

Quiet Sun gamma ray PASS 8 observations during the first six years

N.Giglietto (Dipartimento Interateneo di Fisica "M.Merlin", Politecnico and Università di Bari-INFN Bari) on behalf of the *Fermi*-LAT Collaboration



Abstract

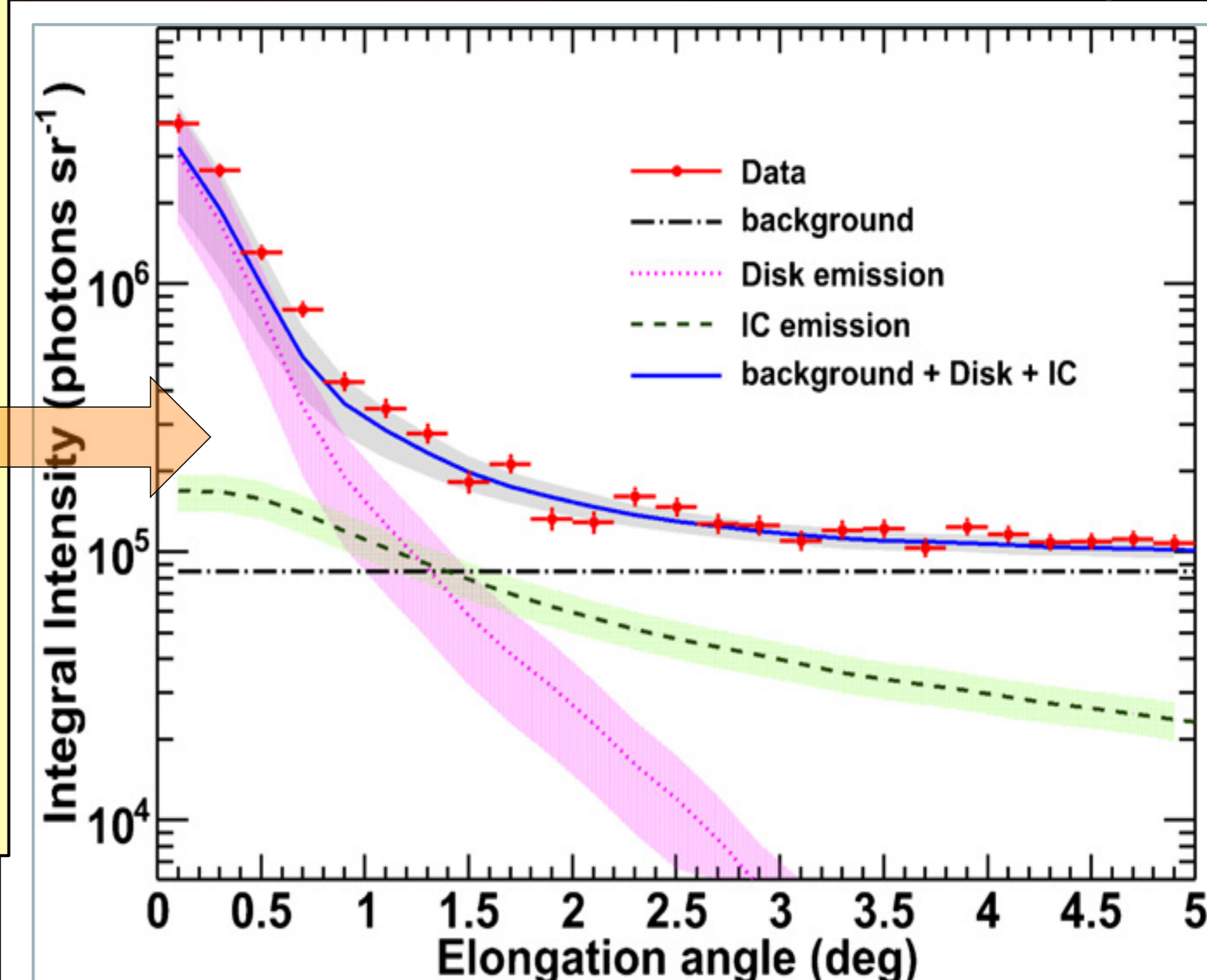
In this contribution we show the current status of the updated analysis of the Quiet Sun emission, using the data collected in the first 6 years and using Pass 8 Instrument Response Functions (IRFs).

The increase of the integrated time, respect to the published analysis of the first 18 months, and the improved effective area for Pass 8 IRFs at low energies, let us to explore some of the open issues left from the first paper, in particular a characterization of the observed inverse compton component.

