The Non-LTE Problem of the Second Kind: the generation and transfer of polarized radiation

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The standard Non-LTE problem consists in calculating the atomic level *populations* that are consistent with the *intensity* of the radiation field generated within any given stellar atmospheric model. In contrast, the Non-LTE problem of the second kind is, indeed, like an "algebraic Annapurna": it requires to calculate the diagonal and non-diagonal elements of the *atomic density matrix* (associated to each level i of total angular momentum J_i) that are consistent with the *intensity* and *polarization* of the radiation field generated within the (generally magnetized) stellar atmospheric model under consideration. After arguing why this problem is of real astrophysical interest, I will introduce the relevant equations and the basic anisotropic radiation pumping processes. Finally, I will show how to solve efficiently Non-LTE problems of the second kind via the development and application of fast iterative methods and accurate formal solvers of the Stokes vector transfer equation.