

Appendix F

Appendix B: Lightcurves and ALPHA plots

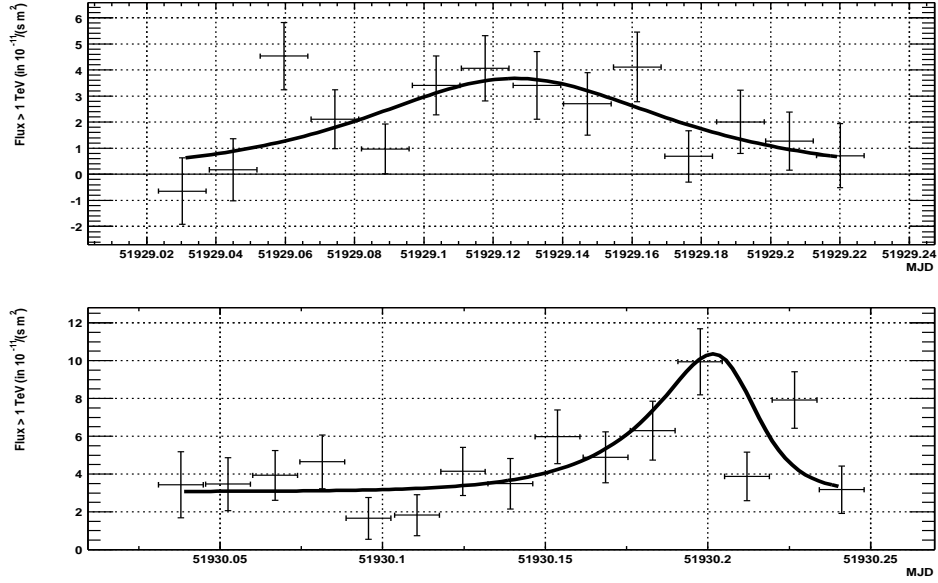


Figure F.1: Lightcurve of the nights 51928, 51929

F.1 The complete daily lightcurve

The following pages present the daily lightcurves of Mkn 421 with more than 7 runs per night from February 2001 until June 2001 as recorded with the CT1 telescope in La Palma, altogether 259 hours of observation. As explained before, a simple flare model

$$F(t) = a + \frac{b}{\left(2^{(t-t_0)/c} + 2^{-(t-t_0)/d}\right)} \quad (\text{F.1})$$

has been fitted to each night, if a simple straight line fit gave a reduced χ^2/NDF worse than 1.5. As starting values have been chosen: a =the constant term from the line fit, $b=8.0$, $c=d=25$ minutes, t_0 =the highest flux point in the curve. The fastest flares are not covered by the fit. Some nights like 51966 contain flares that are very fast and are significantly outside the flare model.

