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Formation and Evolution of the Dust in Galaxies. I. The Condensation Efficiencies

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(Submitted on 22 Jul 2011)

The growing interest in the high-z universe, where strongly obscured objects are present, has determined an effort to improve the simulations of dust formation and evolution in galaxies. Three main basic ingredients enter the problem influencing the total dust budget and the mixture of the dust grains: the types and amounts of dust injected by AGB stars and SNae and the accretion/destruction processes of dust in the ISM. They govern the relative abundances of the gas and dust in the ISM. In this study, we focus on star-dust and present a database of condensation efficiencies for the refractory elements C, O, Mg, Si, S, Ca and Fe in AGB stars and SNae that can be easily applied to the gaseous ejecta, in order to determine the amount and kind of refractory elements locally embedded into dust and injected into the ISM. The best theoretical recipes available nowadays in literature to estimate the amount of dust produced by SNae and AGB stars have been discussed and for SNae compared to the observations to get clues on the problem. The condensation efficiencies have been analyzed in the context of a classical chemical model of dust formation and evolution in the Solar Neighbourhood and Galactic Disk. Tables of coefficients are presented for (i) AGB stars at varying the metallicity and (ii) SNae at varying the density n_H of the ISM where the SNa explosions took place. In particular, we show how the controversial CNT approximation widely adopted to form dust in SNae, still gives good results and agrees with some clues coming from the observations. A new generation of dust formation models in SNae is however required to solve some contradictions recently emerged. A simple database of condensation efficiencies is set up to be used in chemical models including the effect of dust and meant to simulate galaxies going from primordial proto-galaxies to those currently seen in the local universe.

Comments: 28 pages, 15 figures and 3+11 tables

Subjects: **Galaxy Astrophysics (astro-ph.GA)**; Cosmology and Extragalactic Astrophysics (astro-ph.CO); Solar and Stellar Astrophysics (astro-ph.SR)

Cite as: **arXiv:1107.4541 [astro-ph.GA]**

Submission history

From: Lorenzo Piovan [view email]
[v1] Fri, 22 Jul 2011 15:28:51 GMT (312kb)