

Inferring the origins of the pulsed γ -ray emission from the Crab pulsar with ten-year *Fermi*-LAT data (Corrigendum)

Paul K. H. Yeung^{1,2}

¹ Institute of Experimental Physics, Department of Physics, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

e-mail: kin.hang.yeung@desy.de

² Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences, Rabiańska 8, 87-100 Toruń, Poland

A&A 640, A43 (2020), <https://doi.org/10.1051/0004-6361/202038166>

Key words. pulsars: individual: Crab pulsar – gamma rays: stars – errata, addenda

This is a corrigendum to the original article [Yeung \(2020\)](#) and is mostly adapted from Appendix C.4 of the author's Ph.D. Thesis ([Yeung 2021](#)).

In Sect. 3.4 of the original article, we deduced from the power law with a scaling factor (PLSF) fitting result that Γ for $P2_M$ is lower than that for $P1_M$. Nevertheless, the previous calculation of the significance of this difference did not consider the covariance of the Γ values for $P1_M$ and $P2_M$ (it should be noted that the spectral data for $P1_M$ and $P2_M$ are fit simultaneously such that their solutions share the same scaling factor ϵ). After taking this covariance into account, which is computed to be 0.010, we now determine that Γ for $P2_M$ is lower than that for $P1_M$ by 0.35 ± 0.08 , which corresponds to $\sim 4.2\sigma$ (much higher than the $\sim 2.1\sigma$ reported in the original paper). Additionally, Fig. 1 demonstrates that the 4σ confidence region of Γ values for $P1_M$ and $P2_M$ excludes all equal-value combinations.

The revised significance strengthens the argument that the flux ratio of $P1$ to $P2$ still decreases with photon energy even above 10 GeV. This, in turn, strengthens the interpretation that there are anisotropic pulsar winds that could lead to the observed harder spectrum at $P2_M$ relative to $P1_M$ (as put forward by [Aharonian et al. 2012](#)).

Moreover, taking the statistical errors into account, the ϵ values obtained for MAGIC and VERITAS (both ~ 1.22) are basically consistent with the estimated systematic errors of around 15% on energy scales of IACT telescopes under excellent atmospheric conditions (e.g., [Aharonian et al. 2006](#); [Aleksić et al. 2016](#)). This provides further confirmation for the physical reasonableness of those fitting results.

References

Aharonian, F., Akhperjanian, A. G., Bazer-Bachi, A. R., et al. 2006, *A&A*, **457**, 899
Aharonian, F. A., Bogovalov, S. V., & Khangulyan, D. 2012, *Nature*, **482**, 507

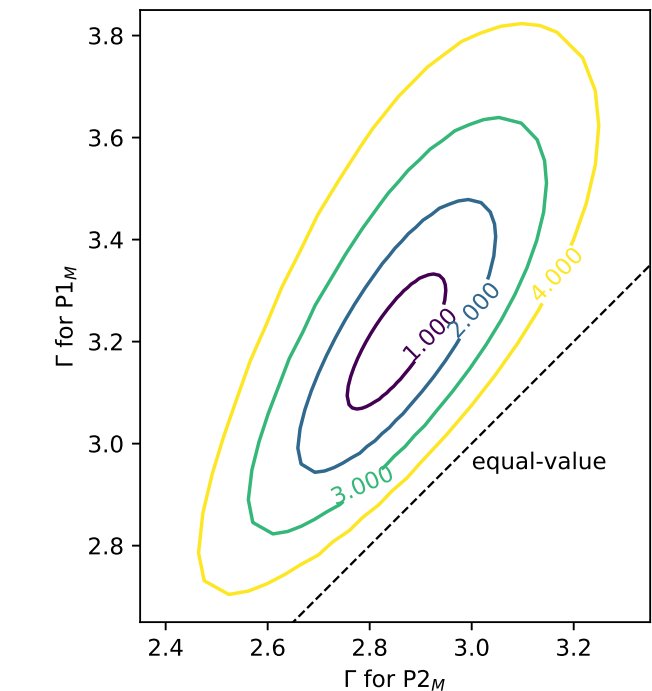


Fig. 1. Confidence regions of Γ values for $P1_M$ and $P2_M$. The plotted covariance contours respectively correspond to the significance levels of 1σ , 2σ , 3σ , and 4σ (from innermost to outermost). The reference line (which is black, dashed, and straight) indicates the combinations of equal Γ values.

Aleksić, J., Ansoldi, S., Antonelli, L. A., et al. 2016, *Astroparticle Physics*, **72**, 76
Yeung, K. H. 2021, PhD thesis, Staats- und Universitätsbibliothek Hamburg Carl von Ossietzky
Yeung, P. K. H. 2020, *A&A*, **640**, A43