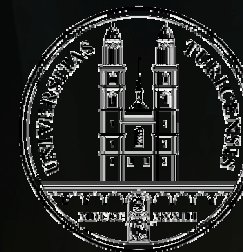


# Biological Applications of Perturbed Angular Correlations of $\gamma$ -Ray Spectroscopy

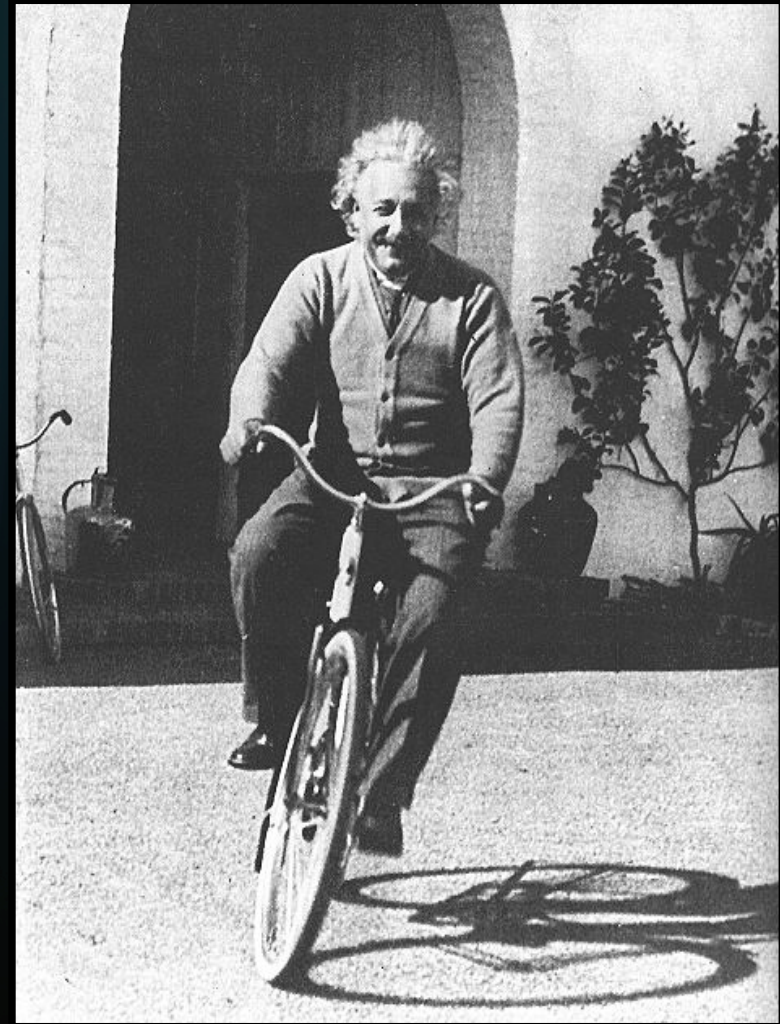
IS488: “Ag(I), Pb(II) and Hg(II) binding to biomolecules studied by Perturbed Angular Correlation of  $\gamma$ -rays (PAC) spectroscopy: Function and toxicity of metal ions in biological systems”

Monika Stachura  
University of Copenhagen



“Learn from yesterday,  
live for today, hope  
for tomorrow. The  
important thing is not  
to stop questioning...”

Albert Einstein

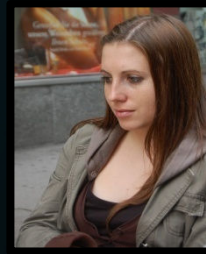
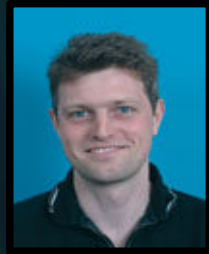