The γ -ray emission produced by solid solar system bodies is due to the interactions of Galactic cosmic ray nuclei (mainly protons) with their surface layers. The main processes involved are the production and decay of neutral pions and kaons by ions[1]. The solar emission has a further component due to the **inverse-Compton scattering** of solar photons in the heliosphere by **galactic cosmic ray electrons**: this component should be extended tens of degrees and a typical radial dependence as the inverse of the distance from the Sun[2,3,4].

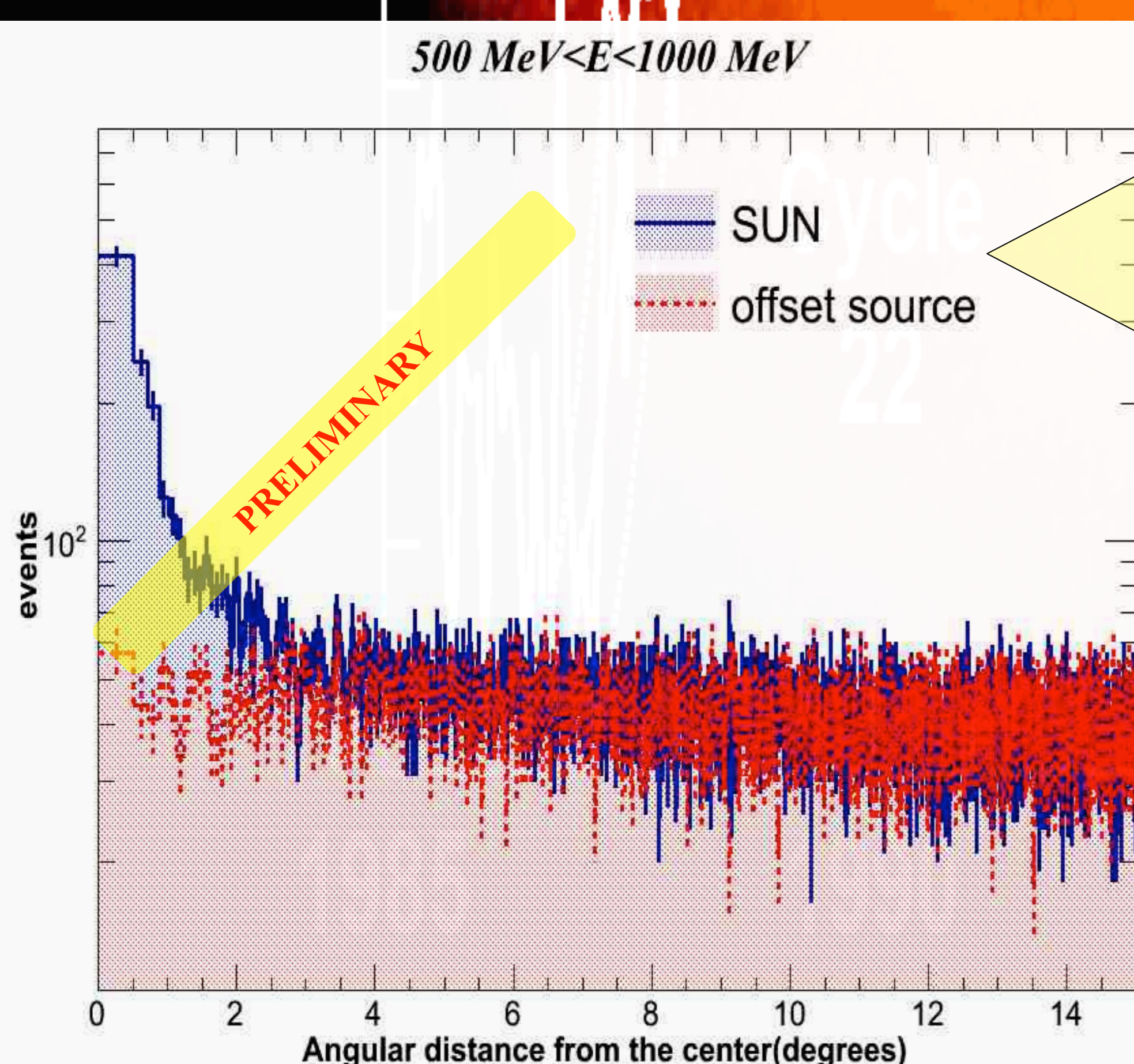
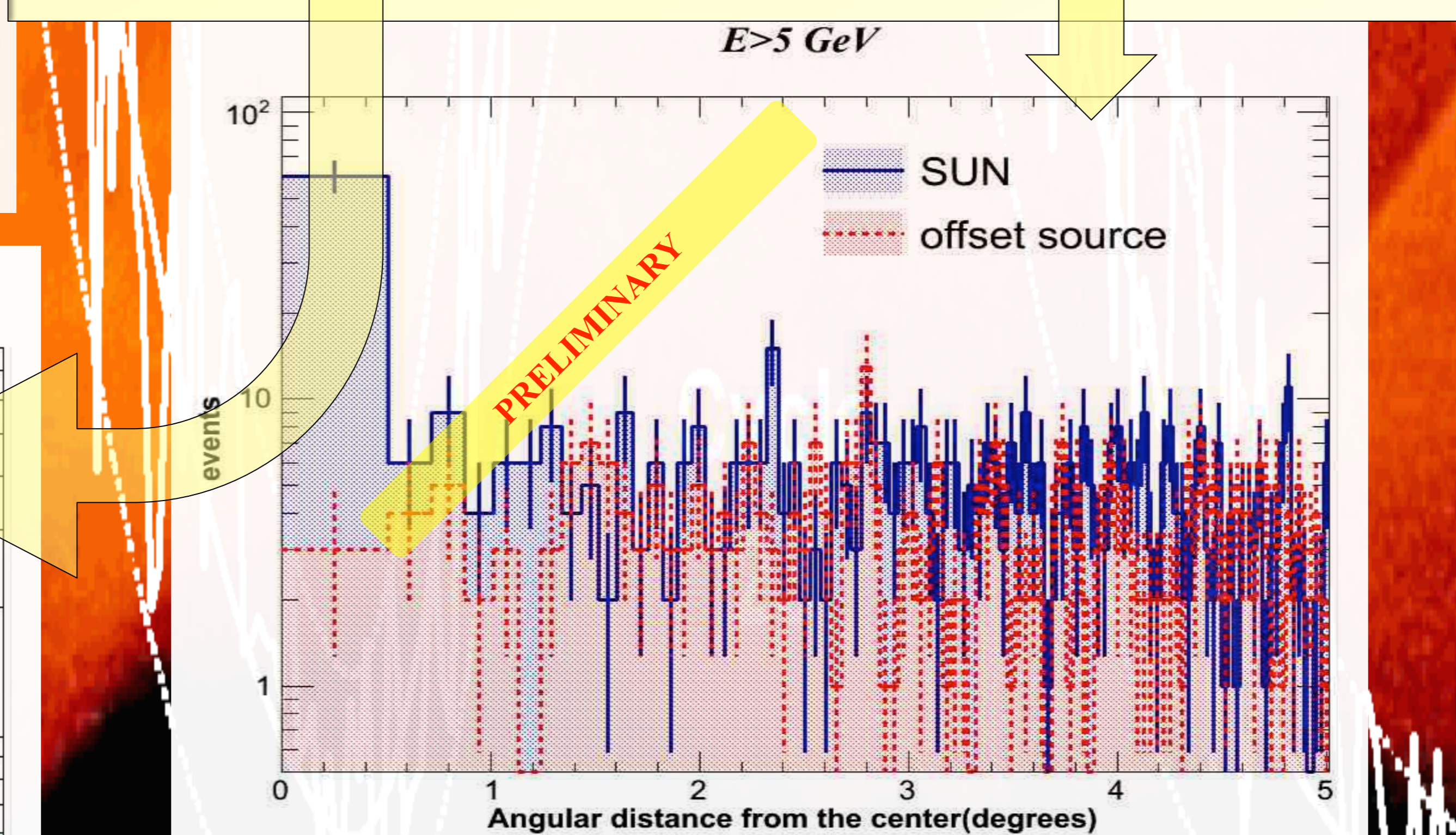
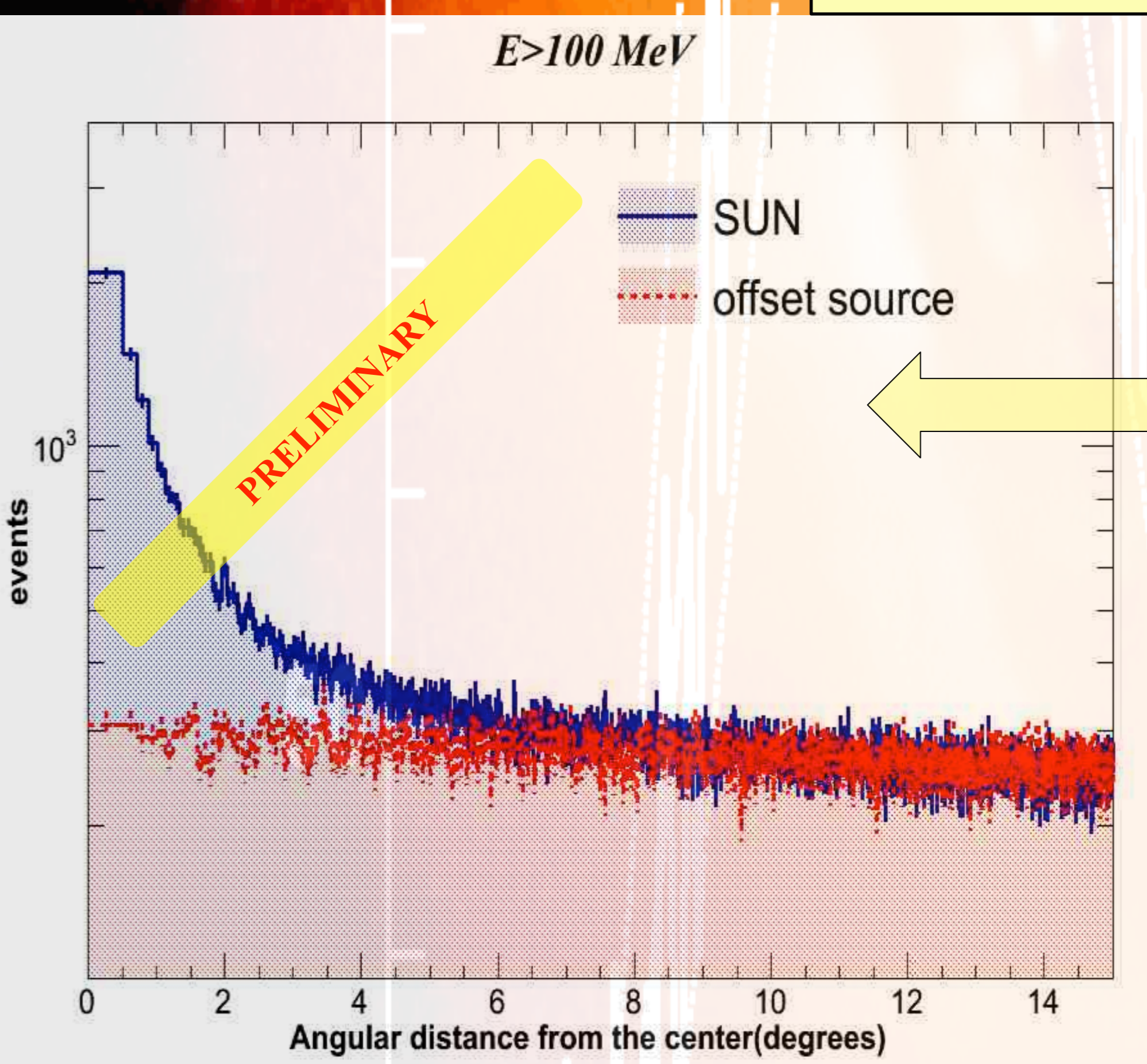
Typically the analysis used for the first analysis [5] was an **ON-OFF** source technique being the off source far away from the true solar position but along the ecliptic path, in order to evaluate the average background in the solar region.