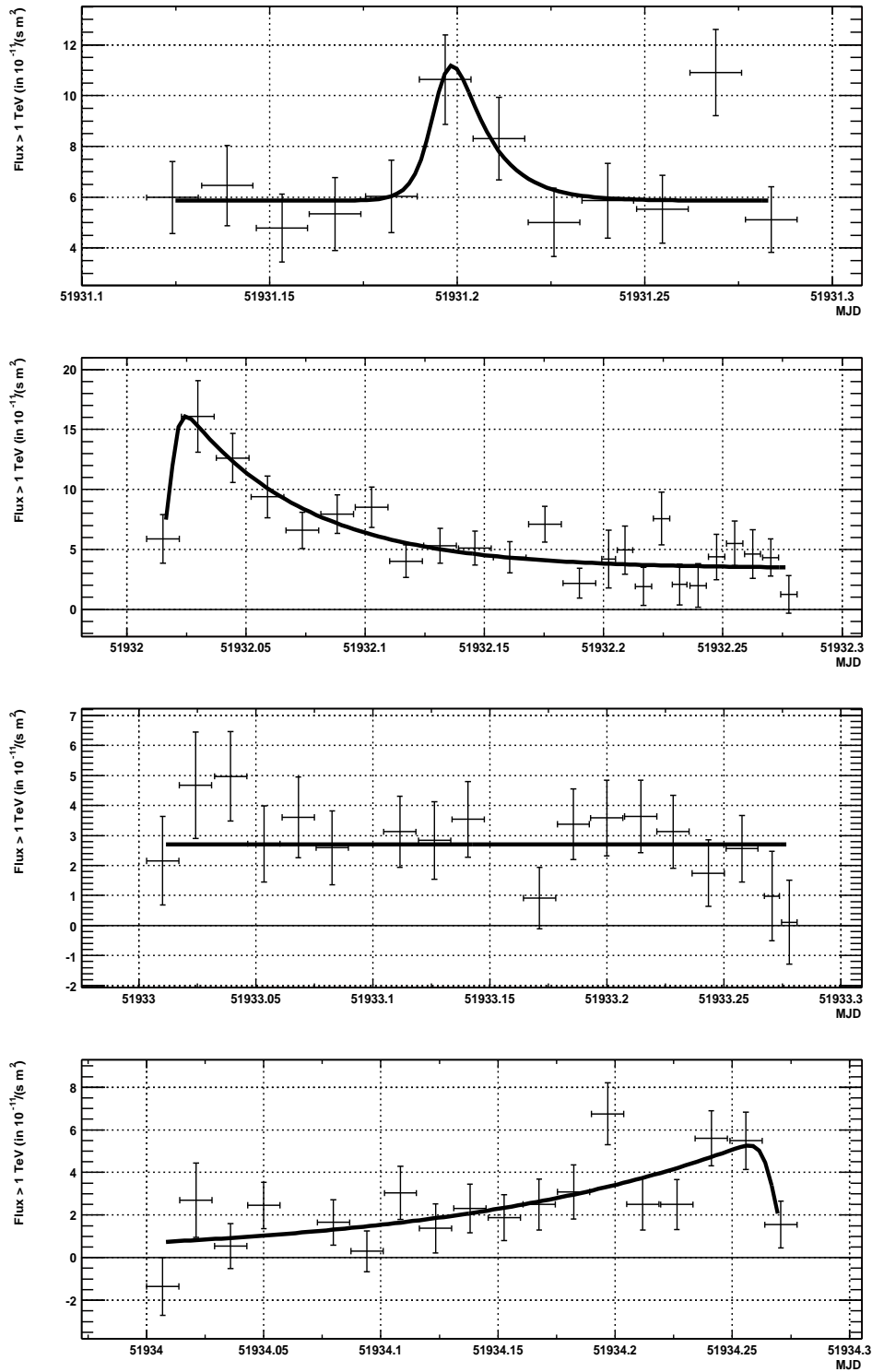


Figure F.2: Lightcurve of the nights 51930, 51931, 51932 and 51933

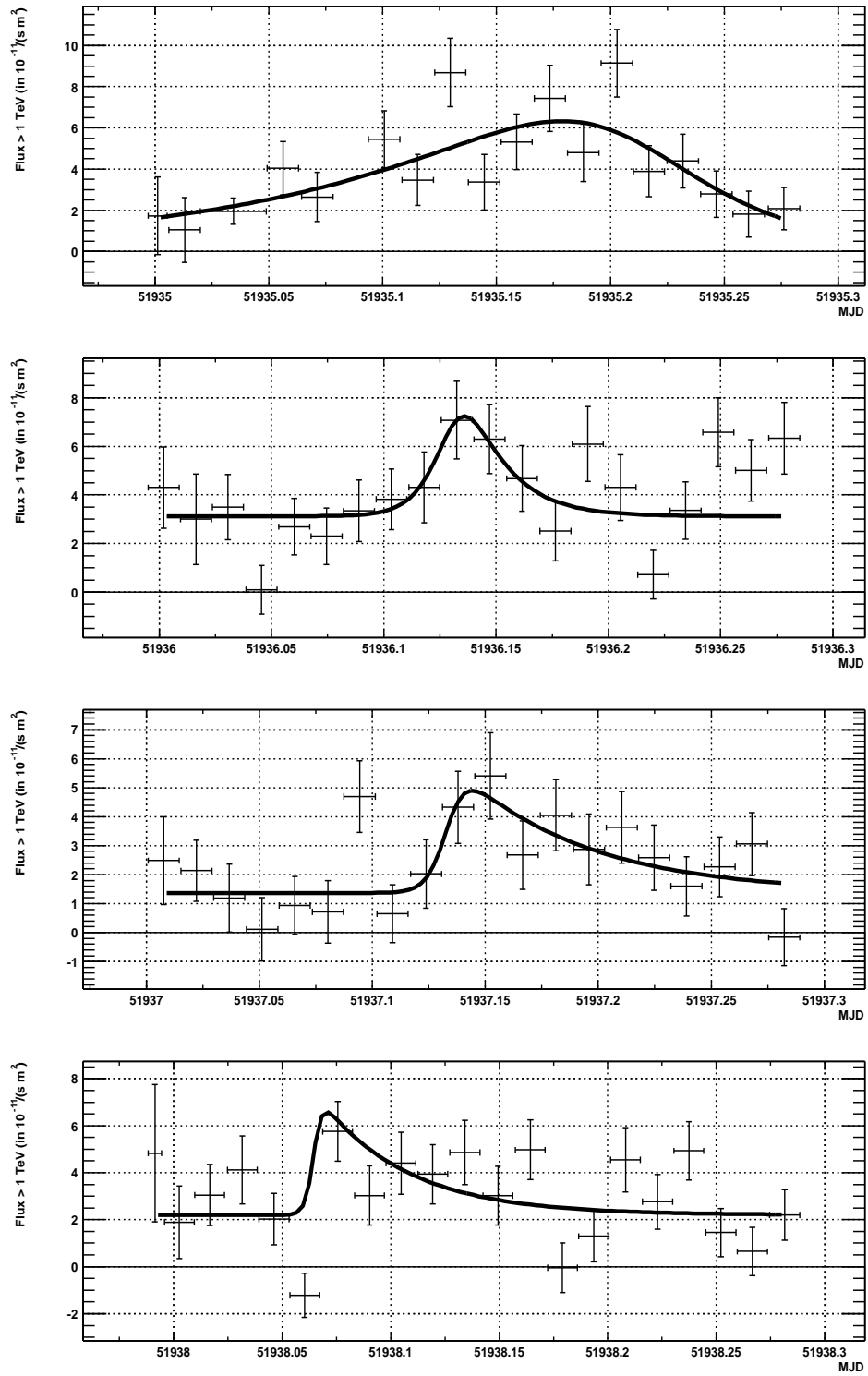


Figure F.3: Lightcurve of the nights 51934, 51935, 51936 and 51937

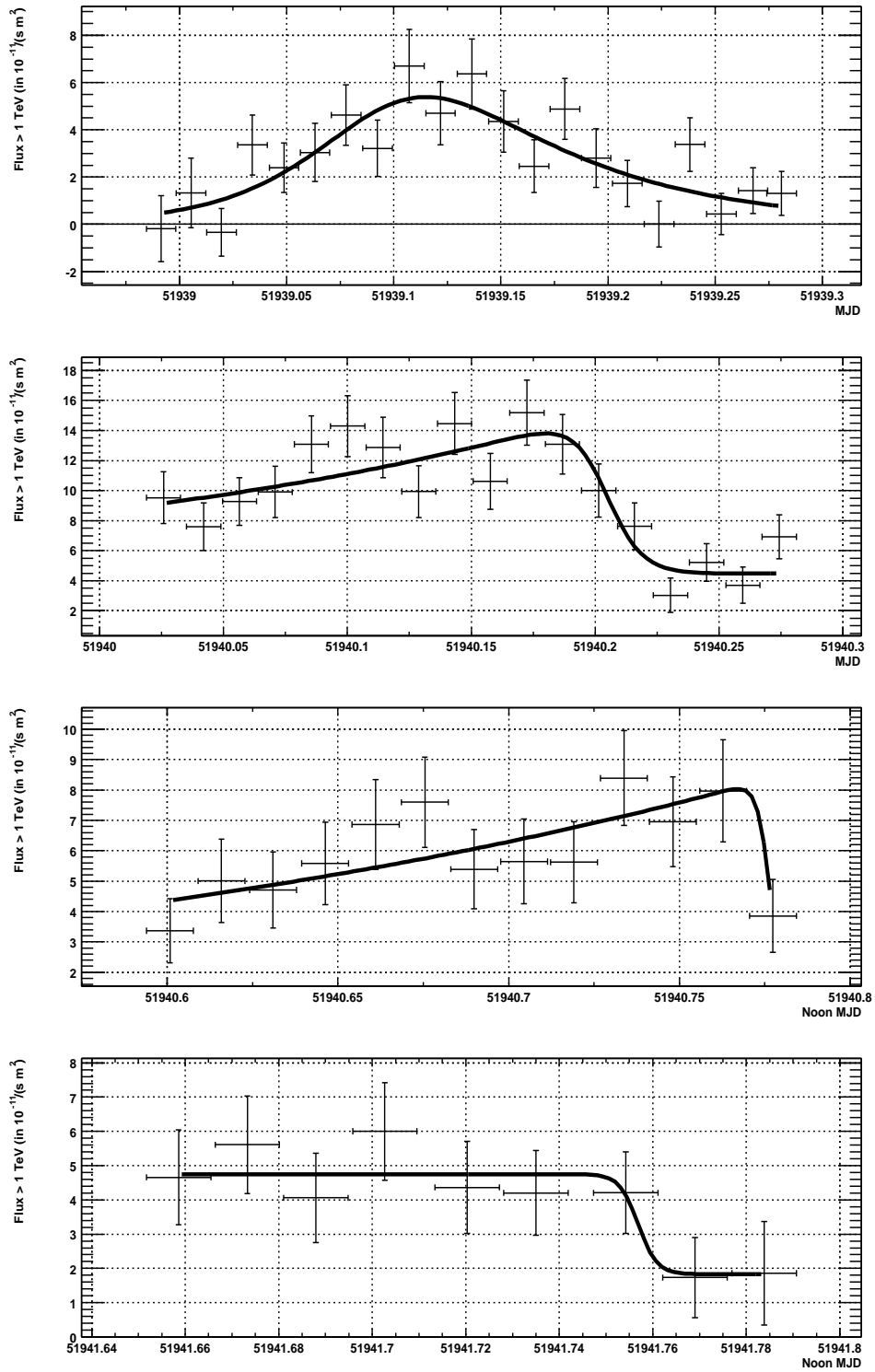


Figure F.4: Lightcurve of the nights 51938, 51939, 51940 and 51941

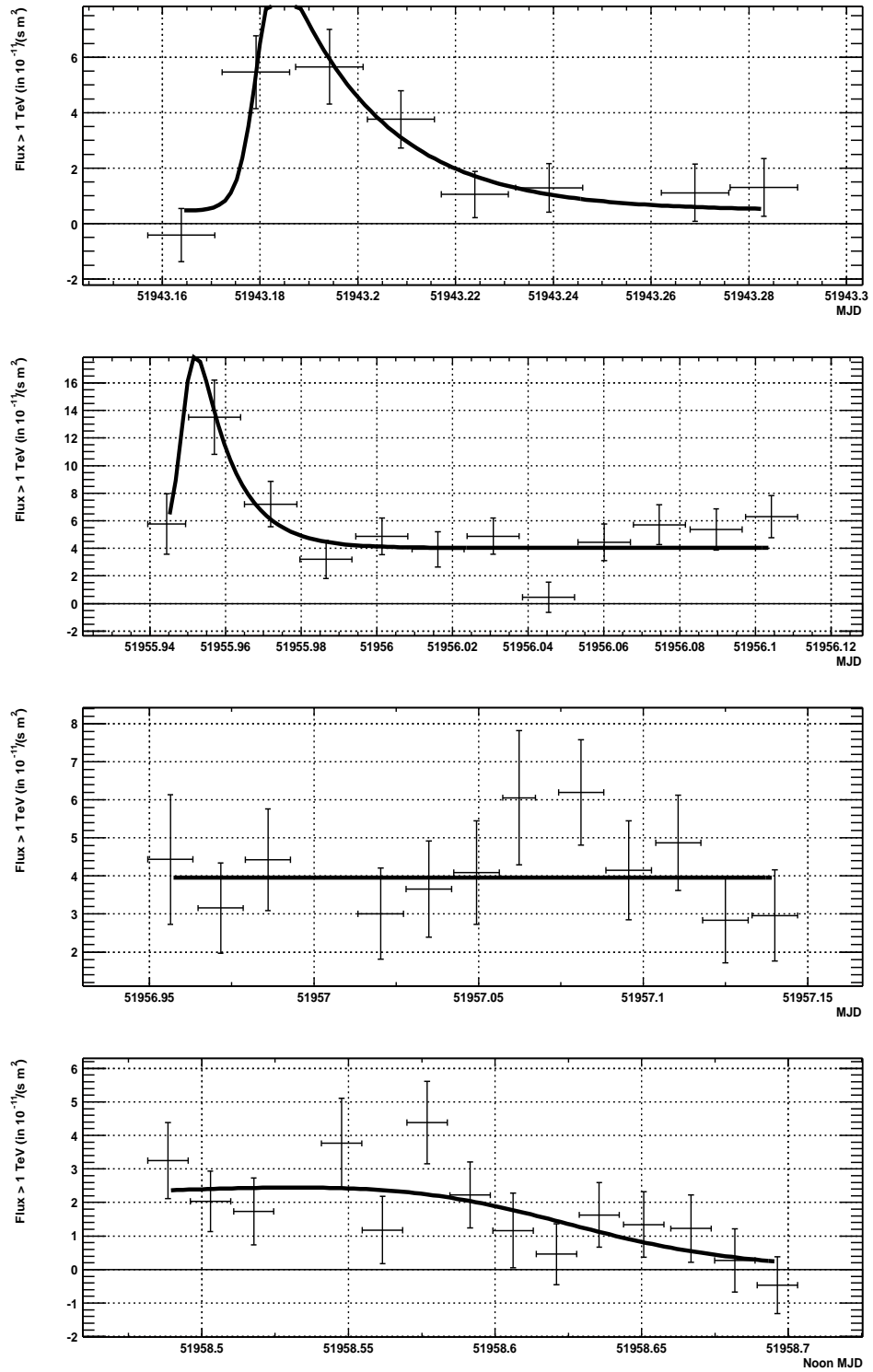


Figure F.5: Lightcurve of the nights 51942, 51928, 51929 and 51930