# Biophysics collaboration



## Copenhagen



## Michigan



## Wroclaw



## Zurich

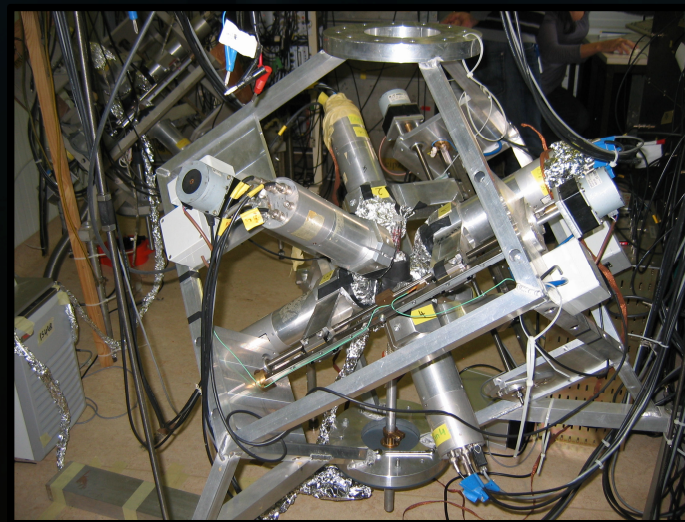
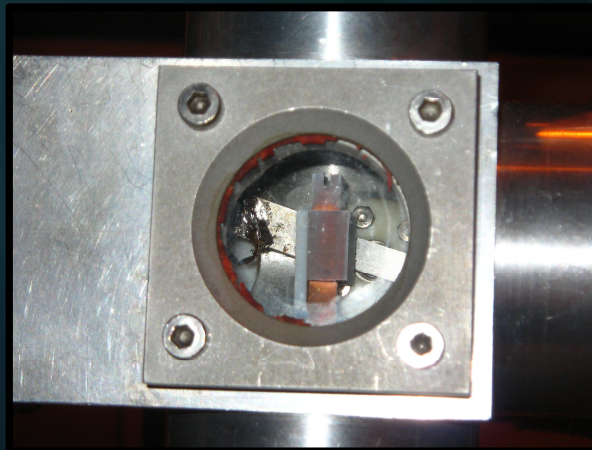


## Szeged





# About our work...





# About our work...



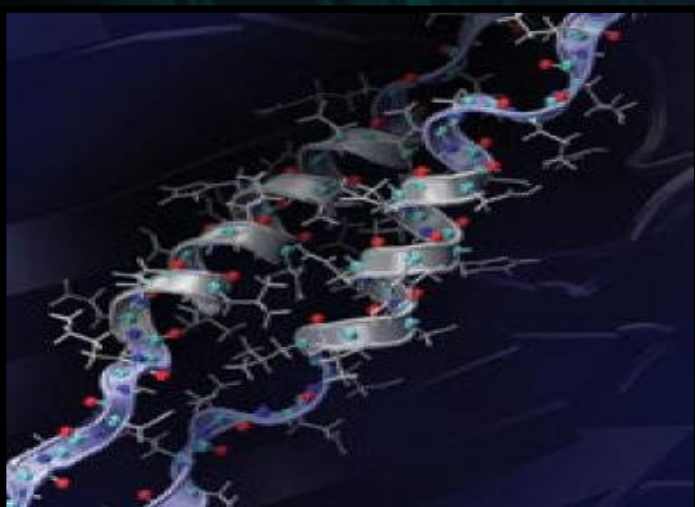
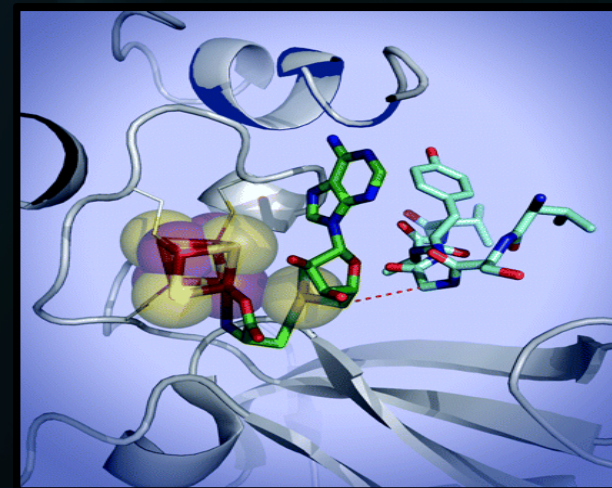


