

Corrigendum

Production of interstellar hydrogen peroxide (H₂O₂) on the surface of dust grains

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A&A 538, A91 (2012), DOI: 10.1051/0004-6361:201118013

Key words. astrochemistry – ISM: abundances – ISM: clouds – ISM: molecules – stars: formation – errata, addenda

In Sect. 2 of [Du et al. \(2012\)](#) we misrepresented the results of [Cuppen et al. \(2010\)](#) by claiming that the grain surface reaction $\text{H} + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{OH}$ is barrierless. It does have a barrier, since its rate was found by [Cuppen et al.](#) to be 20 times slower than $\text{H} + \text{O}_2\text{H} \rightarrow \text{H}_2\text{O}_2$, with the latter being probably barrierless. We thank Herma Cuppen for pointing this out to us, and apologize to [Cuppen et al.](#) and the readers for this misrepresentation.

Considering the reaction $\text{H} + \text{O}_2\text{H}$ has another product channel, $\text{H} + \text{O}_2\text{H} \rightarrow 2\text{OH}$, with a branching ratio 1.6 times that of $\text{H} + \text{O}_2\text{H} \rightarrow \text{H}_2\text{O}_2$, the reaction probability of $\text{H} + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{OH}$ is then ~ 0.02 , assuming $\text{H} + \text{O}_2\text{H}$ is barrierless.

In our previous work we assumed quantum tunneling for reactions with a barrier. We calculated the reaction probability p using the formula from [Hasegawa et al. \(1992\)](#):

$$p = \exp\left[-\frac{2a}{\hbar}(2\mu E_a)^{1/2}\right], \quad (1)$$

where a is the barrier width, μ is the tunneling mass, and E_a is the barrier height. We assumed a barrier width of 1 Å for all reactions.

Using the reaction probability of 0.02 and taking μ as the proton mass, the above formula gives a low barrier height of ~ 92 K for the reaction $\text{H} + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{OH}$. Hence the energy barrier of the eighth reaction in Table B.1 of [Du et al. \(2012\)](#) should be modified to 92 K. However, since its barrier width is not well-known, this value is not necessarily the real height of the barrier, which cannot be obtained without further knowledge of the reaction. For our purpose, what really matters is the product $a(E_a)^{1/2}$.

We reran our model with a barrier width of 1 Å and a barrier height of 92 K, and found that the gas phase abundance of H₂O₂

is not affected noticeably. This is because it is formed from the surface reaction $\text{H} + \text{O}_2\text{H} \rightarrow \text{H}_2\text{O}_2$, followed by desorption due to the heat released in this reaction. Accordingly, a change in the rate of a reaction consuming surface H₂O₂ does not affect the abundance of gas phase H₂O₂. Other gas phase species are not affected either.

The abundance of surface H₂O₂ (denoted “gH₂O₂” in the figures) is affected, which becomes about one order of magnitude higher than before. A few other species are also slightly affected. A corrected version for the right-hand panel of Fig. 1 in [Du et al. \(2012\)](#) is shown in Fig. 1. Other figures containing surface H₂O₂ also need correction, including Figs. 2, and A.1 in Appendix A. Figure A.2 is also affected by a slight leftward shift ($\sim 3 \times 10^3$ yr) in time, owing to the slightly higher surface abundance of H caused by a lower consumption rate of it by suppressing the $\text{H} + \text{H}_2\text{O}_2$ reaction rate. The corrected versions are shown in Figs. 2–4.

The leading sentence in the last but one paragraph on page 4 of [Du et al. \(2012\)](#) is inaccurate. It should be changed into “as a precursor of H₂O₂, O₂H mainly forms from the reaction between O and OH (which does not have a barrier according to [Hasegawa et al. 1992](#)) on the grain at an early stage ($< 5 \times 10^4$ yr), and through reaction $\text{H} + \text{O}_2$ at a later stage”.

None of the main conclusions of our paper are affected.

References

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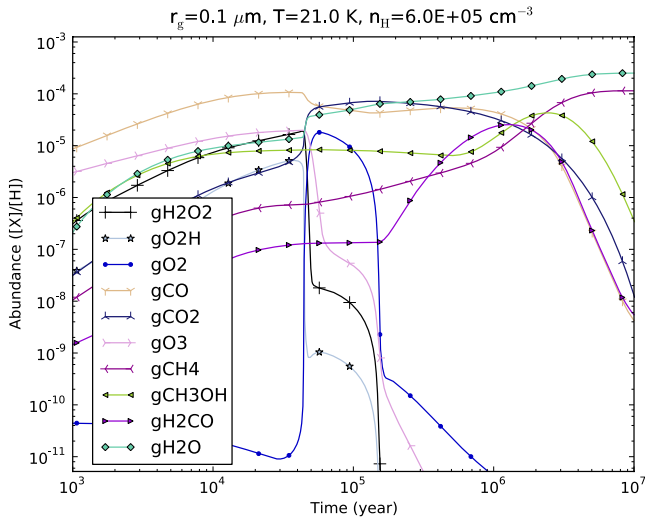


Fig. 1. Corrected version of the right-hand panel of Fig. 1 in Du et al. (2012) for the abundances of a selection of surface species relative to H nuclei as a function of time.

