

Erratum: Refining Galactic primordial black hole evaporation constraints [Phys. Rev. D **110**, 123022 (2024)]

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We correct the results obtained using the diffuse x-ray emission from Xmm-Newton, in light of new results from Ref. [1], that demonstrated that the dataset employed was misevaluated. We also update our calculation of the 511 keV emission from evaporating PBHs, which leads to slightly more conservative constraints as well.

Reference [1], alongside with private communication with the authors of Ref. [2], suggest that recent bounds derived using Xmm-Newton data need to be revised. This arises from a misinterpretation regarding the solid angle of the observations with respect to the geometrical factor of a given ROI (which are 30 concentric rings centered on the Galactic Center), this has also affected other recent dark matter (DM) indirect searches. In Ref. [2], they provide data that are normalized by the exposure-weighted average solid angle, which is orders of magnitude smaller than the geometric one. Taking for example Ring 3 (12° - 18°), which was relevant to our work, the exposure-weighted average solid angle is 3.463×10^{-5} sr, while the geometric angle is 0.156 sr, which is more than 4 orders of magnitude higher.

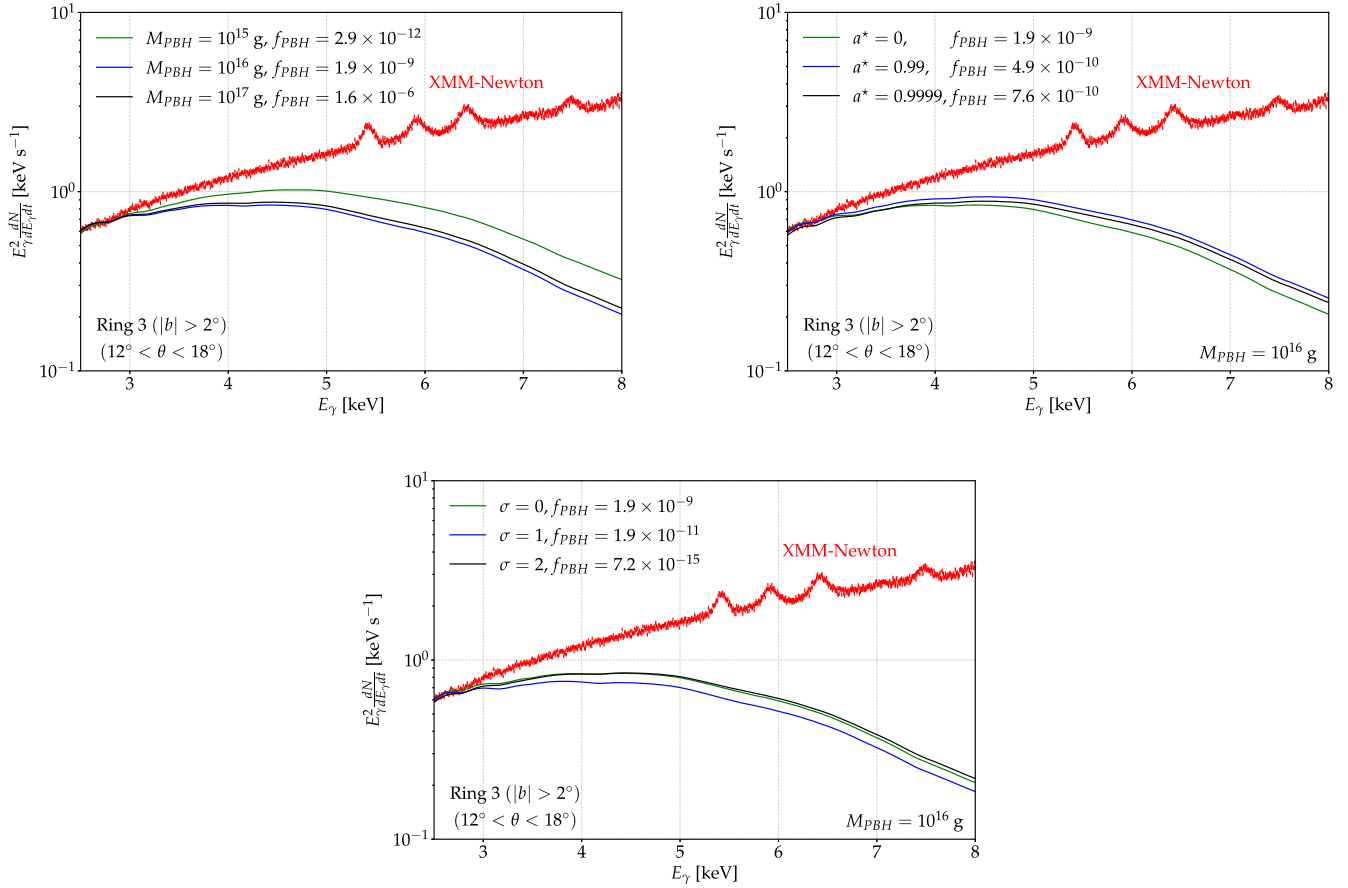


FIG. 1. Comparison of the predicted DM-induced x-ray emission with diffuse x-ray data from Xmm-Newton in a region close to the Galactic Center. We show the prediction is shown for different values of M_{PBH} when the PBH mass distribution is monochromatic (upper left panel), of a^* (upper right panel) and σ when the distribution is log-normal (lower panel).

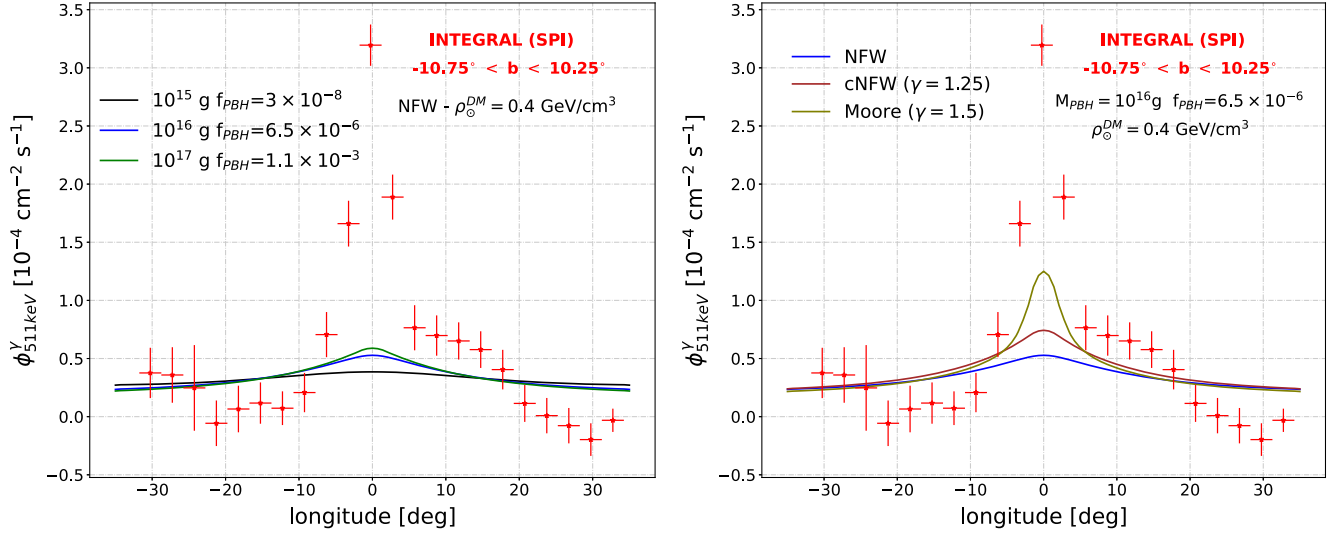


FIG. 2. Comparison of the predicted 511 keV line longitudinal profile with SPI data. The left panel shows a comparison of the signal for different PBH masses following an NFW profile, while the right panel shows a comparison of the signals for a fixed mass of 10^{16} g following different popular DM density distributions.

