HRC

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The big news from the High Resolution Camera (HRC) instrument team is, of course, the passing of our principal investigator, Stephen Murray. A more detailed memorial article can be found on pp. 8-12, but Steve's sudden and unexpected passing shocked and saddened us all. He led the HRC team from the initial development of the instrument concept through construction, calibration and launch. His strong leadership guided the instrument team through all the ups and downs of the development of the flight instrument and post-launch operations. He assembled a strong team of scientists to advise him about how to best use the HRC Guaranteed Observation Time. He was a strong presence in our field, always at the forefront of research both scientifically and technologically. His passing was a great loss to the *Chandra* and broader high-energy astrophysics communities. The impact of his work and his personality will remain with community, particularly within the CXC, for a long time.

The HRC continues to operate well with no major anomalies, although there has been a change in one of the important instrumental trends. Over the past 1.5 years, the rate of gain decrease on the HRC-S has increased. The reason for this change is currently unknown, but the instrument team is trying to understand the phenomenon. There will be little impact on science operations in the short term, but if the gain continues to drop at the present rate we will recommend another high voltage increase later this year or early next year. The last high voltage increase of HRC-S occurred in February 2012. Otherwise the instrument continues to operate well.

The HRC was used for a wide variety of scientific investigations over the past year. This year we focus on a study performed by Drs. Rosanne Di Stefano and Frank Primini on variables in the galactic bulge. The Bulge of our Galaxy is rich in variables of all kinds, including X-ray binaries. Di Stefano and Primini conducted a survey of a portion of the Bulge in Baade's Window, with HRC. Baade's window is attractive for both X-ray and optical surveys because of its relatively low absorption. In fact, Baade's Window has been monitored by numerous gravitational lensing teams such as MACHO, OGLE and MOA for a total of 25 years. These teams have discovered almost 20,000 lensing event candidates while also monitoring millions of variables. Any X-ray source (XRS) discovered in such a well-monitored region may have a long-term optical light curve that can immediately help establish the nature of the source. Furthermore, possible correspondences between XRSs and lensing events offer an exciting possibility.

Chandra's unique angular resolution is a key factor in counterpart studies. However, the HRC field of view is small compared with the size of the desired survey region. This challenge has been faced before. Some groups have conducted wide-field, shallow surveys, while others have gone deep in smaller regions. We decided on a "middle way" in which we used six contiguous HRC fields to cover 1.5 degrees with 30 ksec exposures. This observing strategy also allows us to compare this approach with other observing strategies.

Our preliminary results include a total of 81 newly-discovered XRSs, some of which include optical monitoring, that has provided a treasury of useful information that can help us interpret the X-ray emission and learn more about the XRSs. For example, 23 of the XRSs correspond to OGLE-monitored Be stars, while other counterparts include an RR Lyrae system, an OGLE-identified quasar, an eclipsing binary, a long-period variable, and six objects with currently unclassified variability patterns. In addition, six of the XRSs seem to be matched with Tycho-2 stars, one of which is a star with a planetary system.

With 1130 microlensing events in our fields, there was a non-negligible chance of finding an XRS/lensing-event match. However, we did not find any such matches. Although this was disappointing, it is really only the beginning of the story, since new events are being discovered in this region every year, with the total discovery rate is increasing. Ideally, the discovery of these XRSs can be used inform future discoveries. For example, if a future lensing event coincides with the location of an XRS, that event should receive special attention. If an XRS is part of a lensed system, then new target of opportunity (TOO) X-ray observations can possibly detect the lensing event in X-rays, thus providing a firm prediction of relativity. On the other hand, if the XRS is the lens, then we may be able to measure its mass and multiplicity through a more-detailed multiwavelength monitoring of the system. The combination of large ground-based optical surveys with the wide field of view of the HRC-I has opened up new opportunities to study variable stars and potentially fundamental physics. ■