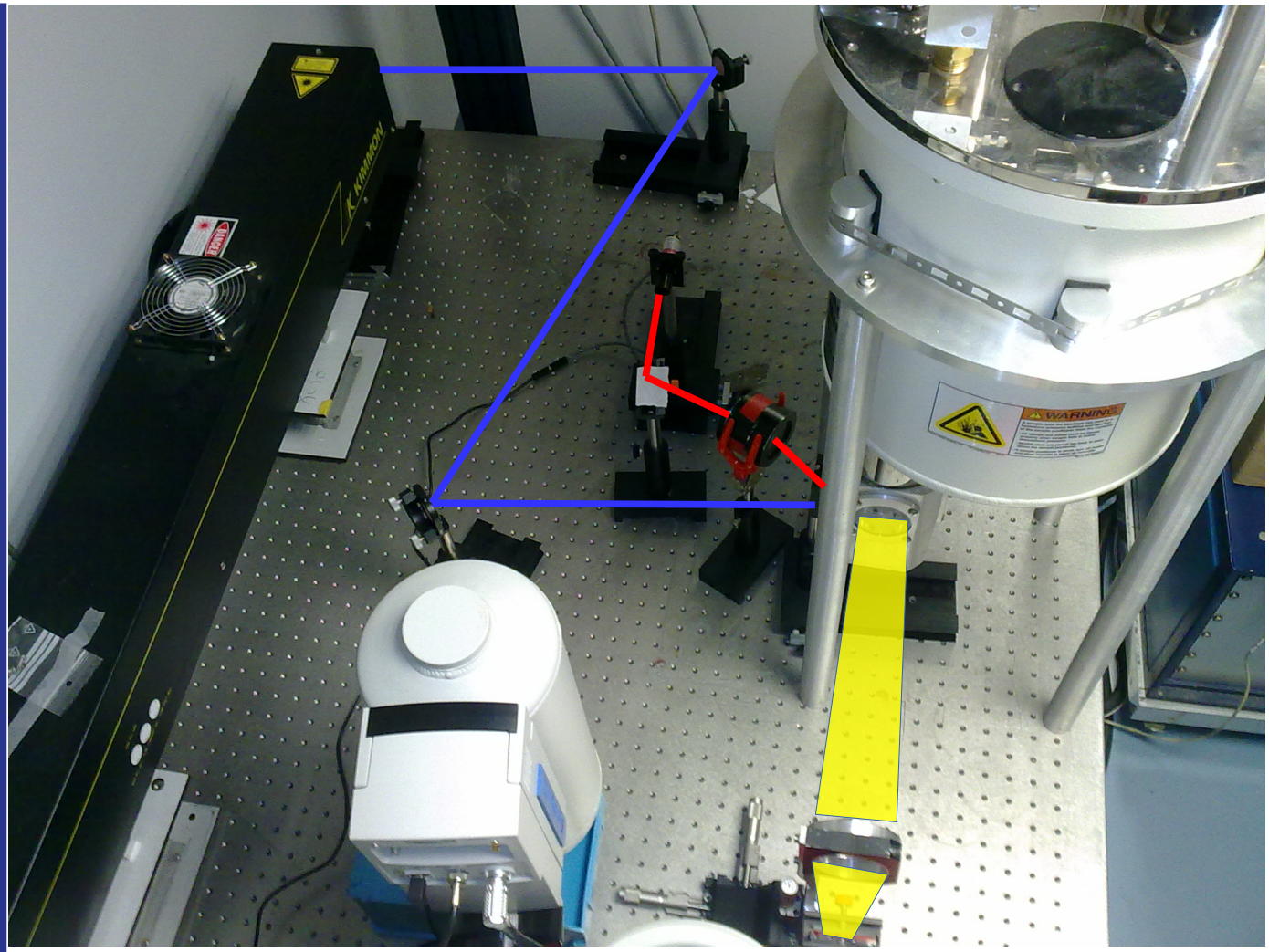


my task...

