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Implementation of Ray-Effect Mitigation Techniques for 3D Radiation Transport

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The discrete ordinates (Sn) method has been widely employed to treat the directional dependence in radiation transport. However, a well-known anomaly called ray effect can be found when this method is applied to problems involving localized source and low scattering ratios. The ray effect arises from restricting particles streaming along the limited, discrete directions, and may produces highly inaccurate solution.

Many techniques to mitigate the ray effect have been proposed and developed throughout the years. In particular, a class of these techniques is based on adding fictitious source to the discrete ordinates equations that convert these equations to the spherical harmonics equations. The latter preserves the rotational invariance characteristic of the transport equation itself and do not exhibit the ray effect. These techniques are also attractive since minimal code modifications are needed. The purpose of this research is to extend the fictitious source formulations from 2D to 3D radiation transport, and to examine their effectiveness using the CEPTRE code currently under development at Sandia.

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