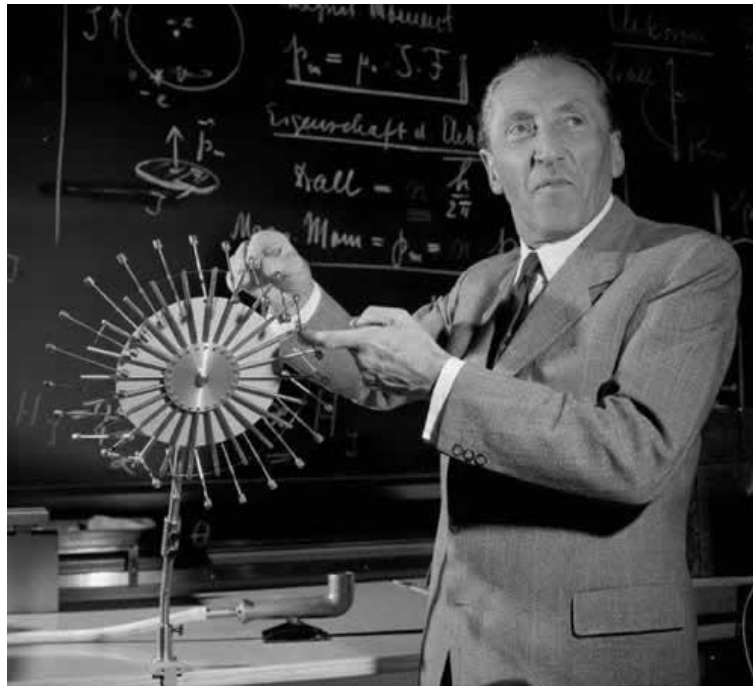


National Student Team Contest (first stage)
Task 6. X-ray diffraction for the analysis of nanoparticles



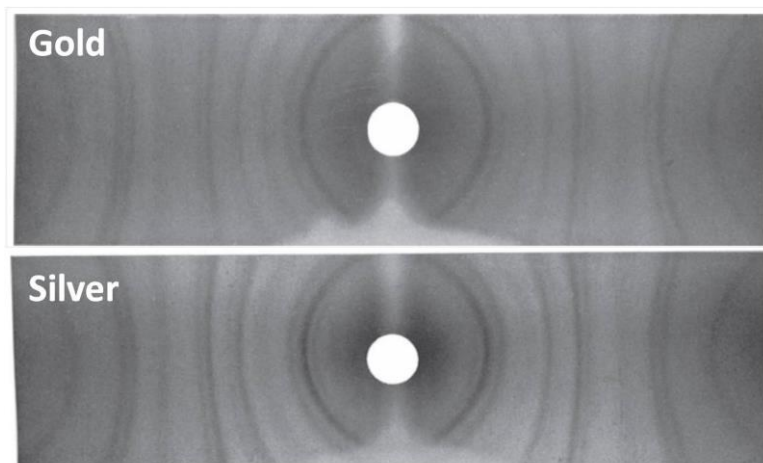
http://www.library.ethz.ch/exhibit/Traum_Reaktor/paul_scherrer.html

Dr. Paul Scherrer was a Swiss physicist, who published the paper on the use of XRD to estimate crystallite size in 1918. That happened only 6 years after the first X-ray diffraction pattern was described by Laue. The equation proposed by Scherrer is still in use because of its simplicity and minimum of related parameters and constants:

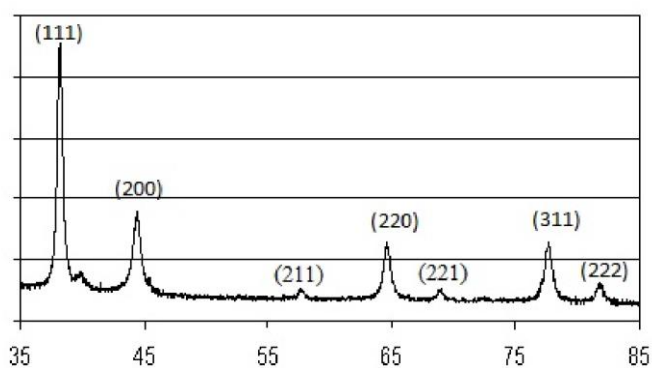
$$B(2\theta) = \frac{K\lambda}{L \cos \theta} ,$$

namely, K is the Scherrer constant, λ is the wavelength of X-rays, θ is a half of the diffraction angle. Nevertheless, L is the coherence length which is not the true particle size or crystallite size and a list of limitations should be in mind.

1. What are the limitations for Scherrer equation? **(2 points)**
2. What is the range for Scherrer constant K and what are the key parameters which affect its value? **(2 points)**
3. What materials were in the first list of samples examined by Prof. Scherrer in late 1918? What kind of anode and monochromator were applied in those experiments? **(1 point)**
4. Two of the samples were nanoparticles of gold and silver. Compare qualitatively the average values for coherence lengths L using the experimental data by Prof. Scherrer. **(1 point)**



5. Which of the reflections in the following XRD pattern of gold are most appropriate for the coherence length calculation? **(1 point)**



Total – 7 points