X-ray diffraction from muscle: radiation damage and how to deal with

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X-ray diffraction from muscle is a unique and valuable technique for the *in situ* studies of the molecular mechanism of muscle contraction. The high brilliances now available at the third generation synchrotrons allow recording the structural changes accompanying the chemo-mechanical energy transduction in the molecular myosin motors at the level of the single skeletal muscle cell with submillisecond - subnanometer resolution, and the forecasted one order of magnitude higher photon flux available after the upgrading of the ESRF to a fourth generation synchrotron will allow recording with reliable signal-to-noise diffraction signals yet too weak for that time resolution, as those from regulatory and cytoskeleton proteins involved in muscle regulation. At the same time, a high photon flux means an increased radiation dose on the sample, the living cell, that undermines the cell function, as indicated by the loss of mechanical response to the electrical stimulation and the deterioration of the diffraction pattern weakening specific reflections or the pattern as a whole.

I will discuss the effects of the radiation damage observed, during the diffraction experiments, in different kind of samples: skeletal whole muscle and single cell and cardiac tissue, together with the strategies adopted to prevent it. I will discuss also how the effects of the damage depend on the experimental protocols used for the study of different aspects of the muscle physiology, and how the protocol itself must be adapted so that the effect of the damage can be recognised and managed during the analysis of the data.