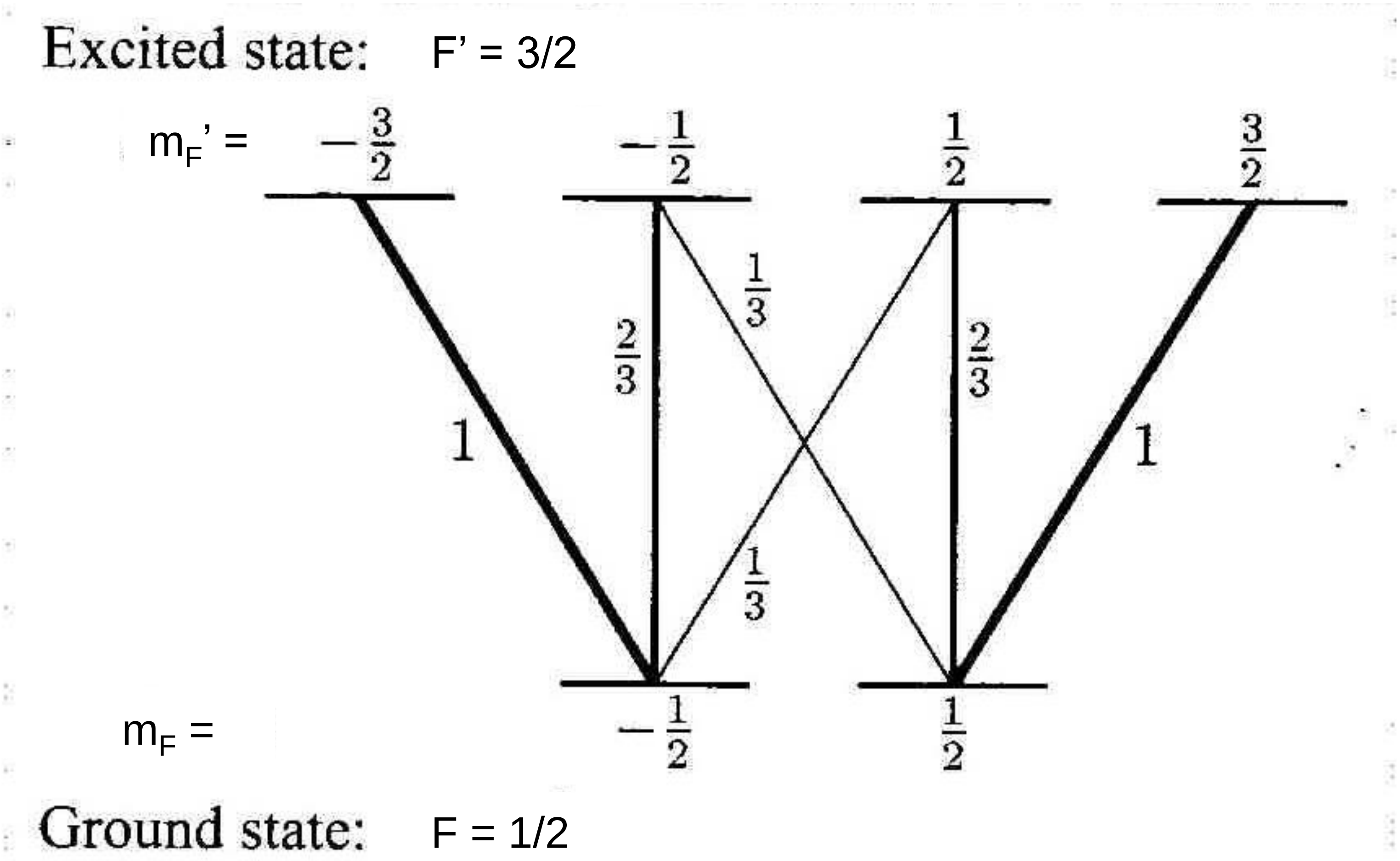
Multi-level atom

Consider an atom with:

- F=1/2 in ground level.
- F'=3/2 in excited level.



