Multi-wavelength Observations of PKS 2142-75 during an Active Gamma-Ray State

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Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry

Introduction

PKS 2142-758 is a flat spectrum radio quasar at a redshift of 1.139 (Jauncey et al., 1978 ApJ, 219, L1) which has been detected in an active state by Fermi/LAT three times. The first flare was on April 4th, 2010, when it reached a flux of (1.1 +- 0.3)* 10^{-6} ph cm^{-2} s^{-1} (ATEL #2539). This flux represented more than an order of magnitude increase over its quiescent flux. Since the initial flare, this source has been found with daily test statistic > 25 by Fermi/LAT in a period ranging from October to November of 2010 and another period ranging from July to August of 2011. During the latest flaring period a multi wavelength campaign was carried out using the Ceduna radio telescope, Australian Telescope Compact Array (ATCA) the TANAMI VLBI Array, Swift, the Rapid Eye Mount Telescope (REM) and of course the Large Area Telescope (LAT) on board Fermi. We present results from these observations and discuss their implications for understanding the flaring behavior of AGN.

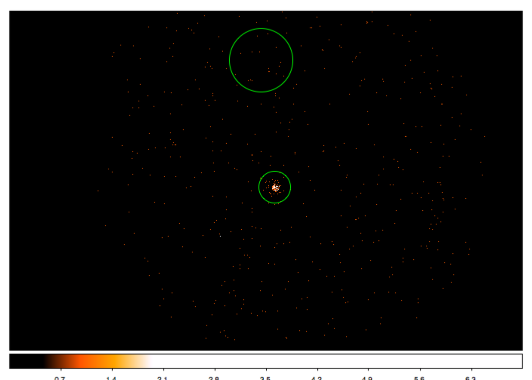
Observations

ATCA- The Australian Telescope Compact Array measured the flux density of this source on 8/30/2011 at 5.5, 17, 19, 38, 40 GHz

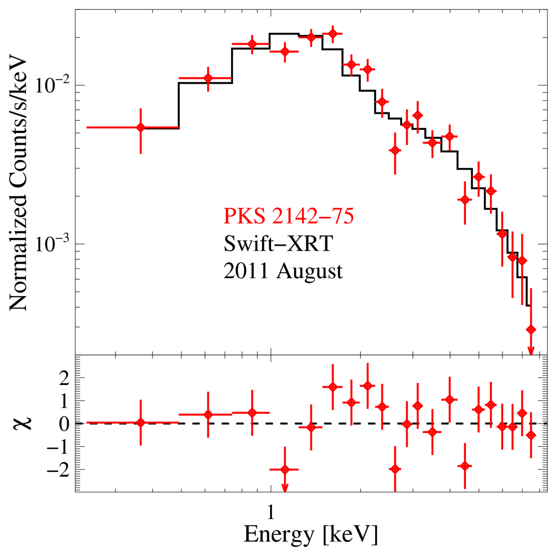
Ceduna-Ceduna observed the source at 6.7 GHz on 07/30/2011. Ceduna will continue to monitor this source every two weeks

TANAMI VLBI-This source was observed with the TANAMI VLBI array however the data are still being reduced

REM-Observations in the near infra red bands J and H occurred on August 10, 2011 however the target source was at the sensitivity limit of the instrument which led to large uncertainties in the measurement of the source's flux density.

