

15 MAGIC years

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why MAGIC ?



why MAGIC ?

Project	to	Schedule	Status
AMS	ISS	2001	delayed >>5yr
BMS	somewhere	sometime	cancelled
CMS	LHC	2002	delayed >>5yr
MAGIC	ORM	2003	ontime

why MAGIC ?



Eckart Lorenz

“MAGIC is the ideal stop-gap experiment: only few years of data-taking, and it is all done.” ...

why MAGIC ?



“MAGIC is the ideal stop-gap experiment: only few years of data-taking, and it is all done.” ...

another distinguished scientist: “It is not worth any effort: we know that SNR are the sources of the cosmic rays, + few Blazars → ~20 observable objects in the sky.”



selected open question



selected open question



Daniel Kranich

“Mrk421 and Mrk501 are very similar Blazars. But for some reason, only Mrk421 shows variability down to the minimum possible time scale of ~ 1 h, while Mrk501 is variable on much longer timescales only.”

(Event Horizon of the SMBH radius ~ 1 light hour)

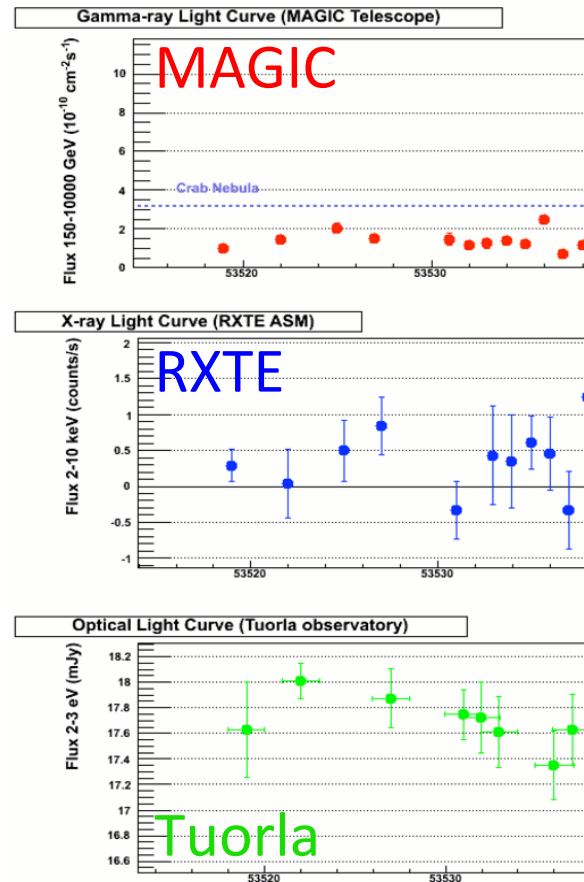
Mrk501

Summer 2005
Scheduled Task:

Measure Mrk501
spectrum in low
state

(no real-time analysis
→ know about data
only next days)

Light curves



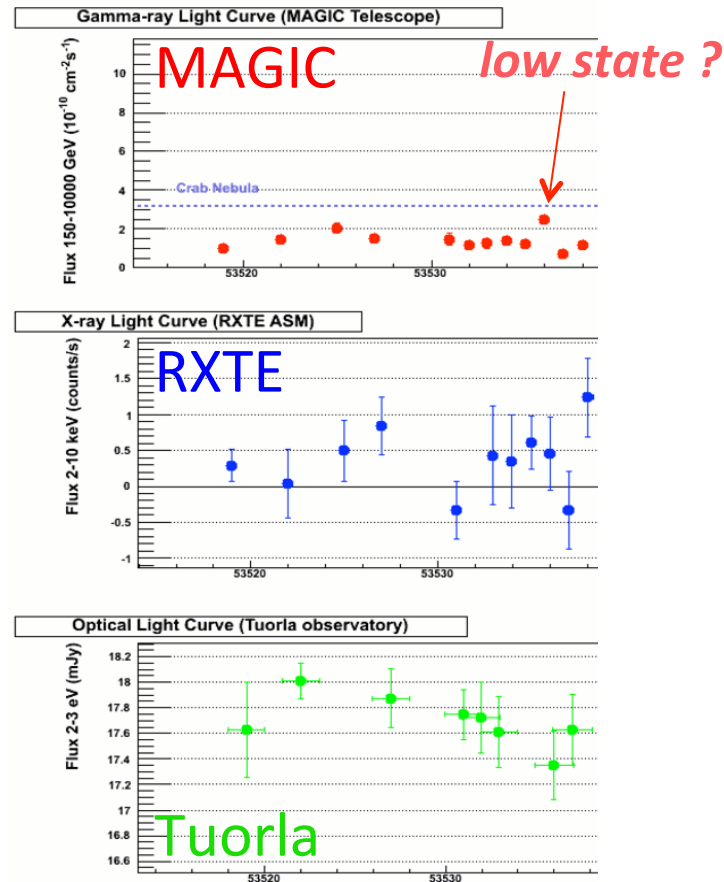
Mrk501

Light curves

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Indication for some
flaring activity;
but fullmoon is
coming ...



