second pulses whose intensity is many orders of magnitude greater than that of the incident laser.

The challenge encountered in past attempts to generate coherent harmonic focusing was that the harmonic spectrum decayed too fast. Timmis, Dromey, and their colleagues overcame that problem by implementing a specialized plasma mirror. It functions essentially as an optical switch that increases or decreases the reflectivity of the plasma created at the glass target's surface. For years, plasma mirrors have been used for boosting laser intensity. Using material coatings to carefully tune the plasma mirror's reflectivity, the researchers enabled the laser pulse to generate a coherent harmonic beam more efficiently.

Simulations of the Gemini laser's interaction with the relativistic plasma by Timmis, Dromey, and colleagues suggest that the intensity of the incident laser pulse can be boosted even further, to 10^{23} W/cm^2. The coherent harmonic focus should scale with laser intensity, so reaching the Schwinger limit could, in principle, be done with a higher-powered laser. The lasers at the ELI-NP (Extreme Light Infrastructure Nuclear Physics) facility in Romania are 10 PW, an order of magnitude more powerful than Gemini's. Laser systems that are even more powerful, including the 25 PW NSF OPAL (Optical Parametric Amplifier Line) lasers at the University of Rochester and the 100 PW system at the Station of Extreme Light in Shanghai, China, are currently in development. **PT**

Reference

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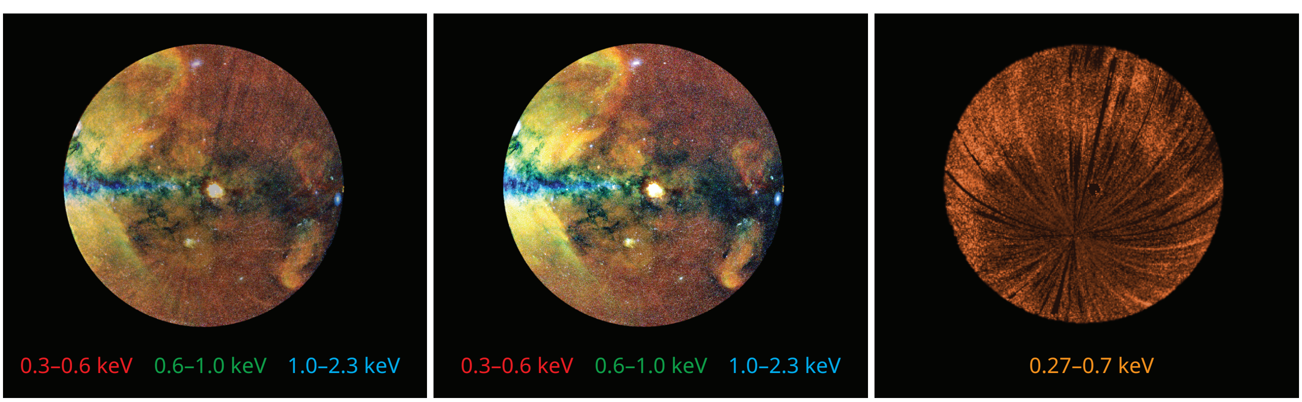
Separating signals in the soft x-ray sky

An analysis of two years of measurements from far beyond Earth's atmosphere has yielded a comprehensive map of x rays that are generated by solar wind.

By Laura Fattaruso

X rays are a valuable source of information about distant, hot celestial bodies, such as supernova remnants and active galactic nuclei. But measurements of soft x rays—which have photon energies of no more than a few kiloelectron volts—have been clouded by local contamination. Gas throughout the solar system emits soft x rays, and so does Earth's outermost atmosphere, which reaches as far as the Moon. And that contamination varies in both space and time.

