

## 10.8: Other Line-Broadening Mechanisms

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I just briefly mention here one or two additional sources of line-broadening.

Lines may be broadened by unresolved or smeared Zeeman splitting, particularly for lines involving levels with large Landé  $g$ -factors. By “smeared” I mean the situation that arises if there is a large range of magnetic field strength through the line of sight or because (as is always the case with stars other than the Sun) you are looking at a whole-disc spectrum. Since the splitting depends on the field strength, the lines will obviously be smeared rather than cleanly divided into a number of discrete Zeeman components. Zeeman smearing is often large in the spectrum of white dwarf stars, where magnetic fields can be large and the observer looks through a large range of magnetic field strength.

Different Zeeman components are plane or circularly polarized according to the direction of the magnetic field. Thus in principle one should be able to recognize Zeeman effect, even if smeared or not fully resolved, by its changing appearance in different polarization directions. However, this will be true only if the magnetic field is uniform in direction, as it may mostly be in, for example, a sunspot. For a whole-disc spectrum there will be a variety of different directions of the magnetic field, and so the polarization information will be lost.

Broad lines are sometimes the result of unresolved hyperfine structure in elements with a large nuclear spin such as vanadium, or unresolved isotopic lines in elements with several isotopes of comparable abundance such as tin, copper or chlorine.

Another source of line broadening is autoionization (in absorption spectra) or dielectronic recombination (in emission spectra) in elements such as copper. These mechanisms were described in section 8.8.

One last remark might be made, namely that line broadening, whether instrumental, thermal, rotational, etc., does not change the equivalent width of a line, provided that the line is everywhere optically thin. This does not apply, however, if the line is not everywhere optically thin.

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