[figure adapted from *Atomic Physics* by C. Foot, Oxford U. Press (2006)]

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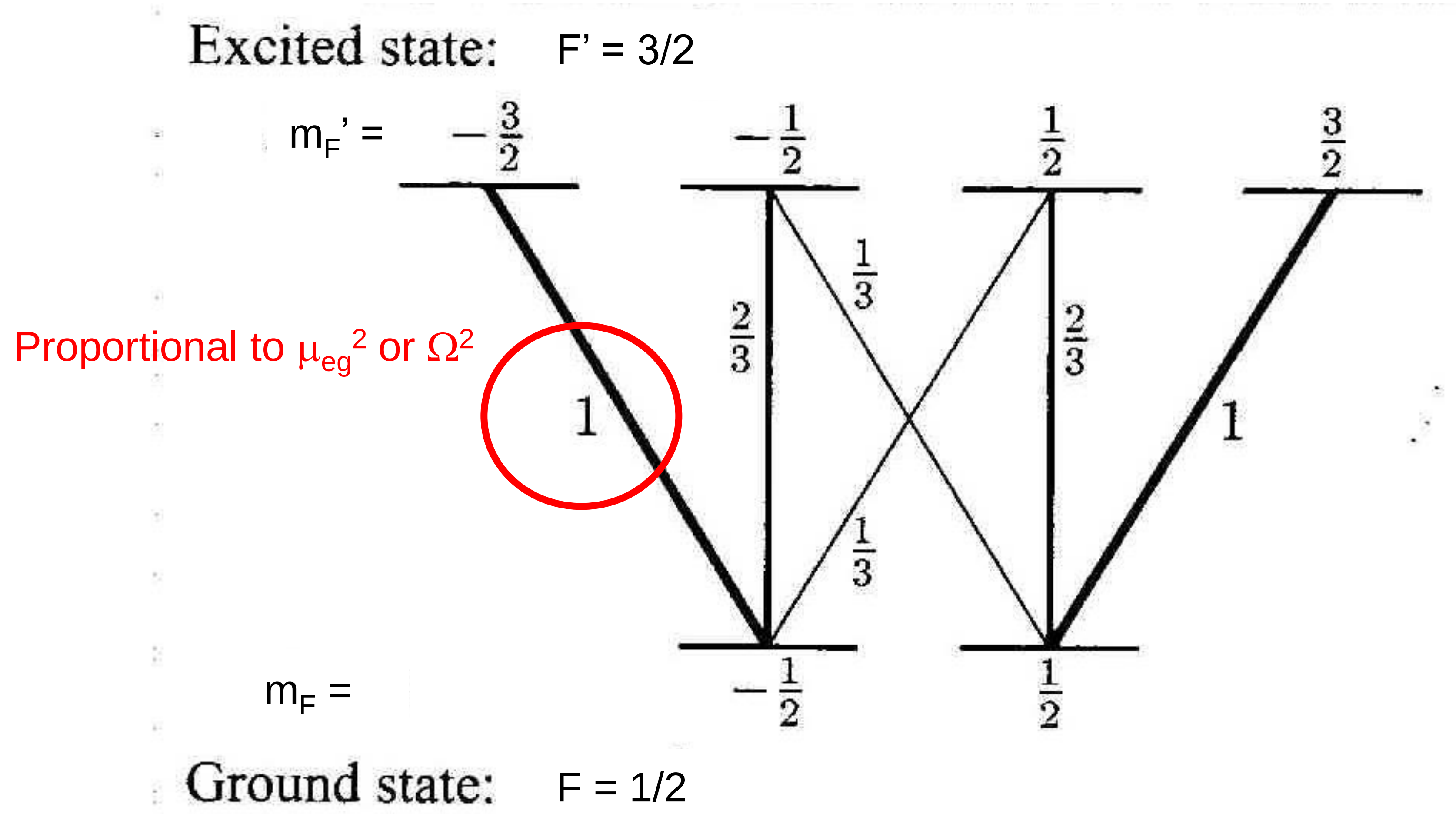

