Dust temperature fluctuations and surface chemistry: H_2 formation

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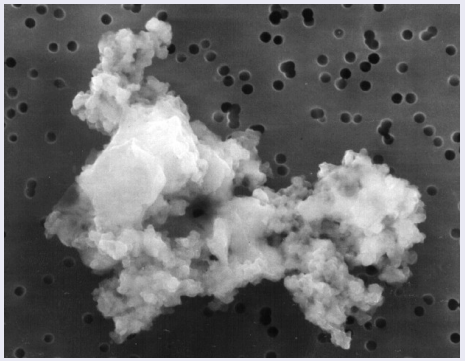

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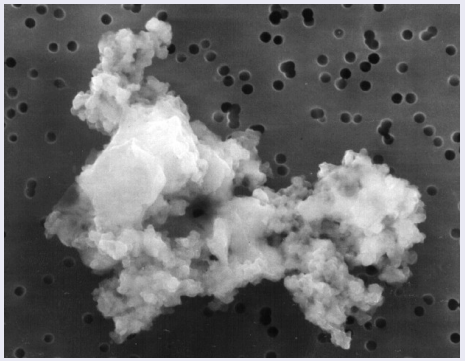

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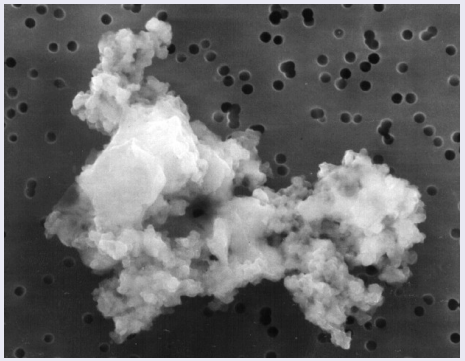

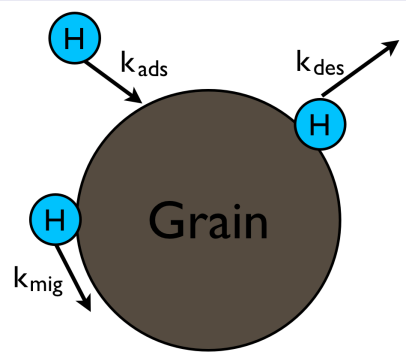

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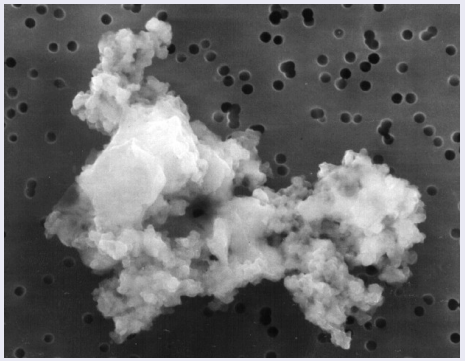

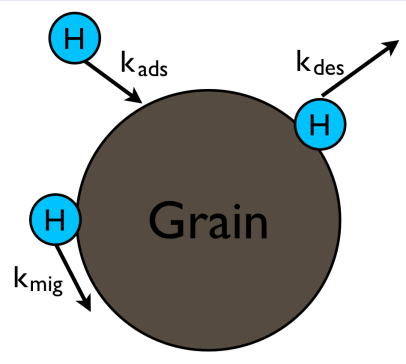

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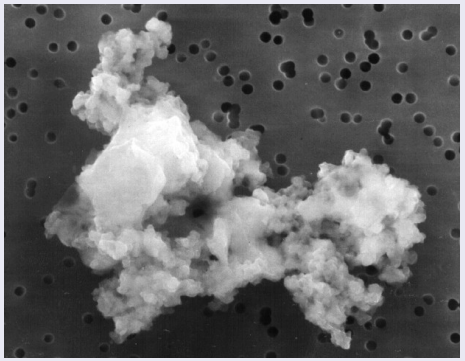

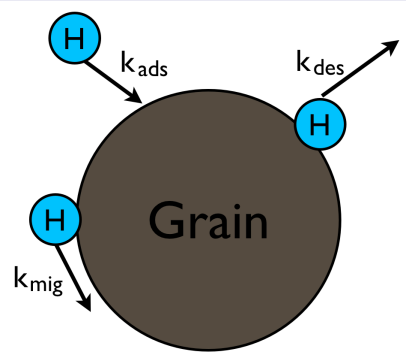

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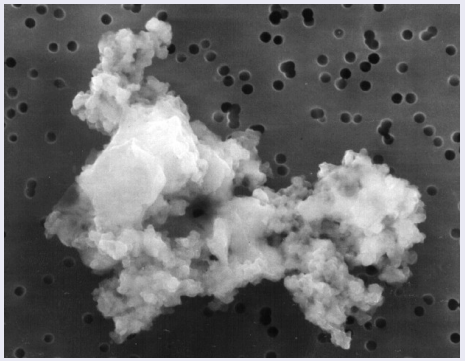

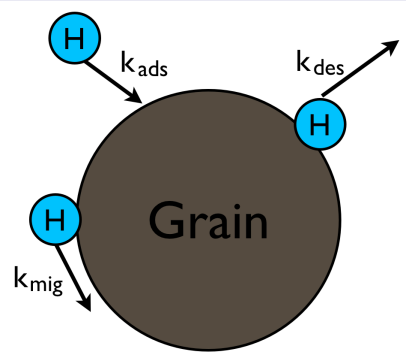

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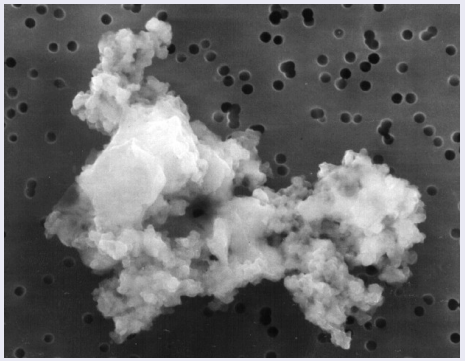

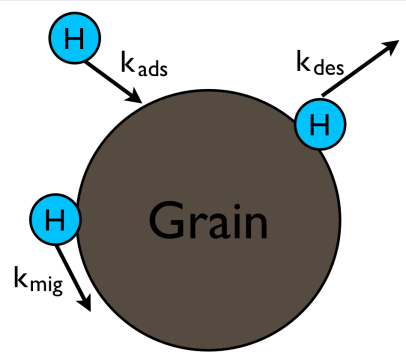

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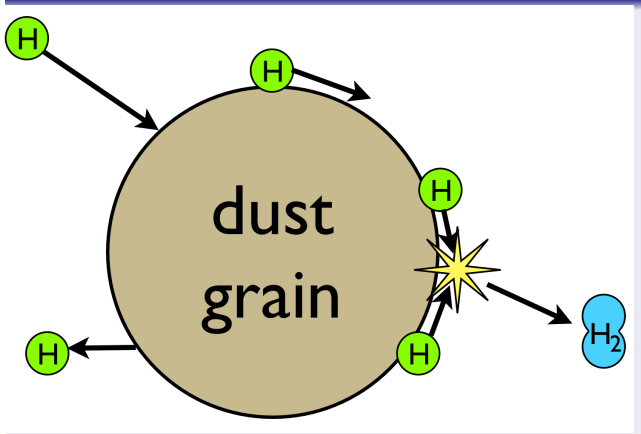
- Fluctuations of the dust temperature
  $\rightarrow$ out-of-equilibrium chemistry !

