ON THE CORRELATION OF IR AND OPTICAL VARIABILITY IN NGC 4151

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ABSTRACT. We combine all published and new unpublished yet NIR (near infrared) photometrical observations of NGC 4151 which can be used for determination of time delays between optical and NIR variations. In previous study we have found that the values of time delay in NIR filters are not the same for different states of the luminosity. Here we consider the new photometrical data for the deep minimum in 2003-2007 following the very high state of the nucleus. We conclude that after sublimation in high state of nucleus the dust particles were recovering during at least several years.

Key words: galaxies: AGNs: dust: IR: variabilty; AGNs: individual: NGC 4151.

1. Light curves

Our past results about NIR time delay in NGC4151 as well as other AGNs were published mostly at Oknyanskij (1993) [1], Oknyanskij et. al. (1999, 2006) [2, 3], Oknyanskij and Horn (2001) [4]. Here we take into account new photometrical data for NGC 4151 obtaned during 2003-2007. The combined light curves at filters K and U presented at Fig.1. See details in [1-4].

2. Cross-correlation analysis

We are using the same method for time delay determination **MCCF** as in the past papers. The cross-correlation function for new data in 2003-2006 time interval is presented at Fig.2 As it is seen the time delay between the variations in U and K is about 40 days.

3. Results and summary

We combine all, published [1-4] and new results about the NIR time delay determinations at the Tab.1. It was found before for a sample of 10 AGNs with $z \leq 0.165$ that the distance from the central source to the NIR (dust) regions increases with UV luminosity as ${L_{UV}}^{0.5}$ [4]. Our investigations of NGC 4151 during more than 30 years show that the time delay in filter K is variable but not following exactly to the relation delay $\sim {L_{UV}}^{0.5}$. Possible explanation of this result may be connected with sublimation of the graphite grains during high level of UV continuum. According to our result the dust recovering or recreation time should be at least several years.

Table 1: Results of NIR-to-Optical time delay determinations.

Time delay in days (1 from 2)	filter 1(2)	Time interval	References
18 ±6	K(U)	1968-1980	[1]
24 ±6	L(U)	1968-1980	[4]
35 ±8	K(U)	1985-1998	[2]
8 ±4	H(U)		
97 ±10	L(U)		
104 ±10	K(U)	1998-2003	[3]
94 ±10	H(U)		
105 ±10	L(U)		
41 ±5	K(U)	2003-2006	this paper
41 ±5	H(U)		
105 ±5	L(U)		
94 ±10	L(J)		
37 ±5	K(U)	2003-2007	

One of the possibilities is that the dust particles (graphite grains) can survive during the powerful outbursts in deep places of gas clouds and then need some time to move closer to cloud's surfaces can be needed.

Alternative explanations can be anisotropy of radiation field, shielding of the central source on the light of sight and also special orientation of the dust region, as well as real physical changes in the NIR emission region during the period of our study.

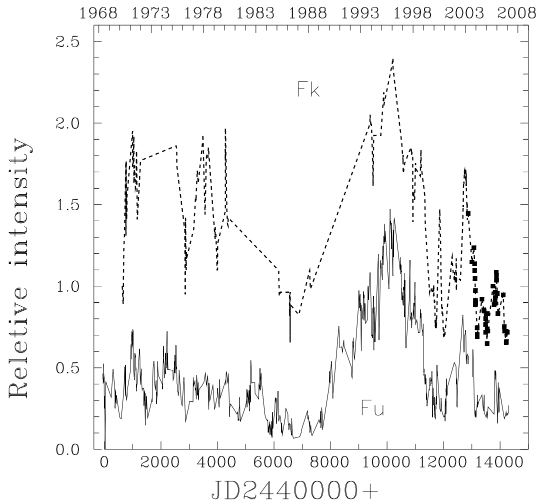

Figure 1: Observed light curves of the nucleus of NGC 4151 over 1968-2007 in relative intensities. Dashed line intensity in K, boxes - new data for 2003-2007, solid line intensity in U.

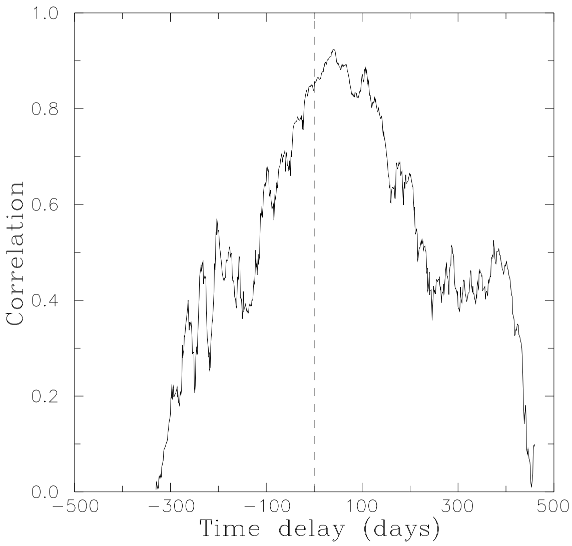

Figure 2: Cross-correlation of K and U flux variations of NGC 4151 over 2003-2006.

References

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