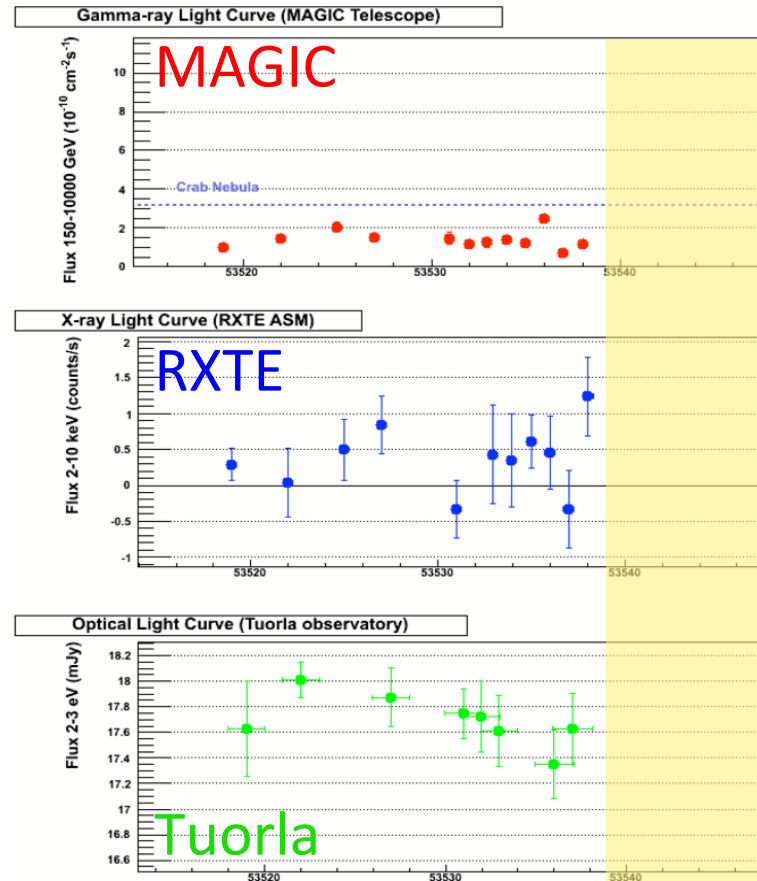
Mrk501

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Measure Mrk501
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For the first time,
take data under
fullmoon conditions
with reduced HV





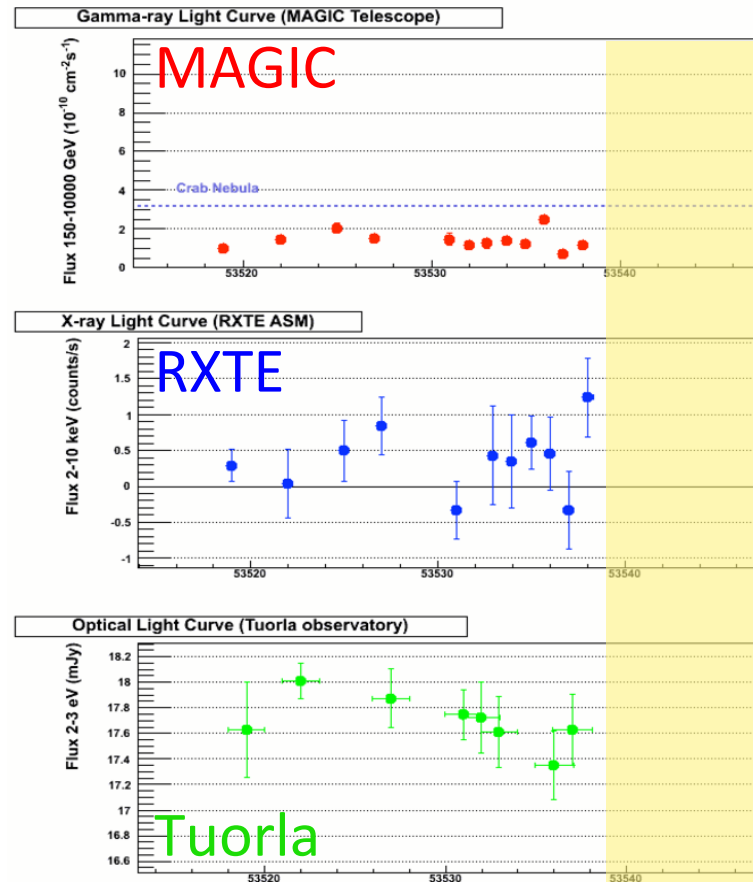
Mrk501

Light curves

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*But data proof
useless
(flatfielding)*



