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”*Introduction into the Dynamical Theory of X-ray Diffraction for Perfect Crystals*”

This series of four lectures will be rather basic and it is intended for interested students and scientists not necessarily from this special field. So we shall proceed slowly and will have time for questions and discussion.

After a few historical remarks starting with the year 1912, some results of the so called “kinematical (or geometrical) theory of X-ray diffraction” will be presented. This is important to demonstrate why another diffraction theory, the “dynamical theory of X-ray diffraction” was necessary. We will see what are the difference and the physical meaning of those two kinds of theory, as well as when the basic theoretical developments and the first experimental confirmations of this dynamical diffraction theory were done. An important point is to find a physical definition under which conditions the older kinematical or newer dynamical diffraction theory for X-rays (and not only for them) is valid. After the presentation of a short theoretical background of the dynamical theory of X-ray diffraction for perfect crystals (there also exist versions for deformed crystals, but will not be discussed here) basic results and helpful tools like “dispersion surfaces”, the “one beam case” (refraction and reflection in this language), the “two beam case” (the one most often used in practice) will be presented. Later, some typical effects will be mentioned that may only be explained by the help of the theory of dynamical X-ray diffraction. Those are the “Pendellösung length” (Laue case), the “Pendellösung effect”, anomalous X-ray transmission or “Borrmann effect”. At the end, the use of asymmetric Bragg cases for X-ray optics and a related problem of (transversal) coherence preservation will be mentioned.

The mentioned dynamical diffraction theory for X-rays, but also for electrons neutrons and other waves/particles is of practical importance for the understanding, analysis, and modelling of diffraction and diffraction imaging experiments on samples with “with a not too small volume”. How “large” or “small”, this depends on several parameters and we shall learn more about this during the lectures.