ROSAT STUDIES OF THE COMPOSITION AND STRUCTURE OF DA WHITE DWARF ATMOSPHERES

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We have made a detailed study of a sample of 28 hot DA white dwarfs detected in the ROSAT EUV and soft X-ray all-sky-survey.

The survey data have been combined with subsequent ROSAT pointed observations, earlier EXOSAT results and optically determined temperatures and gravities (from Kidder/Holberg and Finley). These data have been analysed using theoretical model atmosphere grids (hydrogen with trace helium homogeneously mixed or stratified with a hydrogen layer over helium).

We have found that below ≈40,000K, DA atmospheres are well described by a nearly pure H composition with a small opacity due to trace helium ($H/He < 3 \times 10^{-5}$) or a thick ($mH > 6 \times 10^{-13} M_{\odot}$) hydrogen layer. Above 40,000K however, H+He models (homogeneous or stratified) cannot in general explain the observed X-ray/EUV fluxes.

Analysis of the results shows that additional opacity must be present in the photospheres of these hotter stars and we believe that it is due to the presence of trace metals. In support, other observations have detected trace metal lines in spectra of some of the hottest white dwarfs[1], and in two of stars of this subsample, Feige 24[2] and G191-B2B[3], no significant He 228Å feature was detected. The disappearance of trace metals in DA's when they cool below 40,000K is in agreement with theoretical radiative levitation calculations (see for example[4]).

Thus we propose that these results are direct observational evidence that the atmospheric composition of DA white dwarfs is dominated by the balance between gravitational and radiative forces. Secondly, upper limits on the amount of helium in the atmosphere obtained from the modelling indicate that it makes a minimal contribution to the opacity.

References

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