Formation mechanisms

Langmuir-Hinshelwood mechanism:



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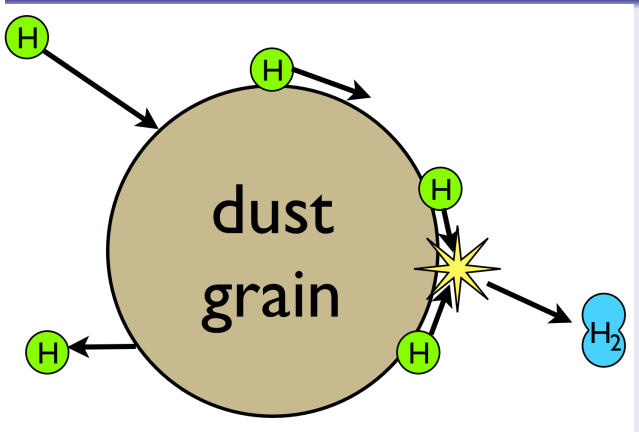

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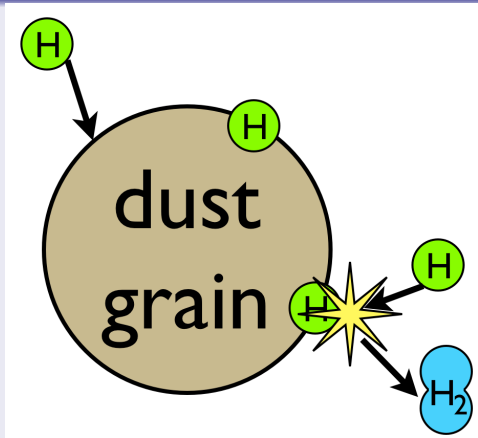
Eley-Rideal mechanism:



- strong bond ($\sim$ 10000 K)
- no migration
- chemisorption barrier (300 K)
- can explain formation in PDRs (Le Bourlot 2012)

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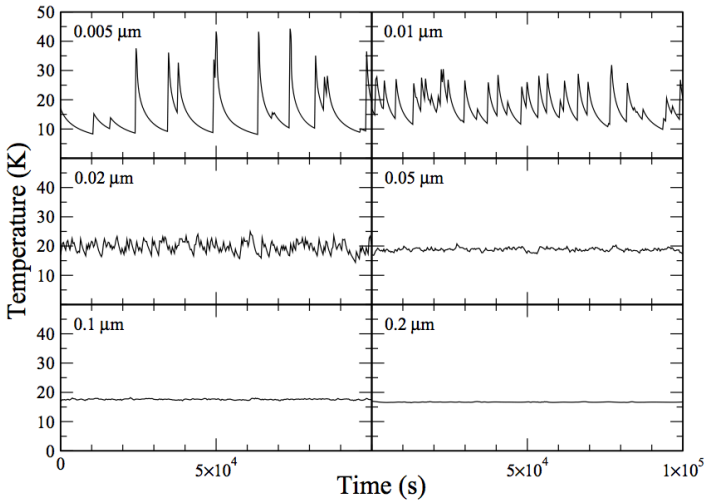

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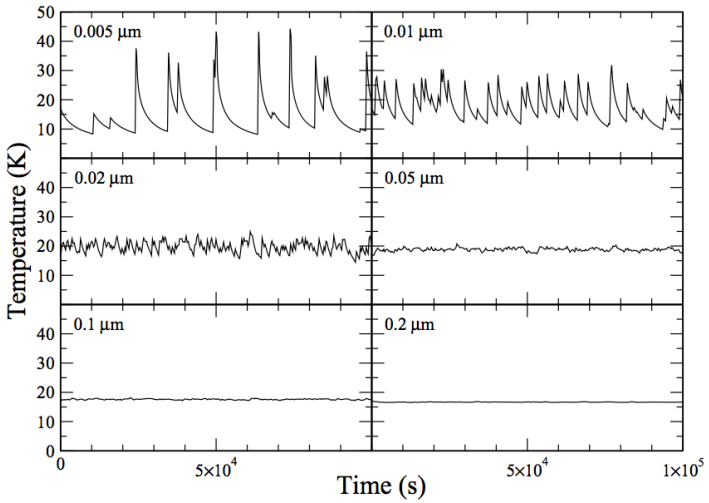

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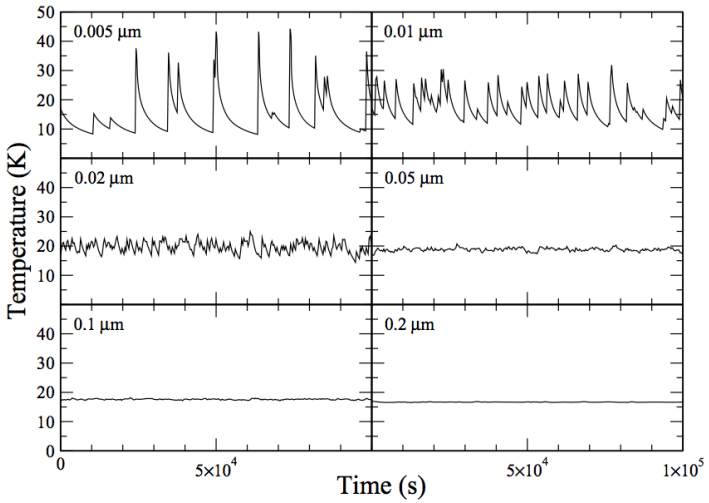