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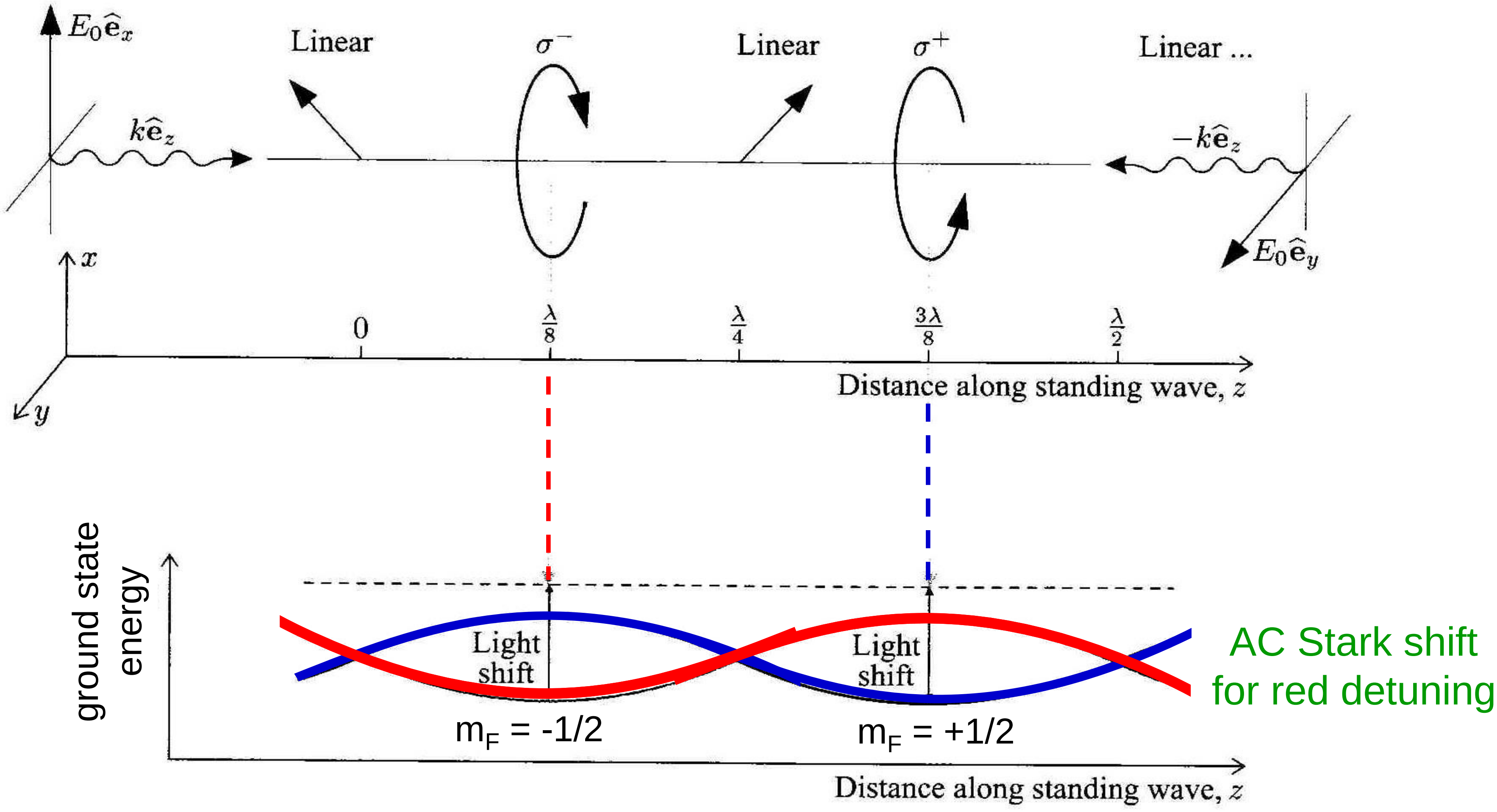
AC Stark Shift in Polarization Gradient Lattice