*change schedule
to continue with
Mrk501 observ.*

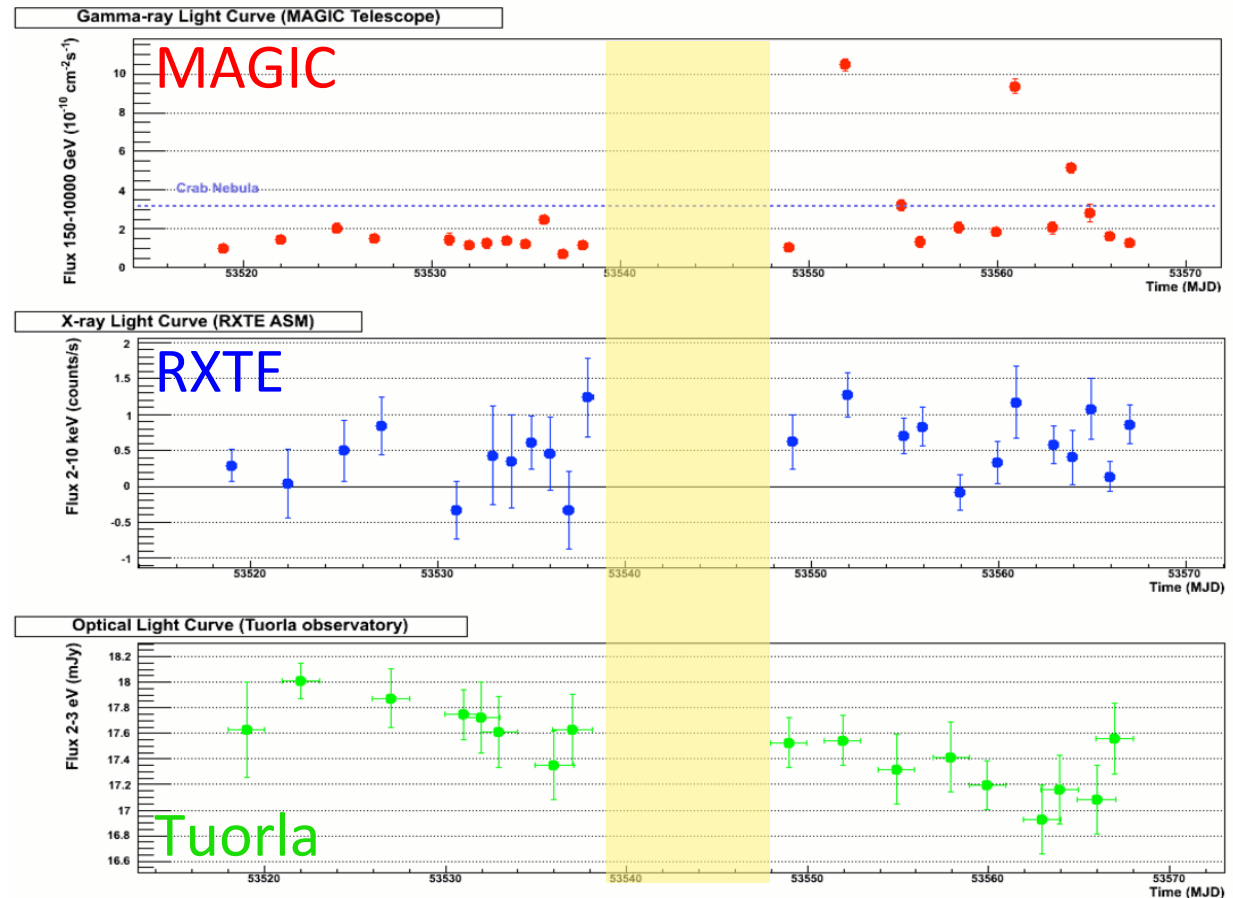
Mrk501

Light curves

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Instead, measure
big outbursts



