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AGN feedback in the nucleus of M 51 *(Corrigendum)*

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The molecular gas outflow rates estimated in Sect. 3.3.1 of this paper contain a numerical error, and applying Eq. (1) to the reported measurements ($M_{H_2} = 4.1 \times 10^6\,M_\odot$, $M_{dense} = 2.7 \times 10^6\,M_\odot$; $R_{out} \sim 37$ pc; $V_{out} \sim 100\,km\,s^{-1}$) leads to an estimate of $32\tan(\alpha)\,M_\odot$/yr for the bulk molecular gas traced by CO(1–0), and $20\tan(\alpha)\,M_\odot$/yr for the dense molecular gas traced by HCN(1–0). This is based on an idealised (multi)conical model, whose applicability to the outflow in M 51 was already questioned in the paper.

The final outflow rate estimates depend strongly on the angle α, which is largely unconstrained. Under the assumption that the outflowing gas has the same inclination with respect to the disc as the one inferred for the radio plasma jet ($\alpha = 70°$), this would result in a molecular outflow rate of $\sim 90\,M_\odot$/yr ($\sim 55\,M_\odot$/yr in the dense phase traced by the HCN(1–0) line); more moderate inclinations with respect to the line of sight lead to numerical values of a few times $10\,M_\odot$/yr. The originally quoted value of $\sim 1\,M_\odot$/yr can only be recovered if the outflowing gas propagates very close to the line of sight.

Therefore, most probably, this instantaneous molecular outflow rate is larger than the secular inflow rate of $\sim 1\,M_\odot$/yr, whereas in the paper both rates were found to be roughly equal. We speculate that this is the result of the different timescales over which the inflow and outflow processes operate, suggesting that the molecular outflow is episodic, whereas the transport of gas from kpc-scales to the nucleus proceeds at a more steady rate.

The corrected outflow rate estimates also affect the kinetic luminosity and momentum flux calculated in Sect. 4.5, resulting in updated values of $L_{kin} = 2.3 \times 10^{42}$ erg/s (1.5×10^{42} erg/s for the dense phase traced by HCN), and $dP/dt = 1.6 \times 10^{35}$ g cm s^{-2} (1.0×10^{35} g cm s^{-2} for HCN). The values of the kinetic energy (E_{kin}) and momentum (P) are not affected by the error in the calculation (but we emphasise that they rely on the assumption of $\alpha = 70°$, whereas the values quoted by Matsushita et al. (2007), are lower limits corresponding to an outflow expanding along the line of sight). These updated values do not change any of the qualitative conclusions in terms of energetics, except for the fact that M 51 would no longer be a lower outlier in the outflow rates-bolometric luminosity compilation from García-Burillo et al. (2015).

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References

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