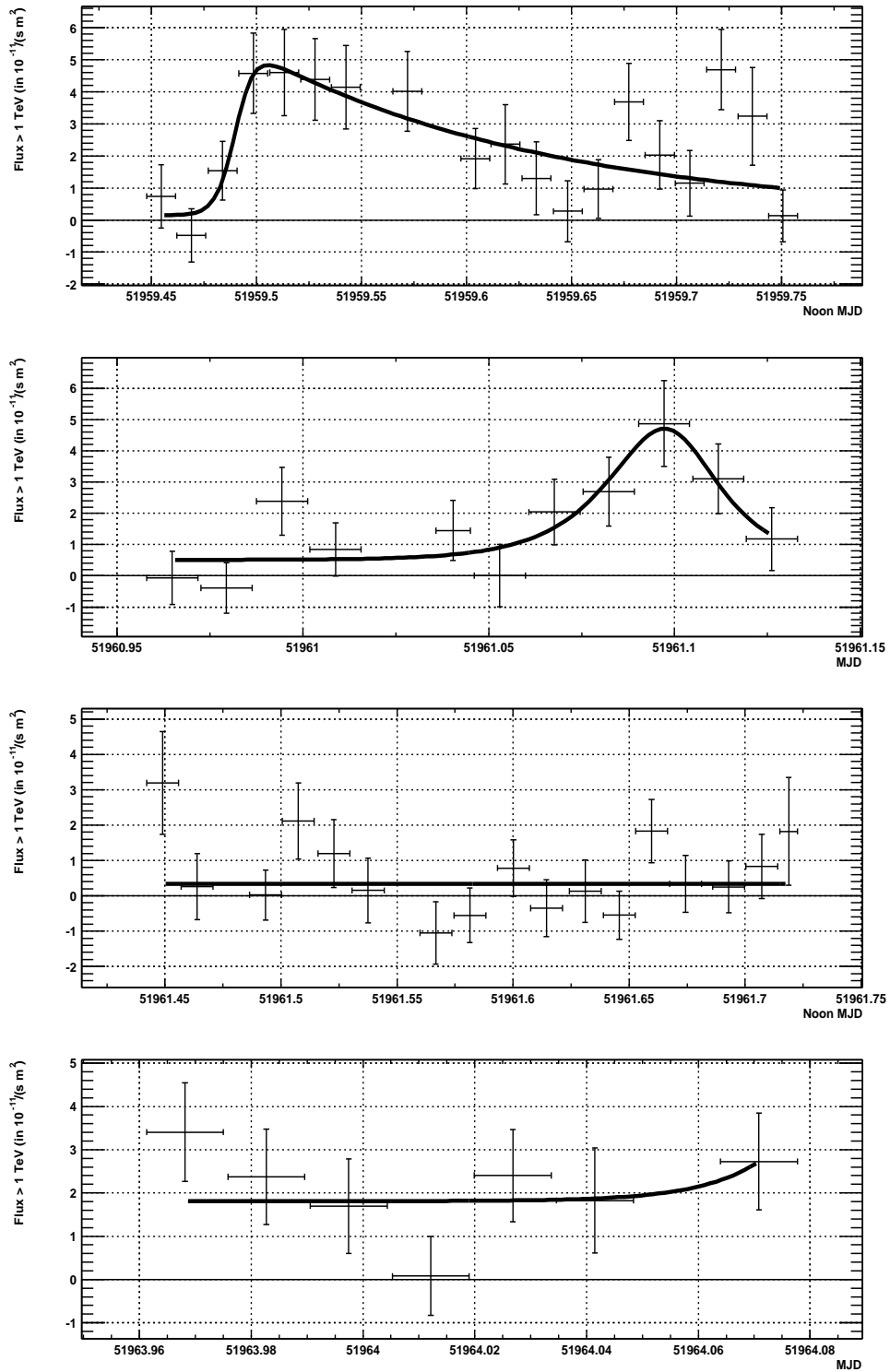


Figure F.6: Lightcurve of the nights 51959, 51960, 51961 and 51963

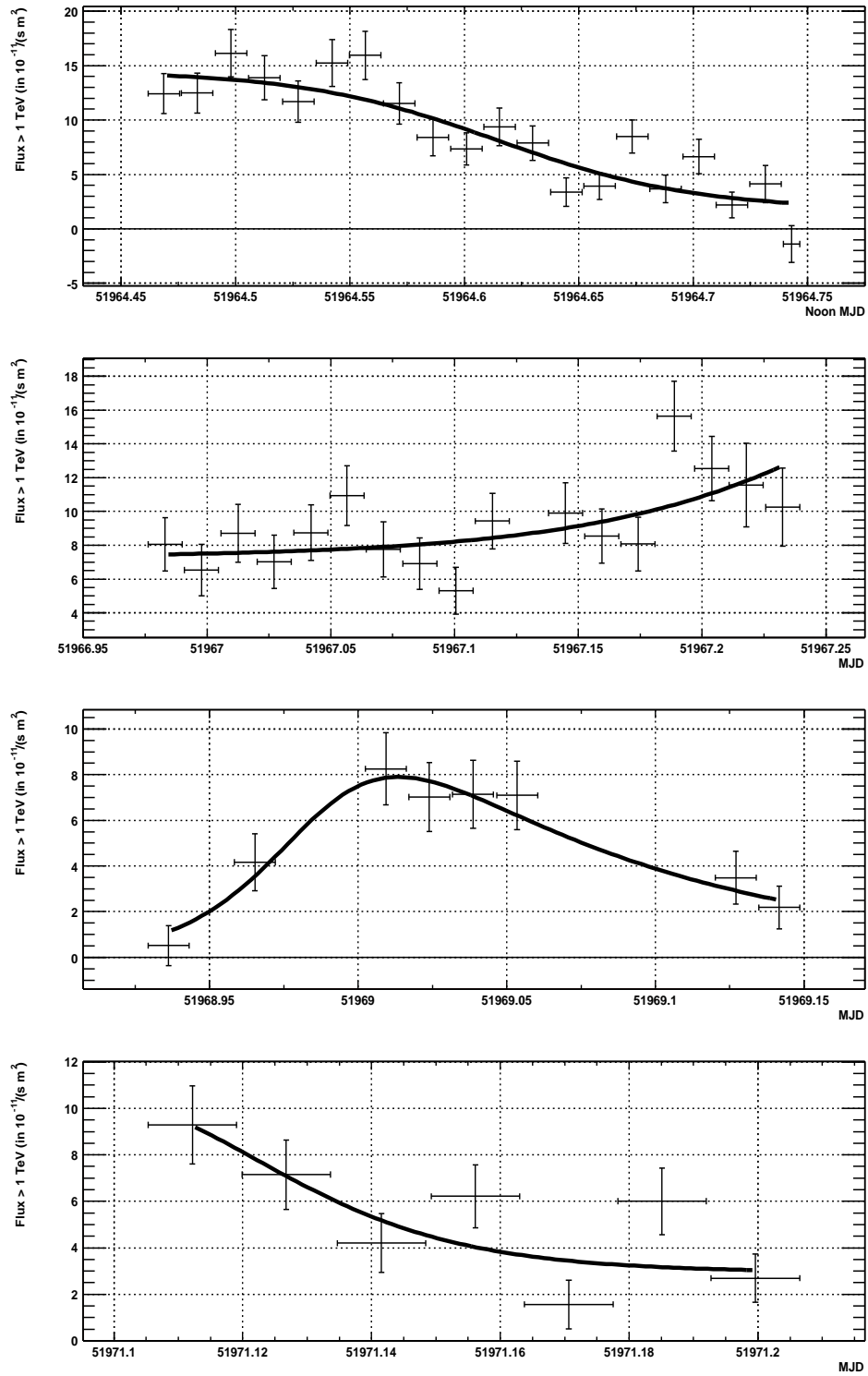


Figure F.7: Lightcurve of the nights 51964, 51966, 51968 and 51970

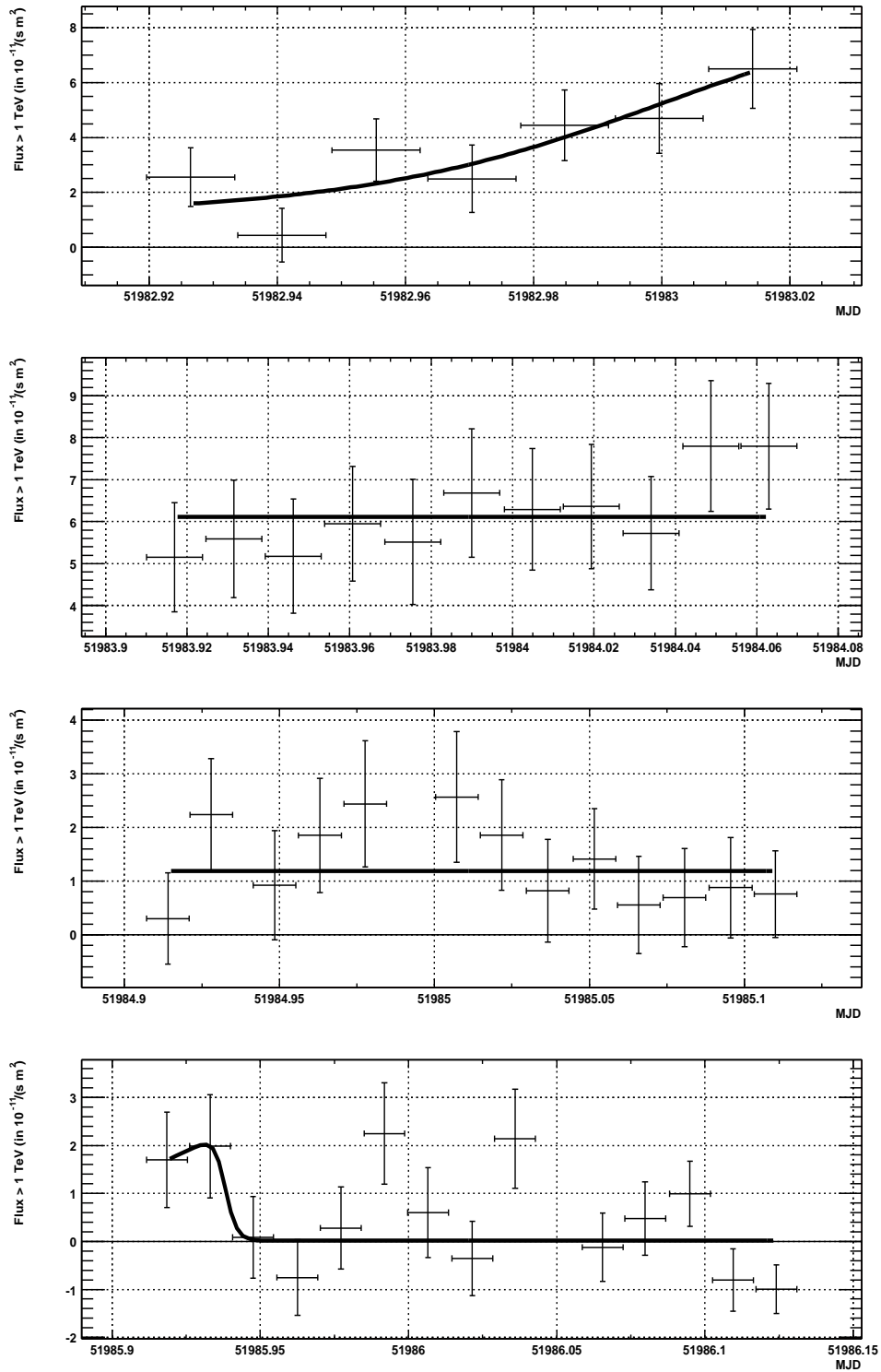


Figure F.8: Lightcurve of the nights 51982, 51983, 51984 and 51985

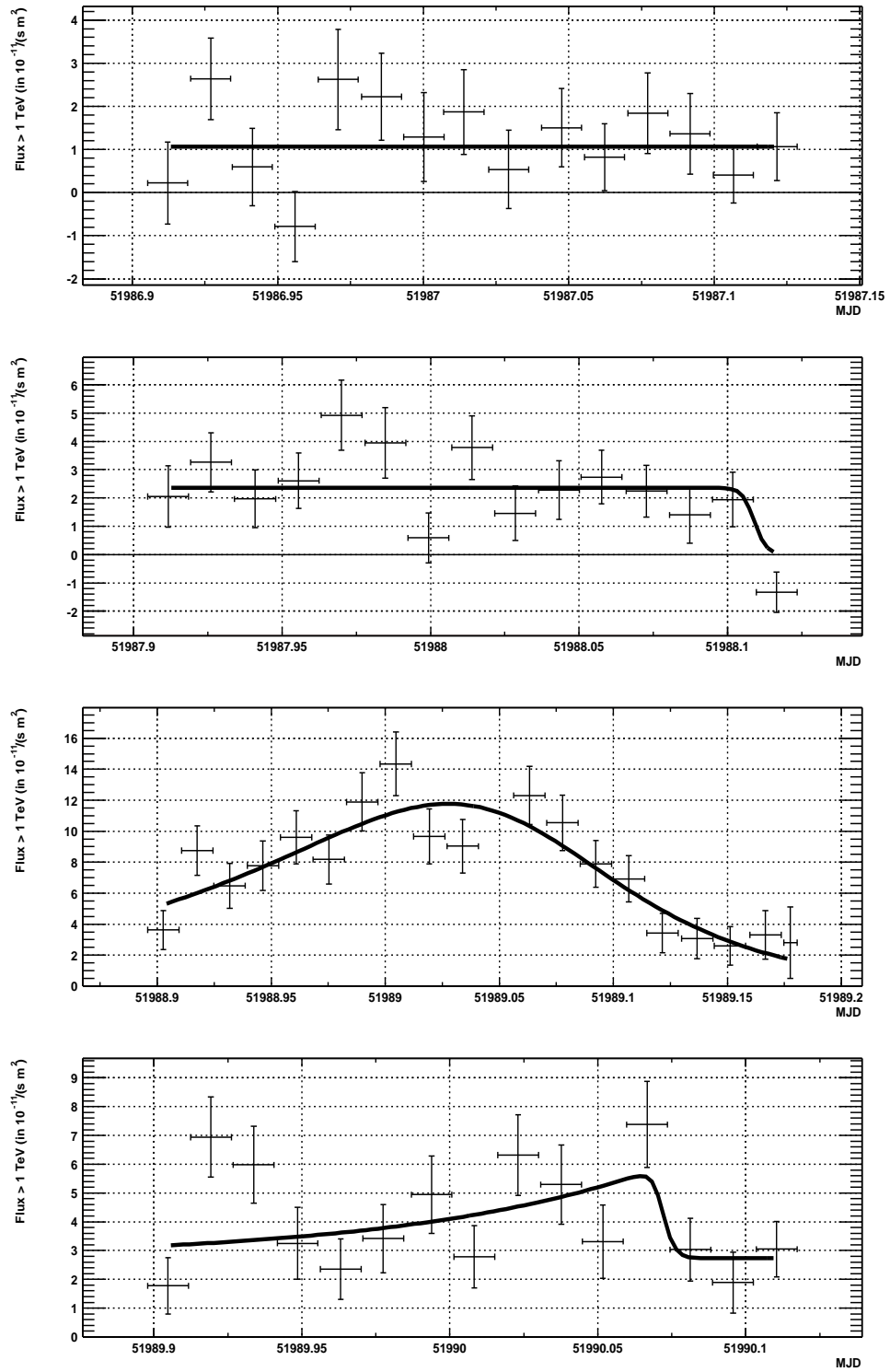