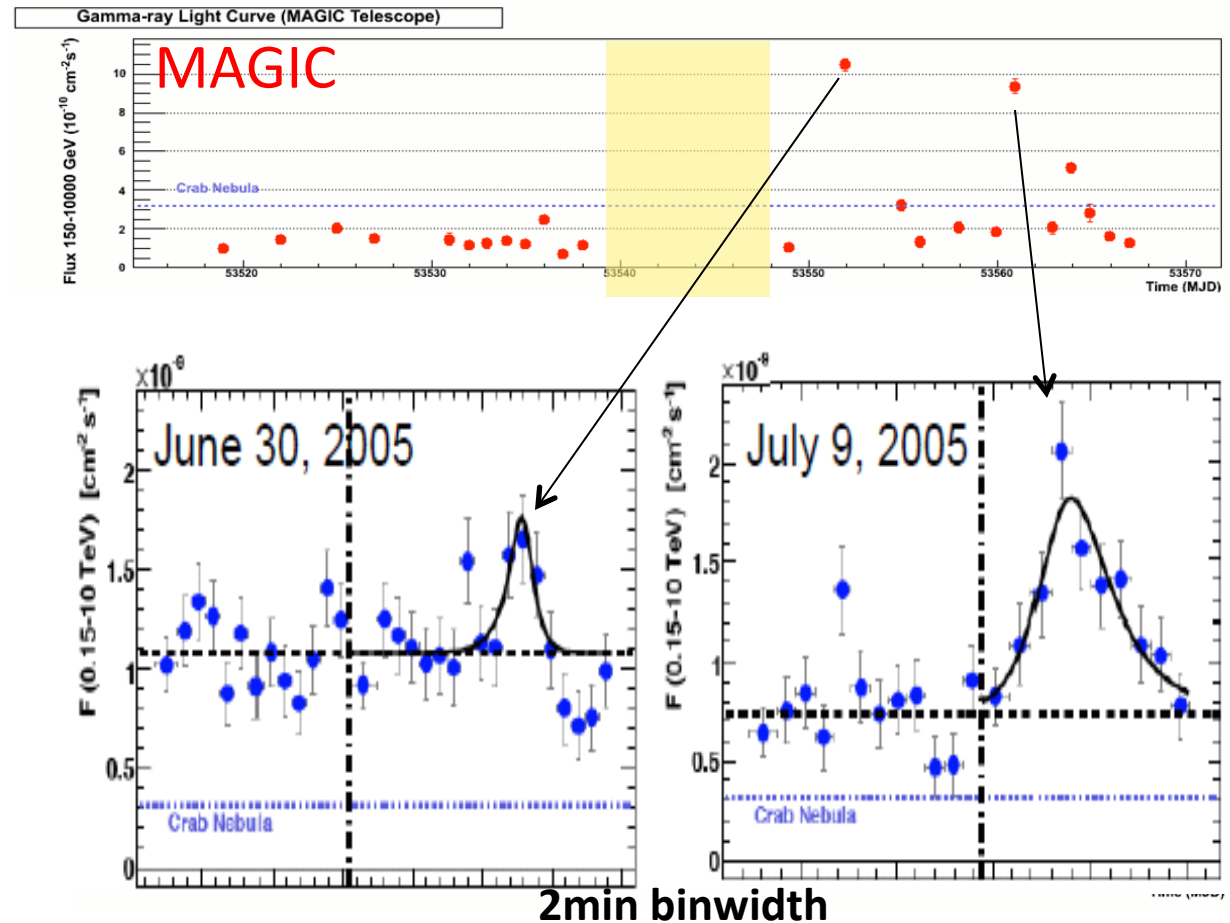
Mrk501

Light curves

Summer 2005
Scheduled Task:

Measure Mrk501
spectrum in low
state

Instead, measure
big outbursts
with variability
timescale much
less than 1 h

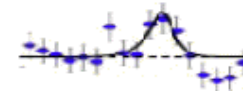




variability on minutes scale ?

Surprising result, several experts did not believe it

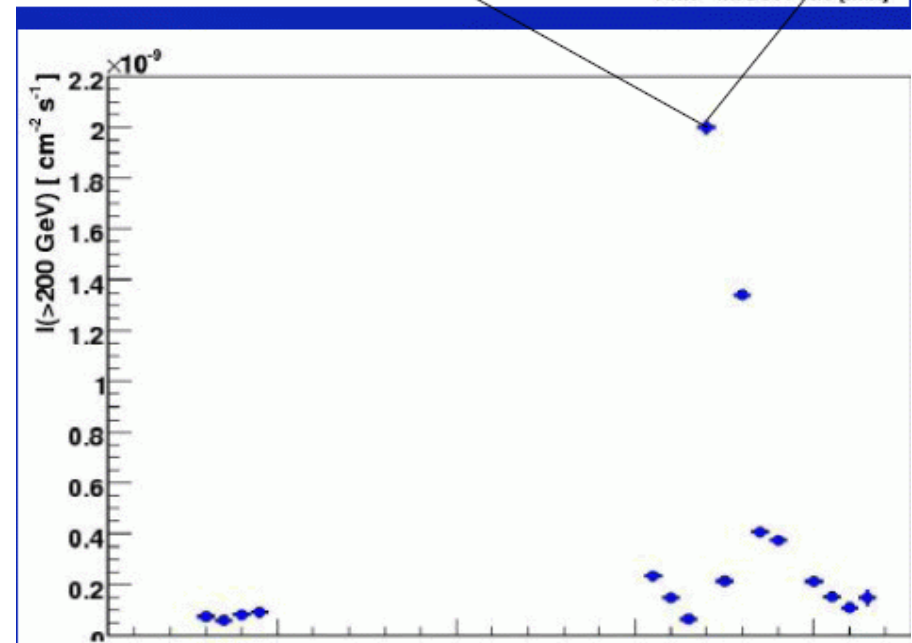
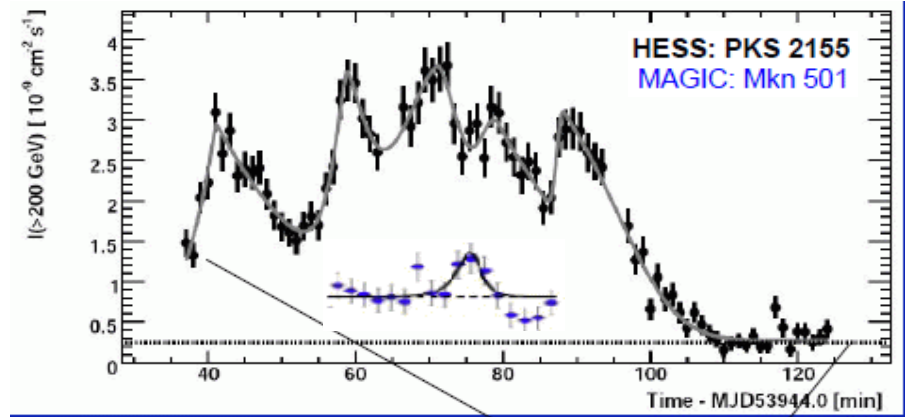
MAGIC: Mkn 501



variability on minutes scale ?

Surprising result, several experts did not believe it

Soon after, H.E.S.S. caught spectacular flare from PKS2155; no longer possible to doubt short duration variability.





Mrk501

Mrk501

Energy dependent arrival time ???

