Project Scientist's Report

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Now in its 19th year of operation, the *Chandra* X-ray Observatory continues to provide unique capabilities for high-resolution X-ray imaging and spectroscopy, enabling high-impact research by the astrophysics community. This was outstandingly confirmed through the use of Director's Discretionary Time (DDT) this past year to search for, and ultimately observe, X-ray emission to a high degree of localization from the aftermath of the collision of two neutron stars. The use of DDT facilitated making the results of the *Chandra* observations to the broad community. The image below shows the continued brightening of the X-ray counterpart (courtesy of the *CXC* and John J. Ruan et al., Astrophysical Journal Letters, Jan. 18, 2018).

The *Chandra* Team continue maximizing the scientific performance and observing efficiency of the Observatory, especially important as NASA and other international space agencies develop their plans for the next-generation facility-class X-ray missions such as *Lynx*.

As noted in the Project Scientist's Reports in previous issues of this Newsletter, three problems are gracefully degrading the Observatory's performance as it ages: (1) thermal warming, (2) radiation damage, and (3) molecular contamination. Here we provide a brief update on the status of each of these issues.

1: Increased heating of some spacecraft subsystems at particular Sun attitudes, due to degradation of the multilayer insulation blanketing the Observatory, introduces complexity in the routine operation of *Chandra*. Significant thermal modeling efforts have been undertaken to provide robust predictions for the time behavior of on-board temperatures for particular spacecraft attitudes relative to the Sun, and these models have been successfully integrated into tools used to generate both long-term and short-term schedules of observations. In addition, these models have been incorporated to introduce small pointing offsets based on predicted thermal profiles in order to ensure that the accuracy for target placement on the focal plane detectors remains within the original Observatory specifications. These efforts have resulted in an ability to maintain *Chandra*'s excellent performance and high observing efficiency, (nearly 70%). While this situation does not yet present thermo-mechanical problems, there is potentially an issue concerning molecular contamination (item 3 below), as components out-gas and off-gas more rapidly at higher temperatures.

2: After radiation damage to the ACIS front-illuminated CCDs during unprotected radiation-belt passes early in the mission, the CCDs continue to exhibit acceptably slow rates of Charge Transfer Inefficiency (CTI) increase. Although the Sun is approaching solar minimum in 2020 or so, there were two intense periods of activity during 2017, the second period (in September) resulting in interruption of science operations to shield ACIS. As low-energy (0.1–0.5 MeV) protons in the radiation belt caused the initial damage to the CCDs, the *Chandra* team monitors low-energy protons using NOAA-provided real-time solar-wind data from the Advanced Composition Explorer (ACE). Although ACE is no longer the primary real-time space-weather satellite at L1, NOAA has been able to provide about 70% ACE coverage, which is adequate for the *Chandra* purposes

3: The *Chandra* calibration team continues to monitor accumulation of molecular contamination on the ACIS optically blocking filters (OBFs). The team regularly releases updates to the calibration files that account for increasing x-ray attenuation, especially at low energies, by the contamination layer. Calibration observations are conducted several times during the year to characterize the temporal evolution of the contamination layer. When the current performance deviates significantly from the existing calibration file, an updated file is created and released for use by the GO community. There are no plans to bake-out the ACIS filters in the near term; however, risk/benefit considerations continue to be reviewed. ■

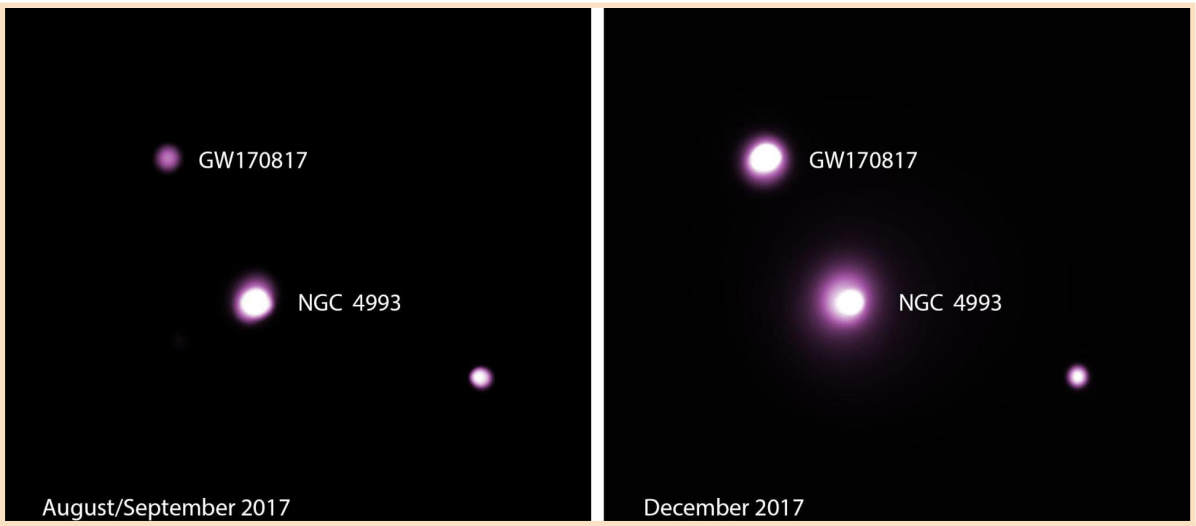

Figure 1: The image shows the continued brightening of the X-ray counterpart (courtesy of the *CXC* and John J. Ruan et al., Astrophysical Journal Letters, Jan. 18, 2018).