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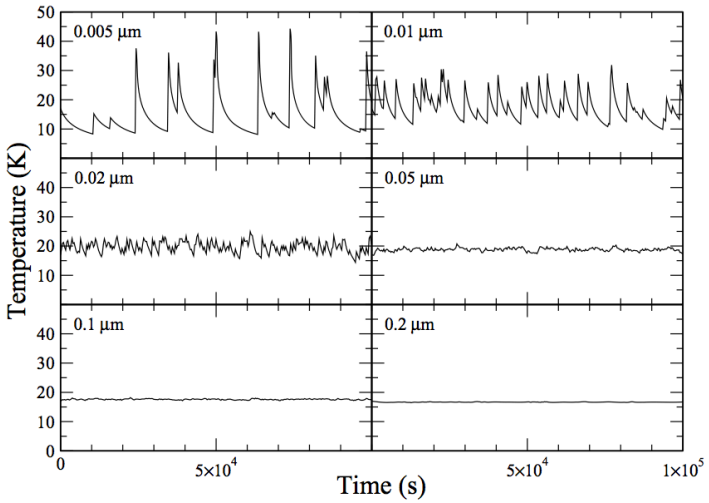
- How does it affect H_2 formation?



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- interested in $\langle r_{\mathrm{H}_2} \rangle = \int dE\, dn\, f(E,n)\, r_{\mathrm{H}_2}(E,n)$

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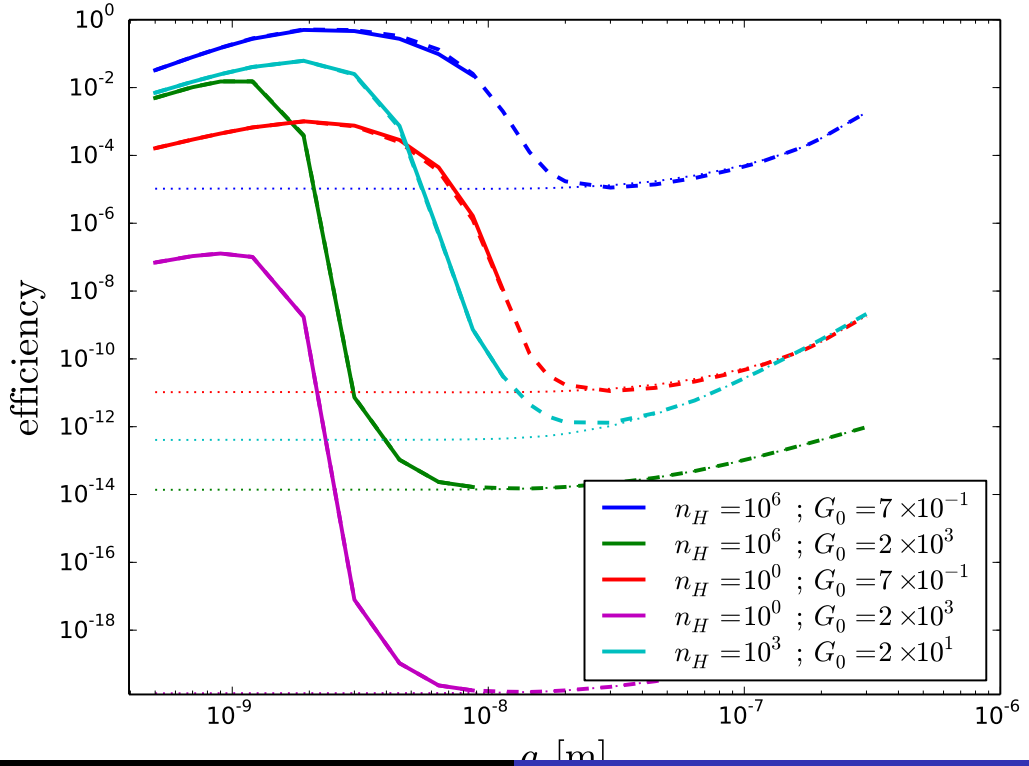
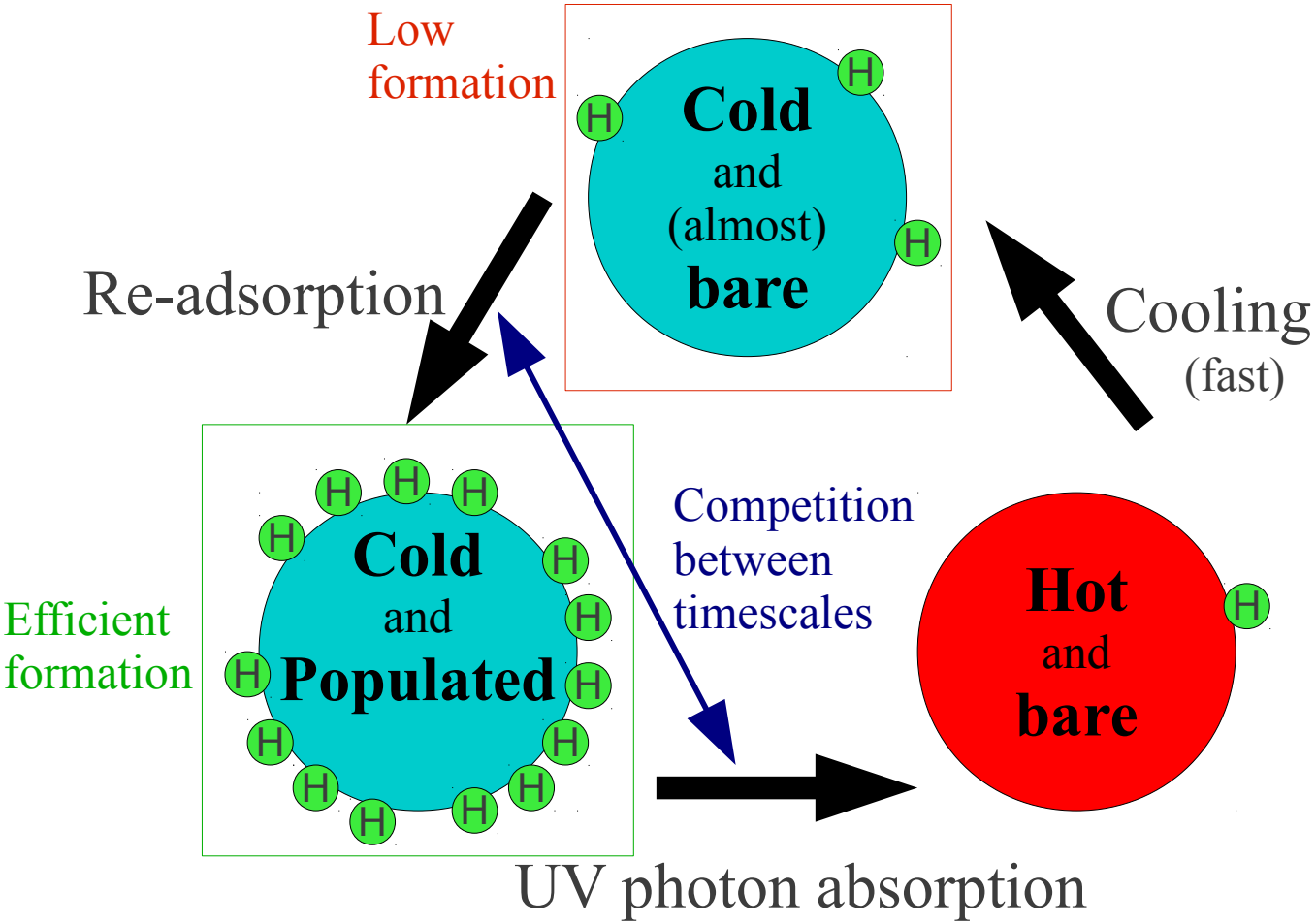