Experimental Setup

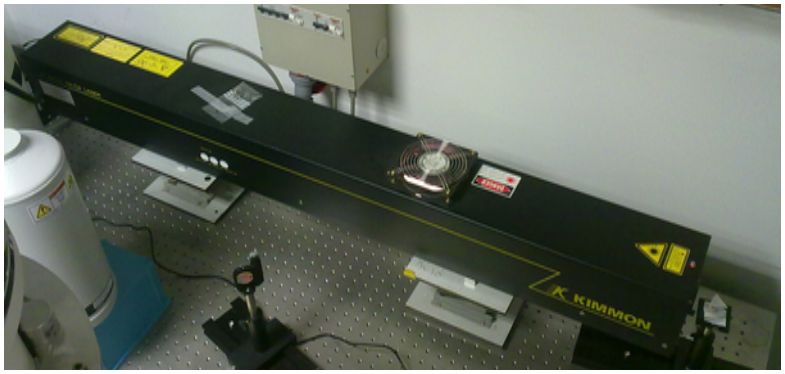


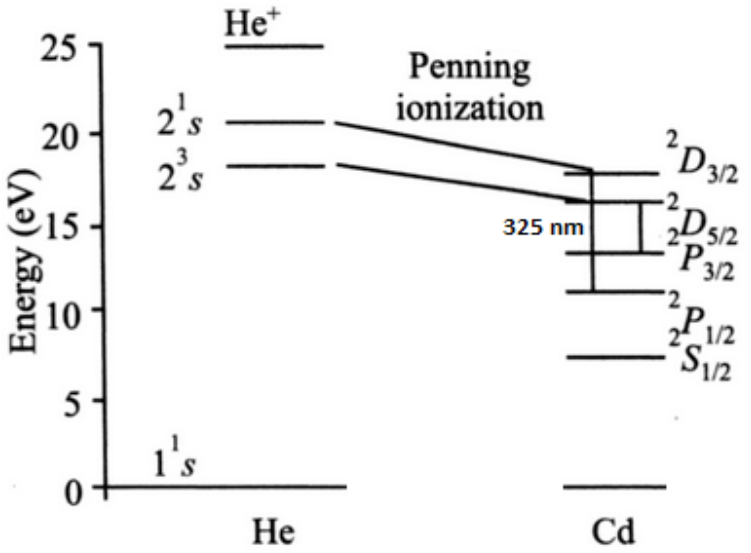
Experimental Setup



He-Cd Laser

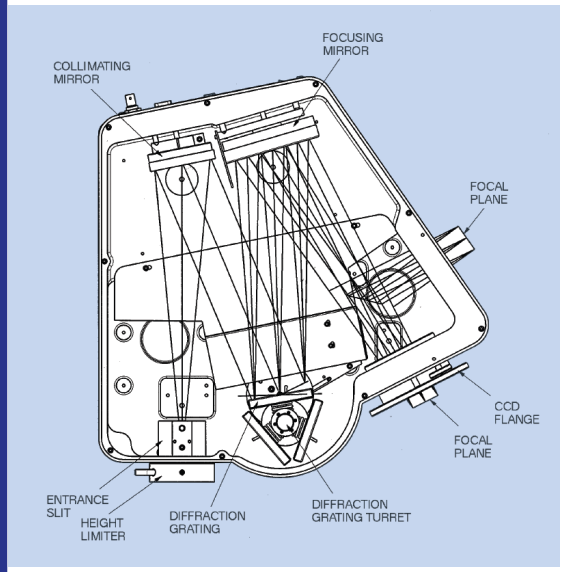
- Length: 1.42 m
- Power (max): 200 mW
- Wavelength: 325 nm (near UV)
- Type: continuous wave (cw) metal-vapor
- Lasing medium: Cadmium
- He:Cd ratio: 100:1
- He excitation by 4 kV electric discharge
- **Laser Class: 3B**
  - **Hazardous for direct eye exposure**
  - **Protective glasses requires**