Figure F.9: Lightcurve of the nights 51986, 51987, 51988 and 51989

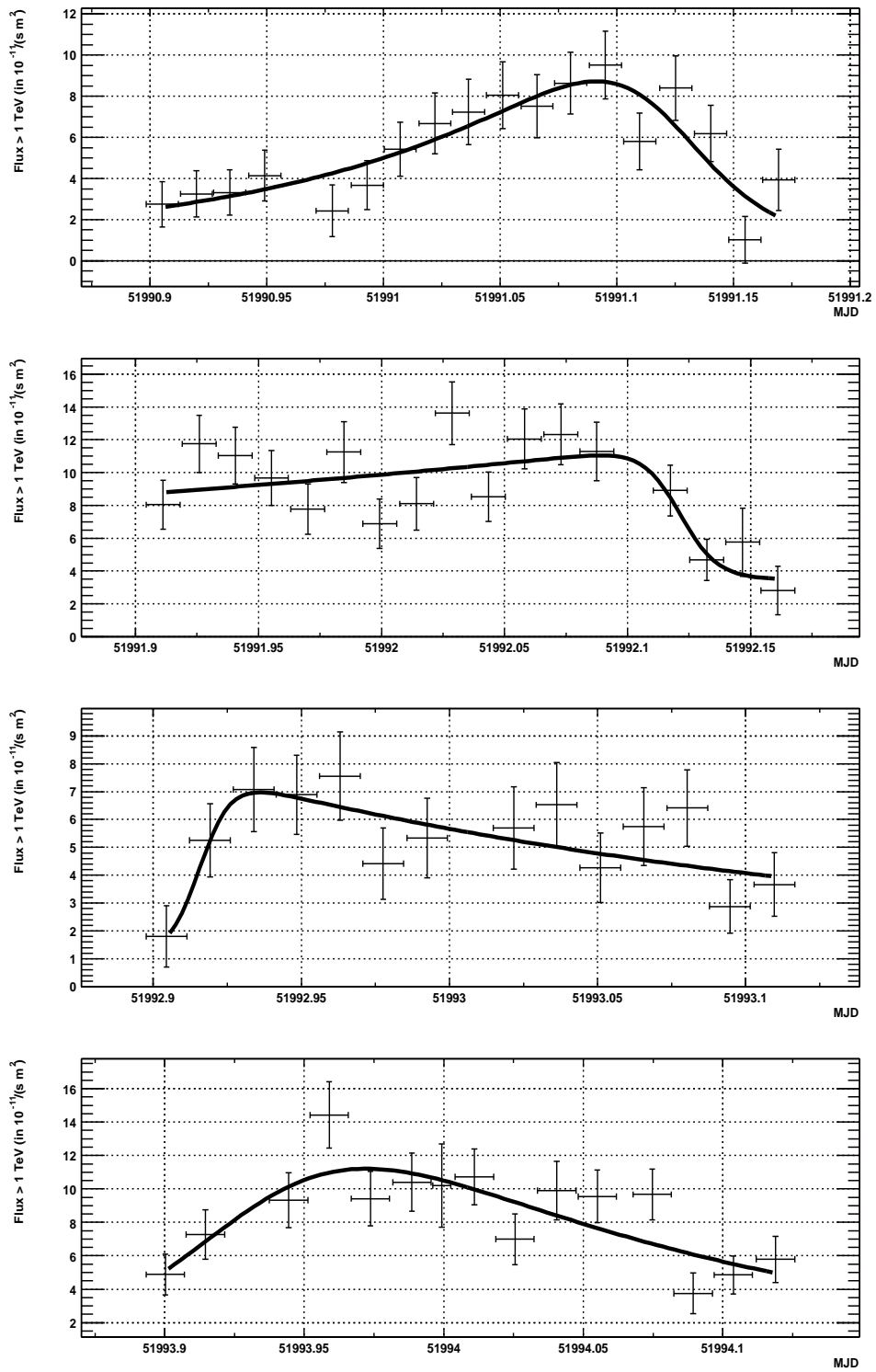


Figure F.10: Lightcurve of the nights 51990, 51991, 51992 and 51993

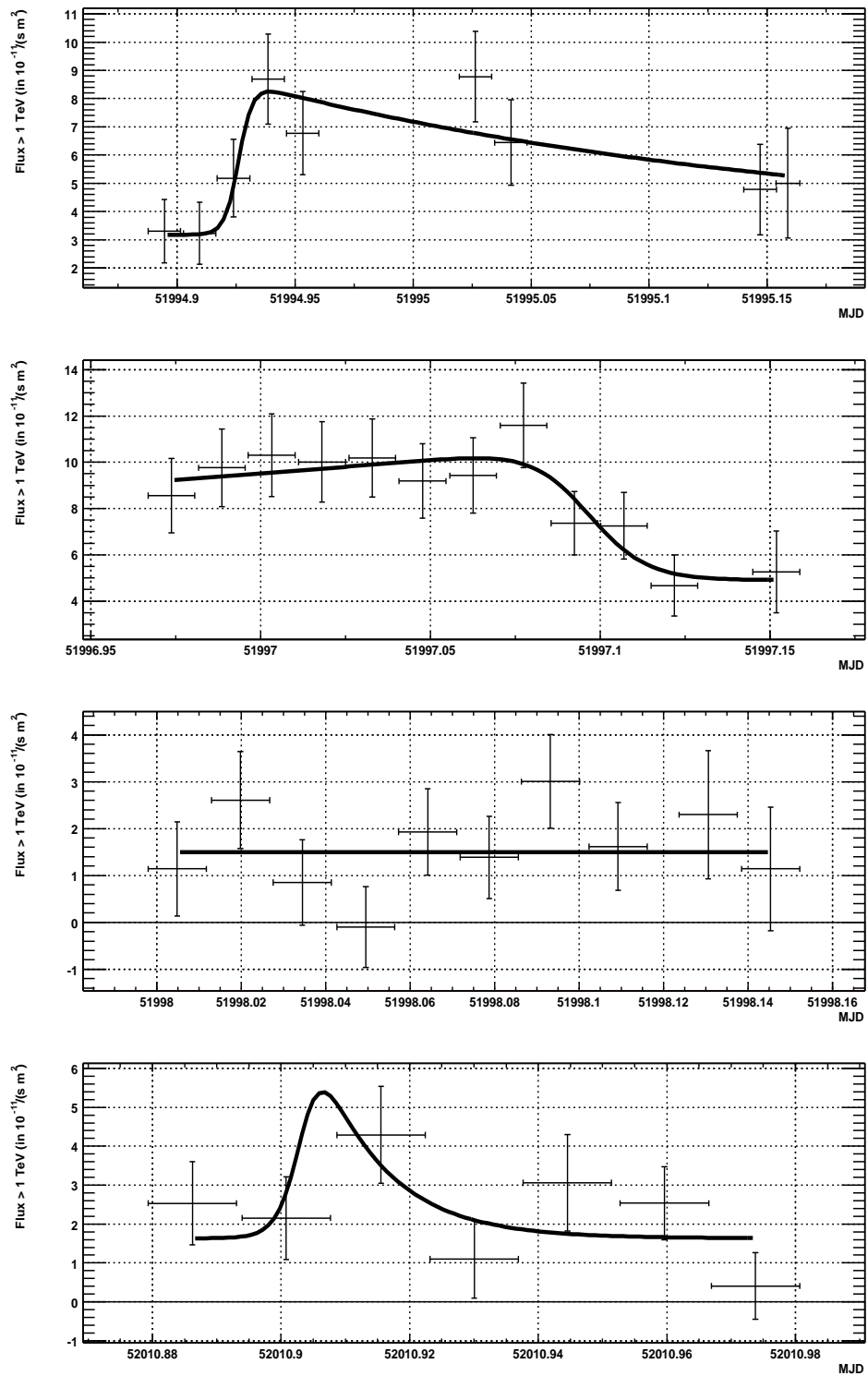


Figure F.11: Lightcurve of the nights 51994, 51996, 51997 and 52010

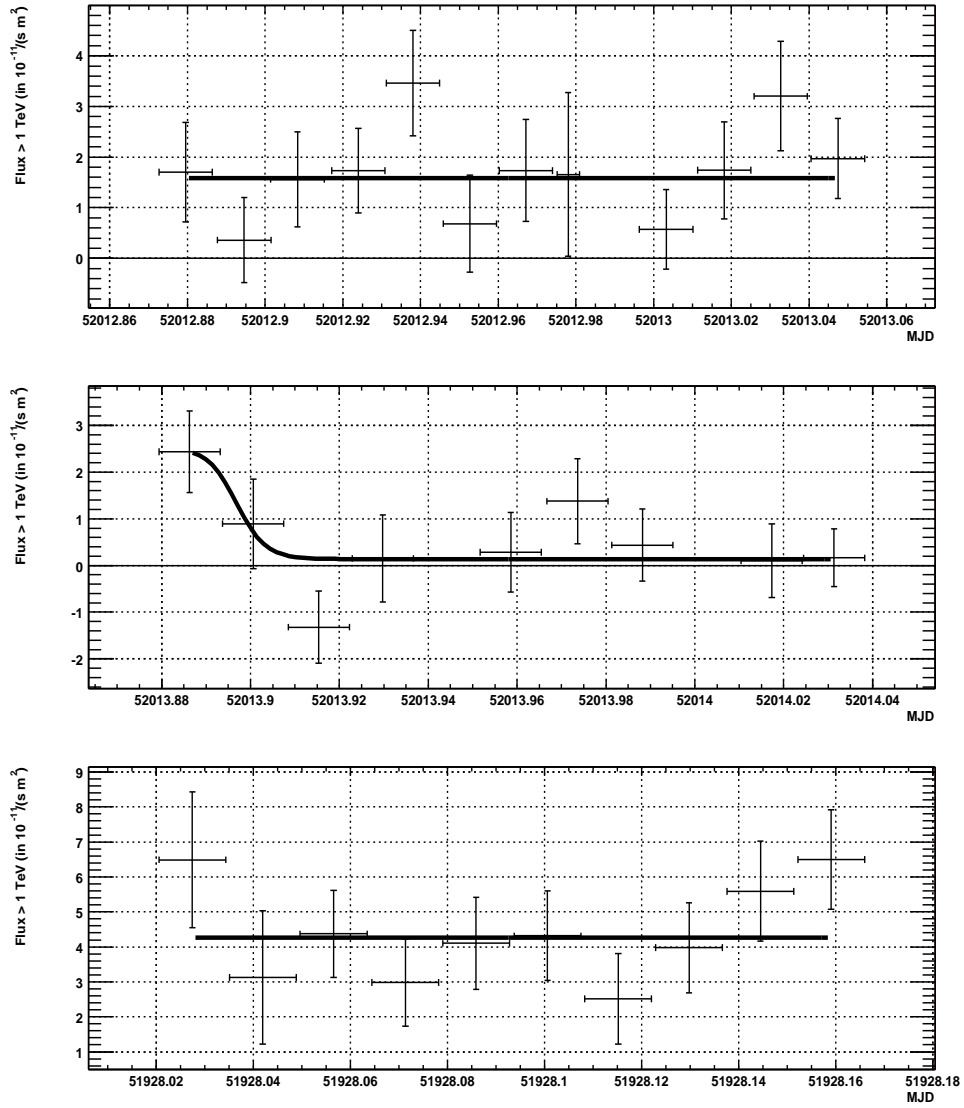


Figure F.12: Lightcurve of the nights 52012, 52013 and 51927

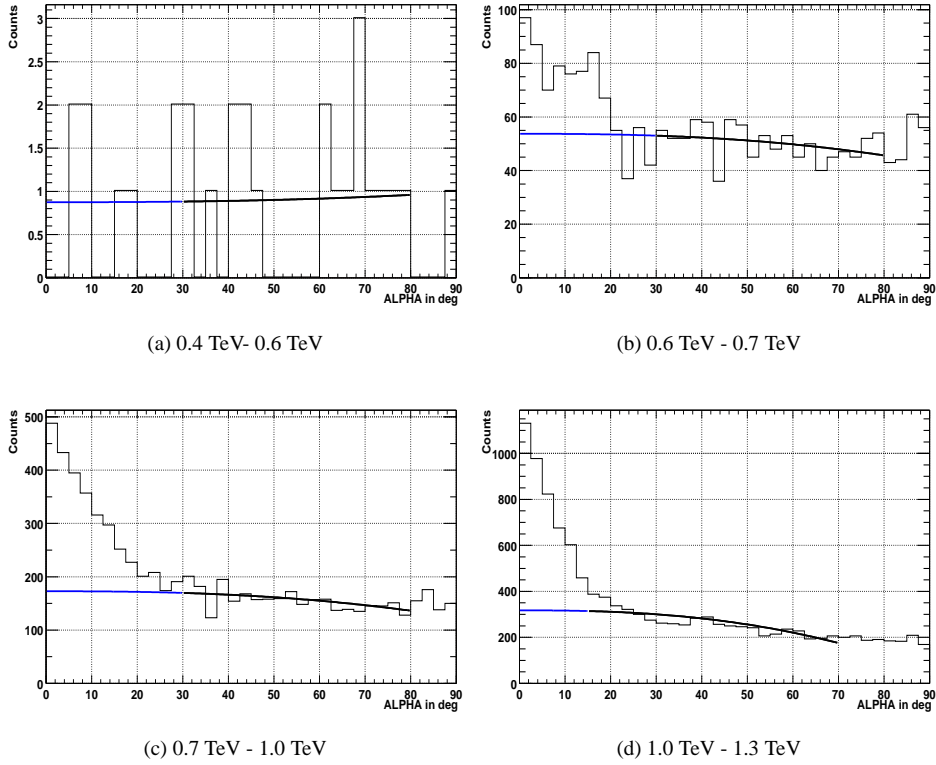


Figure F.13: ALPHA plots for energies from 0.4 TeV to 1.3 TeV

F.2 The estimation of the background for the spectrum

For completeness the plots for the background estimation for the spectrum calculation are shown here. For each energy bin a ALPHA plot has been made and the background from zero up to 18° is estimated by means of a polynomial fit with two free parameters in the ALPHA region without signal. The fit regions have been chosen energy dependent and are: 30° - 80° for energies below 1 TeV, 15° - 70° for energies from 1 TeV to 5 TeV and 10° - 50° for energies above 5 TeV. These values have been chosen to be adequate to the width of the ALPHA distribution of the signal (which becomes wider for lower energies) and to the shape of the background (which becomes more curved for higher energies).