Distribution effects vs. out-of-equilibrium effects



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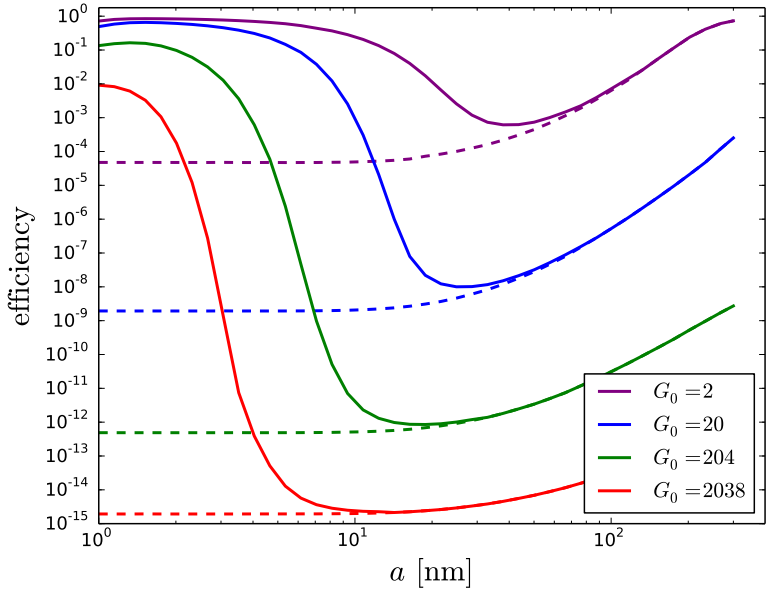

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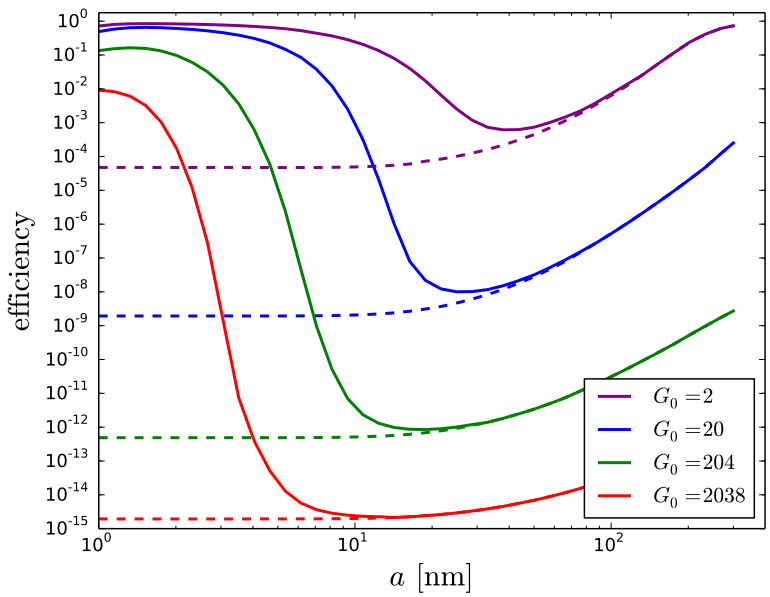

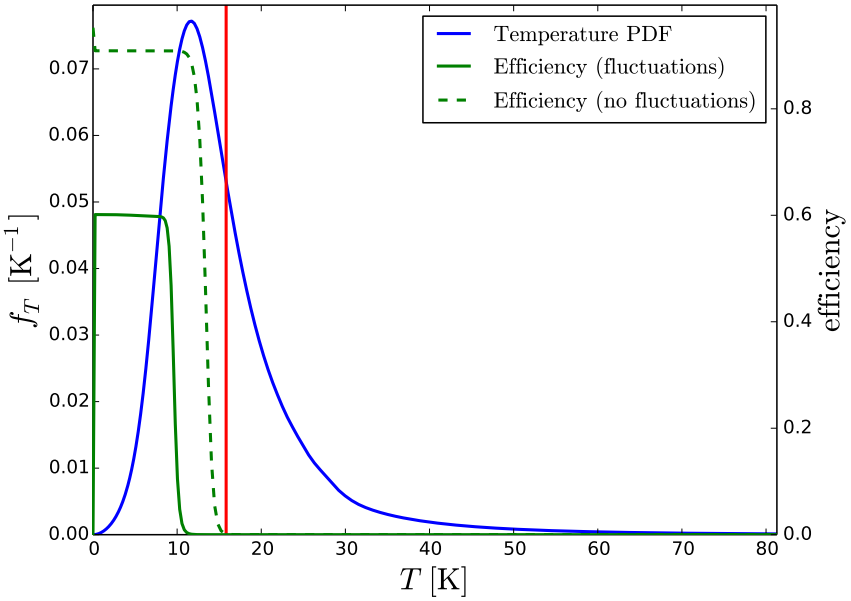

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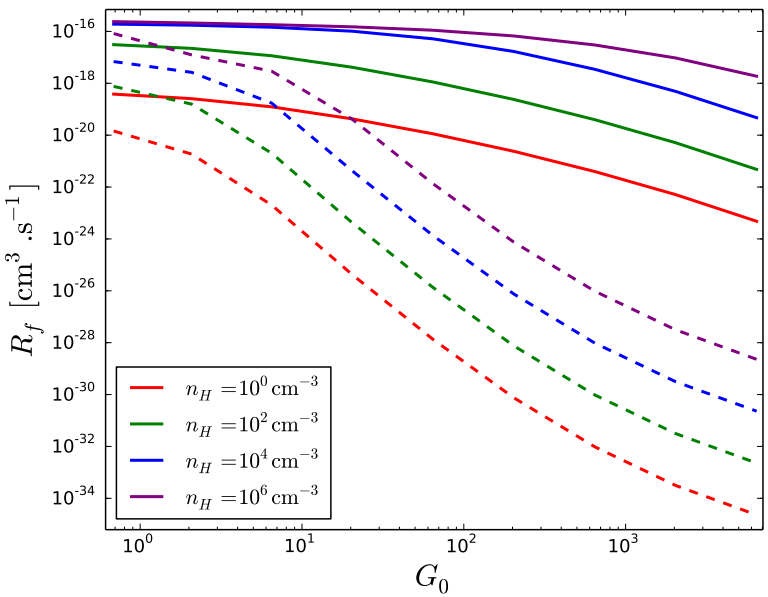