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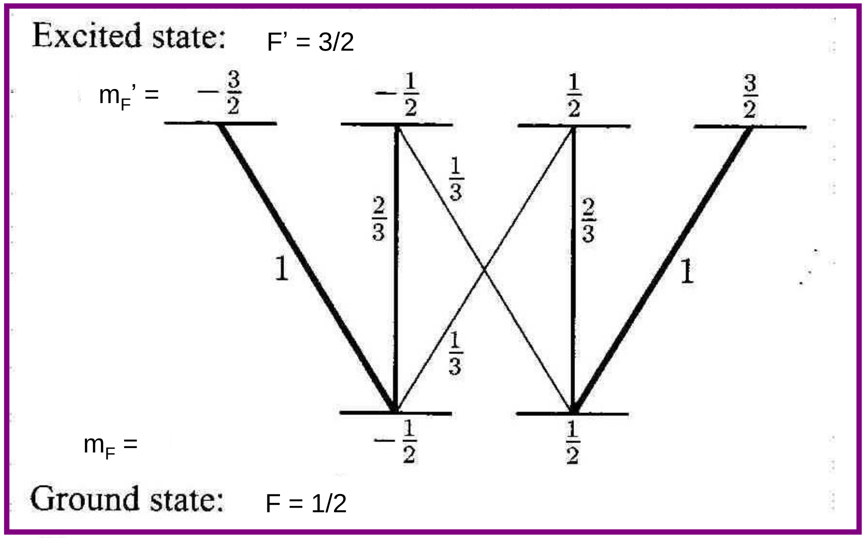
