Photometric study of a microlensing event, detected by Gaia International space mission can help probe dark objects including black holes

Scientists from Aryabhatta Research Institute of Observational Sciences (ARIES) and Indian Institute of Astrophysics (IIA) autonomous institutes of Department of Science & Technology, Government of India studied the photometric and spectroscopic follow-up covering about 500 days of the event evolution observations of the event Gaia16aye, one of the first microlensing events detected by the Gaia International space mission. They established that the system was composed of two main-sequence stars with mass 0.57 and 0.37 mass of Sun, a finding that can help probe dark objects, including black holes.

Microlensing events are phenomena that occur when a sub-stellar object bends the light coming from the background source due to its gravitational potential, which results in a temporary enhancement in the brightness. The photometric data allowed them to solve the microlensing event entirely and to derive the complete and unique set of orbital parameters of the binary lensing system.

Gaia is a space mission of the European Space Agency (ESA) which collects high-precision astrometric data, that is, positions, proper motions, and parallaxes, of all-stars on the sky down to about 20.7 mag in Gaia G band. While Gaia scans the sky multiple times, it provides near-real-time photometric data, which can be used to detect unexpected changes in the brightness or appearance of new objects from all over the sky.

The photometric data that they collected through this joint research of Dr. Alok Chandra Gupta from ARIES and Prof. G. C. Anupama, Senior Professor & Dean. IIA allowed them to solve the microlensing event entirely and to derive the complete and unique set of orbital parameters of the binary lensing system. The study has been recently published in the journal Astronomy & Astrophysics.

The Gaia project is led by Dr. L. Wyrzykowski of Poland including a team of 185 scientists of 102 Institutions from 31 countries (Poland, South Korea, Russia, Spain, UK, Italy, India, Thailand, Turkey, France, Israel, USA, Bulgaria, Greece, The Netherlands, Serbia, Qatar, Slovenia, Germany, Czech Republic, Switzerland, Japan, China, Taiwan, Lithuania, UAE, Chile, Cremia, Norway, Ireland, and South Africa) around the globe.

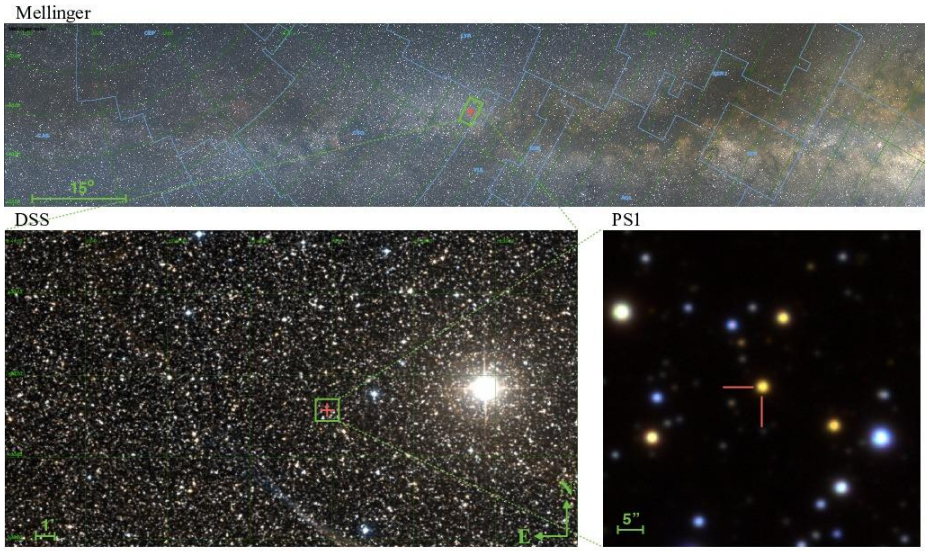
Gaia16aye was binary microlensing (a form of gravitational lensing in which the light from a background source is bent by the gravitational field of a foreground lens to create distorted, multiple and brightened images) event discovered in the direction towards the northern Galactic disc and was one of the first microlensing events detected and alerted to by the Gaia space mission. Its light curve exhibited five distinct brightening episodes, and it was covered in great detail with almost 25000 data points gathered by a network of 53 ground-based optical telescopes around the globe.

The team studying the microlensing event employed a full Keplerian binary orbit microlensing model combined with the motion of Earth and Gaia around the Sun to reproduce the complex light curve.

They have also reported on the detection of the first-ever microlensing space-parallax between the Earth and Gaia located at L2 (the second Lagrange Point, area where gravity from the Sun and Earth balance the orbital motion of a satellite). The properties of the binary

system were derived from microlensing parameters, and the Scientists found that the system is composed of two main-sequence stars with masses 0.57±0.05 $M_{\odot}$ and 0.36±0.03 $M_{\odot}$ at 780 parsec, with an orbital period of 2.88 years and an eccentricity of 0.30.

They also predict the astrometric microlensing signal for this binary lens, as it will be seen by Gaia as well as the radial velocity curve for the binary system. Events such as Gaia16aye indicate the potential for the microlensing method of probing the mass function of dark objects, including black holes, in directions other than that of the Galactic bulge.



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