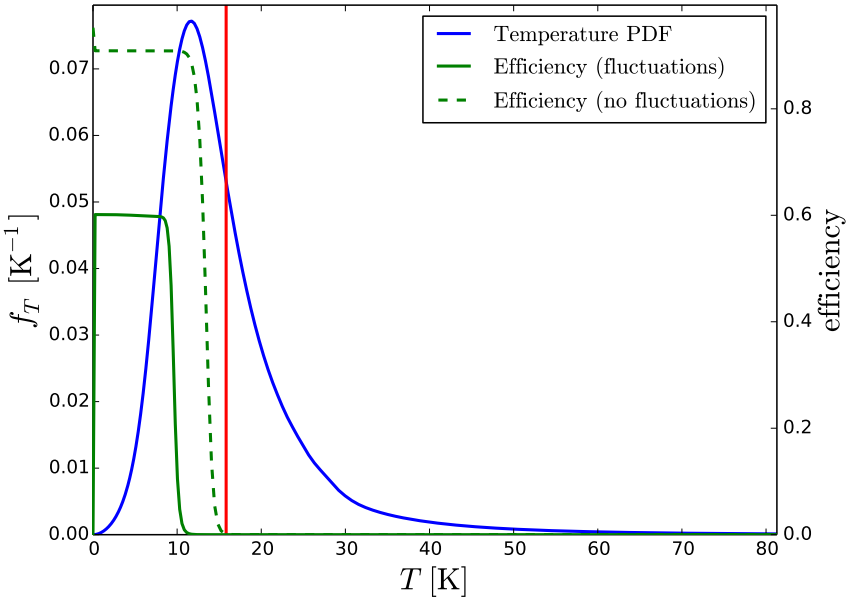

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- Langmuir-Hinshelwood efficient in cloud-edge conditions

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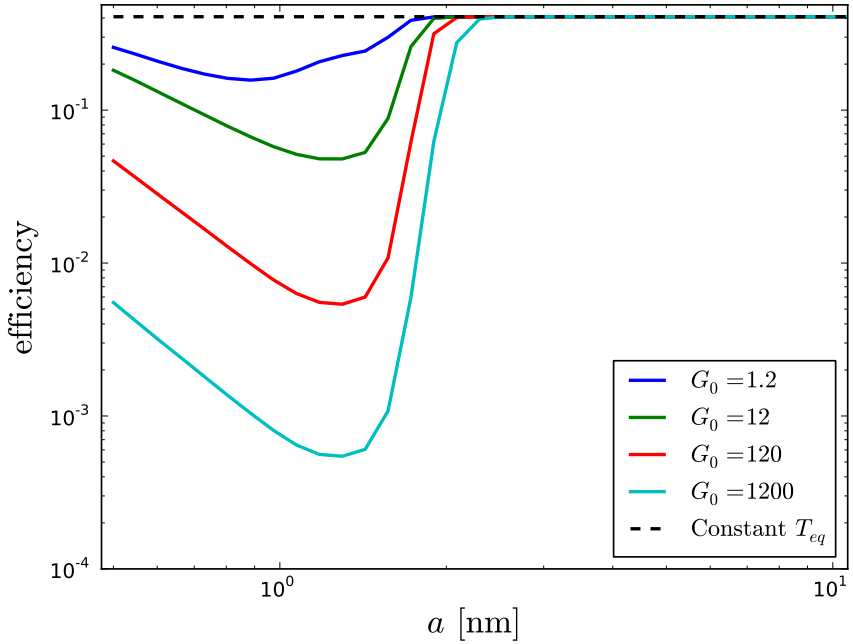