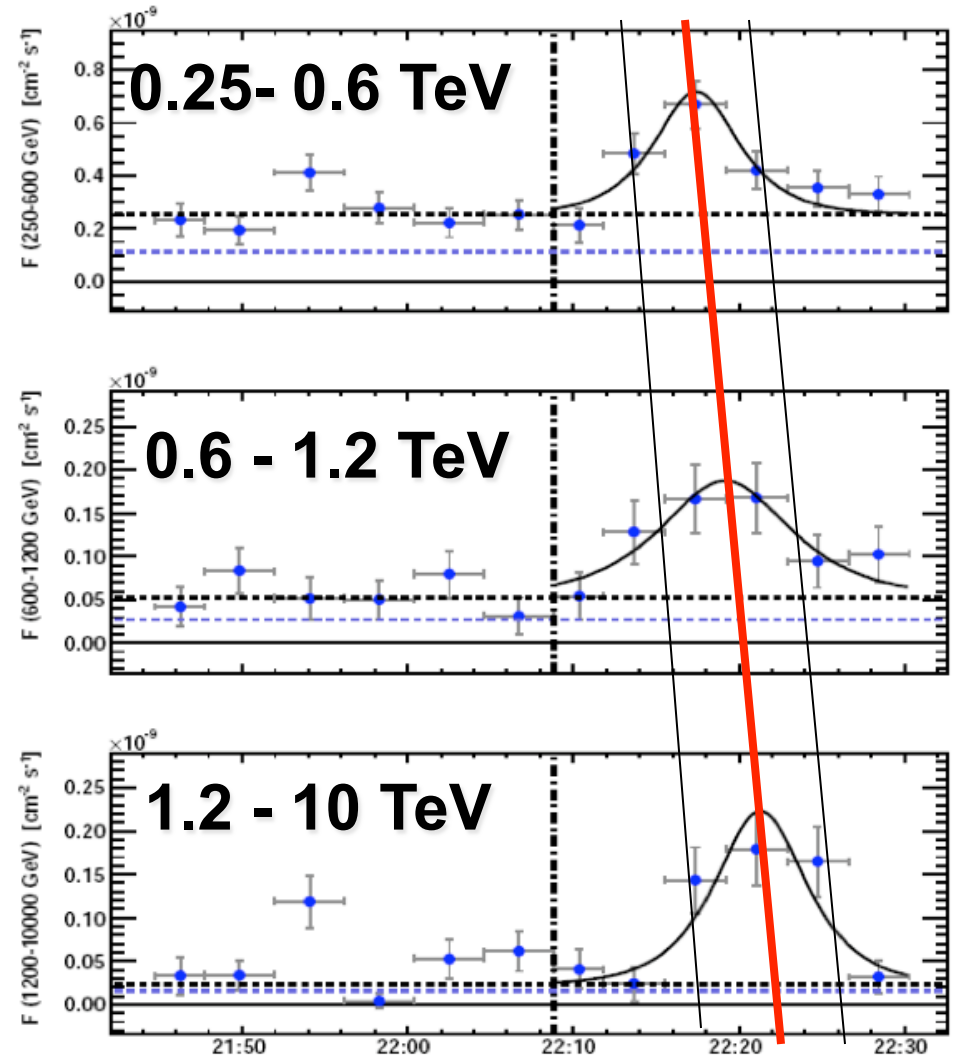
Possible reasons for delay:

- acceleration at source
- emission from source
- **transport between source and observer**

