X-ray/UV/Optical follow-up of the blazar PKS2155-304 after the giant TeV flare of July 2006

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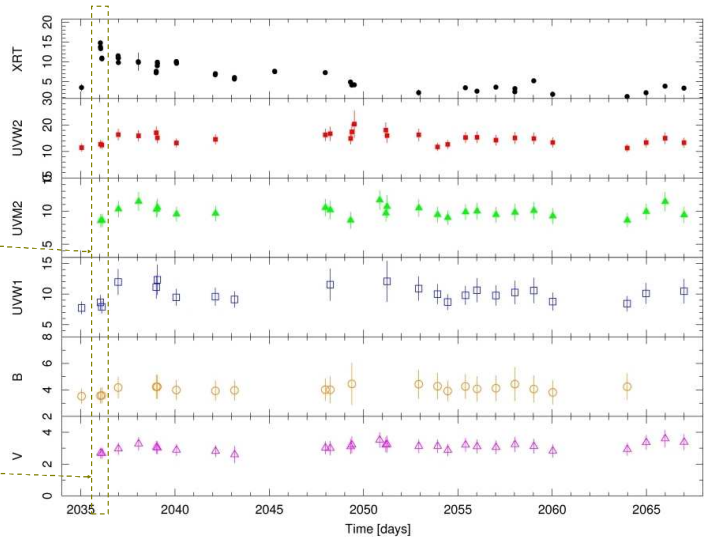
At the end of July 2006, the blazar PKS 2155-304 (z=0.116) literally "exploded" into an exceptional TeV activity observed by HESS Cerenkov Telescope, with flares up to 17 Crab (E > 200 GeV) on time scales of 5 minutes (Benbow et al., 2006, Aharonian et al., in preparation). We present here a summary of the X-ray/UV/Optical follow-up performed with the *Swift* satellite. More details can be found in Foschini et al., astro-ph/0701868.

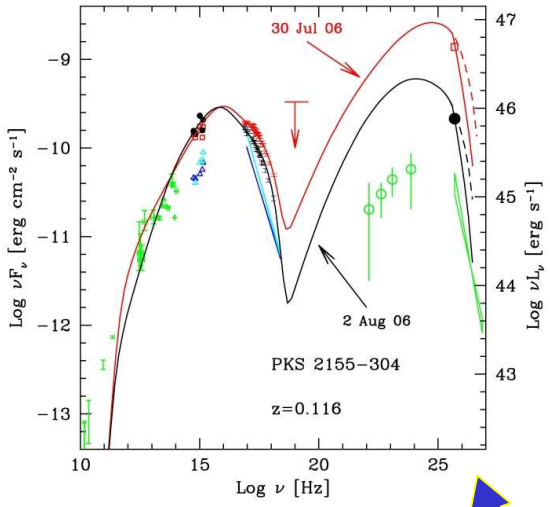
History of the TeV event
(Benbow et al., 2006, Aharonian et al., in preparation, HESS Collaboration)

- *27 July 2006 (afternoon): release of ATel 867 (Benbow et al.) about the increase of TeV activity of PKS 2155-304;*
- *27/28 July 2006: first outburst, with night average of 8 Crab (E>200 GeV) and flares up to 17 Crab;*
- *29/30 July 2006: second outburst with night average of 5 Crab and flares up to 13 Crab.*



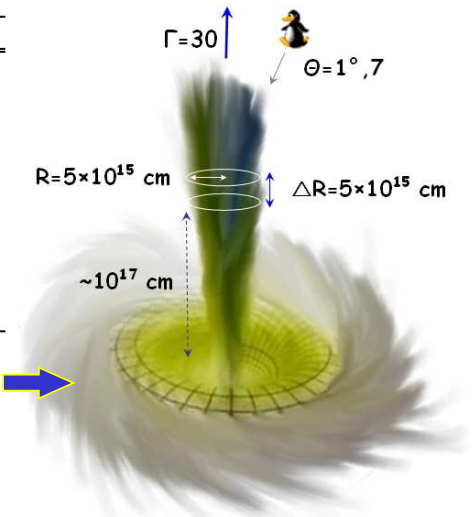
***Swift*/BAT**: no detection, upper limit (20-40 keV; 3σ): 42 mCrab on 29-31/July.
***Swift*/XRT** energy band 0.3-10 keV.
***Swift*/UVOT** Optical fluxes in units 10^{-14} erg cm^{-2} s^{-1} Å^{-1}. No data in U filter are shown, since they are saturated for most of the observing time.