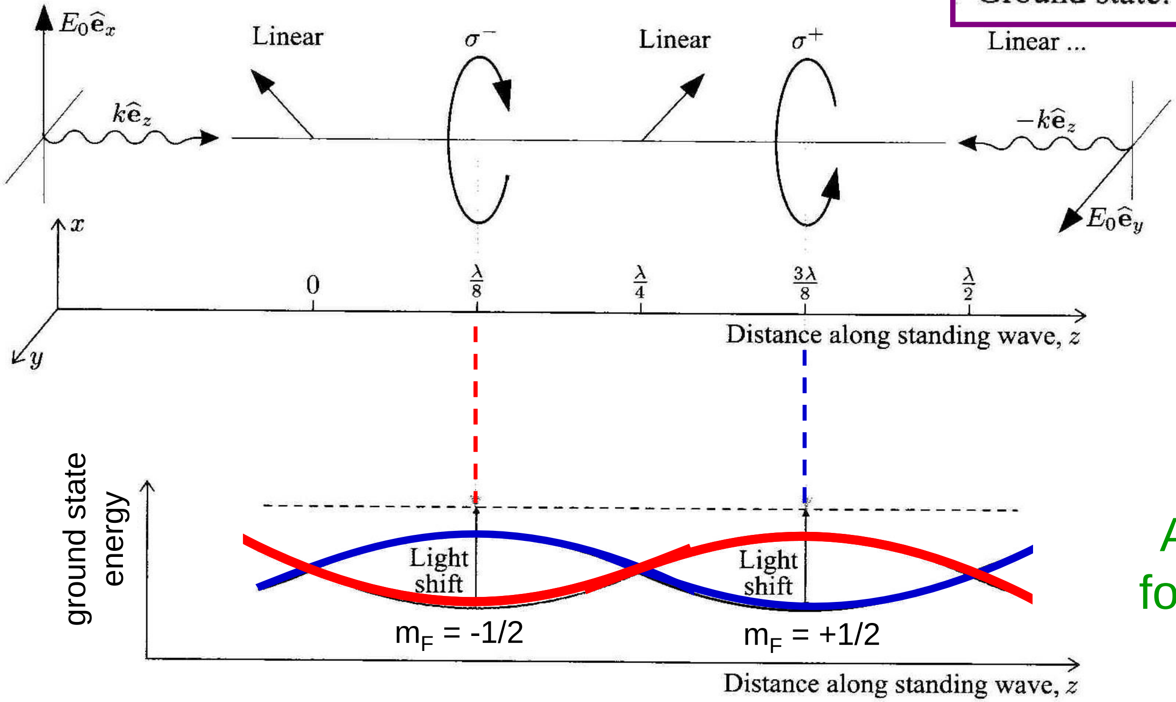
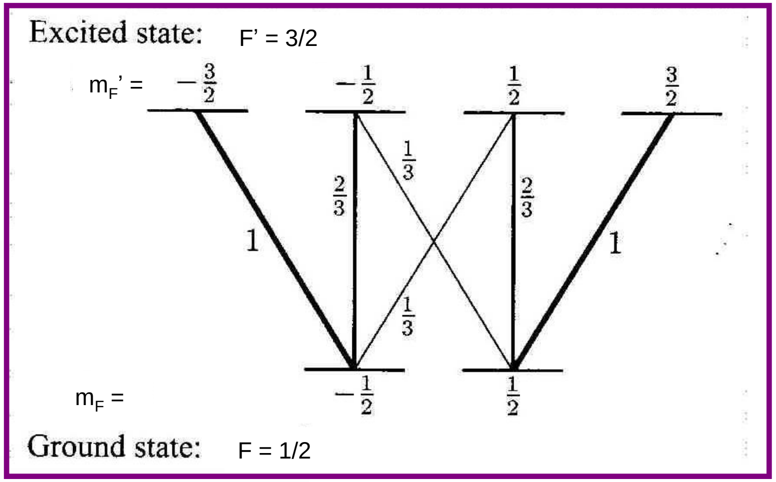