→ energy dependent c

→ Lorentz Invariance Violation

- statistical fluctuations in the measurement



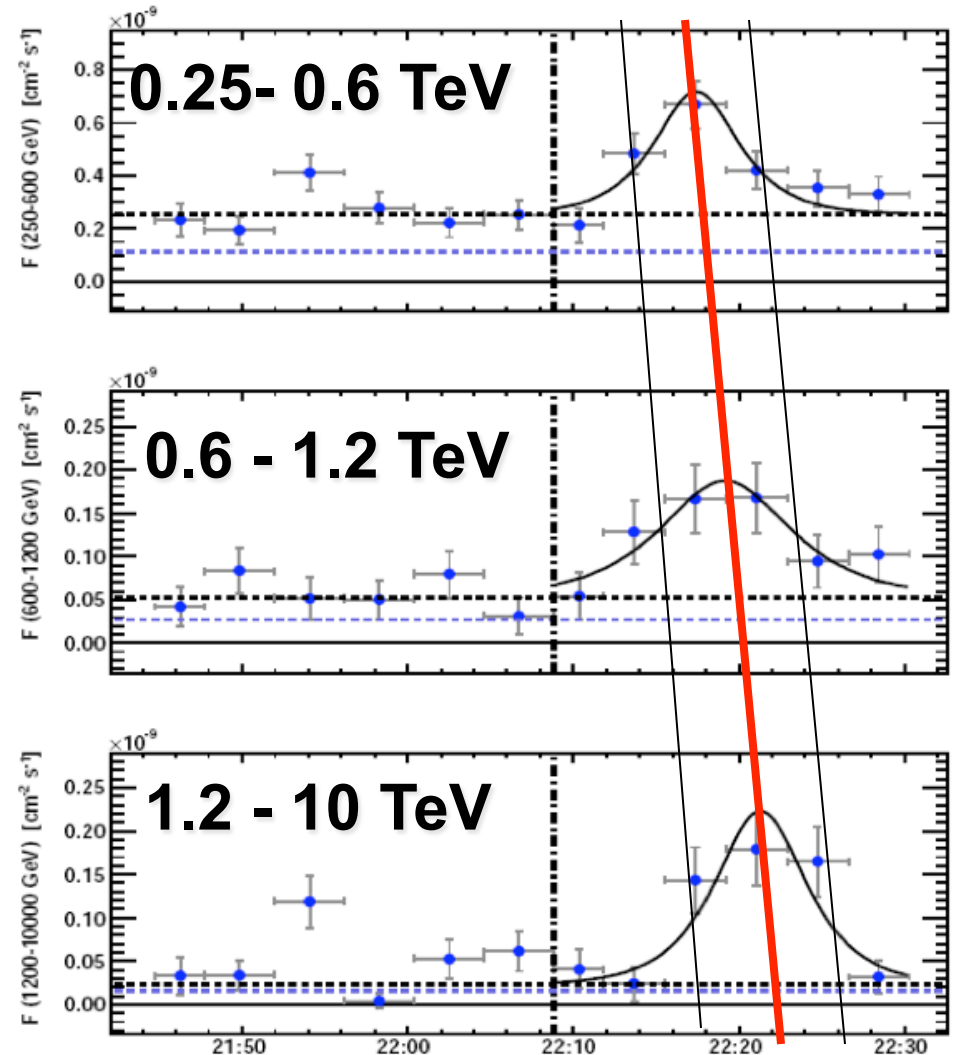
Mrk501

Energy dependent arrival time ???

- energy dependent c
- LIV

effect predicted by some classes of Quantum Gravity theories

→ *big excitement; several travels to CERN for discussions with J.Ellis et al. towards a common paper*



LIV

**Most important effect from
these classes of QG theories:**



LIV

Most important effect from
these classes of QG theories:

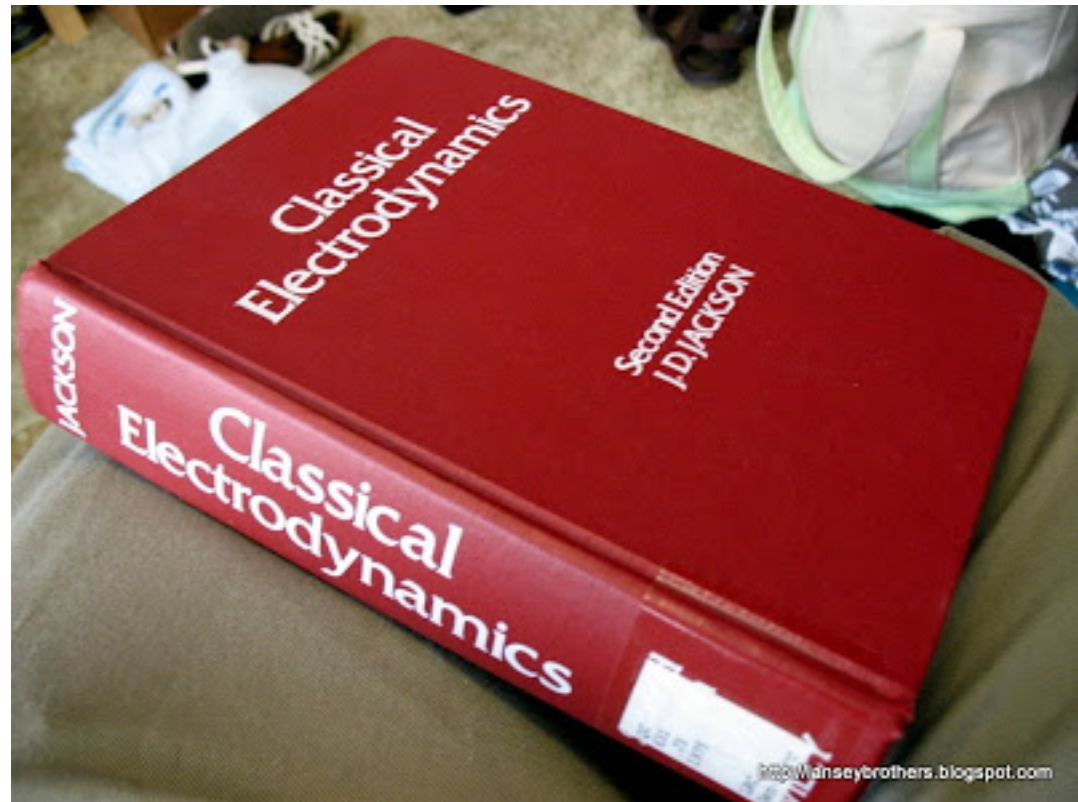
**GET RID OF
STRING** Theory



LIV

quite some fights
with referees to get
LIV paper published

One answer sent
to a referee:
“Please read that book”



Then we changed the journal ...

Mrk501 -> LIV ?

Full unbinned analysis:

- max likelihood

- 'energy cost function'

==> delay $\sim 30 \text{ sec/TeV}$?

