# AN ASYMPTOTIC PRESERVING METHOD FOR THE LINEAR TRANSPORT EQUATION ON GENERAL MESHES

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Abstract. This talk presents a finite-volume scheme [Anguill et al., 2022] for a linear transport equation derived from a linearization of the radiative transfer equations. This scheme has been implemented on 2D unstructured meshes, and satisfies the following properties:

- **P1** to be consistent on general meshes,
- **P2** to enforce the conservation of radiative energy,
- **P3** to be able to handle all the radiation regimes from free-streaming to diffusion (Asymptotic Preserving),
- **P4** to have the radiative energy degrees of freedom located at the centers of the elements to ensure the compatibility with the hydrodynamic scheme.
- **P5** to allow us to use the limit diffusion scheme of our choice.

As our scheme is implicit, we used a system of sub-iterations to avoid to solve a global linear system (of size equal to the cells number $\times$ directions number), while remaining stable. In addition, this sub-iterations system is acting as a fixed point loop, in order to get rid of the non-linearity of the diffusion scheme. Thanks to the properties of our diffusion scheme, we enforce the energy to remain positive in this regime, for which radiation and matter temperature are strongly coupled. We have conducted numerical 1D tests on structured and unstructured 2D meshes, which assess that the expected properties are respected. Finally, we carried out the Lattice problem test to compare our results with existing methods, in particular the Discontinuous Finite Element (DFE) discretization.

**Keywords**: Finite Volume, radiative transfer, asymptotic analysis, computational transport, monotone anisotropic diffusion, unstructured meshes.

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## References

[Anguill et al., 2022] Anguill, P., Cargo, P., Énaux, C., Hoch, P., Labourasse, E., and Samba, G. (2022). An asymptotic preserving method for the linear transport equation on general meshes. *Journal of Computational Physics*, 450:110859.

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