

FACT- Studying the X-ray/gamma-ray correlation using 5 years of data

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Overview

- Introduction
- Leptonic Vs Hadronic models
- Monitoring Mrk 421
- FACT LC
- X-ray/gamma-ray correlation
- Follow up

Introduction

- Mrk 421 has been object of several multi-wavelength campaigns in both low and high states
 - Campaigns are mainly carried out to collect data to make a SED of the source
 - Simultaneous data is collected in several frequencies
 - Technical difficulties and external factors like weather (IACTs) can affect the amount of data obtained
- There are two preferred methods to model the SED of Mrk421
 - Leptonic
 - Hadronic
- Correlation studies between X-ray and gamma-ray emissions can shine some light on which model is favored
 - There is not prediction about what exactly the correlation might be
 - Multiple zones present? in some cases a one-zone model describes the data good enough

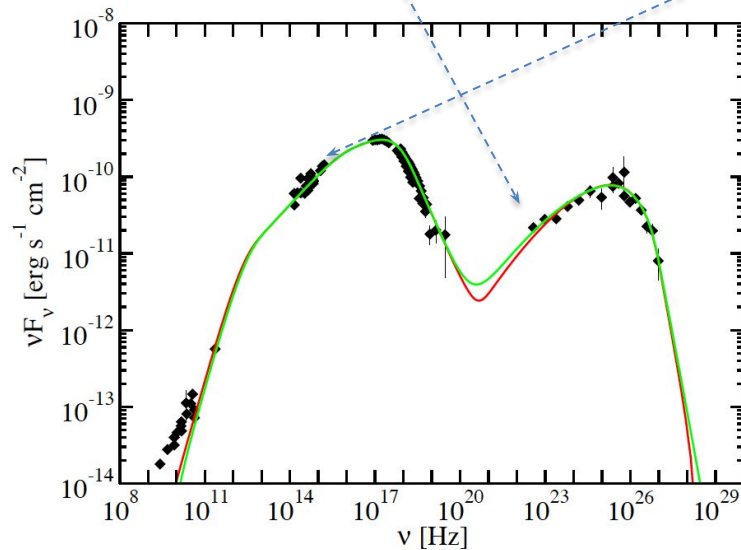
Leptonic

vs

Hadronic

Inverse Compton (SSC) model

High-energy peak
(X-rays to gamma-rays)



Abdo et al. 2011

Jet power is
larger for
hadronic
than leptonic

Correlation:

TeV gamma-rays and X-rays

Small magnetic field (< 100 mGauss)

Fast Variability

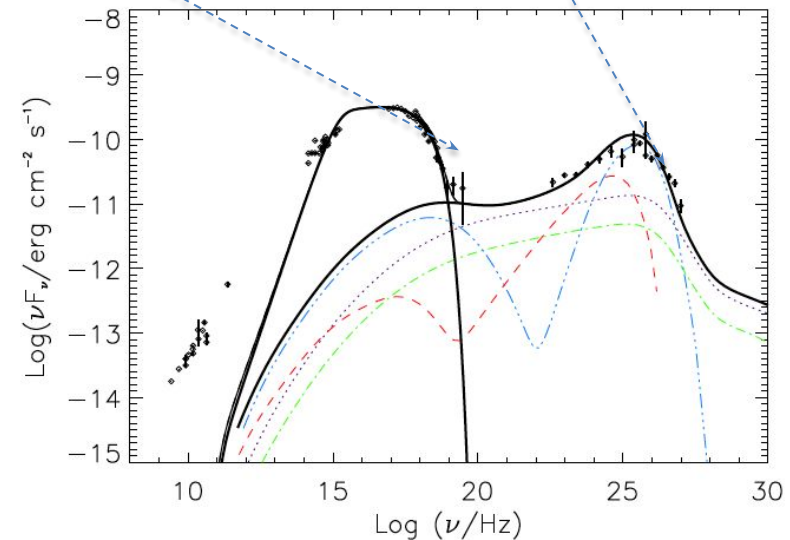
No neutrino production

e^- Synchrotron radiation

Low-energy peak
(radio to optical/UV)

