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# **An Evaluation of the Difference Formulation for Photon Transport in a Two Level Atomic System in Slab Geometry**

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# An Evaluation of the Difference Formulation for Photon Transport in a Two Level Atomic System in Slab Geometry <sup>1</sup>

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The difference formulation of photon transport, introduced for thermal radiation by some of the authors, has the unique property that the transport equation is written in terms that become small for optically thick systems. In this presentation we extend the difference formulation for radiation transport to the case of a single atomic line in a strongly absorbing and emitting medium of two-level atoms. We examine the accuracy, performance and stability of the difference formulation within the framework of the Symbolic Implicit Monte Carlo method. We find that the difference formulation offers a significant computational advantage over the standard formulation for a thick system. The correct treatment of the line profile, however, requires that the difference formulation in the core of the line, where the photon field is strong, be mixed with the standard formulation in the wings, where the photon field is weak. This may limit the computational advantage of the method. We bypass this problem by using the gray approximation, and develop three Monte Carlo solution methods based on different degrees of implicitness for the treatment of the source terms. We find only conditional stability unless the source terms are treated fully implicitly.

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