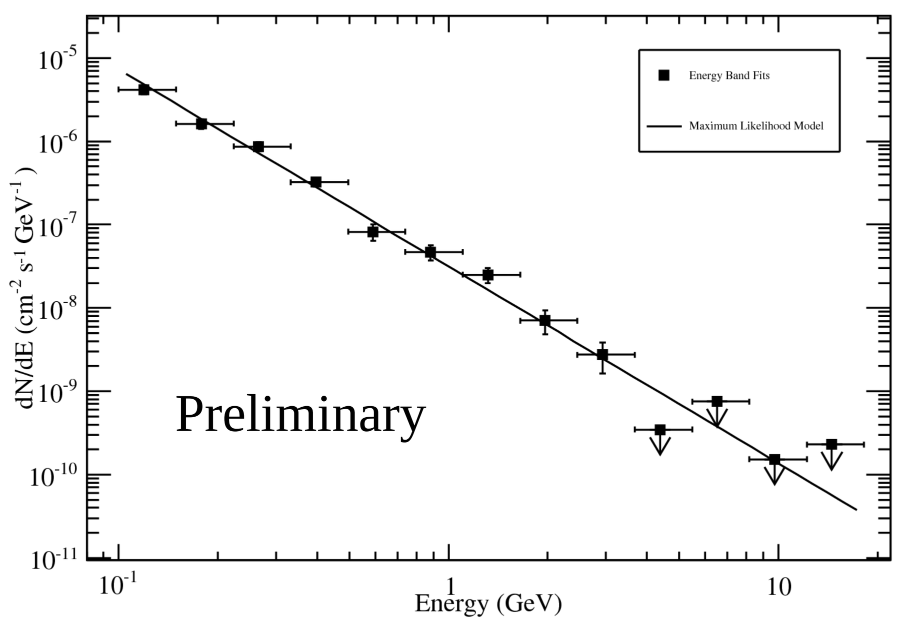


First ever X-ray image of PKS 2142-758



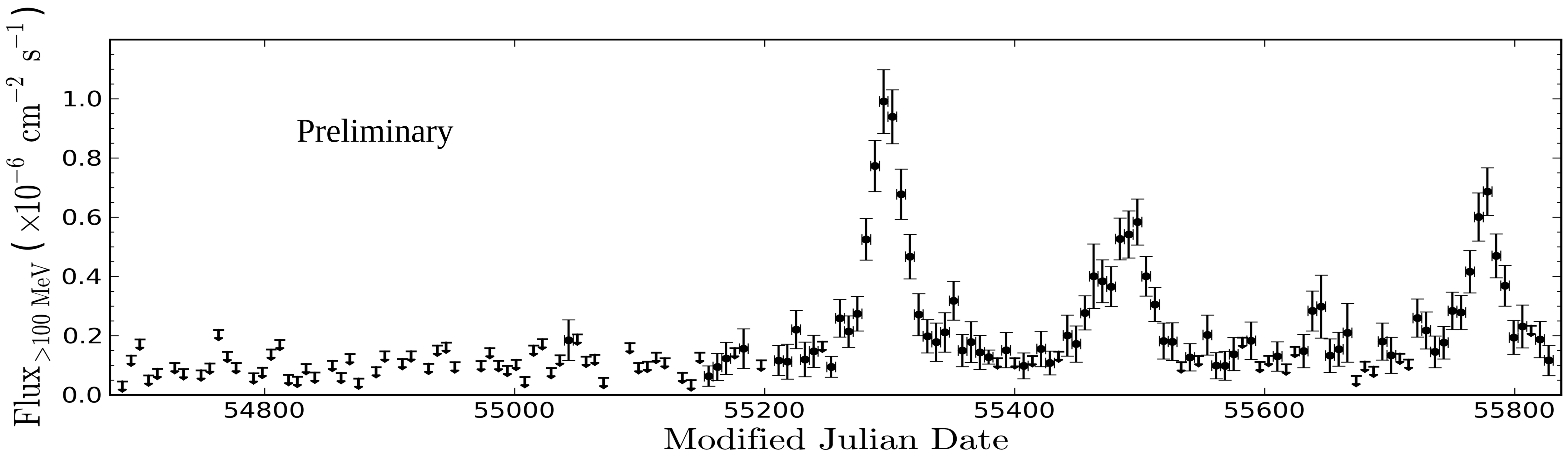
X-ray Counts Spectrum

Swift-Swift observed this source with both the UVOT and XRT instruments on August 10, 16, 18, and 23 2011 resulting in exposure times of 2085 s, 4890 s, 3666 s, and 1441 s respectively. This resulted in four UVOT observations with 3 different filters. The XRT spectrum was made using all four observations for a total exposure time of 12082 seconds which gave us a good spectrum in the 0.3 keV to 8 keV range.