Synchrotron proton model

High-energy peak
(X-rays to gamma-rays)



No correlation:

TeV gamma-ray and X-ray

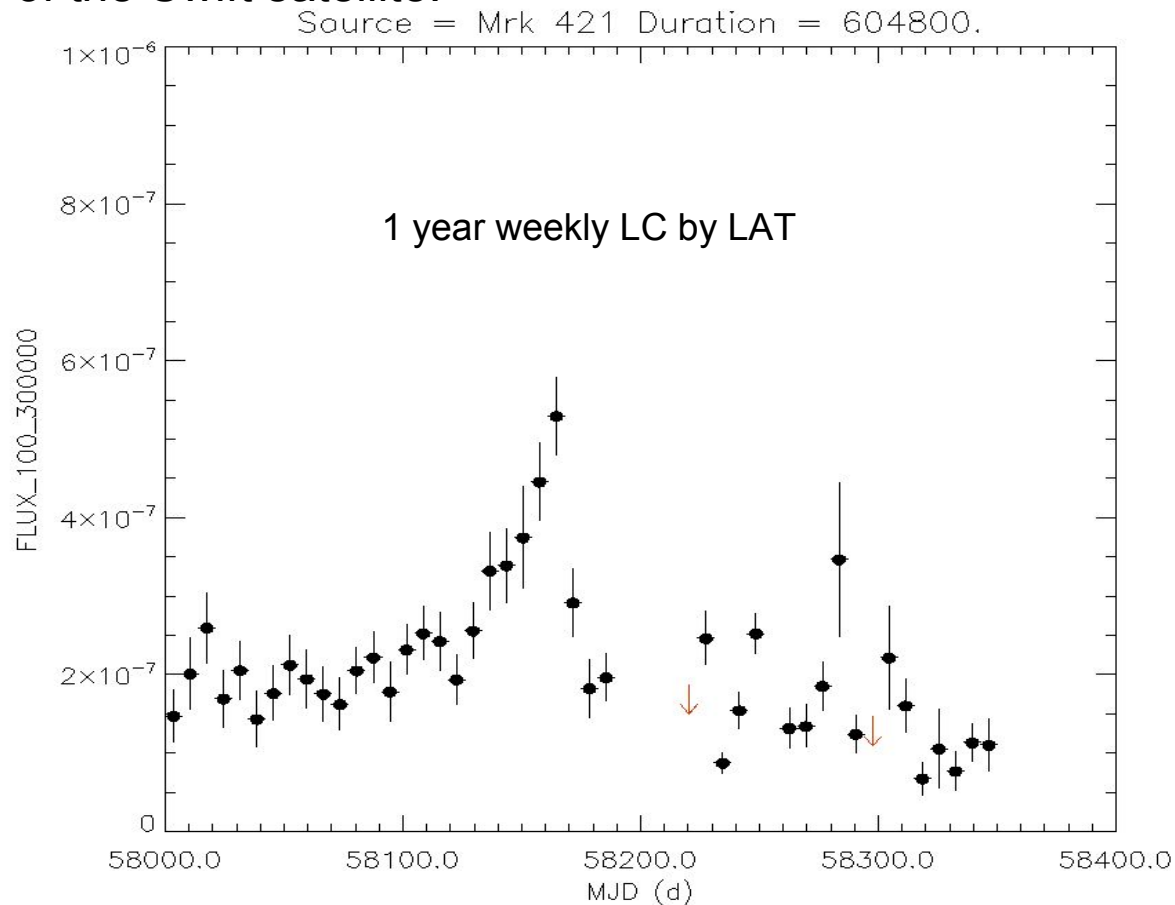
Large magnetic field (50 Gauss)

