



Universiteit
Leiden
The Netherlands

Non-equilibrium chemistry and cooling in simulations of galaxy formation

Richings, A.J.

Citation

Richings, A. J. (2015, December 8). *Non-equilibrium chemistry and cooling in simulations of galaxy formation. PhD Thesis*. Retrieved from <https://hdl.handle.net/1887/36959>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/36959>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/36959> holds various files of this Leiden University dissertation.

Author: Richings, Alexander James

Title: Non-equilibrium chemistry and cooling in simulations of galaxy formation

Issue Date: 2015-12-08

Propositions

accompanying the thesis

NON-EQUILIBRIUM CHEMISTRY AND COOLING IN SIMULATIONS OF GALAXY FORMATION

1. The radiative cooling rate at densities $n_{\text{H}} \leq 10^4 \text{ cm}^{-3}$ and temperatures $10^2 \text{ K} \leq T \leq 10^9 \text{ K}$ can be accurately obtained from a chemical model with 157 species that includes the effects of shielding of the UV radiation by HI, H₂, HeI, HeII, CO and dust.
Chapters 2 and 3
2. Non-equilibrium chemistry can enhance the radiative cooling rate by up to two orders of magnitude in *idealised* scenarios of gas cooling at constant density or constant pressure.
Chapter 2
3. The column density of the HI-to-H₂ transition decreases with increasing density and/or metallicity.
Chapter 3
4. The total star formation rate and outflow properties of a galaxy are strongly affected by metallicity and UV radiation, but are insensitive to non-equilibrium chemistry.
Chapter 4
5. Molecular abundances in galaxies and molecular clouds are often out of equilibrium, which affects the CO emission and the X_{CO} factor.
Chapters 4 and 5
6. The mean CO intensity of a molecular cloud becomes saturated at high dust extinction, and is strongly suppressed below this saturated value at low dust extinction.
Chapter 5
7. Theorists and observers should be encouraged to talk to one another and collaborate together on projects.
8. Regular preprint meetings are a useful way to force oneself to keep up with the current literature.
9. Every astronomy department should have at least one computer scientist.
10. The history of astronomy is as interesting as astronomy itself.
11. You don't fully appreciate publicly-funded healthcare that is free at the point of use until you move to a country without it.
12. The UK will be better off if it remains within the EU.
13. University tuition fees aren't necessarily a bad thing, as long as there is sufficient financial support for students from poorer backgrounds.

Alexander Richings
Leiden, August 2015