# What are the essential metal ions?

$\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Zn}^{2+}$ ,

$\text{Fe}$ ,  $\text{Co}$ ,  $\text{Ni}$ ,  $\text{Cu}$ ,  $\text{Mn}$ ,  $\text{Mo}$ ,  $\text{Cr}^{(a)}$

<sup>(a)</sup>charge not given since this varies with oxidation state



## Toxic metal ions

$\text{As}^{3+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Pb}^{2+}$

# Heavy metal poisoning



## Mercury

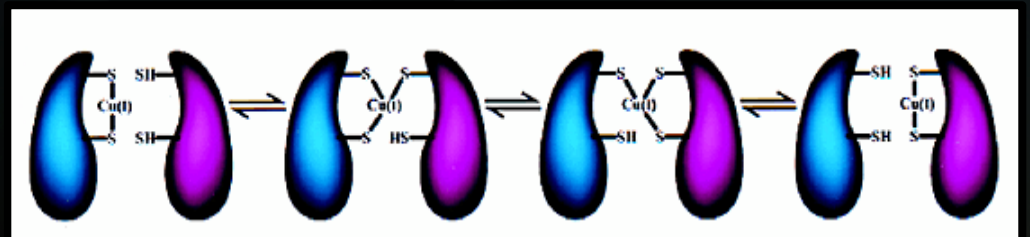
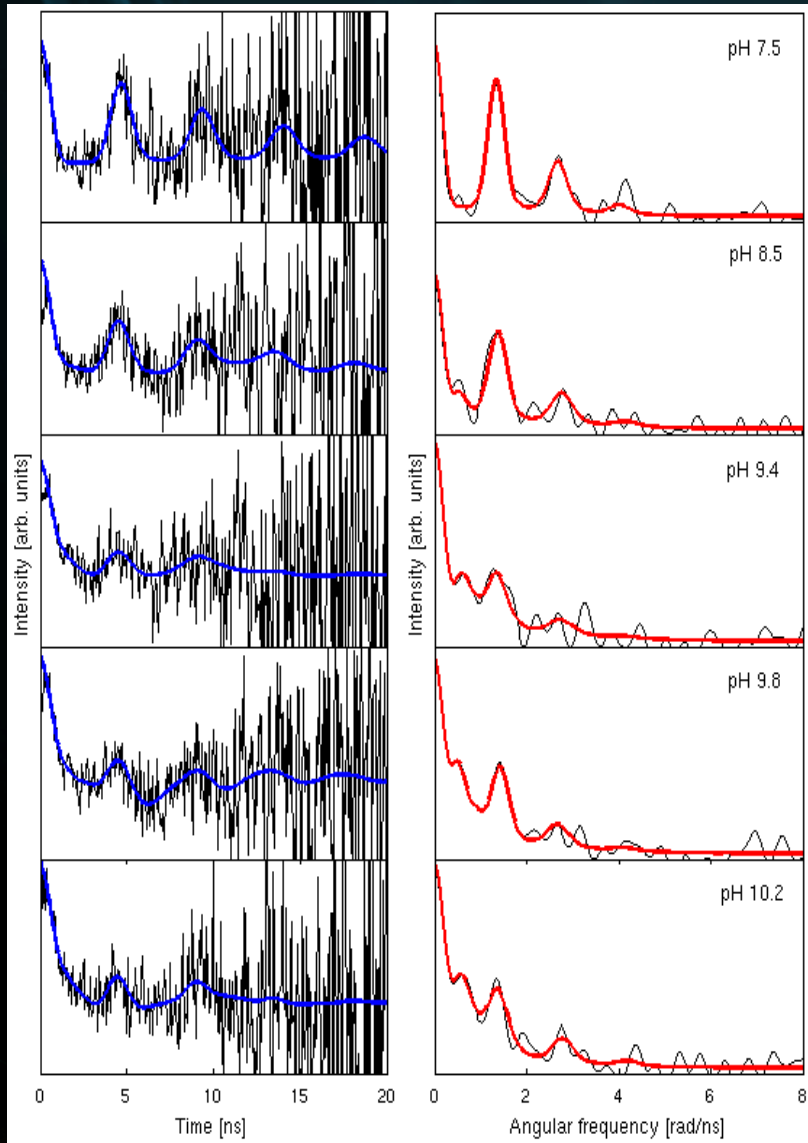
- "silver" dental fillings, gold mining and fish
- cancer, autoimmunity, kidney and brain damage, autism