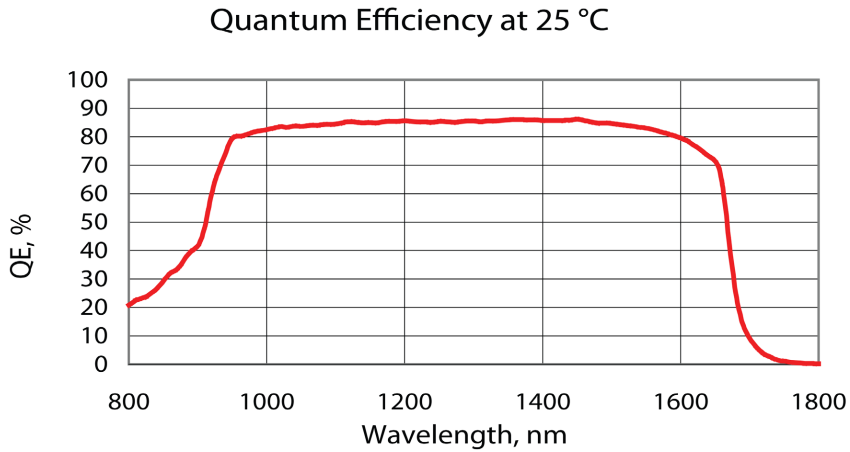
Spectrometer and detectors

Spectrometer



- 3 blazed diffraction gratings:
  - 600 g/mm (500 nm)
  - 900 g/mm (1500 nm)
  - 2400 g/mm (400 nm)
- Speed:160 nm/s

InGaAs Detector



- Liquid Nitrogen cooled detector
- operating temperature: -103.3 C

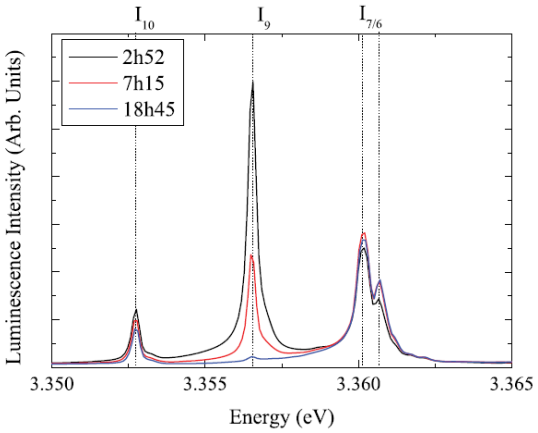
CCD Detector

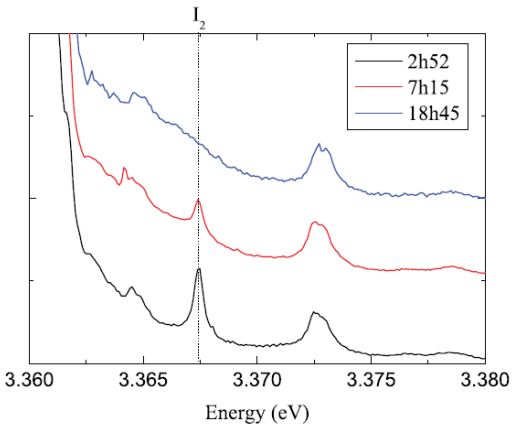
- High QE to visible spectrum
- operating temperature: -33 C

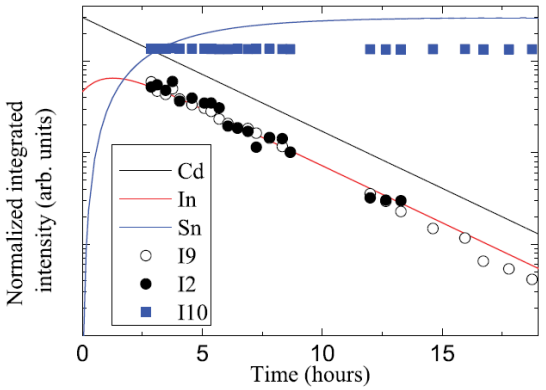
Results

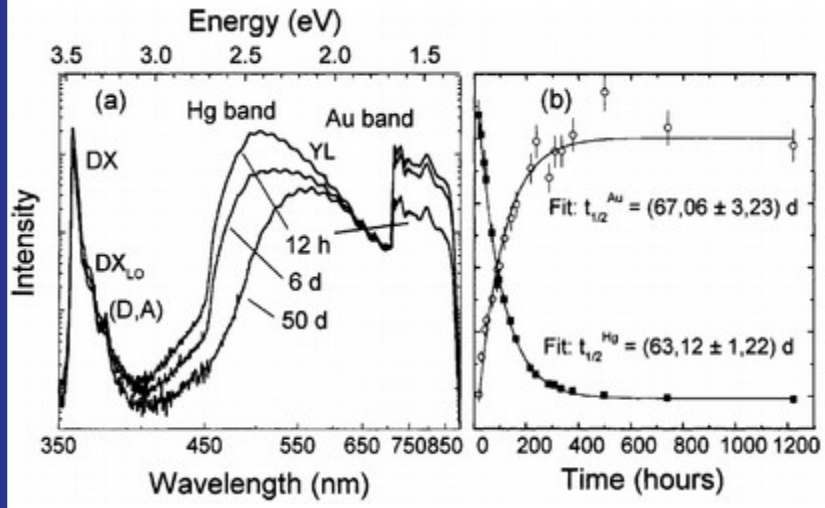
Identification of impurities in semiconductors

