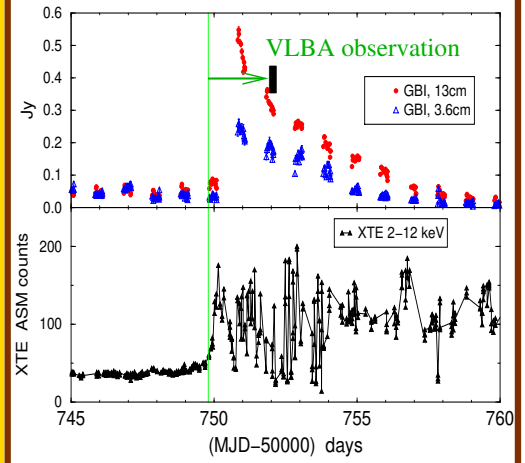
Microquasar GRS 1915+105 : VLBA Images of the AU–scale Jet & Superluminal Ejecta.

V. Dhawan (NRAO), I.F. Mirabel (CEA Saclay), L.F. Rodriguez (UNAM), ApJ 543, 1 Nov 2000

A: Radio / X–ray Flares

1997 Oct 24 – Nov 08



X-ray binaries contain a neutron star or stellar-mass black hole and a more normal companion star, in such a tight orbit that matter is transferred to the compact star. The infalling gas is flattened by rotation into a disk, and heated by friction. The inner accretion disk is a site of high-energy frenzy: extreme gravity, temperature, pressure, magnetic field, & radiation, in rapid rotation.

Microquasars are a subset of binaries that emit radio waves from relativistic plasma in addition to X-rays from the hot accretion disk. Such ejection of matter along the axis of rotation occurs in many accreting systems, including nascent stars, collapsed stars, and black holes containing millions of solar masses in the center of distant quasars.

The fireworks here are from one spectacular example, GRS1915+105.

A: The flare indicates a major change in the accretion disk, emitting a million solar luminosities in X-rays, accompanied by the 'cannon' - the ejection of blobs of radio-emitting plasma moving at nearly the speed of light.

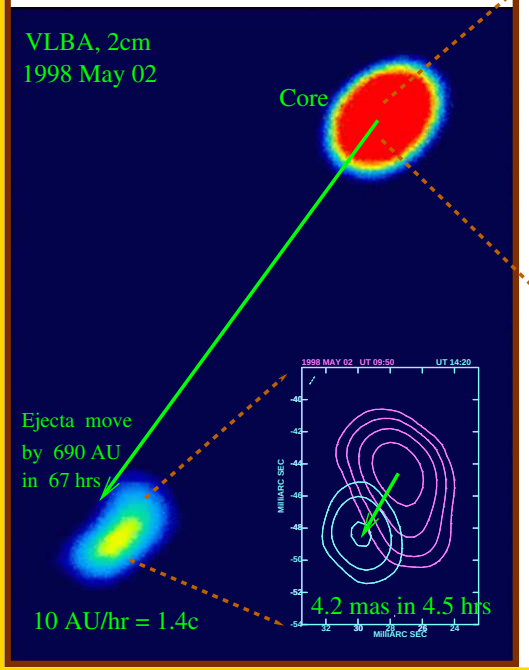
B: The VLBA image just after a flare. The green arrows in figures A and B show the time elapsed since the flare, and the motion of the plasma blob away from the stationary core during that time. Inset is the motion over a few hours.

C: Zooming into the stationary core, high-resolution VLBA images show a 'blow-torch' - a jet - pointing in the ejection direction.

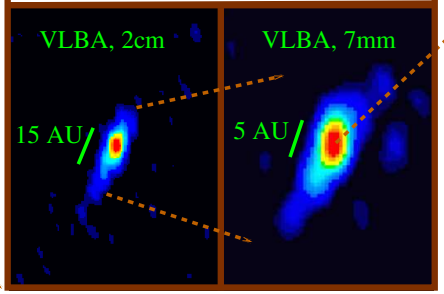
D: Simultaneous data in the radio and X-rays show dropouts every 12min or so, as the X-ray emitting matter is ejected in puffs of plasma that light up the symbiotic radio jet.

E: Measuring the location of the black hole over time, shows that it rotates in the disk of our Milky Way, about 38,000 light-years away.

B: Superluminal ejecta.

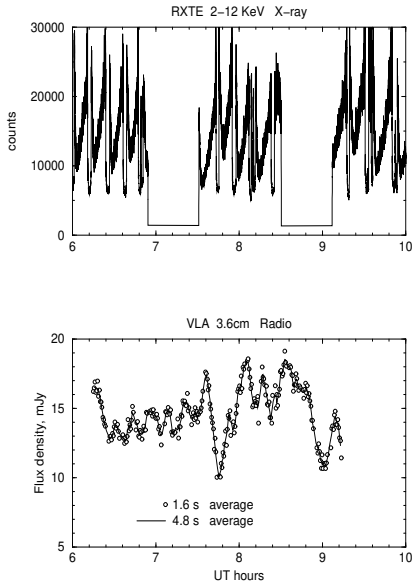
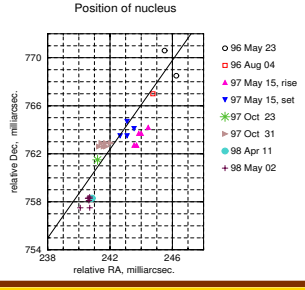


C: AU–sized nuclear jet



D: Disk & Jet co–evolution

1997 Sep 05



E: Astrometry