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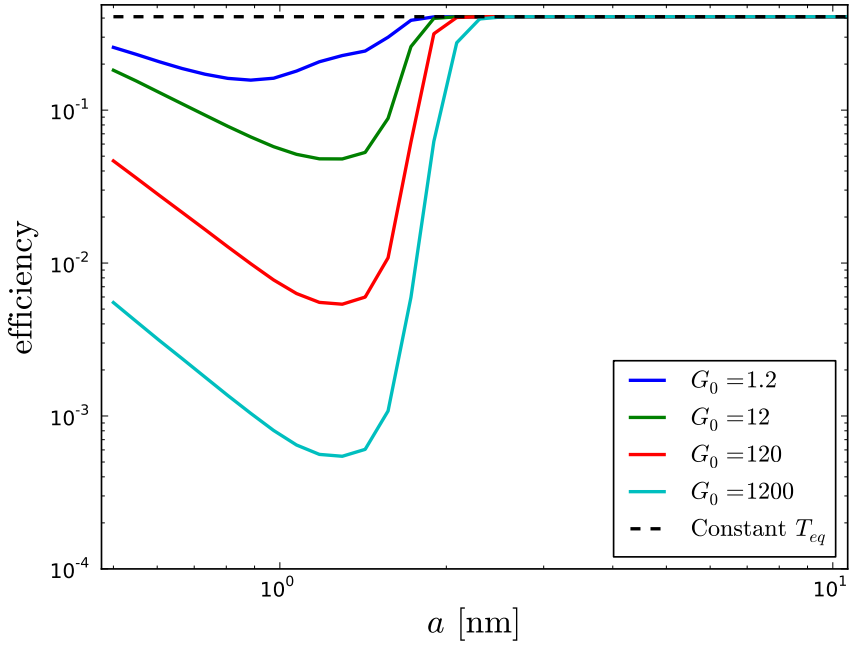
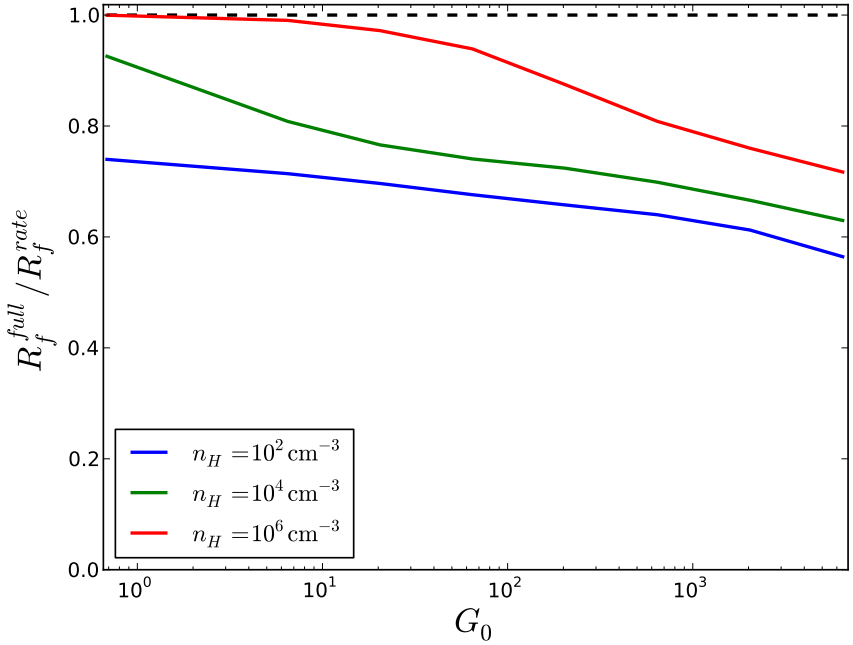
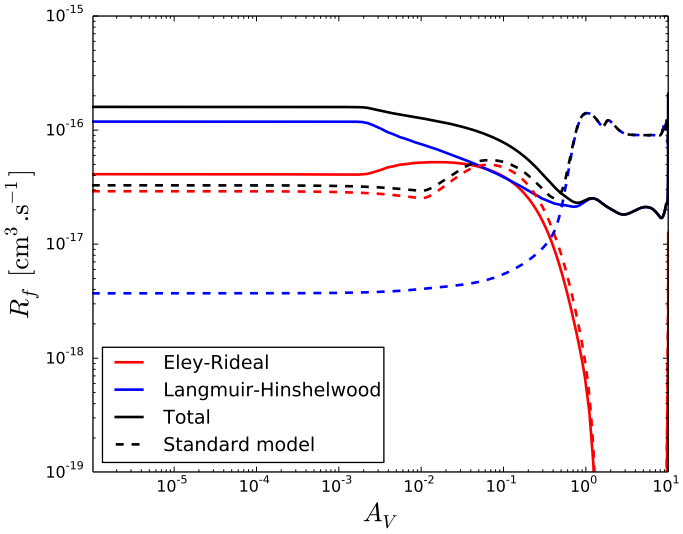




- Only very small grains affected (below $2\,\mathrm{nm}$)
- Limited effect on the total formation rate

Interstellar cloud simulations



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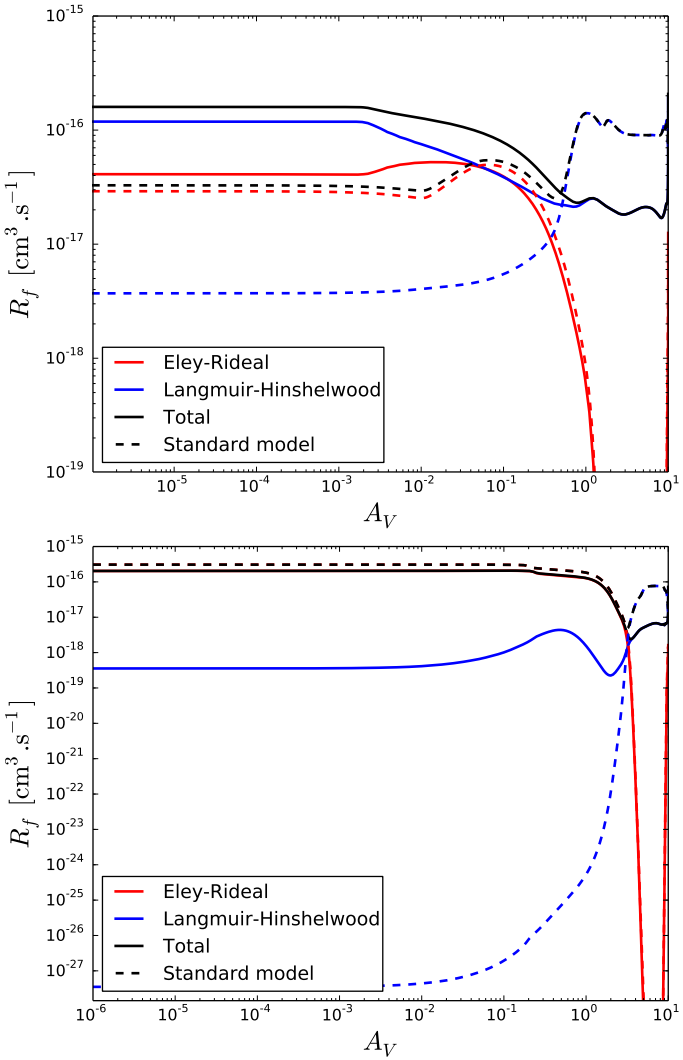