Large (Ne) Variability

Neutrino production

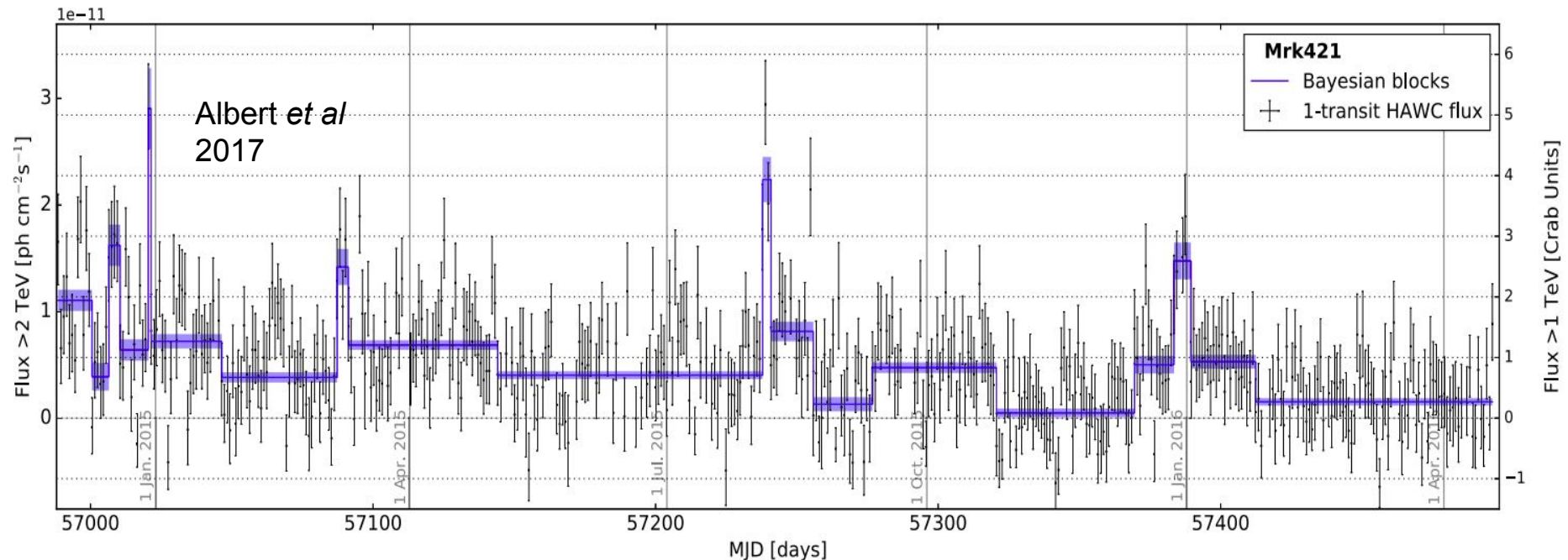
Monitoring of Mrk 421

- Mrk 421 has been extensively monitored by the Large Area Telescope on-board of the Fermi satellite, and the BAT and XRT instruments on-board of the Swift satellite.



Monitoring of Mrk 421

- The X-ray emission measured by satellites (SWIFT-XRT) and VHE gamma-ray emission measured by IACTs might be biased towards flaring states.
- Correlation studies benefit of unbiased monitoring of sources
 - HAWC monitors on a daily basis Mrk 421 in a transit of ~ 6 hr/day

