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Wim de Boer (Karlsruhe Inst. of Technology): The FERMI excess investigated over the whole gamma-ray sky

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The so-called Fermi-excess in the diffuse Galactic gamma-ray sky is observed as a shift of the maximum in the Eˆ2 weighted gamma-ray spectrum from 0.7 GeV to around 2 GeV. Such a shift can be explained by the contribution of a new source with a spectrum peaking at 2 GeV. Three sources have been proposed: a dark matter (DM) annihilation signal, a signal from millisecond pulsars (MSPs), a signal from molecular clouds (MCs). All three have Eˆ2 weighted spectra peaking around 2 GeV, but the slightly different shapes yield different goodness of fits. In addition, DM is expected to show a smooth spatial distribution, while MSPs and MCs are expected to show spatial fluctuations („speckling") because of the discrete nature of the sources. Furthermore, the excess is maximal towards the Galactic center with a steeply falling intensity into the halo, which is true for all hypothesized sources.
We study the three hypothesis by investigating the spectral shapes, the spatial morphology and the speckling of the excess by fitting the spectral templates of all gamma-ray contributions in all sky directions. Such a spectral template fit based on data driven templates allows to simultaneously measure the excess and the background in all sky directions including the Galactic disk without the need for using propagation models with their large uncertainties. We find that the MC explanation best describes the data: it yields a chi2/dof close to unity over the entire sky (see 1707.08653) and moreover exhibits a strong correlation of the morphology and speckling with the all-sky CO maps from the Planck satellite, which traces MCs.

Presenter: DE BOER, Wim (KIT - Karlsruhe Institute of Technology (DE))

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