Gamma ray light curve and polarimetry of Mrk421

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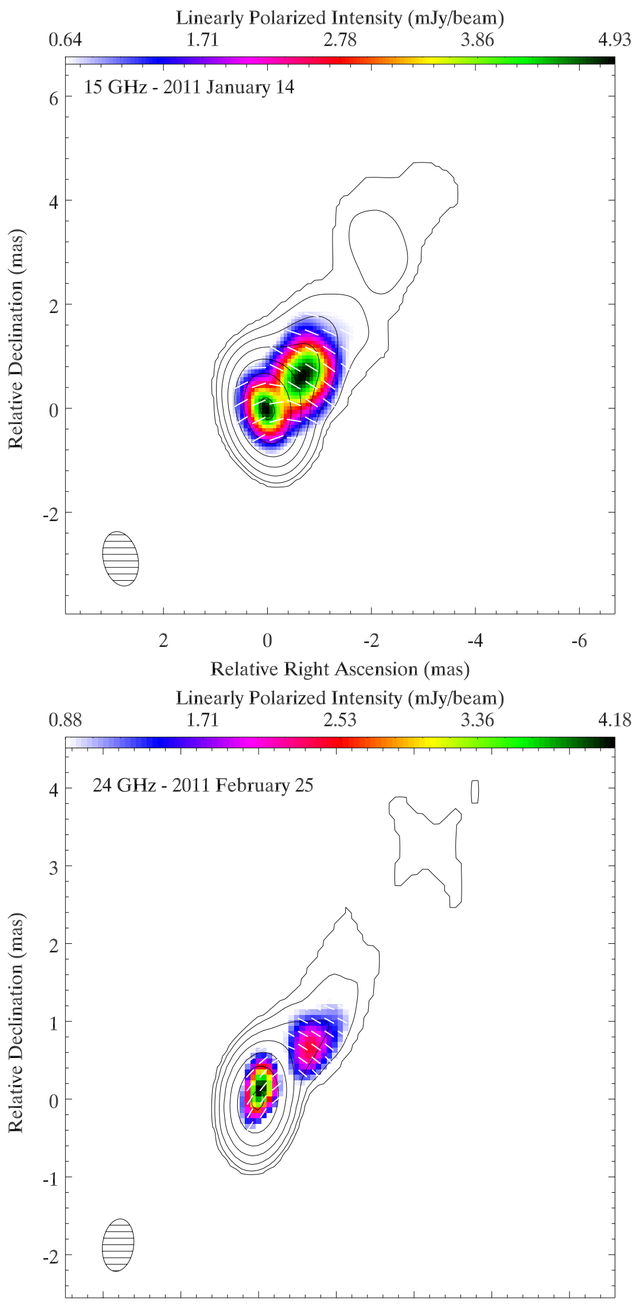
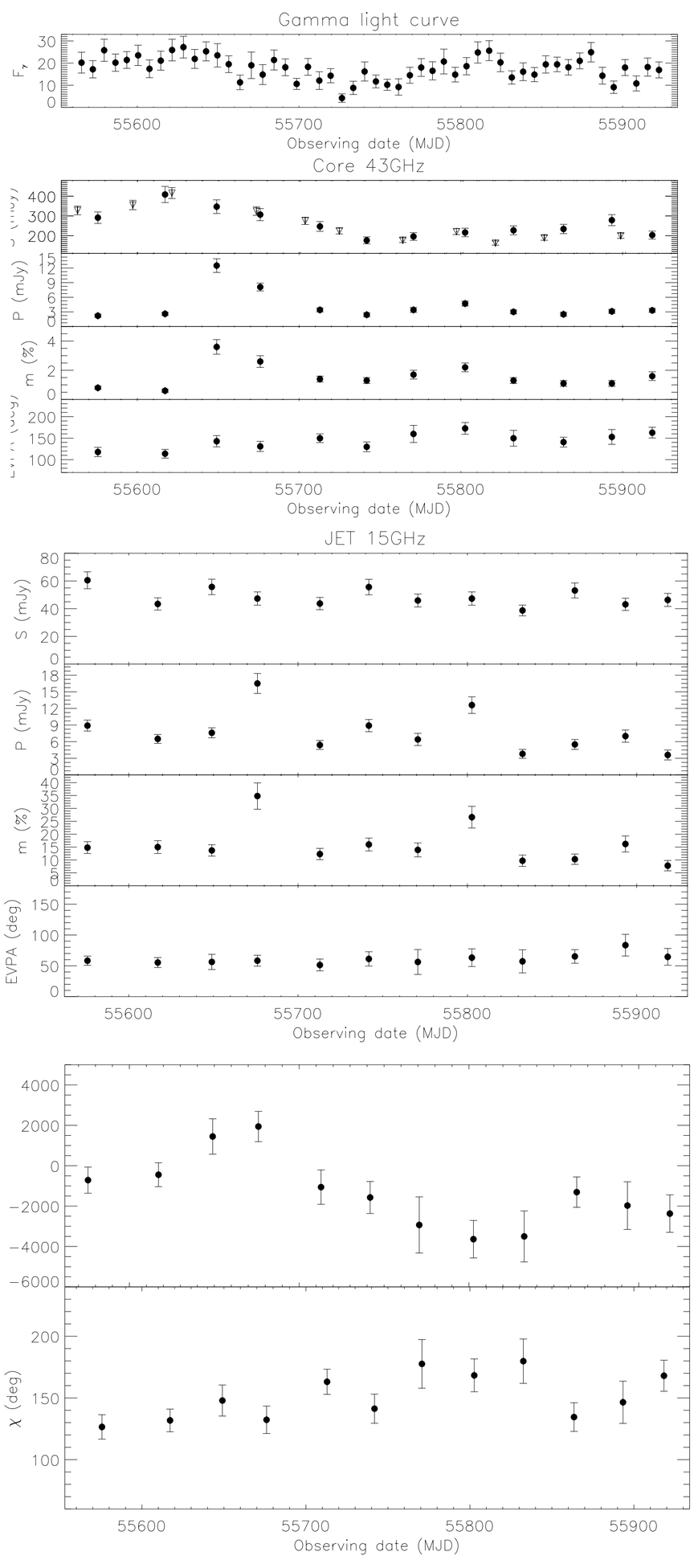
Radio data

