# The Use of Cryogenic Helium in Macromolecular Crystallography

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Ultrahigh resolution data (0.9 Å) is needed to unambiguously position H atoms in macromolecular structures solved using X-ray diffraction methods. However, radiation damage to crystals during data collection at synchrotrons can significantly affect the ability to collect information to ultrahigh resolution. Decakelvin temperature data collection provides a means of increasing crystal diffraction and mitigating radiation damage. Resolution improvements at helium cryogenic temperatures are probably the consequence of both lowering B factors and the minimization of static disorder conformations. We have seen extended lifetimes in crystals at APS with both the nucleosome core particle and the human light chain dimer, Mcg. Our studies with the anti ssDNA antibody Fab BV0401 have shown an extension of resolution (1.6 Å to 1.48 Å) and an increase in signal-to-noise ratio at the highest resolution shell (1.4 to 4.1). Thus, the potential benefits of using cryogenic helium at high-intensity third-generation synchrotron beamlines include significant reduction in radiation damage, lower temperature factors, and increased resolution. These studies have been made with the HeliToledo device, which has some significant differences from other commercially available cryostats. In addition, structure modulation effects have been noted in some crystals at He temperature. Experiments are underway to classify these modulation effects, and to use He in ultrahigh resolution diffraction experiments.

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