Project Scientist's Report

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We are very fortunate that *Chandra* will shortly begin its 18th year of operation, with expectations of continuation into the foreseeable future. As the next major U.S. X-ray-astronomy facility will not launch before the late 2020s, the *Chandra* Team recognizes the importance both of maintaining *Chandra*'s unique capabilities for at least another decade and also of preparing for the future.

As the Observatory ages, three issues—(1) thermal, (2) molecular contamination, and (3) radiation damage—are resulting in graceful degradation of the Observatory's performance.

1. Thermal degradation has required progressively more sophisticated mission planning to ensure that each critical component remains within its acceptable temperature range. The overall observing efficiency has remained high; however, observations at thermally unfavorable orientations are subject to limits on pointing duration or on number of operating ACIS CCDs.

2. Molecular contamination on the (cool) ACIS optical blocking filters continues to accumulate, persistently decreasing the low-energy response. Consequently, the *Chandra* Team has undertaken a detailed study of the risk/benefits of baking out the ACIS, revisiting the 2004 decision not to bake out.

3. Radiation degradation of the ACIS CCDs continues to slowly increase the charge-transfer inefficiency—especially of the front-illuminated devices. Fortunately, the *Chandra*'s radiation management program, implemented shortly after the start of science operations, has limited the subsequent rate of radiation damage to acceptable levels. A key component of this program relies upon NOAA-provided real-time space-weather monitoring of low-energy (0.1–1 MeV) protons, which have been most damaging to the front-illuminated CCDs. Working through NASA, the *Chandra* Team has requested NOAA to continue to provide this real-time data stream from the Advanced Composition Explorer (ACE) after the recently launched Deep Space Climate Observatory (DSCOVR) becomes the primary real-time space-weather satellite at L1. NOAA is currently seeking to identify the additional ground stations needed to support this capability.

The recent first detection of gravitational waves—from the coalescence of two ≈30 $M_\odot$ black holes—has spurred excitement for its astrophysical implications, which surely will involve *Chandra* in some way. Also recently, the *Chandra* Team prepared for and completed another Senior Review, which we believe went quite well: We anticipate release of the panel report later this spring.

Turning to the future, the astrophysics community is invigorated by the NASA Astrophysics Division Director's decision to pursue four mission studies in preparation for the 2020 National Academy of Sciences Decadal Survey for Astronomy and Astrophysics. In last year's newsletter, we reported that a subset of the *Chandra* Team had organized an informal science team to initiate preliminary mission concept studies with MSFC's Advanced Concepts Office in support of one such mission. Subsequently, NASA HQ selected a Science and Technology Definition Team (STDT)—with Co-chairs Alexey Vikhlinin (SAO) and Feryal Özel (Arizona) and Study Scientist Jessica Gaskin (MSFC)—to support the study of the "*X-ray Surveyor*" as one of these four missions. ■