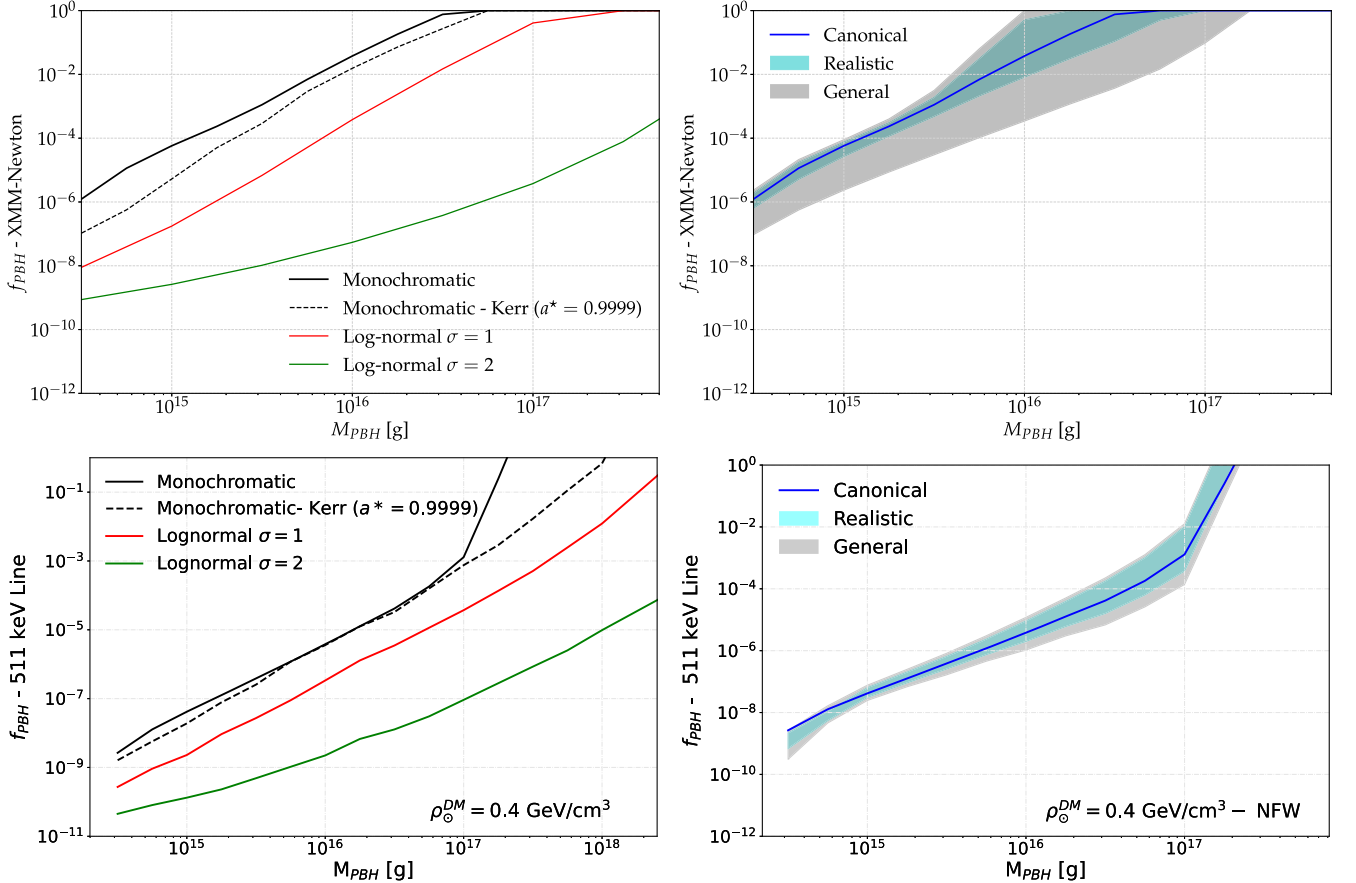


FIG. 3. Top left panel: limits we derive using Xmm-Newton for mass distributions with $\sigma = 0$ (monochromatic, solid black line), 1 (red line) and 2 (green line), as well as for the extreme assumption where all PBHs have a spin of $a^* = 0.9999$ (dashed line). Top right panel: uncertainties in the limits we derive using Xmm-Newton. The solid blue lines correspond to the limits using our fiducial propagation model. The blue bands show how our limits are impacted when varying the Alfvén speed V_A and the halo height H within their 3σ uncertainty. The gray bands correspond to a more conservative scenario where we vary V_A between 0 and 40 km/s and H between 3 and 16 kpc. Bottom panels are similar to the top panels but for the calculation of the 511 keV line emission.

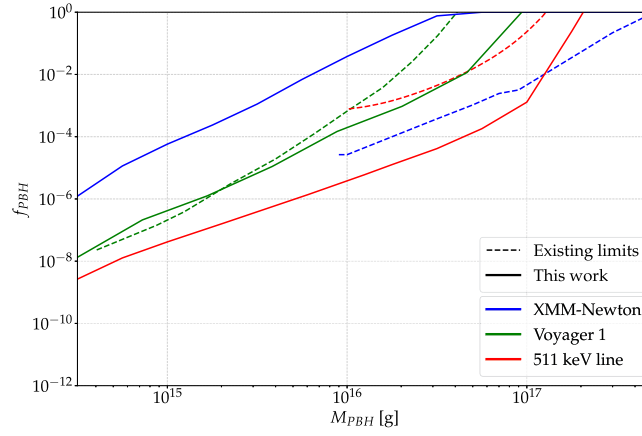


FIG. 4. Comparison of the 95% confidence limits on f_{PBH} derived in this work with other existing ones. The color of the lines represent the different probes used to set the constraints: green for the $e^\pm$ measurements from Voyager 1, blue for x-ray diffuse observations from Xmm-Newton, red for the 511 keV excess reported by Integral. The two different line styles correspond to either the bounds derived either in this work (solid) or in the literature [5–8] (dashed) reported in PBHbounds [9].

In our work, the prediction of the x-ray flux from PBH evaporation collected by Xmm-Newton in the Ring 3 took into account the geometric angle. It was therefore dramatically overestimated (See Fig. 1).

Moreover, we take the opportunity to update our estimations for the 511 keV line emission. In Ref. [3] we noticed that our calculation of the 511 keV flux over-counted the number of positrons contributing to positronium formation. This is due to the fact that we integrated the positron flux over all energies, thereby considering high-energy positrons that typically escape or annihilate in-flight before thermalizing, and therefore will not produce 511 keV photons in the region studied. We have updated our calculation to account only for the thermalized positrons, following Refs. [3,4]. This correction weakens the PBH fraction limits at low PBH masses, while the effect is not appreciable at high PBH masses, around $\sim 10^{17}$ g. The spatial morphology of the signals remains roughly unchanged, since they mostly inherit the source DM density profile adopted (See Fig. 2).

In light of these new revisions, we provide the corrected figures (Figs. 1–4) that refer to the results derived using the corrected Xmm-Newton data and the updated estimation of the 511 keV signal associated with PBH evaporation.

The conclusions of our papers remain unchanged, although the Xmm-Newton constraints on f_{PBH} weakened substantially. The 511 keV constraint was corrected and remains one of the leading existing constraints, while the Voyager-1 constraint required no revision.

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