After that the usual likelihood analysis is performed for the events in the SUN region. The systematic in this analysis is mainly due to the background evaluation. Results of the first analysis in the picture on **right side**.



Integral intensity profiles above 500 MeV for elongation angles $<5^\circ$ as reported in [5] (Pass-6 V3 SOURCE class analysis). **Red points** the observed counts, dash-dotted horizontal (black) line is the background, **dotted (magenta)** and **dashed (green)** lines are the **point-like** and **extended** components of the emission, correspondingly. The **solid (blue)** line is the sum of the background and the two components of the emission.

These pictures show the solar emission using **PASS8_SOURCE_V5** IRFs selections compared to the off source, the **whole emission for $E>100$ MeV**, intermediate energies and higher energies ($E>5$ GeV). The emission is still evident at $E>5$ GeV.



The analysis using **PASS 8** IRFs is in preparation and will evaluate the two emission components, comparing the observation with models like calculations, for example in [3,6,7,8]. Finally it will be added a focus on the effects of the **solar modulation** on the two components.

References

- [1] Seckel, D., Stanev, T., & Gaisser, T. K. 1991, *ApJ*, 382, 652
- [2] Orlando, E., & Strong, A. W. 2007, *Astrophysics and Space Science*, 309, 359 and arXiv:astro-ph/0607563
- [3] Moskalenko, I. V., & Strong, A. W. 1998, *ApJ*, 493, 694
- [4] Moskalenko, I. V., & Strong, A. W. 2000, *ApJ*, 528, 357
- [5] Moskalenko, I. V., Porter, T. A., & Digel, S. W. 2006, *ApJ*, 652, L65
- [6] Abdo, A. A., Ackermann, M., Ajello, M., et al. 2011, *ApJ*, 734, 116, 2
- [7] Johanesson, G., & Orlando, E., 2013, *Proc. 33rd ICRC*, paper ID 0957
- [8] Orlando, E., & Strong, A. W., 2013, *Proc. 33rd ICRC*, ID 0967 and <http://sourceforge.net/projects/stellarics>