# Requirements of Very High Angular Resolution X-Ray Telescopes Enabled by Formation Flying Between Optics and Detector Spacecraft Separated by Very Large Distances

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Abstract

This year (2012) is the 50th anniversary of the discovery of the first cosmic X-ray source. During the 50 years X-ray studies has matured into a major branch of astronomy especially in the detection and study of black holes, neutron stars, supernova remnants, clusters of galaxies and more. Four spacecraft with focusing X-ray telescopes, the most prominent being the Chandra X-Ray Observatory, are currently operating in space. They all employ grazing incidence reflection to produce images and concentrate the flux of point sources. The 0.5 arc second resolution (half power diameter) of the Chandra X-Ray Observatory is likely to be the practical limit of grazing incidence reflection while future astronomy studies require better angular resolution. Diffractive/refractive X-ray telescopes offer the several orders of magnitude better angular resolution that is needed for future missions. The optics are also much lower mass and less expensive to construct than grazing incidence telescopes. However, they require focal lengths of ~1000 km. The optics and detector must be on separate spacecraft in an environment with low gravity gradients such as solar orbits. At least one of the two spacecraft requires propulsion to overcome the gravity gradient forces that would disrupt the alignment of the optics and the detector spacecraft, and for one to navigate to a new target position. We would like to bring these technical issues to the attention of engineers and scientists that are engaged in developing the tools of propulsion so that they include in their future planning the requirements of "formation flying" alignment between two spacecraft separated by ~1000 km.