Example telescope simulations with the AstroX telescope toolbox for McXtrace


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**ABSTRACT**

We present a number of example studies of telescope optics using the latest version of the AstroX add on toolbox for McXtrace. Among which are first, a benchmark study of effective area and vignetting for the Chandra X-ray Observatory. Second, a convenient way of building a telescope model (in this case NuSTAR) with many similar optical elements scripted using a python module. This lends itself well to be included in online notebooks and/or for teaching. Third, we show a new AstroX module for lobster eye optics, and fourth, a study of the proposed solar axion telescope BabyIAXO.

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**ASTROX LIBRARY**

Component Contents of the AstroX toolbox are move towards release 1.0.

The most basic module that could make up a Wolter telescope is the Pore from which the other elements may be derived. The MCP is the basic block of a lobster eye optic.

**CHANDRA**

Left: Effective area for the Chandra optic as modeled by AstroX (blue) and extracted from the plots Chandra Proposers’ Guide (POG). For AstroX the coatings of the mirrors were modeled using IMD.

Bottom: Normalized effective area as a function of off-axis angle, i.e. vignetting function for a set of X-ray energies, matching those reported in the POG.

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**NuSTAR Simulations**

We can (easily), through a new python package, script the creation of AstroX/McXtrace simulations. As you would normally do in python scripts, we can inject them into AstroX/McXtrace.

This way integrates well with jupyter notebooks for teaching.

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**MCP/Lobster eye optic**

A lobster eye module, or micro-channel plate (MCP) is now included in AstroX. Below we show a 3D rendering of the structure showing the square channels with reflecting parabolic/hyperbolic mirrors. Above are heatmaps of radiation immediately after the optic, for 2 keV, 12 keV, and a representative solar spectrum.

Using the fact that AstroX can flag photons according to events in their paths.

Left: Effective area for the two optical module parts and in combination. This clearly shows in which region the parts are most significant.

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**REFERENCES**