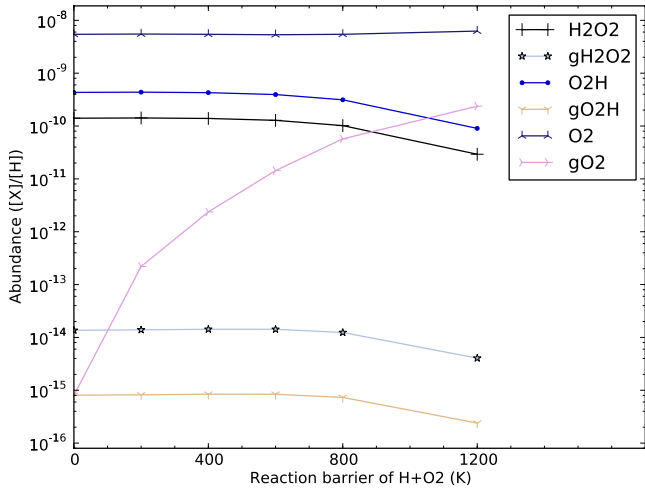


Fig. 2. Corrected version of Fig. 2 in Du et al. (2012). The abundances of gas phase and surface H_2O_2 , O_2H , and O_2 (at $t = 6 \times 10^5$ yr) as a function of the reaction barrier of the reaction $\text{H} + \text{O}_2 \rightarrow \text{O}_2\text{H}$. A prefix “g” means a surface species.

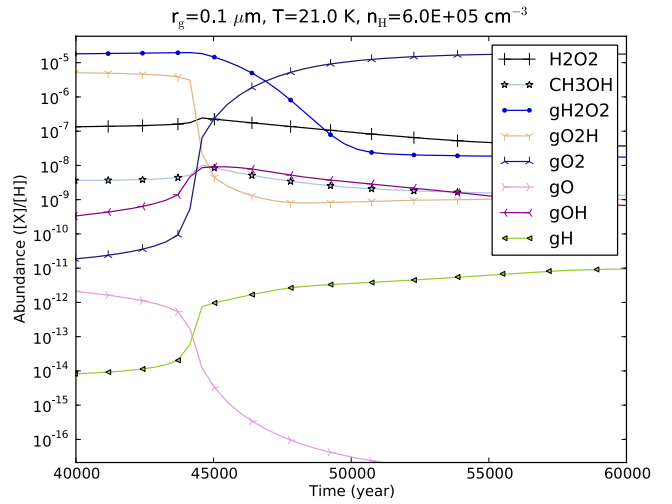


Fig. 3. Corrected version of Fig. A.1 in Du et al. (2012). This is just a zoom-in plot for Fig. 1 (with several species removed and several added) to show the details of the spike-like or jump-like features in the evolution curves.

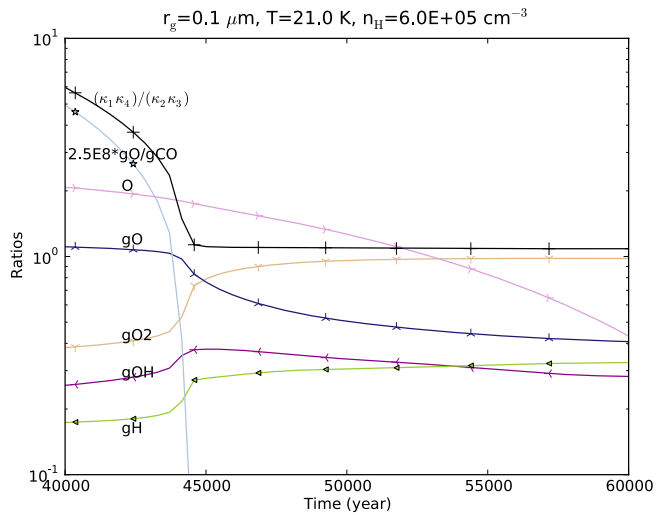


Fig. 4. Corrected version of Fig. A.2 in Du et al. (2012). The ratios $(\kappa_1 \kappa_4)/(\kappa_2 \kappa_3)$ and 2.5×10^8 gO/gCO are used in the text to explain the appearance of the spike-like feature in the evolution curves, where 2.5×10^8 is the ratio between two related reaction rates. The abundances of a few other species are plotted for reference (*not* to scale).