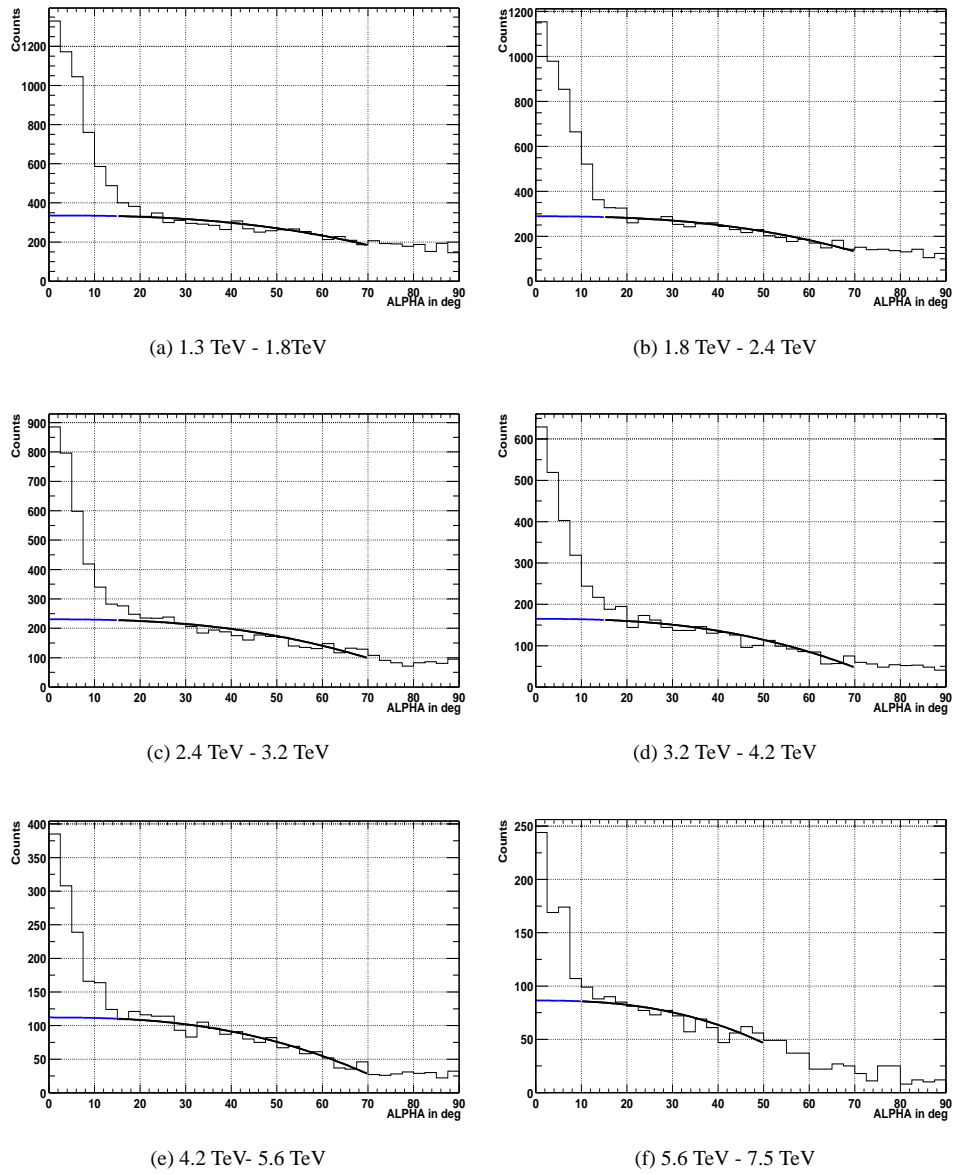


Figure F.14: ALPHA plots for energies from 1.3 TeV to 7.5 TeV

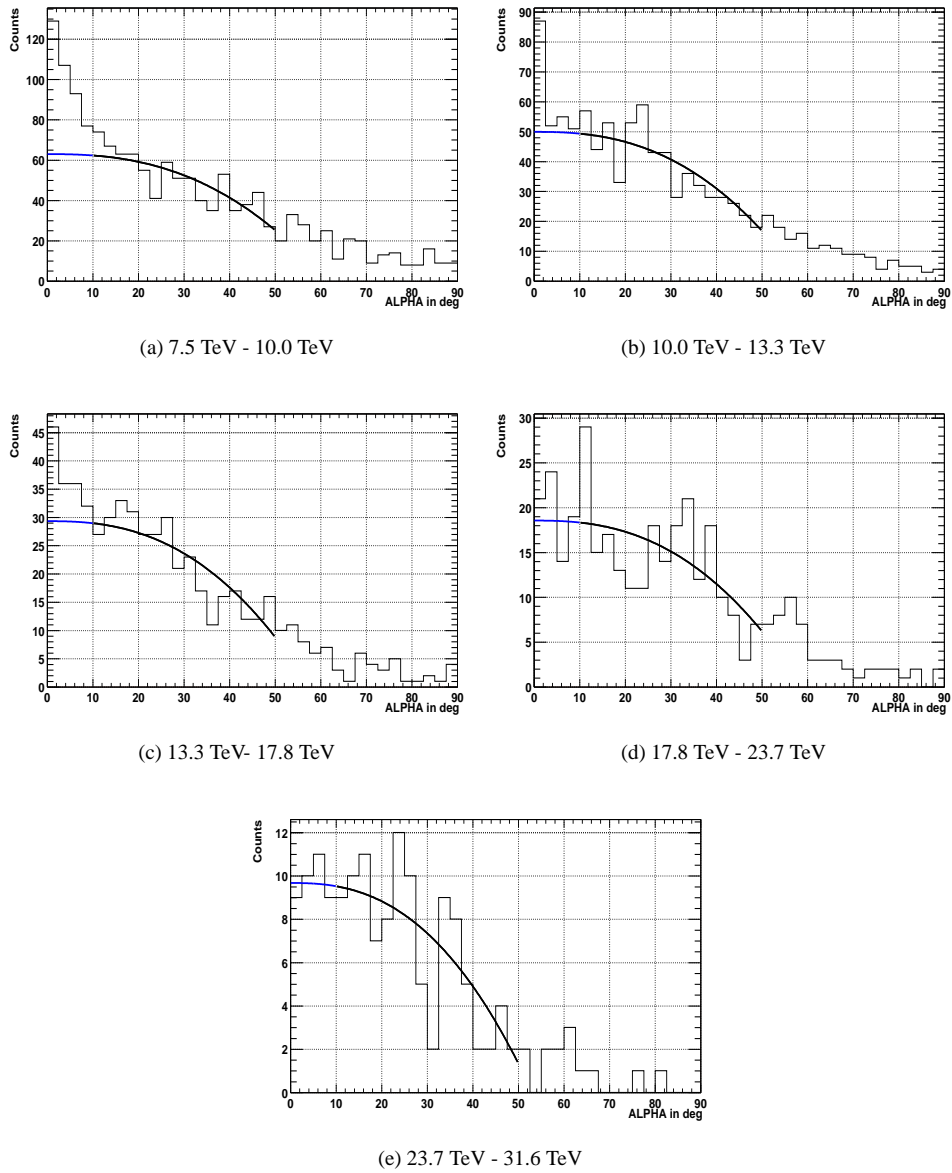


Figure F.15: ALPHA plots for energies from 7.5 TeV to 31.6 TeV

Bibliography

- [Ame00] Giovanni Amelino-Camelia and Tsvi Piran, Cosmic rays and TeV photons as probes of quantum properties of space time, hep-ph/0006210, June 2000
- [Ame96] G. Amelino-Camelia et al., Distance Measurement and Wave Dispersion in a Liouville-String Approach to Quantum Gravity, May 1996
- [Aha00] Aharonian et al., Complex Spectral Variability from Intensive Multi-wavelength Monitoring of Mkn 421 in 1998, astro-ph/0008505, 2000
- [Aha99/1] Aharonian, *Astrophysics and Astronomy*, 349, 29, 1999
- [Aha99/2] Aharonian, *Astrophysics and Astronomy*, 350, 757, 1999
- [Bad98] Badley, Peterson et al., On uncertainties in Cross-Correlation Lags and the Reality of Wavelength dependent Continuum Lags in Active Galactic Nuclei, *Astronomical Society of the Pacific*, 110, pp. 660-670, June 1998
- [Bir02] J.A. Biretta, W. Junor, M. Livio, Evidence for initial jet formation by an accretion disc in the radio galaxy M87, *New astronomy reviews* 46
- [Bed96] W. Bednarek, R. Protheroe, Modulation of AGN gamma rays by interaction with X-rays from an accretion disc hot spot, astro-ph/9612211, Dec 96
- [Beg80] Begelman et al., *Nature* 287, 307, 1980
- [Bro90] Bronstein, *Handbuch der Mathematic*, 1990
- [Bla01] O. Blanch, M. Martinez, Exploring the gamma ray horizon with the next generation of gamma ray telescopes, astro-ph/0107582, July 2001
- [Blo96] S. D. Bloom and A. P. Marscher, An analysis of the Synchrotron Self-Compton Model for the Multi-Wave band spectra of blazars, *Astrophysical Journal*, 461: 657+, April 1996
- [Böt97] M. Böttcher, *Zeitabhängiger Strahlungstransport in Jets von aktiven galaktischen Kernen*, Ph.D. Thesis, Rheinische Friedrich-Wilhelms-Universität Bonn, January 97
- [Bra93] H. Bradt, X-ray timing explorer mission, *Astronomy and Astrophysics, Supplement Series* 97, 355-360, January 93
- [Car99] M.J. Carson, B. McKernan, T. Yaqoob, D.J. Fegan, Short time scale variability in the broadband emission of the blazars Mkn 421 and Mkn501, astro-ph/9906200, June 1999
- [CAT89] S. Bohec, A new analysis method for very high definition Imaging Cherenkov Telescopes as applied to the CAT telescope, astro-ph/9804133, April 98

- [CAT01] Temporal and spectral gamma-ray properties of Mkn 421 above 250 GeV from CAT observations between 1996 and 2000, astro-ph/0106196, June 2001
- [Car99] M. Carson, et al., SHort-timescale Variability in the broadband emission of the Blazars Mkn 421 and Mkn501, astro-ph/9906200, January 1999
- [Dar97] A. Dar and A. Laor, Hadronic production of TeV Gamma-ray flares from Blazars, The astrophysical journal, 478:L5-L8, March 1997
- [Des95] G. Zech, Comparing statistical Data to Monte Carlo Simulation-Parameter, Fitting and Unfolding, Desy 95, 13, June 1995
- [Fab97] B. Fabbro, Linear Discriminant analysis with stepwise method. Application for MSSM Higgs boson search in the $hA \rightarrow b\bar{b}b\bar{b}$ channel at LEP2, ALEPH 97-012, February 1997
- [Fer49] E. Fermi, On the origin of the Cosmic radiation, Physical Review, vol 75, number 8, April 1949
- [Fis37] R. Fisher, The use of multiple measurement in taxonomic problems. Annals of Eugenics, Vol.7, 1936
- [Gai90] Thomas K. Gaisser, Cosmic Rays and Particle Physics, Cambridge University press 1990
- [Gal02] Y. A. Gallant, Particle acceleration at relativistic shocks, astro-ph/0201243, January 2002
- [Gru96] D. Gruber, The high energy X-ray timing experiment on XTE, Astronomy and Astrophysics, Supplement Series 120, C641+, December 96
- [Gui98] G. Guisellini, Blazars: Recent developments, astro-ph/9810230, October 98
- [Hau01] M. G. Hauser, The cosmic infrared background: Measurements and implications, astro-ph/0105539, May 01
- [Hil96] A. Hillas, Differences between Gamma-Ray and Hadronic Showers, Space Science Review, 75: 17-30, January 1996
- [Hil85] A. Hillas, Cherenkov light images of EAS produced by primary gamma, In NASA, Goddard Space Flight Center 19th Intern. Cosmic Ray Conference, Vol 3, 445-448, August 85
- [Hil98] Hillas et al., TeV Blazars: Status of Observations, astro-ph/9812029, 1998,
- [Hil82] A. Hillas, Angular and Energy Distributions of charged particles in electron-photon cascades in air, J. Phys. G. 8, 1461-1473, 1982
- [Hsu02] S. Hsu, A Laboratory Plasma Experiment for Studying Magnetic Dynamics of Accretion Discs and Jets, astro-ph/0202380, February 02
- [Ino96] S. Inoue and F. Takahara, Electron acceleration and gamma-ray emission from blazars, Astrophysical journal, 463: 555-564, June 1996
- [Jor01] M. Jordan, J. H. Buckley, R. Cowsik et al., Multiwavelength observations of Mkn 421, Proceedings of ICRC 2001, 2001
- [Jel58] J. V. Jelley. Cherenkov radiation and its applications. Pergamon Press, 1958
- [Kat01] J. Kataoka, et al., Five year monitoring of TeV Blazars with ASCA and RXTE, astro-ph/0105029, May 2001

