MS48 What should undergraduate students learn about crystallography?

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Condensing a degree into a few hours of lectures

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Abstract

Crystallography is a highly interdisciplinary subject and basic knowledge at the undergraduate level should be taught in chemistry, physics, biology, material sciences and other related subjects. With the exception of mineralogy, there is usually only very limited time available to introduce undergraduates to crystallography, which makes it even more important to bring across the right message. How to condense the knowledge of a whole degree into a few hours of lectures? As far as I am concerned symmetry and in particular solid state symmetry has to occupy a large portion of the available time. On the other hand, some form of motivation has to be given, such that students become interested in this field. As a chemist, chemical crystallography is introduced by reference to an actual publication, containing a molecular structure determined by X-ray crystallography and a more or less elaborate footnote or supplementary information, with the crystallographic details. The challenge put in front of the students is to decipher terms like triclinic, Fddd or GooF. Subsequently translational symmetry is introduced in contrast to the (hopefully) known point group symmetry of molecules. Wooden models of the crystal systems are distributed in the classroom and students are asked to identify symmetry elements, which are translated from Schoenflies to Hermann-Mauguin notation. After the introduction of screw-axes and glide-planes examples of space groups are discussed. This completes the symmetry part. The practical aspects of X-ray diffraction have to be given some room, in order to combine the material introduced so far to an actual experiment. This is then continued with a step-by-step process involving some simple geometrical diffraction considerations, a derivation of Bragg's law, the origin of diffraction intensities and finally a brief comment on the phase problem and its possible solution. At the end the results of a successful single crystal structure determination are re-examined and the cryptic terms of the initial crystallographic footnote are put into context. Time permitting differences and similiarities to powder diffraction are presented and further examples are given in the course. As part of this ECM-lecture there will be a discussion on the pros and cons of online teaching, including a review of personal experiences during three corona terms.