

7.26: Stark Effect

The Stark effect concerns the separation of the states within a level as the result of the application of an external electric field, and the consequent splitting of lines into Stark components. The atmosphere of a star, being hot and highly ionized, is an electrical conductor and consequently cannot sustain electric potential gradients (fields). Thus the splitting of a line into its Stark components is not normally observed in stellar atmospheres, and for that reason I am not going into a detailed description of it or the theory of the effect here. There are just two small points that are probably worth mentioning.

The first point concerns the Balmer series of H_I . The details of the Stark pattern vary from line to line in the series, but it happens that in every even member of the series, that is to say $H\beta$, $H\delta$, etc., there is no central, undisplaced Stark component. Under some circumstances, even if the hydrogen lines are broad and the Stark components are unresolved, this may result in a small dip at the top of an emission line, or a small bump at the bottom of an emission line. There are other effects (see the chapter on line profiles) that can result in a dip at the top of an emission line or a bump at the bottom of an absorption line, but if the cause is Stark splitting, this may be recognized in that it affects only the even members of the Balmer series, and not the odd members ($H\alpha$, $H\gamma$, etc.).

The second point is that, although a stellar atmosphere cannot sustain a large macroscopic electric field, when two atoms approach each other in a near-collision, each induces a temporary electric dipole on the other. (This is the origin of the van der Waals forces, which fall off inversely as the sixth power of the interatomic distance.) The resulting electric field of one atom on the other, and the other on the one, results in a general broadening of the lines, often asymmetrically, as a result of Stark effect, and this effect obviously increases with pressure and is one of the components of the phenomenon of *pressure broadening*, to be discussed in a later chapter.

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