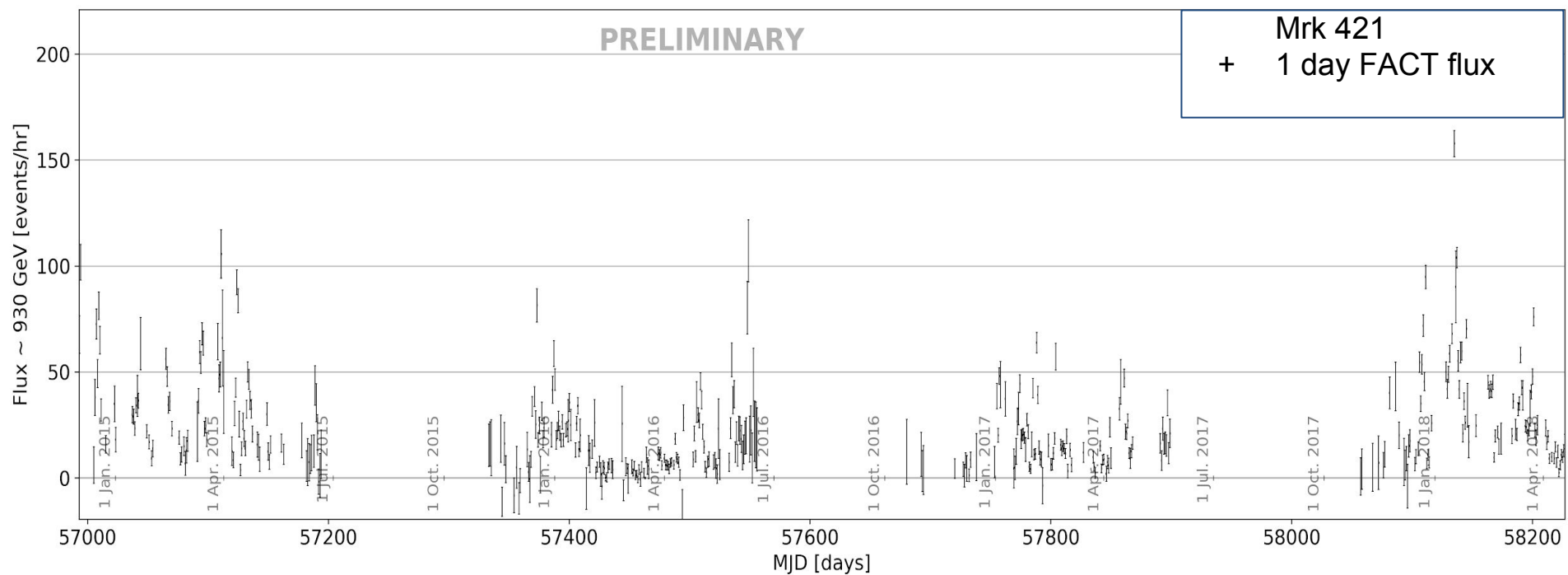


Monitoring of Mrk 421

- FACT can also perform an unbiased monitoring of Mrk 421
 - Although is limited to measure at night (seasonal)
- FACT has been monitoring blazars at TeV energies for more than six years ($> 11,700$ hr)
 - Mrk 421 has being monitored ~ 2500 hr
- For a more complete view of FACT monitoring please look at Axel's presentation on Friday

