



Multi-frequency observation of Galactic micro-quasar Cygnus X-3 during flare

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Abstract. We studied the multi-frequency radio observations of the Galactic micro-quasar Cygnus X-3 using the Giant Metrewave Radio Telescope at 244, 325, 614 and 1280 MHz and Very Large Array at 8.43, 22.5 and 43.3 GHz during various flaring activities between 2006 to 2009. We have calculated the two point spectral index from the simultaneous observations at 244 and 614 MHz. These spectral index varies from positive (optically thick) and negative (optically thin) values which is consistent with the synchrotron self absorption model. We calculated some physical parameters such as the size of emitting region, turn over frequency and corresponding peak flux using the synchrotron self absorption model. The size of the emitting region are different at different time of the flare.

Keywords : radio continuum: stars – X-rays: binaries – X-rays: individual: Cygnus X-3 – stars: flare

1. Introduction

Cygnus X-3 is one of the most energetic X-ray binary systems. Cygnus X-3 is well known for the major flaring activities from γ - ray to radio wavelength. The flare of 2006 May-June was one of the largest flare in the history of the source (Pal et al. 2015, 2006). Using Giant Metrewave Radio Telescope (GMRT), Very Large Array (VLA) data and published results using RATAN, we construct the radio spectrum in the rising and fading phase of flare (Pal and Rao 2007; Pal et al. 2008; Trushkin et al. 2008). From these radio spectrums, we clearly see that the turn-over frequency is shifting towards lower frequencies as the flares developed gradually.

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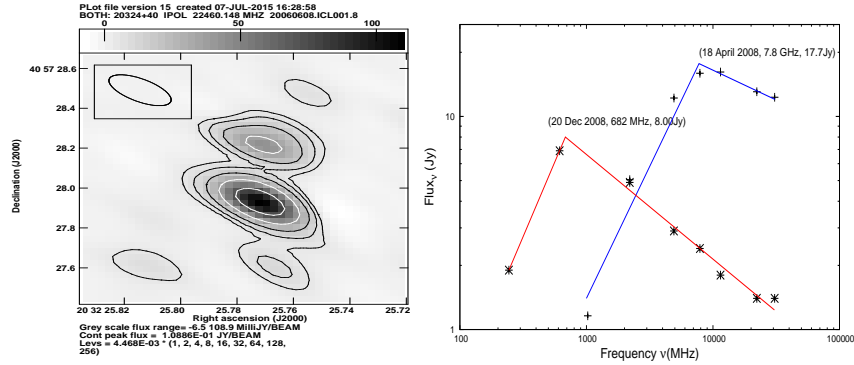


Figure 1. Resolved image of Cygnus X-3 on 8th June, 2006 at 22 GHz (left). A combined radio spectrum of 18th April and 20th December, 2008 which shows that break-down frequency is shifting towards low-frequency region (right).

2. Results

We report the multi-frequency radio observations of flaring events of the Galactic micro-quasar Cygnus X-3. Spectral index in the low radio frequency region were changing from negative to positive values for the flares which was consistent with the model of radio emitting bubble expanding from optically thick to thin state. Absorption towards lower radio frequencies was seen which was consistent with the synchrotron self absorption mechanism. We have modeled the evolution of radio spectrum to obtain the source parameters such as the turn-over frequency and the corresponding peak flux and also the size of the emitting region. We calculate the size of the radio emitting blob $\theta = 0.26, 0.83$ and 1.48 milliarcsecond during the peak of an arbitrary 18th April, 2008 flare and $\theta = 6.22, 19.86$ and 35.53 milli arc-second during the decay time of a flare on 20th December, 2008, if we assume the value of the magnetic field strength $0.1, 1$ and 10 Gauss respectively. This results is consistent with our model.

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