Preliminary Fermi LAT counts spectrum

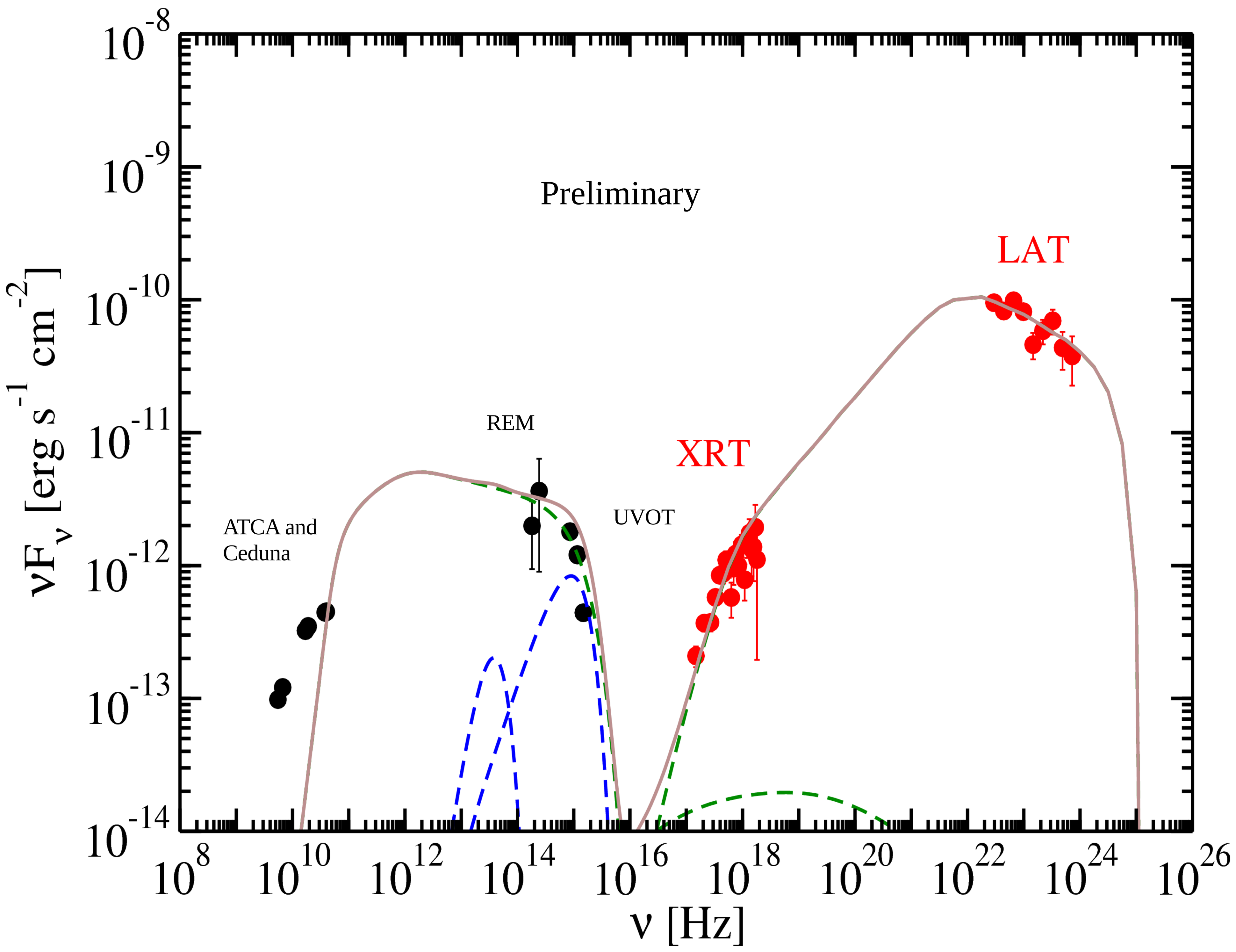
Fermi LAT-The LAT spectrum was made using data from 07-21-2011 to 08-18-2011 which corresponds to a time period when the source's daily TS was greater than 25. Initially a likelihood analysis was run over the whole spectrum to get a power law fit, Then likelihood analysis was run in each energy bin using the initial power law as a starting part for the analysis. The points displayed on the SED are those energy bins which resulted in a 5 sigma detection of the source so the final four points of the LAT counts spectrum are left out.