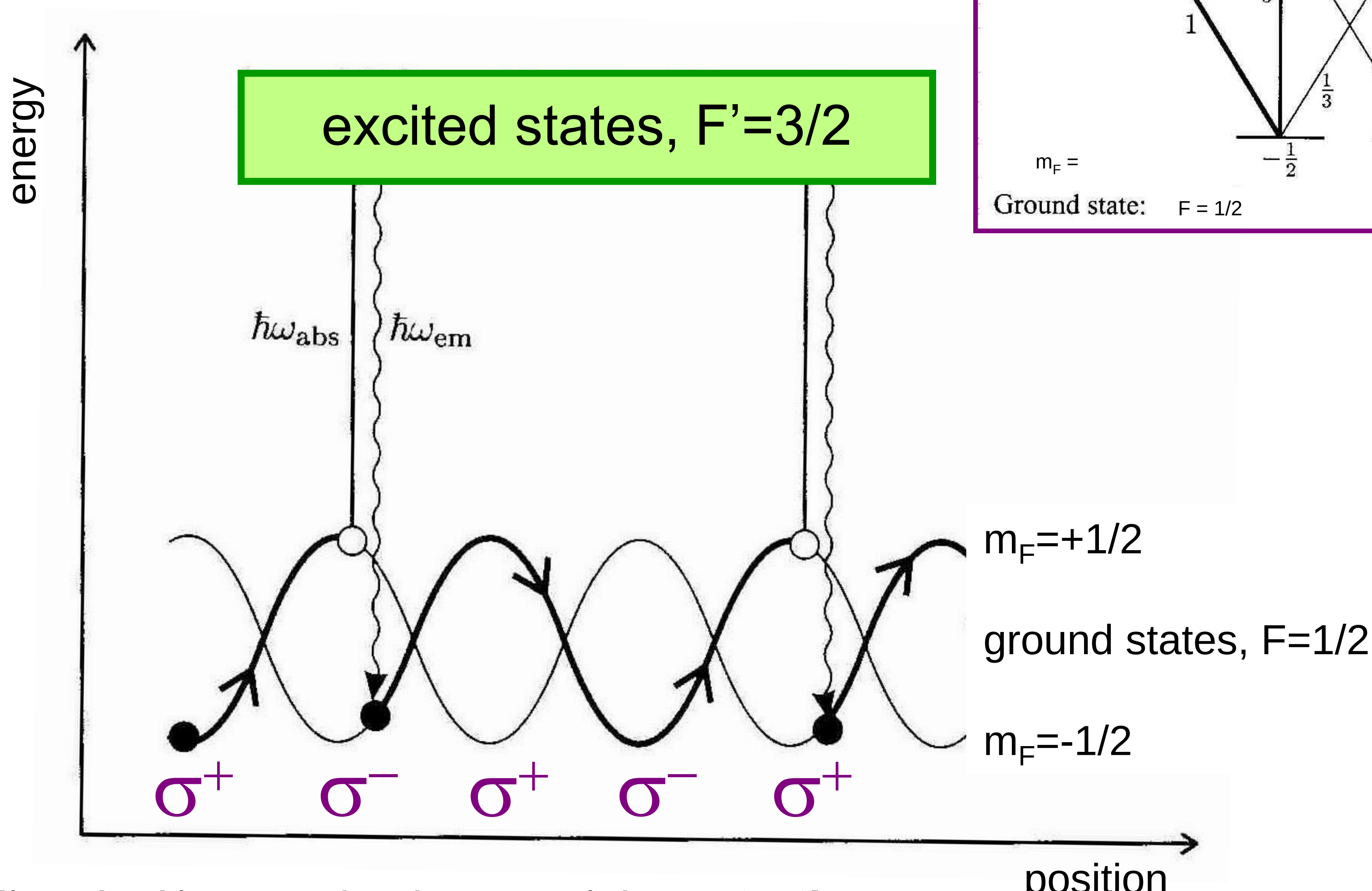


AC Stark shift for red detuning

[figure adapted from *Atomic Physics* by C. Foot, Oxford U. Press (2006)]