Far beyond the Moon's orbit, the eROSITA telescope measured x rays outside the influence of Earth's atmosphere. And now, using data from its four full-sky surveys of the western galactic hemisphere, Konrad Dennerl of the Max Planck Institute for Extraterrestrial Physics and colleagues have separated the signals of x rays generated in the heliosphere from those generated beyond it.[1] The resulting map provides a clearer



Measurements from the eROSITA telescope were used to separate soft x rays generated in the solar system **(right)** from x-ray emissions generated beyond the heliosphere **(middle)**. A superposition of the two **(left)** represents the combined x-ray emissions. Because of restrictions on the release of the dark-sky x-ray map, the middle image shows x-ray emissions from the first eROSITA survey, which closely resemble dark-sky x-ray emissions. The right image shows heliosphere x-ray emissions from the third eROSITA survey. (Images courtesy of Konrad Dennerl/Max Planck Institute for Extraterrestrial Physics.)

picture of the x rays generated by solar wind and will help x-ray astronomers better account for them when analyzing distant x-ray signals.

The issue of soft x-ray contamination was identified three decades ago. Though it had long been known that x rays are emitted by ultrahot gas, it came as a surprise in 1996 when they were found coming from a comet.[2] The observation led to recognition of a process known as solar wind charge exchange: When heavy ions in solar wind interact with neutral matter, such as that found in comets, planetary atmospheres, and interstellar matter, the ions capture electrons and emit x rays at the same wavelengths as the ionized gases in ultrahot astrophysical objects.[3] "All observations are contaminated with this extra emission," says Kip Kuntz of Johns Hopkins University, who studies x-ray emissions.

For bright sources under study, the impact is insignificant. But for faint sources, the contamination can make up a significant fraction of the measured emissions. Estimates for the pressure, mass, and other physical parameters of astrophysical objects are affected by the difference. "That has consequences for [studying] dark matter and even for cosmology," says Dennerl.

X-ray measurements by eROSITA began in 2019, when the Sun's activity was at a minimum, and extended over a two-year period. The data, illustrated in the figure on page 9, provide insights into the spatial, temporal, and compositional variability of solar wind. Solar wind has fast and slow components—slow wind is more ionized and is thus the more dominant source of x rays. As solar activity increased over the observation period, slow wind expanded out from low latitudes. X-ray spectroscopy can reveal the wind's heavy-ion composition and highest charge states, both of which are otherwise difficult to measure remotely and typically require *in situ* sampling.

The new data confirm previous observations that as interstellar matter flows into the solar system, the Sun's gravity sends helium from the matter into a ballistic trajectory that produces a concentrated cone of the gas. The measurements also verified the presence of a hydrogen cavity around the Sun that is caused by the interaction of ionized hydrogen with solar wind.

The eROSITA instrument was built by the Max Planck Institute for Extraterrestrial Physics in Germany and is carried on the *Spektr-RG*, a Russian–German satellite launched in 2019. The collaboration included an agreement that data from the western galactic hemisphere would go to the German eROSITA consortium and the Russian eROSITA consortium would retain data from the eastern hemisphere. The instrument stopped collecting data in 2022 because of a breakdown in cooperation between the consortia following Russia's invasion of Ukraine. **PT**

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Analysis of B-meson decay hints at new physics

The measured trajectories of the products of a rare B-meson decay deviate from the predictions of the standard model.

By Sarah Wells

For more than 50 years, the standard model (SM) of particle physics has been the prevailing description of the fundamental forces and elementary particles in the universe. But notable omissions from the theory, such as explanations for gravity and dark matter, have motivated experiments, like those at CERN's Large Hadron Collider (LHC), to search for yet-undiscovered physics. Now an analysis of collision data from the LHCb (Large Hadron Collider beauty) experiment, shown in figure 1, has yielded fresh evidence that the properties of some decays of B mesons, which are composed of a bottom antiquark and a lighter quark, deviate from those predicted by the SM.[1] Though the discrepancy is still under the five-standard-deviation threshold that, by convention, is needed to claim a discovery, it adds to growing support for the idea that new physics may play a role in the behavior of B mesons.

The new work focuses on the decay of a B meson into a kaon, pion, and two muons. Known as a penguin decay, it is playfully named for the rough resemblance its Feynman diagram has to the flightless bird, as shown in figure 2. The penguin decay of B mesons