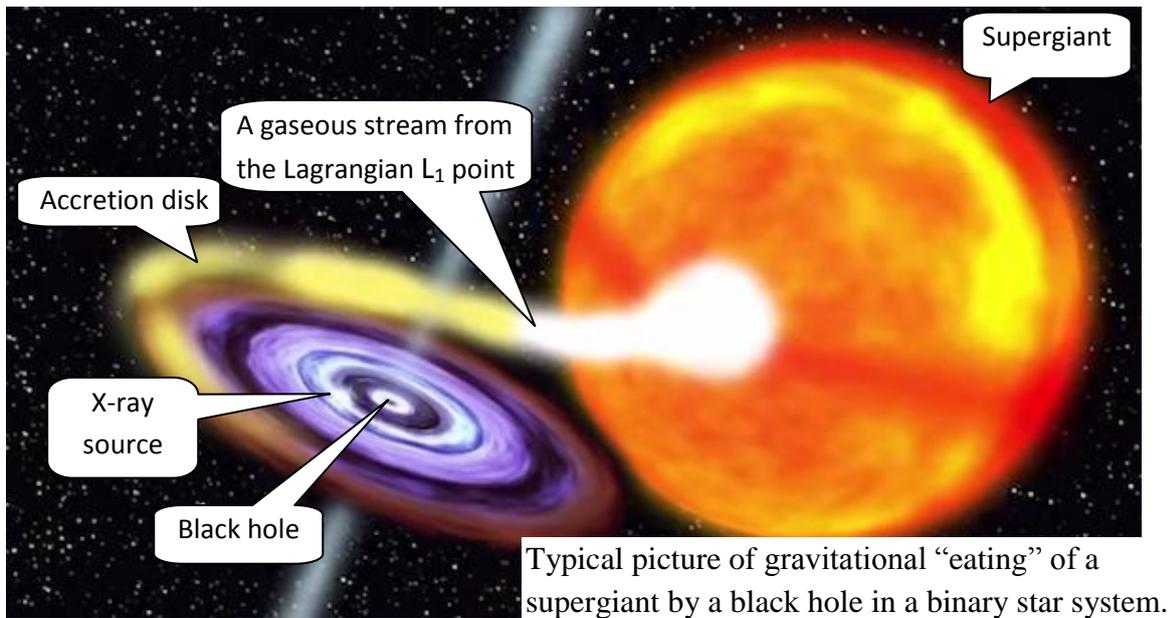


Research (What is it about?)	Doppler tomography of the binary star system containing a black hole
UNN authors	<i>Agafonov M., Sharova O.</i>
We find (The result)	By means of 3D Doppler tomography, a detailed picture of the gaseous flows motions in the X-ray binary Cyg X-1 system has been revealed including all three velocity components
Abstract	<p>Cyg X-1 is a galactic X-ray source in the constellation Cygnus, and the first such source widely accepted to be a black hole. It is one of the strongest X-ray sources seen from Earth. It belongs to a high-mass X-ray binary system that includes a supergiant variable star. A stellar wind from the star provides material for an accretion disk around the black hole. Matter in the inner disk is heated to millions of degrees, generating the observed X-rays. A pair of jets, arranged perpendicular to the disk, are carrying part of the energy of the infalling material away into interstellar space.</p> <p>We demonstrate the results of a 3D Doppler tomography (<i>in V_x, V_y, V_z space</i>) for Cyg X-1 by analysis of spectral profiles of <i>He</i> lines in rotating system. The reconstruction was realized using the radio-astronomical approach, developed for solving problems in tomography with a limited number of projections. We obtained for the first time the full picture of gaseous flows velocities as inside so outside the orbital plane of the system. The resolution of the constructed 3D tomogram in velocity space is less than 60 km/s.</p> <p>The maximum absorption (corresponding to the supergiant) and emission structural features in the 3D tomogram are located in its central section, where the velocity component perpendicular to the orbital plane is zero ($V_z=0$). The emission is generated mainly in the outer part of the accretion structure, close to the supergiant. A gaseous stream from the Lagrangian point L1 with its motion close to the orbital plane is identified. Its maximum velocity V_x reaches 800 km/s. The flow from the magnetic pole of supergiant with the velocity $V_z \approx 300$ km/s perpendicular to the orbital plane is registered.</p>

Representative articles 2017-2018, quartiles	1. <i>Agafonov M.I., Karitskaya E.A., Sharova O.I., Bochkarev N.G., Zharikov S.V., Butenko G.Z., Bondar' A.V., Sidorov M.Yu.</i> 3D Doppler Tomography of the X-ray Binary System Cygnus X-1 from Spectral Observations in 2007 in the HeII λ 4686A Line. <i>Astronomy Reports.</i> 62 (2), 89–102 (2018).	Q4
	2. <i>Agafonov M.I., Karitskaya E.A., Sharova O.I., Bochkarev N.G., Zharikov S.V., Butenko G.Z., Bondar' A.V., Bubukin I.T.</i> Analysis of 3D Doppler Tomography of the X-ray Binary System Cygnus X-1 from Spectral Observations in 2007 in the HeII λ 4686A Line. <i>Astronomy Reports.</i> 62 (3), 225-237 (2018).	Q4
Q-index (Qi) for the result		1
high green		

In collaboration	<p>Institute of Astronomy RAS, Moscow 119017, Russia National Autonomous University of Mexico, Ensenada, Mexico Lomonosov Moscow State University, Moscow 119991, Russia International Center for Astronomical and Medical-Biological Research, NAS Ukraine, Kiev, Ukraine Volga State Academy of Water Transport, Nizhny Novgorod, Russia</p>
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Cyg X-1 system: 6 light years away from the Sun, optical component $M_o \approx 25 M_{Sun}$, X-ray component $M_x \approx 10 M_{Sun}$, $R_{hole} \approx 300 \text{ km}$

Emission – absorption pictures in (V_x, V_y) plane (sections of 3D Doppler tomogram) for different V_z