Sisyphus Cooling

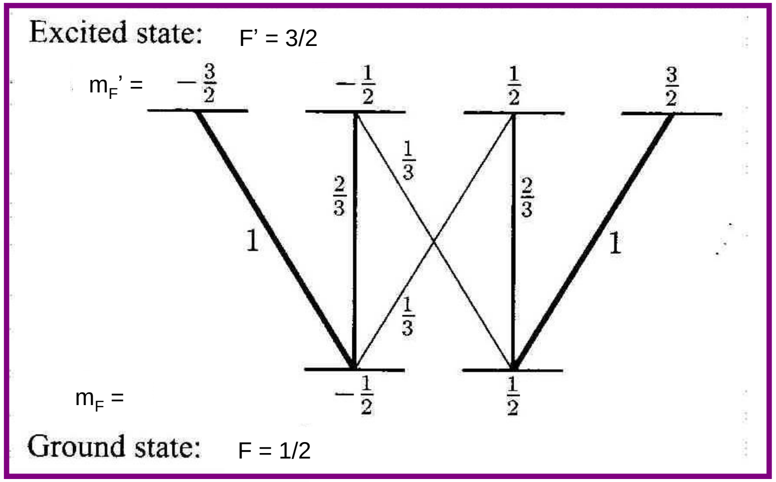


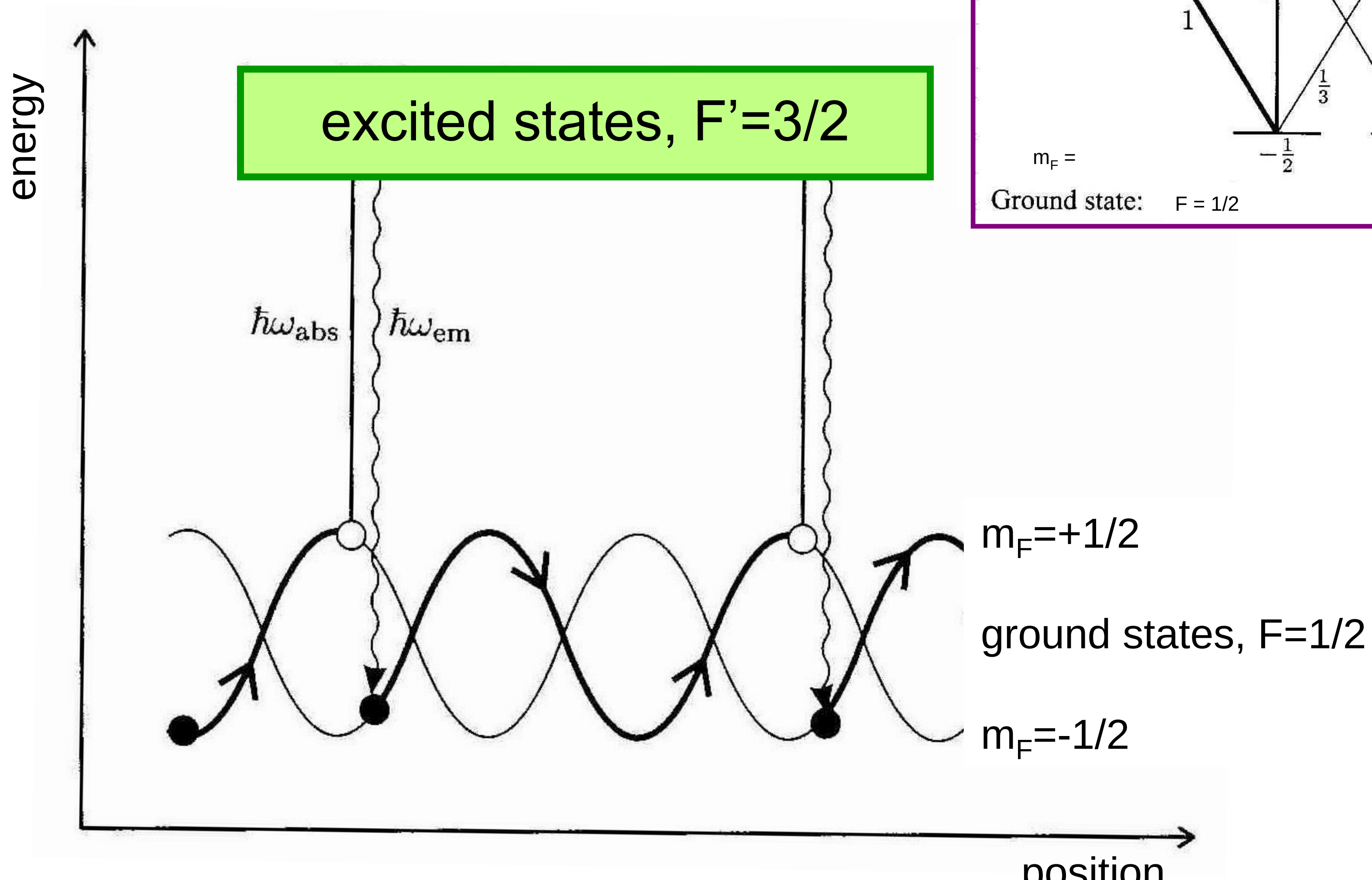


[figure adapted from *Atomic Physics* by C. Foot, Oxford U. Press (2006)]

Sisyphus Cooling

Atoms that are excited at the top of a **hill** are most likely to decay to **valley**.





