Modeling Radiative Transfer in Astrophysics using MPI

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Abstract: Interpretation of astronomical observations relies on the understanding of the emission and transport of electromagnetic radiation through the environments such as molecular clouds, circumstellar envelopes. The interaction between an incoming radiation beam and the environment alters the characteristics of the outgoing radiation and provide important information on the physical conditions of the environment. Unfortunately, the radiative transfer equations in realistic three-dimensional astronomical environments with complex distribution of matters have no exact analytic solution, so numerical solution is necessary. In this presentation we detail the development of a three dimensional radiative transfer code based on the short-characteristic method and the method to solve the system of statistical equilibrium equations. Our code is optimized for the high performance computing platform of the Vietnam Academy of Science and Technology using MPI interface. We use our code to simulate the formation and transport of the hydorgen recombination lines (HRLs) in H II region of MWC 349 where these lines are known to be masers. We show that our simulations can explain qualitatively the line shape and intensity of these HRLs. In addition, we also assess the saturation status of these maser lines in MWC 349.

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