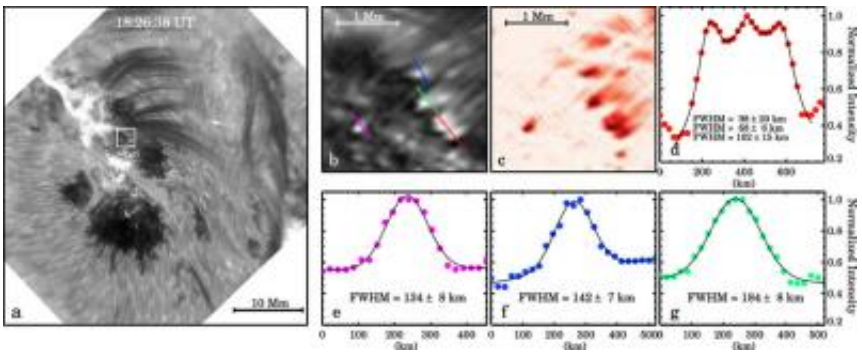
From bright flare ribbons to coronal rain, high-resolution images capture a solar flare as it unfolds

April 19 2016, by Tracey Regan



The impulsive phase of the solar flare, in which most energy is released. Credit: NJIT

Scientists at NJIT's Big Bear Solar Observatory (BBSO) have captured unprecedented images of a recent solar flare, including bright flare ribbons seen crossing a sunspot followed by "coronal rain," plasma that condenses in the cooling phase shortly after the flare, showering the visible surface of the Sun where it lands in brilliant explosions.

The new images provide insights into one of the central puzzles of solar physics - how energy is transferred from one region of the Sun to another during and after a solar flare, an explosive release of magnetic energy responsible for space weather.

"We can now observe in very fine detail how energy is transported in solar flares, in this case from the corona where it has been stored to the lower chromosphere tens of thousands of miles below it, where most of the energy is finally converted into heat and radiated away," said Ju Jing, a research professor in NJIT's Department of Physics and the lead author of the study, "Unprecedented Fine Structure of a Solar Flare Revealed by the 1.6?m New Solar Telescope," published this week in *Scientific Reports*, a journal affiliated with the Nature group of publications.

Ju noted that while electron beams are traditionally seen as the major agent for transporting flare energy, the new observations provide novel information on the spatial scale of the energy transport.

Dale Gary, a distinguished professor of physics at NJIT and a co-author of the study, described the images as "the highest-resolution observations of this kind of activity we've had before."

"What is particularly interesting is that these bright areas of impact are so small in size that they have been present, but overlooked in previous observations with lower resolution," he added.

Captured by NJIT's 1.6 meter New Solar Telescope (NST) during a solar flare on June 22, 2015, the images of coronal rain are among a series of recent pictures captured by the NST providing scientists new insights into the complex dynamics of the Sun's multi-layered atmosphere and the massive eruptions on the star's surface.

NST's high-resolution observations have led to new information in particular on all phases of solar flares, including the instability of magnetic flux tubes that can trigger flares, the behavior of the bright flare ribbons that occur in the initial phase of flares, and new observations by Ju and her colleagues of the cooling phase.

"Ever since a solar flare was first detected by Carrington and Hodgson in 1859, this spectacular phenomenon of solar activity has been a subject of intense research and has served as a natural laboratory for understanding the physical processes of transient energy release throughout the universe," Ju noted in her recent paper.

The newly revealed solar phenomena will lead, the researchers hope, to a better understanding of their impact on Earth.

"Our measurements bridge the gap between models and observations, while also opening interesting avenues of future investigation," Ju said. "With large, ground-based telescopes, will we will be able to measure, for example, these features on the Sun's surface down to their fundamental spatial scale? We look forward to further investigation coupled with theoretical modeling to fully understand what we have observed."

More information: Ju Jing et al. Unprecedented Fine Structure of a Solar Flare Revealed by the 1.6 m New Solar Telescope, *Scientific Reports* (2016). DOI: 10.1038/srep24319

Provided by New Jersey Institute of Technology