ZnO implanted with radioactive ^{117}Ag (73 s) -> ^{117}Cd (2.5 h) -> ^{117}In (43 m) -> ^{117}Sn









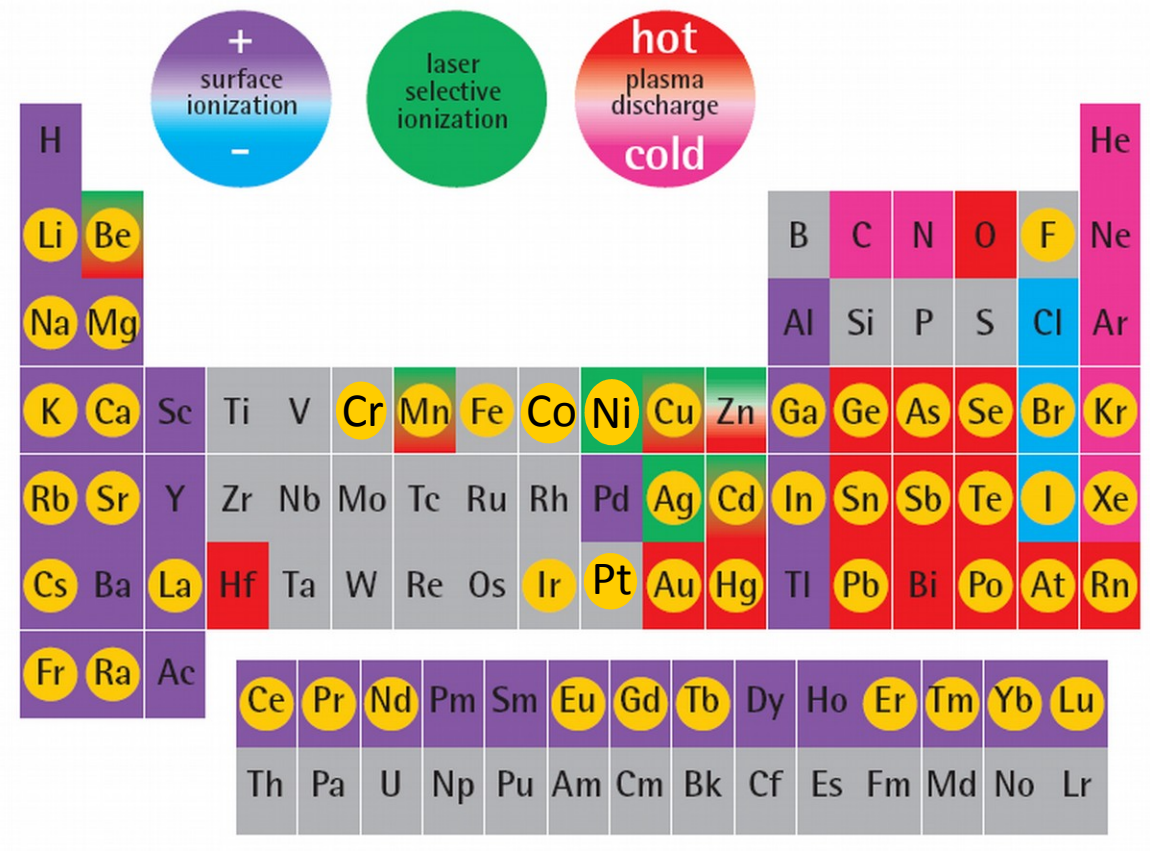
GaN implanted with radioactive ^{197}Hg (64.14 h) -> ^{197}Au

Why PL at ISOLDE CERN?

- No Higgs boson, no tetraquark, no pentaquark BUT...

Why PL at ISOLDE CERN?

- No Higgs boson, no tetraquark, no pentaquark BUT...
- More than 1200 isotopes of 72 different elements



Isotopes of this element ● used for solid state physics or life science

Special thanks to my supervisor

Thank you for your attention