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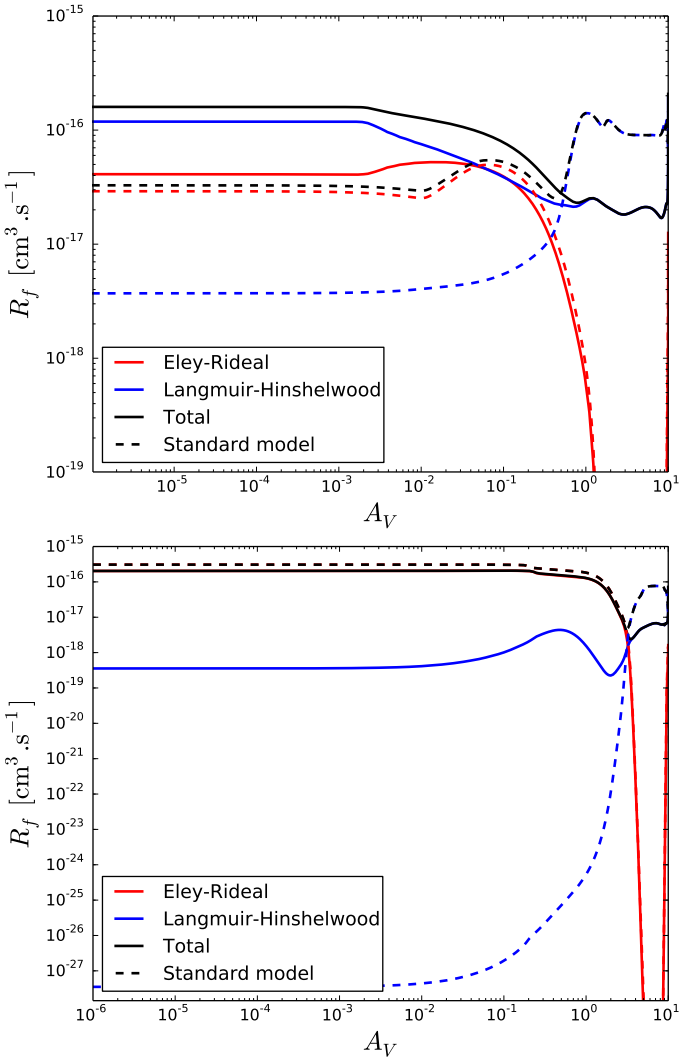

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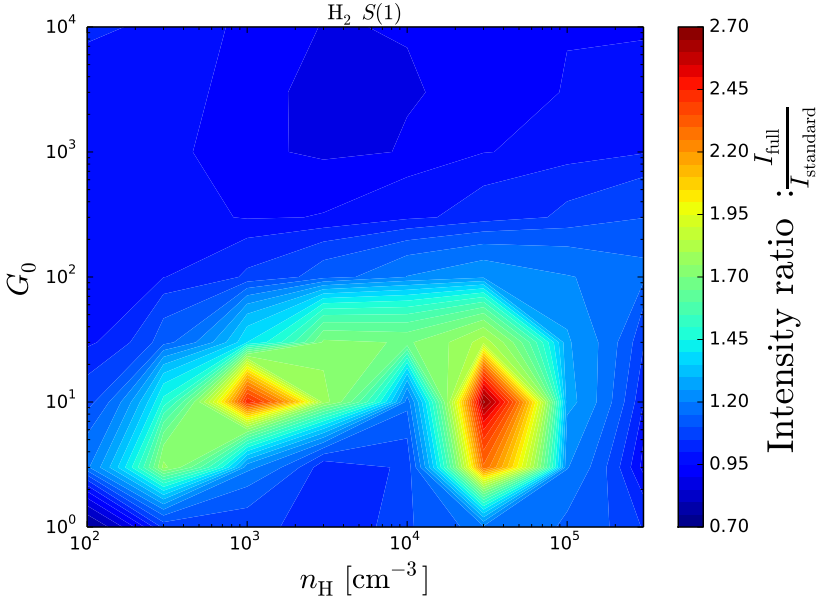

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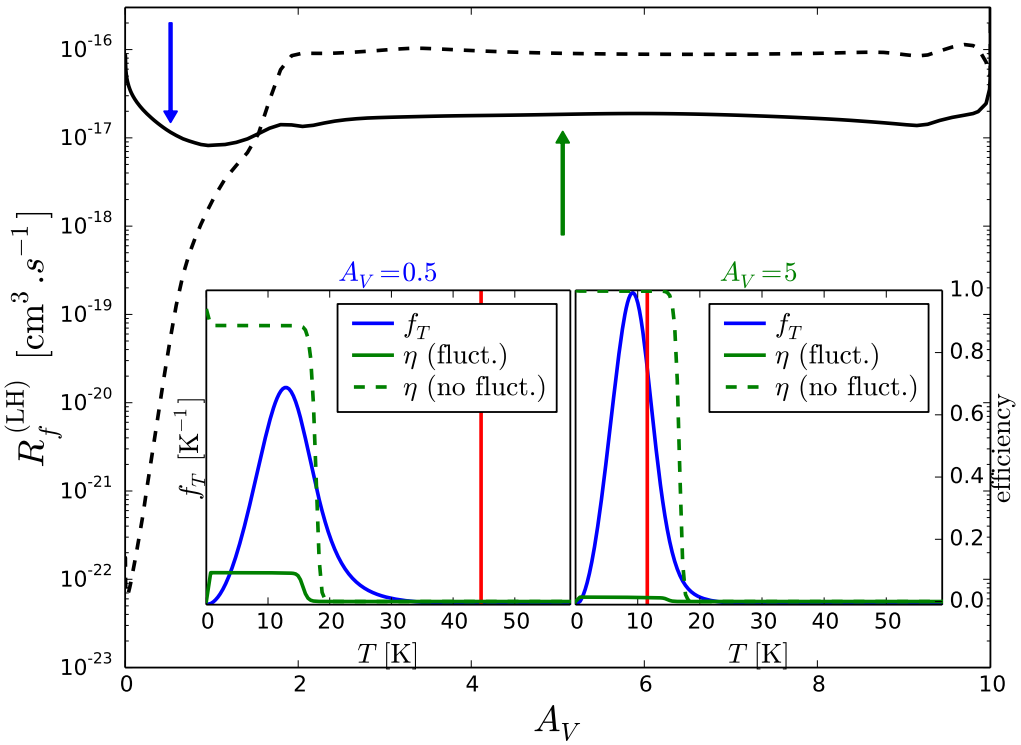

