# Beryllium and lithium x-ray lenses at the APS*

Ali Khounsary[a], Eric M. Dufresne[a], and Andrew N. Jansen[b]

[a]Advanced Photon Source, Argonne National Laboratory, Argonne, IL 60439

[b]Chemical Engineering Division, Argonne National Laboratory, Argonne, IL 60439

**Abstract.** Compound refractive lenses (CRLs) are arrays of double concave lenses used to focus x-rays. For a given incident x-ray beam energy, the focal length of a CRL depends on the material and shape of individual lenses, and in particular is inversely related to the number of lenses in the array. The throughput of a lens array is heavily impacted by absorption of the x-rays in the lens. For this reason, it is necessary to employ low-atomic-number materials and fabricate the lenses as thin as possible, especially for low to moderate x-ray energy range (~ 5-20 keV) photons.

Lithium is one of the best candidate materials for x-ray lenses due to its relatively high (real decrement) index of refraction and its low x-ray absorption. It is very malleable, however, and reacts strongly with moisture in the air thus requiring special fabrication environment and housing. Beryllium, on the other hand, is a solid metal, easy to machine and handle. Exposure to beryllium dusts and fumes during fabrication constitutes a serious health risk but as a solid lens material, once fabricated, it requires no especial handling other than safeguarding it against breakage or skin abrasion.

In this presentation, lithium and beryllium lenses developed at the Advanced Photon Source (APS) are described. These include parabolic lithium lenses, and both spherical and cylindrical beryllium lenses. These lenses have been tested on an APS x-ray beamline. Their performance in terms of the focal size and gain is described and further improvements including tighter manufacturing tolerances and thinner lens walls are discussed.

**Keywords**: focusing, x-ray lens, compound refractive lens, lithium, beryllium, gain

---

* Work supported by the US Department of Energy, Office of Basic Energy Research, under Contract No. W-31-109-ENG-38.