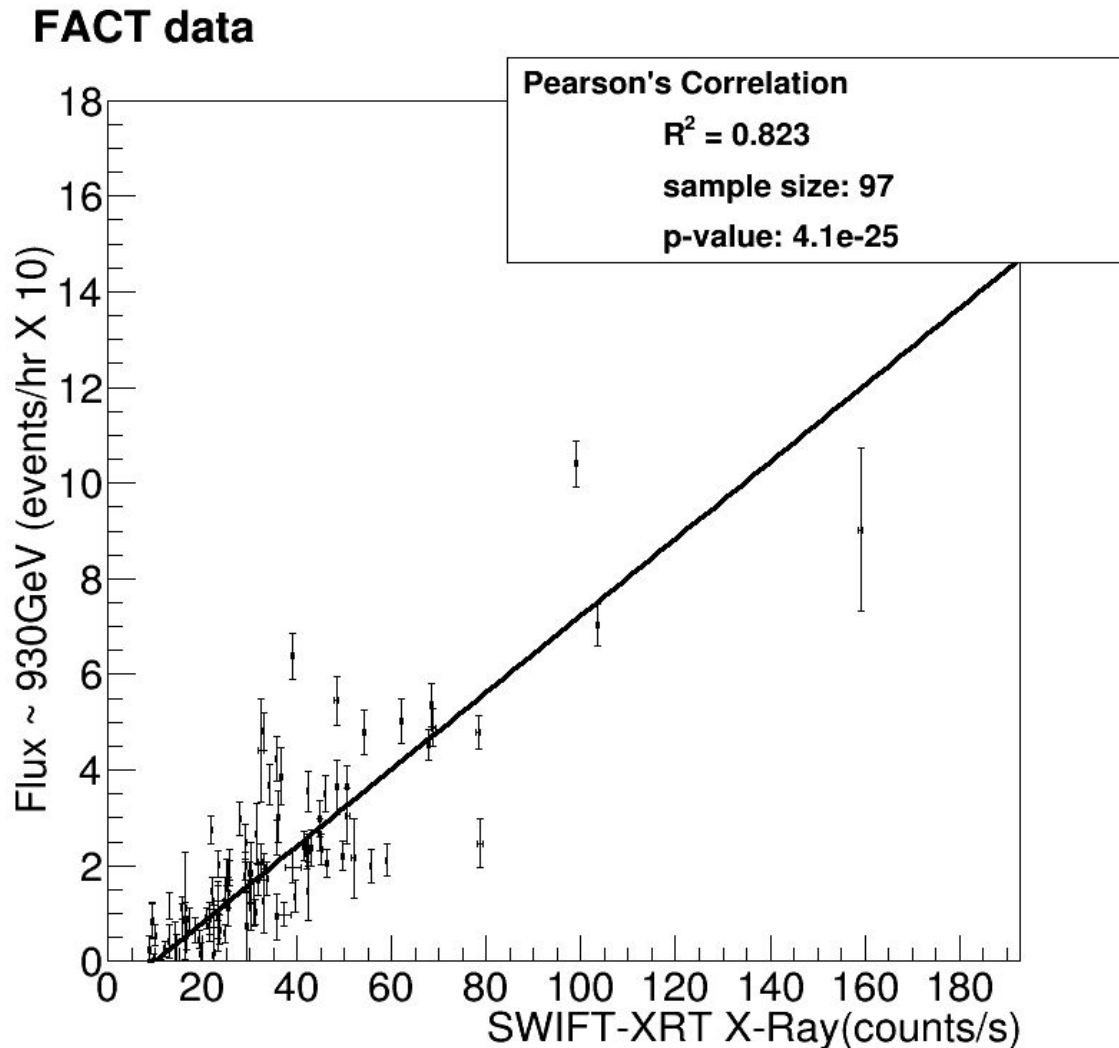
FACT LC

Data from Nov 2014 to April 2018



X-ray/gamma-ray correlation

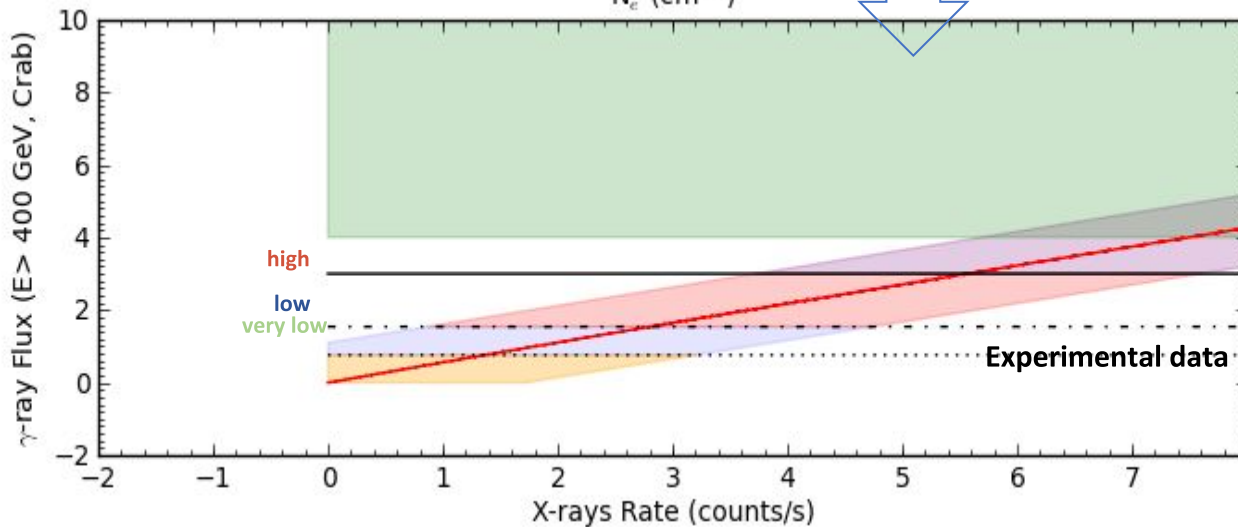
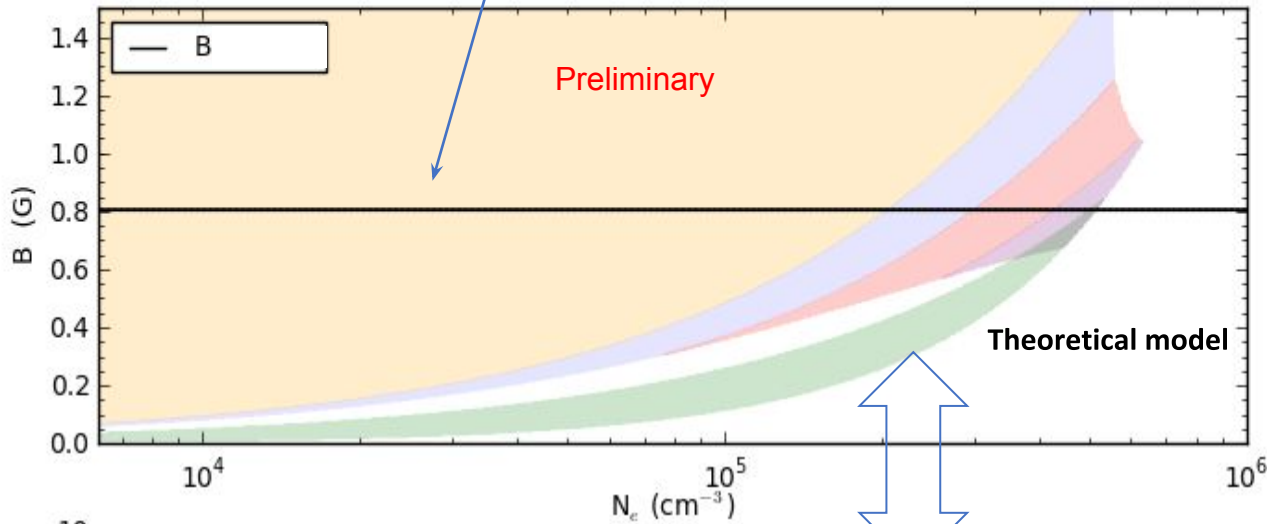
Preliminary



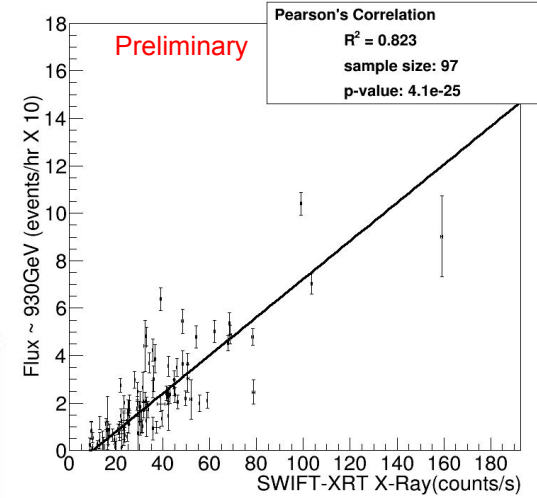
X-ray/gamma-ray correlation

Assuming one-zone SSC model

Unique correlation



FACT data



see Nissim's talk on Wednesday

Conclusions & Follow up

- Mrk 421 shows strong X-ray/gamma-ray linear correlation
 - Strength of correlation will be tested using alternative methods (D'Agostini 2005)
 - A bayesian blocks analysis will be applied to the LC to study correlations by block
- From this work we can see that a leptonic model is favored for Mrk 421 and there is a trend for a linear correlation
 - Higher orders for correlation are not obvious
 - Multi-zone emissions?
 - We can not ruled out completely the existence of a hadronic component on the VHE gamma ray flux, although correlation is not expected in the scenario