## Lead

- gasoline, house paints, lead pipes, mines, and batteries
- cancer, autoimmunity, damage of nervous connections, blood and brain disorders



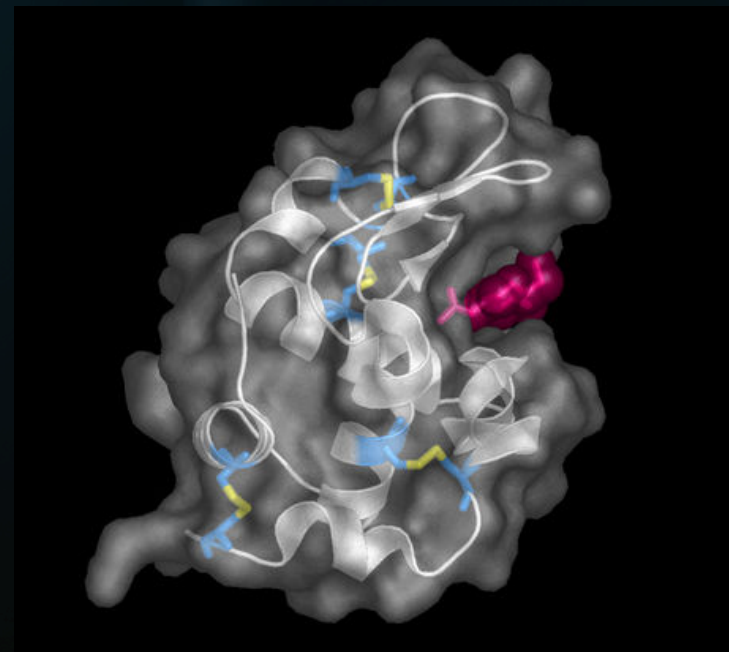
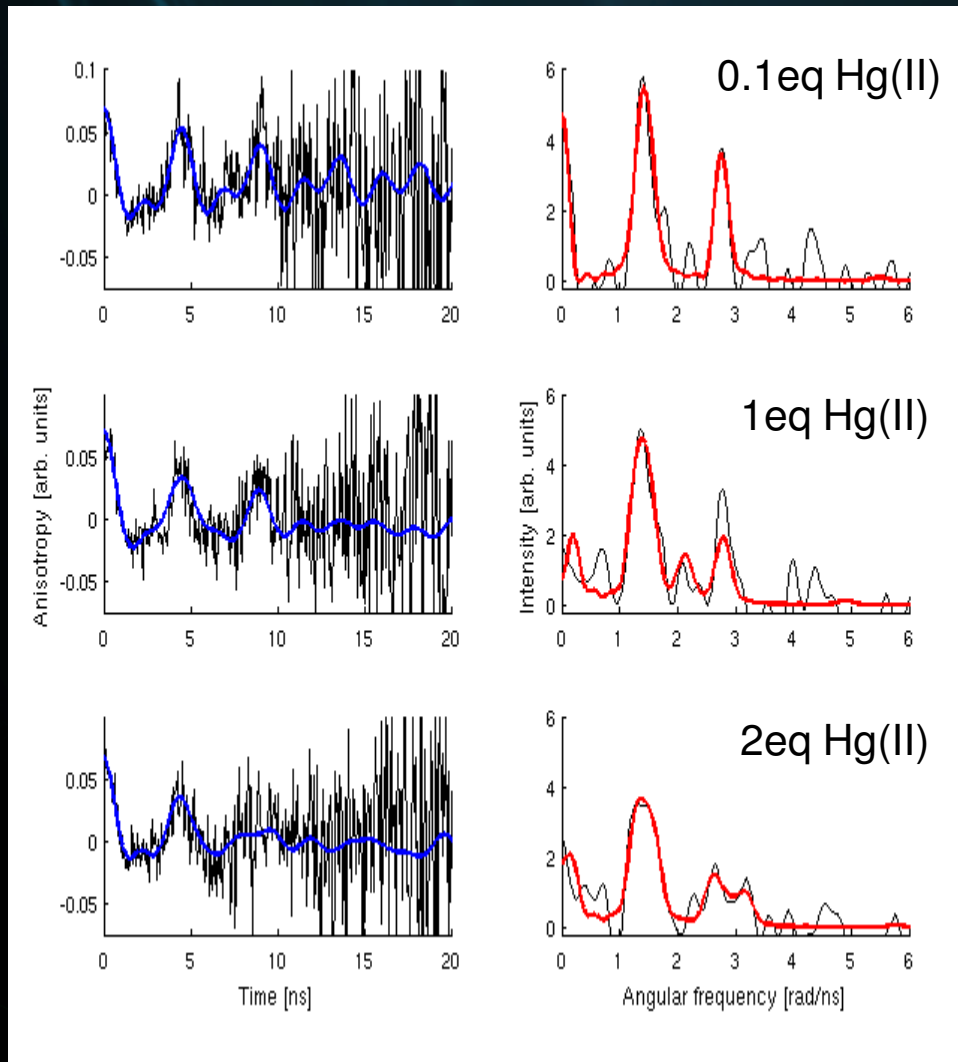
# Metalloprotein structure