Each mark in the abscissa corresponds to the 00:00 UTC of the day. For example, the mark at day 2036 corresponds to 00:00 UTC. The night between 29 and 30 July, when the second TeV outburst occurred, is approximately emphasized by the yellow rectangle.

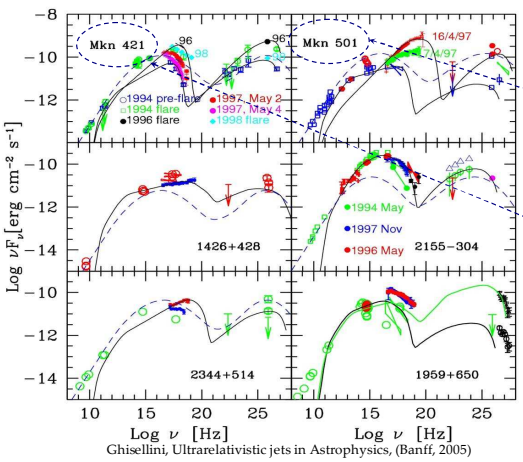


	Jul 29	Aug 2	Units
R	5	5	10^{15} cm
$L'_{\rm inj}$	1.1	0.3	10^{42} erg s^{-1}
$\gamma_{\rm break}$	1.5	0.9	10^4
$\gamma_{\rm max}$	1.75	1.1	10^5
s	2.5	2.6	
B	0.27	0.55	Gauss
$\Gamma_{\rm bulk}$	30	30	
θ	1.7	1.7	degrees
δ	33.5	33.5	

Geometry of the Ghisellini, Celotti & Costamante model applied to the present case (not in scale, parameters enlarged for a best view)



Synchrotron Self-Compton (SSC) model by Ghisellini, Celotti & Costamante (2002) has been usef to fit the SED: the distribution of emitting particles is $N(\gamma)\propto\gamma^{-s}$, where s is a piecewise linear function of the particle Lorentz factor γ.



Ghisellini, Ultrarelativistic jets in Astrophysics, (Banff, 2005)

It is possible to compare the SED of PKS 2155-304 of July/August 2006 with the SED of other TeV blazars and past observations of PKS 2155-304.

The most striking example todate is the strong TeV activity exhibited by Mkn 501 in April 1997, observed by the Whipple Observatory: during the nights from 7 to 19 April 1997, its flux (E > 350 GeV) changed from 0.5 to the peak of 3.8 Crab occurred on 16 April, with an average of 1.6 Crab and no hourly timescale variability (Catanese et al. 1997, Pian et al. 1998).

A less extreme, though analogous, behaviour was observed in Mkn 421 in 1998-2000. The X-ray and TeV activity were correlated also on short timescale (Maraschi et al 1999, Takahashi et al. 2000) with larger amplitude variations in the TeV band. The synchrotron peak appeared to shift to higher energies but not as dramatically as for Mkn 501.

The behaviour of PKS 2155-304 appears less striking in X-rays than for the previous two sources but more extreme in the TeV variability.

CONCLUSIONS:

We presented the observations of the blazar PKS 2155–304 performed by the *Swift* satellite immediately after the giant TeV flare observed by HESS at the end of July 2006 (Raue et al. 2006; Aharonian et al., in prep.). The most important result appears to be that, in correspondence with the dramatic TeV activity, the X-ray intensity changed by a factor 5 but without large spectral changes. In particular the frequency of the synchrotron peak remained at values similar to those observed in the past (e.g. 1997, Chiappetti et al. 1999), during low TeV activity. Modeling of the SED based on the SSC process in a homogeneous region suggests an increase of the Doppler factor (33 in 2006; 18 in 1997) and of the relativistic electrons associated with a decrease of the magnetic field (0.27 G in 2006; 1 G in 1997).