A COCOON TRANSPARENCY AND THE 3C 345 LOW FREQUENCY VARIABILITY

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Abstract. The structure of the quasar 3C 345 is studied at $\lambda = 49cm$. The core has a low-frequency cut off spectrum and $\alpha \sim 3$. The brightest knot is in the nearest part of the jet. The cocoon wall absorbs low-frequency emission and changes the polarization orientation, RM = 3500 $rad\ m^{-2}$, $B_{||} \sim 100\ \mu$G at the core region.

The studies of the quasar 3C 345 fine structure at $\lambda = 49cm$ with a global VLBI network show that the core emission is weak [1, 2]. The core spectrum has a low frequency cut off and the spectral index in the optically thick part is $\alpha \sim 3$. The compact brightest component corresponds the nearest part of the jet, with a size of $\sim 5 \times 4mas$. In 1983.9-1990.8 the flux density of the component and the solid angle increased by a factor of $\sim$ 2. The brightness temperature was $T_b = 0.5 \cdot 10^{12} K$ and did not change significatively.

According to the black hole model, an accretion disk implies a surrounding medium in the azimuth plane, leaving a relatively free space in the direction of the rotation axis. The relativistic plasma is ejected along the axis, within an angle of $\leq 1str$ [3]. A magnetic field focuses the plasma into thin filaments. The rotation of the black hole (the ejector) twists the filaments around the axis [4, 5] and forms the spiral structure jet [6-8].

The ejector is the source of the synchrotron emission, i.e. what we call the "core". The is core located $\sim 15mas$ E of the brightness peak in the $\lambda = 49cm$ map [1, 2] and has a brightness temperature of $T_b \sim 10^{10} K$. The relativistic plasma flow is surrounded by thermal plasma in the form of a cocoon. The cocoon absorption of the core emission at $\lambda = 49cm$ is equal ~ 100 and the optical depth $\tau \sim 5$. The absorption at 6 cm will be $\leq 20\%$ and the cocoon wall is practically transparent at mm-cm wavelengths.

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The time scale of the low frequency variability is $t \sim 1$ yr [9] and the recombination time of the thermal plasma must be ≤ 1 yr. The recombination time is equal $t_r = 10^5 N_e^{-5}$ yr therefore $N_e \sim 10^5$. If the optical depth of the cocoon wall is $\tau \sim 1$, the wall thickness is $l \sim 10^{-3} pc$. The thickness increases with the distance from the core and the total number of thermal electrons in a column is $N_e \sim r^{-2}$. The transparency is determined by the emission measure EM $\sim N_e^2 l$ and varies as $\sim r^{-4}$. The rotation measure $RM \sim N_e B_{||} l$ varies as $\sim r^{-3}$.

The wall is transparent at the centimetre wavelengths, however, the screen can change the orientation of the polarization plane. According to VLBA measurements of 3C 345 with a beam size $\sim 5 mas$ [10], the rotation measure in the 18-21 cm band is $RM \sim 28 rad\ m^{-2}$ and the degree of polarization is $\sim 4\%$. The size of polarized region is equal $\sim 5 mas$ [11]. The brightest emission region at 18 cm corresponds to the nearest part of the jet [1, 2]. We propose that the polarization emission at 18 cm arises from the same region. The polarization position angle, corrected for the Faraday rotation, gives the position angle of the magnetic field and the jet orientation at the distance of $\sim 5 mas$ from the core. The rotation measure, RM $\sim r^{-3}$, will be 3500 $rad\ m^{-2}$ at the core region and the magnetic field is $B_{||} \sim 100\ \mu$G.

The changes in the cocoon wall transparency will change the polarization position angle and the low frequency emission.

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