

Photon-dominated region modelling of the clumps in protoplanetary nebulae

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Abstract. HST images have directly observed dense clumps of material in several planetary nebulae (PNe) including the famous Helix Nebula (NGC 72793). The origin of the clumps remains very unclear; in particular, at what stage in the transition from the asymptotic giant branch (AGB) star through protoplanetary nebula and PN stages these clumps form is still unknown. Recent high-sensitivity millimetre observations (Josselin & Bachiller 2003) have shown that the molecular gas in PNe is affected by the large radiation fields from the central stars which are expected to cause a dramatic effect on the chemical composition. The strong UV radiation from the central star photodissociates molecules in the outflowing slow stellar wind, if this wind is smooth. If the wind is clumpy it will shield these products allowing many of them to survive into the PN phase. We have used a recently developed time-dependent photon-dominated regions (PDR) code to trace the chemical evolution of molecular clumps, assuming them to have formed early on in the history of the PN. In this poster, we present preliminary results from our models and comparisons with observations.

Keywords. astrochemistry — stars: AGB and post-AGB — ISM: molecules — planetary nebulae: general

References

Josselin, E. & Bachiller, R. 2003, *A&A* 397, 659