Setting up and running the photoluminescence laboratory at ISOLDE

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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

- He-Cd laser
- glass prism
- focusing lens
- cryostat's window
- sample
- spectrometer
- CCD detector
- InGaAs detector
- cryostat
- mirror
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 $^{117}\text{Ag}$ (73 s) $\rightarrow$ $^{117}\text{Cd}$ (2.5 h) $\rightarrow$ $^{117}\text{In}$ (43 m) $\rightarrow$ $^{117}\text{Sn}$

GaN implanted with radioactive $^{197}\text{Hg}$ (64.14 h) $\rightarrow$ $^{197}\text{Au}$
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