SIMULTANEOUS MULTIWAVELENGTH OBSERVATIONS OF THE BLAZAR 1ES 1959+650 AT A LOW TEV FLUX

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The blazar jets

- Non-thermal emission over a large energy band
- Highly variable, with different properties at the various wavelengths
- SED characterised by two broad components

Therefore, simultaneous MW observation are very important to understand their properties
The double bump

IR-X

Synchrotron

Wehrle et al. 1998
The MW observations

- There have been various MW campaign organised by different groups

- Observations from the radio to the TeV band using on ground facilities and satellites

- We organised a number of campaign, concentrating in particular on the X-ray (BeppoSAX and XMM-Newton) and optical bands and on sources that were in an active state
The BeppoSAX Observation of MKN 501 in an active state

<table>
<thead>
<tr>
<th>Source</th>
<th>Obs. Date</th>
<th>Exp.</th>
<th>Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON 231</td>
<td>11 May 1998</td>
<td>25ks</td>
<td>Optical</td>
</tr>
<tr>
<td></td>
<td>11 Jun 1998</td>
<td>32ks</td>
<td></td>
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<td>PKS 2005-489</td>
<td>01 Nov 1998</td>
<td>52ks</td>
<td>X-ray</td>
</tr>
<tr>
<td>BL Lac</td>
<td>05 Jun 1999</td>
<td>54ks</td>
<td>Optical + X-ray</td>
</tr>
<tr>
<td></td>
<td>05 Dec 1999</td>
<td>54ks</td>
<td></td>
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<tr>
<td>OQ 530</td>
<td>03 Mar 2000</td>
<td>26ks</td>
<td>Optical</td>
</tr>
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<td>26 Mar 2000</td>
<td>23ks</td>
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</tr>
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<td>S5 0716+714</td>
<td>30 Oct 2000</td>
<td>43ks</td>
<td>Optical</td>
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<td>MS 14588+2249</td>
<td>19 Feb 2001</td>
<td>48ks</td>
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<td>1ES 1959+650</td>
<td>23 Sep 2001</td>
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<td>28 Sep 2001</td>
<td>48ks</td>
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<td>S5 0716+714</td>
<td>04 Apr 2004</td>
<td>50ks</td>
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<td>S5 0716+714</td>
<td>24 Sep 2007</td>
<td>50ks</td>
<td>GeV</td>
</tr>
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ON231: the SED

ON231: the

BL Lac: complex spectrum

Simple but effective SSC + external Compton scenario. Importance of the location of the emitting region with respect to the BLR

Ravasio et al., 2002, A&A
BL Lac: complex spectrum

Ravasio et al., 2002, A&A
The problem of getting a MW too

• the observation of a blazar in an active state allows to test the models in extreme conditions stretching the parameter space, but it is very difficult (often impossible) to get many observatories to re-point a target on a very short notice.

• however, a very large band coverage (in particular the simultaneous coverage of both SED peaks) is also very important in order to discriminate between the various models (e.g. the observation of BL Lac).

• therefore we are also trying to get simultaneous optical-UV-X-ray and TeV observations of selected blazar, even if they are not in an active state.
1ES1959+650

• This source is an HBL very bright in both X-ray and bands

• An “orphan” TeV flare, without an X-ray counterpart, has been detected on May 2002 (Krawczynski et al. 2004)

• We already observe this source while it was in a high state with BeppoSAX (Tagliaferri et al. 2003)
On May 2006 we performed a MW campaign with the Suzaku and Swift satellites, the MAGIC TeV telescope and on ground optical telescopes.
The campaign was organised around the Suzaku and Magic observations.

We were monitoring the source also in the optical and succeed in getting these observations while the source was quite bright in the optical.

The May 2006 MW campaign on 1ES1959+650

The campaign was organised around the Suzaku and Magic observations. We were monitoring the source also in the optical and succeeded in getting these observations while the source was quite bright in the optical.

![Graphs showing data from the campaign.](image-url)
The May 2006 MW campaign on 1ES1959+650

The spectrum

\[ \Gamma_1 = 1.94 \pm 0.01 \]
\[ \Gamma_2 = 2.20 \pm 0.02 \]
\[ E_b = 1.83 \pm 0.03 \]
The May 2006 MW campaign on 1ES1959+650

The spectrum

![Spectrum Graph](image)
The May 2006 MW campaign on 1ES1959+650

The SED

- X-ray flux ~2 higher, optical similar, TeV ~2 lower
- Synchrotron peak moves to higher energies
- Overall variability < ~2

- Synchrotron peak higher than Compton peak

Assuming a one-zone SSC model we derive parameters typical of HBL objects ( $\delta=18$, $R=7.3\times10^{15} \text{ cm}$, $B=0.25 \text{ G}$, $L'=5.5\times10^{40} \text{ erg s}^{-1}$)
The May 2006 MW campaign on 1ES1959+650

The X-ray variability

Higher variability above synchrotron peak

Not random, but follow a raising/decaying trend of ~10 days

A single blob would have move by ~2.7 pc

⇒ difficult to be explained by the internal shock model

⇒ “Standing shock” (e.g. Krawczynski et al. 2002, Sokolov et al. 2004)
Conclusions

1ES1959 MW campaign of May 2006

1. Source was bright in the X-ray and optical bands, weak in the TeV band

2. Synchrotron peak much higher than Compton peak, SED can be fitted by a one-zone SSC model

3. Overall variability $\leq 2$

4. X-ray variability follow a trend over at least 10 days and can be explained by a “standing shock scenario”