- [Kes01] M. Kestel, A method to correct HILLAS Parameters of Imaging Cherenkov Telescope Data taken at different Background Light levels, Proc. 27th ICRC (Hamburg), OG269, 2001
- [Kne01] T. Kneiske, K. Mannheim and D. Hartmann, Evolving Stellar Background Radiation and Gamma-Ray Optical Depth, astro-ph/0011013
- [Kne02] T. Kneiske, Implications of cosmological gamma-ray absorption, I. Evolution of the metagalactic radiation field, Astronomy & Astrophysics 386, 1-11, 2002
- [Koi02] S. Koide et al., 3-D General relativistic MHD simulations of Generation Jets, astro-ph/0202396, February 2002
- [Kra01] D. Kranich, Temporal and spectral characteristics of the active galactic nucleus Mkn 501 during a phase of high activity in the TeV range, PhD thesis at the Technische Universität München, March 2001
- [Kre02] F. Krennrich, Discovery of Spectral Variability of Mkn 421 at TeV Energies, astro-ph/0207184, July 2002
- [Kud99] T. Kudoh, S. Aoki, S. Koide and K. Shibata, Are blazar jets magnetically driven outflows ?, Astronom. Nach. 320, 4/5, 1999
- [Mar99] Alan Marscher, The compact jets of TeV blazars, Astroparticle physics 11, 19-25, 1999
- [Lev96] A. Levine, H. Bradt, W. Cui et al., First results from the All-Sky Monitor on the Rossi X-Ray Timing Explorer, Astrophysical Journal Letters, 469: L33+, September 96
- [Liv02] Mario Livio, The jet set, Nature, vol. 417, May 2002
- [LiMa83] Ti-Pei Li and Yu-Qian Ma, Analysis Methods for Results in Gamma-Ray Astronomy, The astrophysical Journal, 272:317-324, September 83
- [LON97/1] Longair, High energy astrophysics, volume 2, p340, 1997
- [LON97/2] Longair, High energy astrophysics, volume 2, p326, 1997
- [Lon1/92] M. Longair, High energy astrophysics, vol. 1, p. 122-p. 127, 1992
- [Lon95] J. Lonway, J. Wobel, A helical jet in the orthogonally misaligned BL LAC object Mkn 501, Astrophysical journal, 439, 98-112, January 1995
- [Lor01] E. Lorenz, Status of ground-based GeV/TeV gamma ray astronomy, Journal of physics G:Nuclear and particle physics, 27, 1675-1690, 2001
- [MagCom] Norbert Magnussen, private communication
- [Mag01] Norbert Magnussen, Course given at IFAE, July 2001(2002) 239-245, 2002
- [Mar02] Alan Marscher et al., Observational evidence for the accretion-disk origin for a radio jet in an active galaxy, Nature vol 417, 6 June 2002
- [Man00] F. M. and K. Mannheim. A possible black hole binary in Mkn 501, Proc. of the Heidelberg International Symposium on High Energy Gamma-Ray Astronom, 2000
- [Mas01] Masterson et al., Temporal and spectral gamma-ray properties of Mkn 421 above 250 GeV from CAT observations between 1996 and 2000, astro-ph/010696, 2001

- [Mas99] A. Mastichiadis, J. Kirk, Models of Variability in Blazar Jets, *astro-ph/9903280*, March 99
- [Mei01] D. Meier, Magnetohydrodynamic Production of Highly Relativistic Jets, Proceedings of Astrophysical Phenomena Revealed by space VLBI, 2001
- [Mir94] R. Mirzoyan, R. Kankanian, P. Sawallisch et al., The first Imaging Air Cherenkov telescope of the HEGRA collaboration, *Nuclear instruments and Methods, A* 351:513+, 1994
- [Mir00] Mirzoyan, Conversion factor calibration for MAGIC based on the use on measured F-factor of PMTs, MAGIC internal note, April 2000
- [MirCom] Razmik Mirzoyan, MPI für Physik, Munich, private communication
- [Nis02] K. Nishikawa, 3-D General Relativistic MHD Simulations of Generation jets, *astro-ph/0202396*, February 2002
- [Ose01] S. Oser, et al., High energy Gamma-ray Observations of the Crab Nebula and Pulsar with the Solar Tower Atmospheric Cherenkov Effect Experiment, *Astrophysical Journal*, 2001
- [Pad95] P. Padovani, Unified Schemes for Radio-Load Active Galactic Nuclei, *The Publications of the Astronomical Society of the Pacific* 107: 803+, September 1995
- [Pad1/99] P. Padovani, Unified Schemes and the two Classes of BL LACs, *astro-ph/9901128*, Jan 99
- [Pad2/99] P. Padovani, High Energy Emission from AGN and Unified Schemes, *astro-ph/9901130*, Jan99
- [Pet97] D. Petry, Beobachtung hochenergetischer γ -Strahlung ($E > 1$ TeV) aus Richtung der aktiven Galaxien Mkn 421 und Mkn 501, PhD. thesis, Technische Universität München, Föhringer Ring 6, 80805 München, September 1997, MPI-PhE/97-27
- [Pir01] F. Piron et al., Temporal and spectral gamma-ray properties of Mkn 421 above 250 GeV from CAT observations between 1996 and 2000, *astro-ph/0106196*, June 2001
- [Qui96] Quinn J et al, *Astrophys. J.* 456, L83, 1996
- [Rau95] G. Rauterberg et al., A new 127 Pixel Camera for Cherenkov Telescopes of the HEGRA Array on la Palma, In 24th Interbational Cosmic Ray Conference (Rome), volume 3, p 460+, 1995
- [Rey93] P. T. Reynolds, C. W. Akerlof, M. F. Cawley et al., Survey of candidate gamma-rays sources at TeV energies using a high resolution Cherenkov imaging system - 1988-1991, *Astrophysical Journal*, 404: 206-218, February 1993
- [Sal98] M. Salvati, Rapid Variability of Gamma-Ray Blazars: A model for Markarian 421, *astro-ph/9801049*, Jan 98
- [Sch01] Schweizer, The calibration of the MAGIC telescope camera, to be published in *IEEE Trans. Nucl. Sci.*, 2001
- [Sal98] M. Salvati et al., Rapid variability of gamma-ray blazars: a model for Mkn 421, *astro-ph/9801049*, January 1998

- [Sch00] T. Schweizer and M. Dosil, Measurements of the NSB in La Palma on the Roque de los muchachos, September 2000
- [Ste95] F. W. Stecker, O. C. De Jager, Absorption of high energy gamma rays by low energy intergalactic photons, astro-ph/9501065, Jan 95
- [Ste01] F. W. Stecker, O. C. De Jager, Extragalactic gamma ray Absorption and the intrinsic spectrum of Mkn 501 during the 1997 flare, astro-ph/0107103, October 01
- [Tan98] Tanimori et al., TeV gamma-ray observations of southern BL LACs with the CANGAROO 3.8m imaging Telescope, astro-ph/9811260, 1998
- [Tav98] F. Tavecchio and Lausra Marashi, Constraints on the Physical Parameters of TeV Blazars, astro-ph/9809051, 1998
- [Tak96] T. Takahashi, et al., Ap J, 470, L89, 1996
- [TW] This thesis
- [Vas99] V. V. Vassiliev, Extragalactic background light absorption signal in the TeV γ -ray spectra of Blazars, astro-ph/9908088, August 99
- [Wan02] Y. Wang and P. Biermann, Effects of galaxy mergers on the faint source counts and the background, to be published in Astronomy and astrophysics
- [Wie94] B. Wiebel, Chemical Composition in High Energy Cosmic Rays, Technical Report, Bergische Universität Gesamthochschule Wuppertal, January 1994
- [WitCom] Wolfgang Wittek, MPI für Physik, Munich, private communication
- [Zwe97] J. A. Zwerink, et al., The TeV Gamma-ray spectrum of Markarian 421 during an intense flare, The Astrophysical Journal, 490, L141-L14, December 1997