Wernimont AK et al. Nature Structural Biology 7, 766 - 771 (2000)



# Protein dynamics



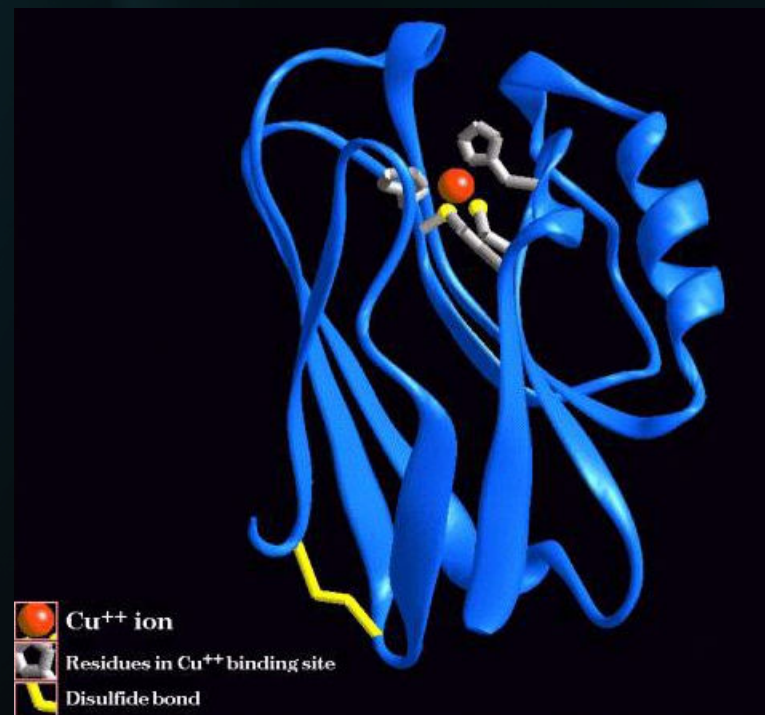
PDB input 2LYZ.pdb

# Beta-NMR applied to biophysics

## Beta-NMR

→ Cu, Zn, Mg, Mn, Fe, Ni

→ Measurement of electric field gradient



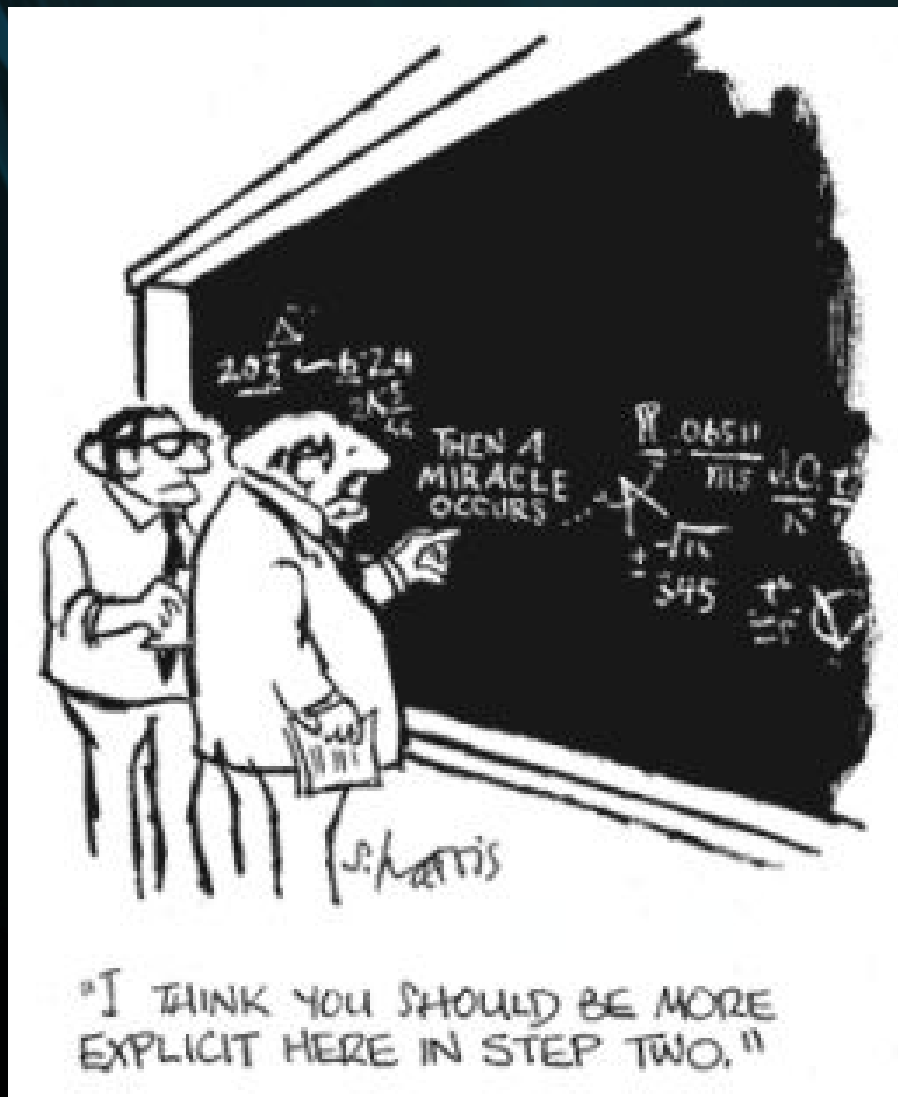
- Cu(I) is “invisible” in most (except X-ray and nuclear) spectroscopic techniques because it is a closed shell ion
- Cu(I)/Cu(II) are essential in many redox processes and electron transport in biology



# Acknowledgements



- Karl Johnston
- The ISOLDE collaboration
- Danish Research Council for Nature and Universe
- And many more...



Thank you