A Monte Carlo code for radiative transfer in molecular lines: Application for CO and water lines in circumstellar shells.

V. I. Shematovich, Institute of Astronomy RAS, 48, Pyatnitskaya St., Moscow, 109017 Russia
shematov@inasan.rssi.ru

R. Szczerba, NCAC, Torun, Poland
K. Volk, Department of Physics and Astronomy, University of Calgary, Calgary, Canada

A Monte Carlo approach (Bernes ,1979, A&A 73, 67) is well suited to study the non-LTE, multi-level radiative transfer in molecular lines, because it is based on the statistical interpretation of the molecular excitation processes due to both radiative transfer and collisions. We have applied the standard Monte Carlo technique to investigate the radiative transfer in molecular lines in circumstellar shells where physical conditions can vary significantly over the region under study (variable mass loss rate, transition from collisional to radiative excitation mechanism, continuum dust radiation, etc.). This code allows us to treat an arbitrary geometry, velocity and density distribution. Tests have been performed for spherically symmetric circumstellar shells with uniform velocity and density structures and comparison with Large Velocity Gradient solutions for carbon oxide and water molecules are presented.