$$\Delta c/c = -\Delta E/M_{\text{QG1}} \text{ or}$$

$$\Delta c/c = -(\Delta E/M_{\text{QG2}})^2 \text{ or higher order}$$

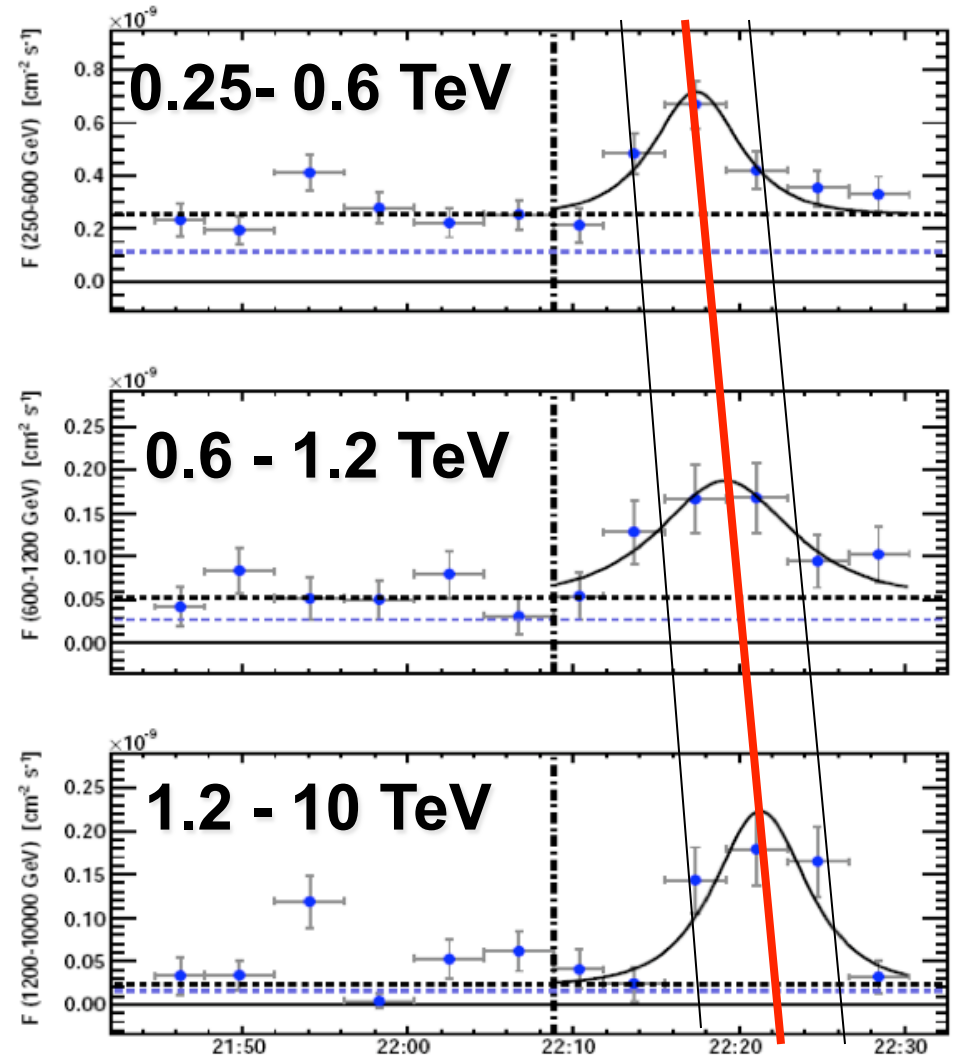
$$M_{\text{QG1}} = (0.47^{+0.31}_{-0.13}) 10^{18} \text{ GeV}/c^2$$

$$M_{\text{QG2}} = (0.61^{+0.49}_{-0.14}) 10^{11} \text{ GeV}/c^2$$

or 95% lower limits:

$$M_{\text{QG1}} > 0.21 10^{18} \text{ GeV}/c^2$$

$$M_{\text{QG2}} > 0.27 10^{11} \text{ GeV}/c^2$$



Mrk501 -> LIV ?

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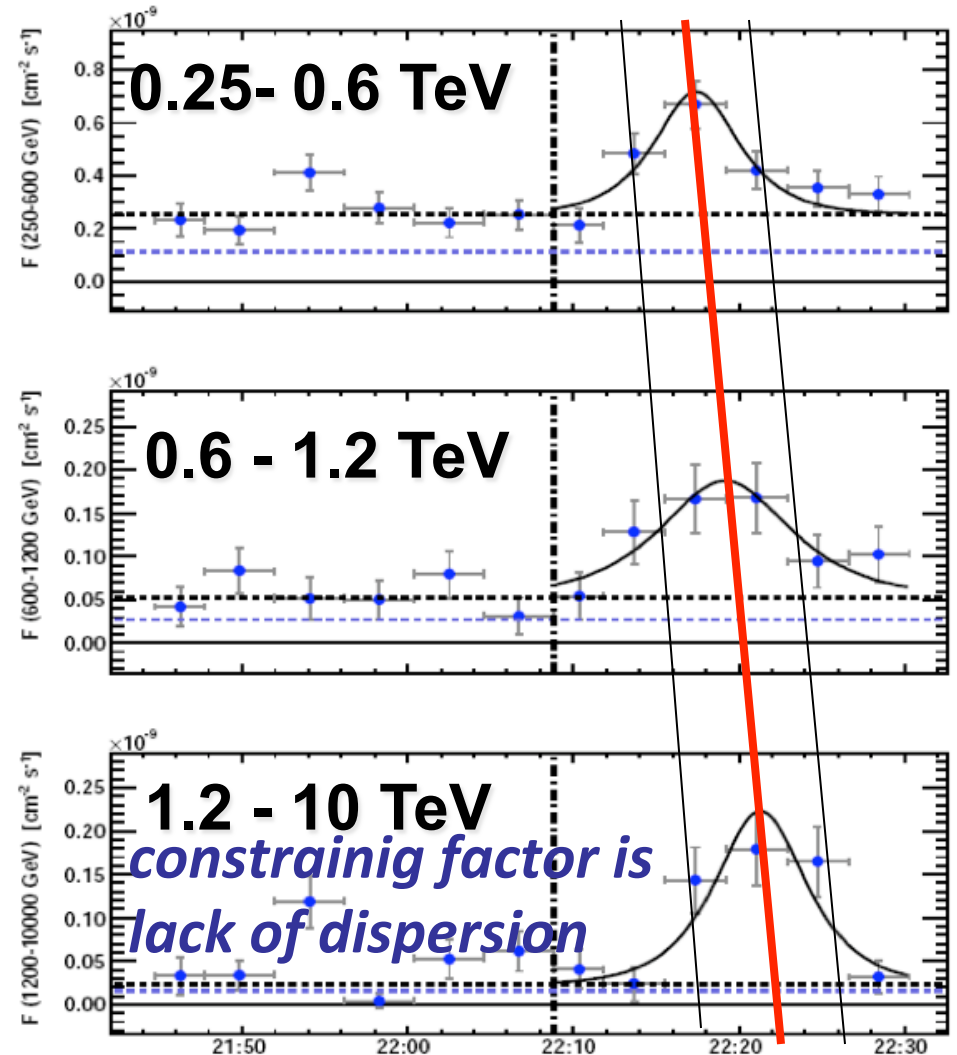
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LIV ?