We observed Mrk421 with the VLBA for 12 times (once per month) throughout 2011 at 15, 24, and 43 GHz. We carried out a full calibration and analysis describing the evolution with time of total intensity and polarized flux density, and of their combinations such as spectral index and rotation measure. Core and inner jet are spatially resolved and separately analyzed. Spatial resolution is as good as 0.2 pc at 43 GHz and sensitivity just below 1 mJy/beam.

Gamma-ray data

We analyzed gamma-ray data from the Large Area Telescope on board *Fermi*, which continuously scans the whole sky in the energy range 100 MeV < *E* < 300 GeV. We analyzed the data with the ScienceTools software package version v9r32p5, using instrument response functions P7REP_SOURCE_V15. Mrk421 is bright enough to be significantly detected in every weekly bin, and we obtained photon flux and photon index for every bin.





Radio core

- shows variability in total intensity and polarization
- peak is ~415 mJy, reached on March 1st at 43 GHz
- spectral index is $\alpha_{15\text{-}24} = 0.16$ and $\alpha_{24\text{-}43} = 0.23$, with flatter when brighter behaviour
- polarization fraction is variable, in frequency (~1% at 15 GHz, ~2% at 43 GHz) and time
- EVPA at 43 GHz is nearly stable, parallel to the jet → transverse magnetic field
- EVPA at lower frequency is more stable, with two opacity induced 90deg flips at 15 GHz
- once flips are removed, residual low frequency variability remains
  - time variable Faraday rotation, in range -3000 to +2000 rad m^{-2}

Radio jet

- total intensity light curve very regular
- no prominent knots
- no pattern motion
- steep spectral index
- polarized emission only detected at 15 and 24 GHz
- higher fractional polarization (~15%) than in core
- stable EVPA (55º, ~perpendicular to the jet → parallel magnetic field)
- quite stable fractional polarization flux density, with one jump in April

Gamma rays

- the source is point like at Fermi angular resolution
- mean photon flux and photon index are F = $(17.4\pm0.5)\times10^{-8}$ ph cm^{-2} s^{-1} and $\Gamma=1.77\pm0.02$
- light curve on weekly time bins shows variability
- three peaks in March, Sept., and Nov. as bright as $(38\pm11)\times10^{-8}$ ph cm^{-2} s^{-1}
- no spectral variability

Discussion

- radio data require only moderate beaming, suggesting radio and gamma-ray emission regions are not cospatial
- however, radio and gamma-ray light curves are strongly correlated, with 0 lag based on DCF
  ➡ radio/gamma-ray crisis continues!

- core B-field typical of shocked regions
- jet B-field stretched by layered velocity structure?
- features in the polarized flux light curve suggest connection between magnetic field and gamma-ray emission
- are RM changes are associated to accretion rate variation?

References

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- Blasi, Lico, Giroletti et al. 2013 A&A 559, 75
- Lico, Giroletti, Orienti et al. 2014 A&A submitted