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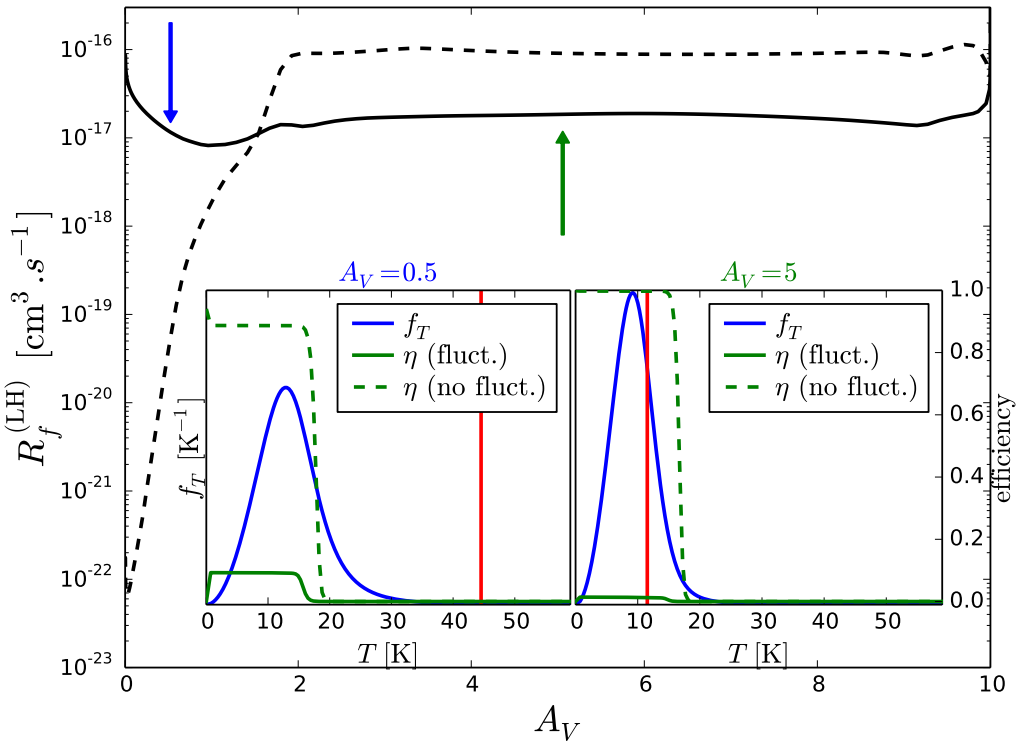

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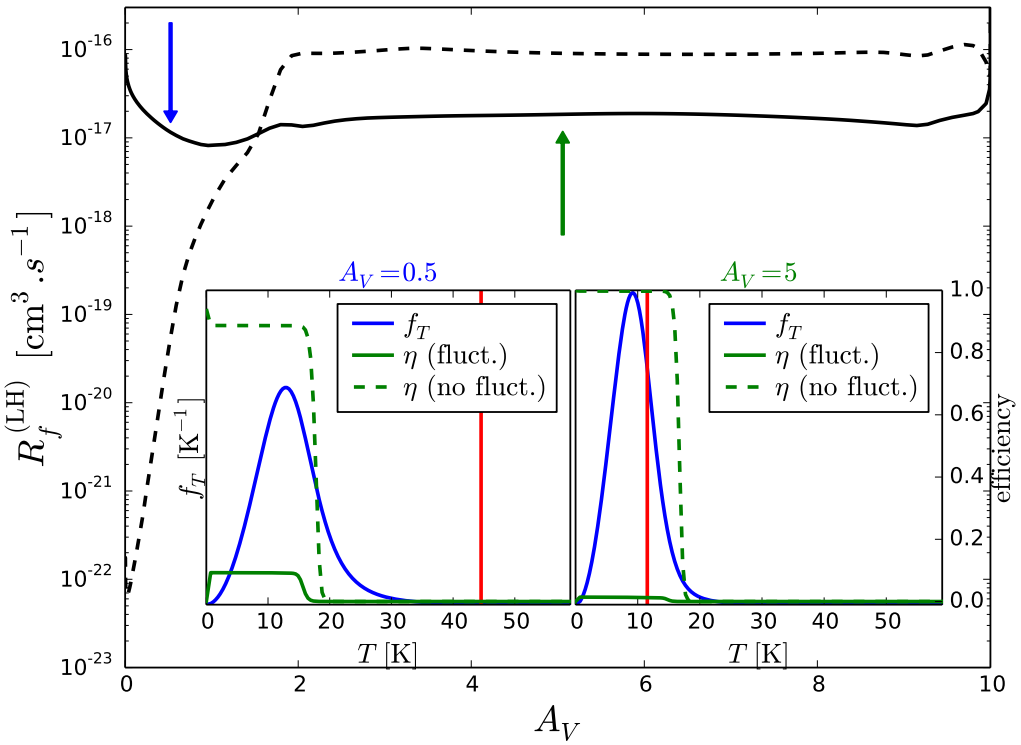

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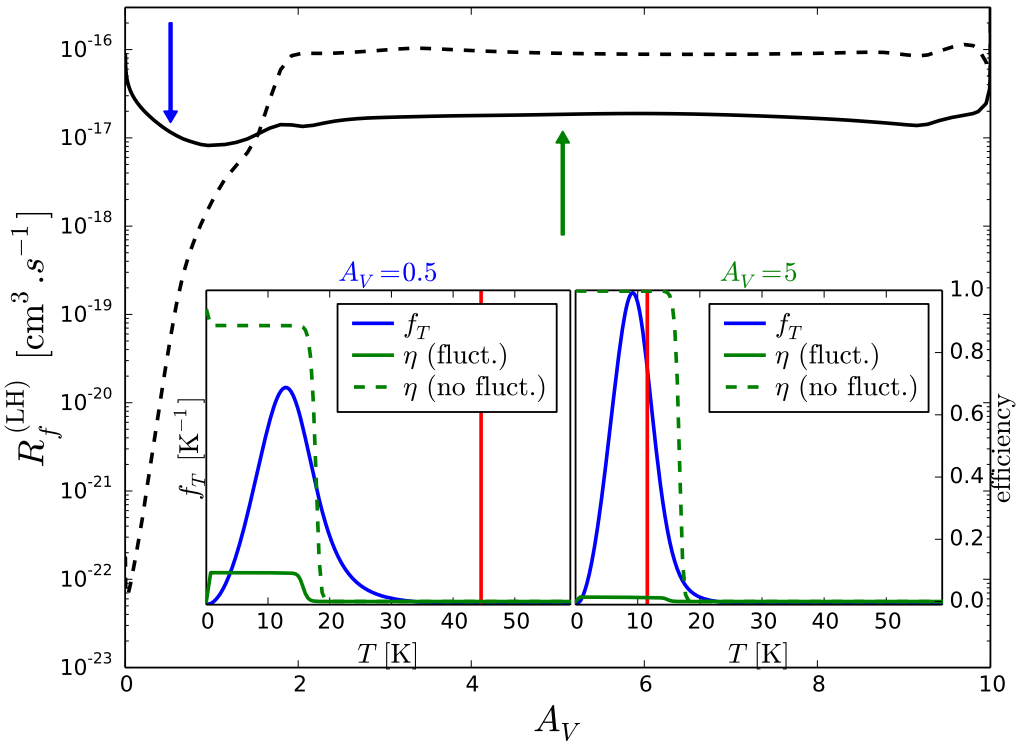

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Possible applications : maximal molecular fraction in the diffuse ISM, residual atomic fraction in dark cores

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- Other surface reactions: effects of secondary UV photons ? cosmic rays ?