Preliminary LAT light curve

Gamma Ray Behavior

The light curve above shows the gamma ray flux of PKS 2142-758 in the 100 MeV to 300 GeV energy range using the P7SOURCE_V6 IRFS averaged into weekly time bins. Upper limits are calculated when the test statistic for that week is below 9 (9 corresponds to a 3 sigma detection of the source). The three flares originating from this source peak at ~1 * 10^{-6} ph cm^{-2} s^{-1} in the 100 MeV to 300GeV range. The other multi wavelengths observations all occurred during the the last peak. The gamma ray emission from this source is infrequent and weak when compared to LAT detected sources that have extensive multi wavelength coverage however it's properties at other wavelengths are similar. This indicates that the mechanisms of gamma ray production in this source are possibly different than for AGN which frequently emit strong gamma ray flares.



SED Fit Parameters

Variability Timescale = 5e5 sec
Radius of Emission Region = 2.8e17 cm
Gamma = delta = 40
B = 0.23 G

Broken Power Law Electron Distribution Parameters:
gamma_min = 2.3
gamma_brk = 230
gamma_max = 9e3
p1 = 2.0
p2 = 3.2

Dust Torus Parameters:
Temperature Dust = 1e3 K
Luminosity Dust = 2e45 erg/s
Radius Dust = 5.0e19 cm = 16.2 pc

Shakura Sunyaev Accretion Disk Emission Parameters:
M_BH = 1e9 M_solar
eta = 1/12
R_inner = 6 R_g (note that R_g = 1.5e14 cm)
R_outer = 1e4 R_g
L_disk = 0.05 L_Edd = 6.5e45 erg/s

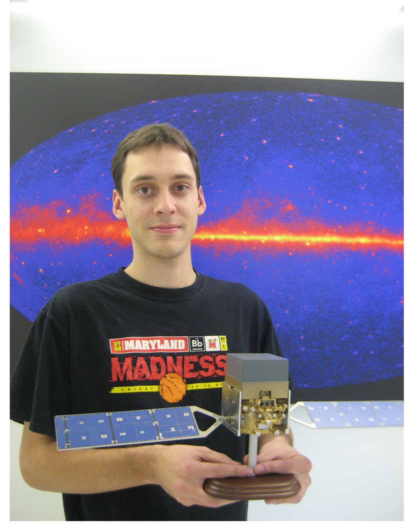
Equipartition Parameters:
L_j,B = 5.0e46 erg/s
L_j,e = 2.9e45 erg/s

SED Modeling

The data from each instrument are plotted on the spectral energy distribution (SED). An initial attempt at SED modeling was done according to the method described in Dermer et. al. (2009 ApJ, 692, 32). The blue curves represent emission from the accretion disk and the dust torus. The LAT and XRT points are fit to emission from Compton scattering of dust torus photons (larger green curve on the high energy side). The contribution of the synchrotron self Compton (small green curve on the high energy component) effect is very small and plays almost no role in the plot. The variability timescale derived from the LAT light curve constrains the size of the gamma ray emitting region. The synchrotron self absorption process is included in this fit so the small region that is consistent with the variability timescale cannot explain the radio points.

Conclusions and Future Work

The next step of the project will be to create and model a similar SED of the source while it is in a gamma ray quiescent state and analyze the VLBI data. A VLBI image of the source will allow us to measure the size of the emission region more accurately which will provide a better constraint for the SED model. A comparison of the SED while the source is in two distinct gamma ray states will give us insight into the method by which this source produces gamma rays.



Acknowledgments

On behalf of the coauthors I would like to thank the Fermi and Tanami teams, Bill McConville for his assistance with Fermi data reduction, Neil Gehrels and the Swift team for scheduling the ToO