Today, better LIV limits exist →
Energy dependent arrival time in
Mrk501 flare not due to LIV

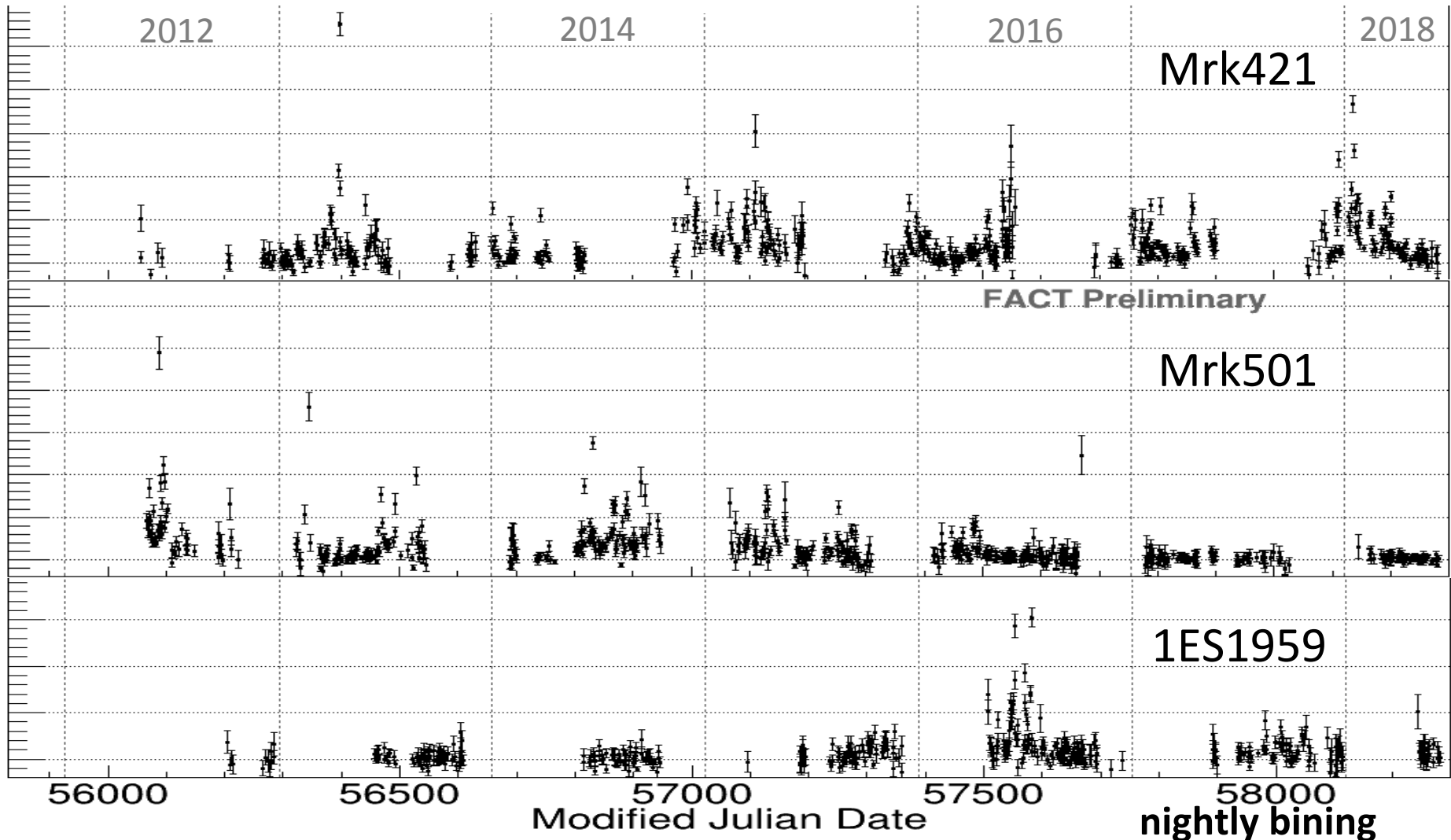
Monitoring of AGN might reveal other
surprises, but this consumes precious
observation time ...
(see also presentation D. Paneque)

AGN Monitoring





FACT Monitoring





much more to come ...