Mon. Not. R. Astron. Soc. **000**, 1–2 (2002) Printed 3 April 2013 (MN LATEX style file v2.2)

Systematic uncertainties in nebular abundance determinations

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ABSTRACT

Determinations of abundances from emission line nebulae are of crucial importance in understanding many astronomical environments. Many methodological choices must be made before abundances can be calculated, including the choice of interstellar extinction law, the atomic data to be used, and the ionisation correction scheme. Naturally one needs to know if the methodology chosen matters, and if so, how much and when? This question has only been partially answered in the literature and for many methodological choices, personal preference is the deciding factor.

In Wesson et al. 2012, we developed a method of uncertainty propagation which accounted for non-gaussian uncertainties and avoided approximations which may break down in real astronomical data. This method allows us to accurately quantify statistical uncertainties in abundance determinations. We now use our code to analyse a large sample of nebulae, using 5 extinction laws, 4 sets of heavy element collisional data, 2 sets of helium atomic data, and 2 ICFs. By comparing the differences between all possible permutations of methodological choice with the statistical uncertainties, we answer the question.

Key words: ISM: abundances – atomic processes – methods: statistical

1 INTRODUCTION

Outline of empirical method
Brief discussion of different atomic data, extinction laws, ICFs

2 SUMMARY OF PAPER I

Propagation of statistical uncertainties, reliability of MC method as opposed to analytical techniques
Description of updates to code since Paper I. Mention the correction to the Ar ICF which was wrongly given in KB94?

3 SAMPLE NEBULAE

Reasons for selection (if we have any beyond "they were there").
Plots showing histograms of extinction, excitation class, temperatures, densities, O/H

4 RESULTS

Results for each parameter in turn, reddening, atomic data, ICF. How much of a difference does each one make?
Can we quantify this in a simple way by saying for example, for O/H, that the "effect" is the ratio of the amount a change of methodology changes the abundance by to the statistical uncertainty? For example, if O/H in the reference case is found to be 1e-4 +- 1e-5, and using a different extinction law makes it 1.4e-4 +- 1e-5, then the "effect" is 4x the statistical uncertainty. Presenting these results clearly and effectively is crucial.

5 DISCUSSION

What have we found?

ACKNOWLEDGMENTS

This work was co-funded under the Marie Curie Actions of the European Commission (FP7-COFUND). DJS is supported by an NSERC Discovery Accelerator Grant. PS is supported by the ESO Studentship Programme.