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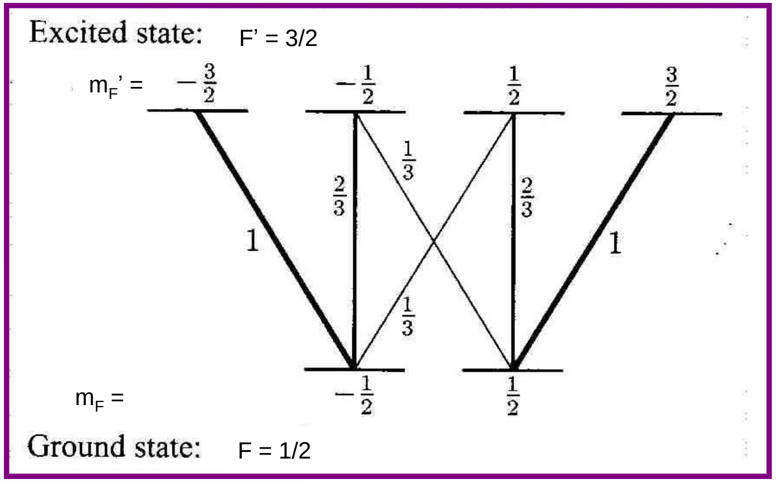
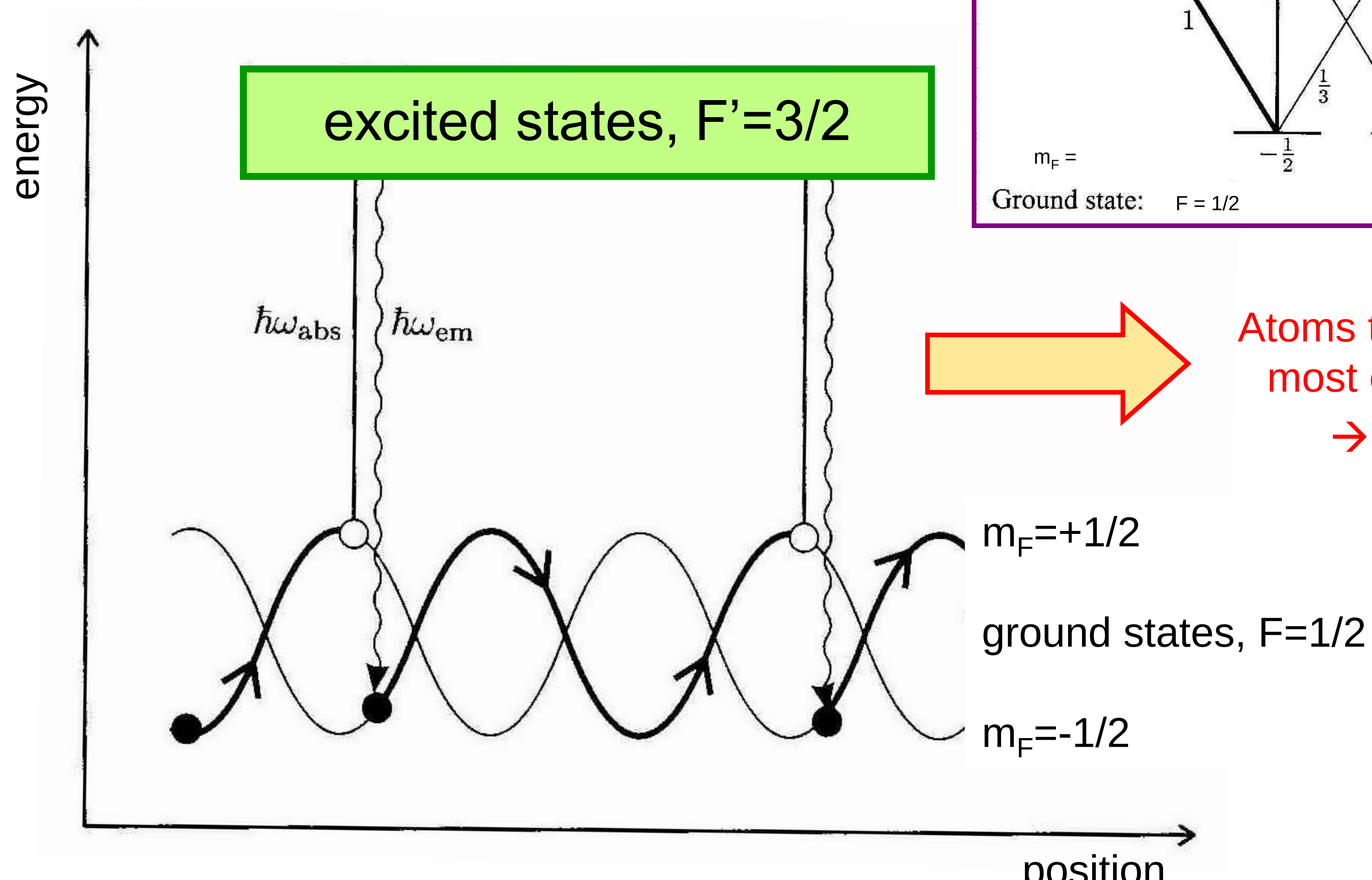


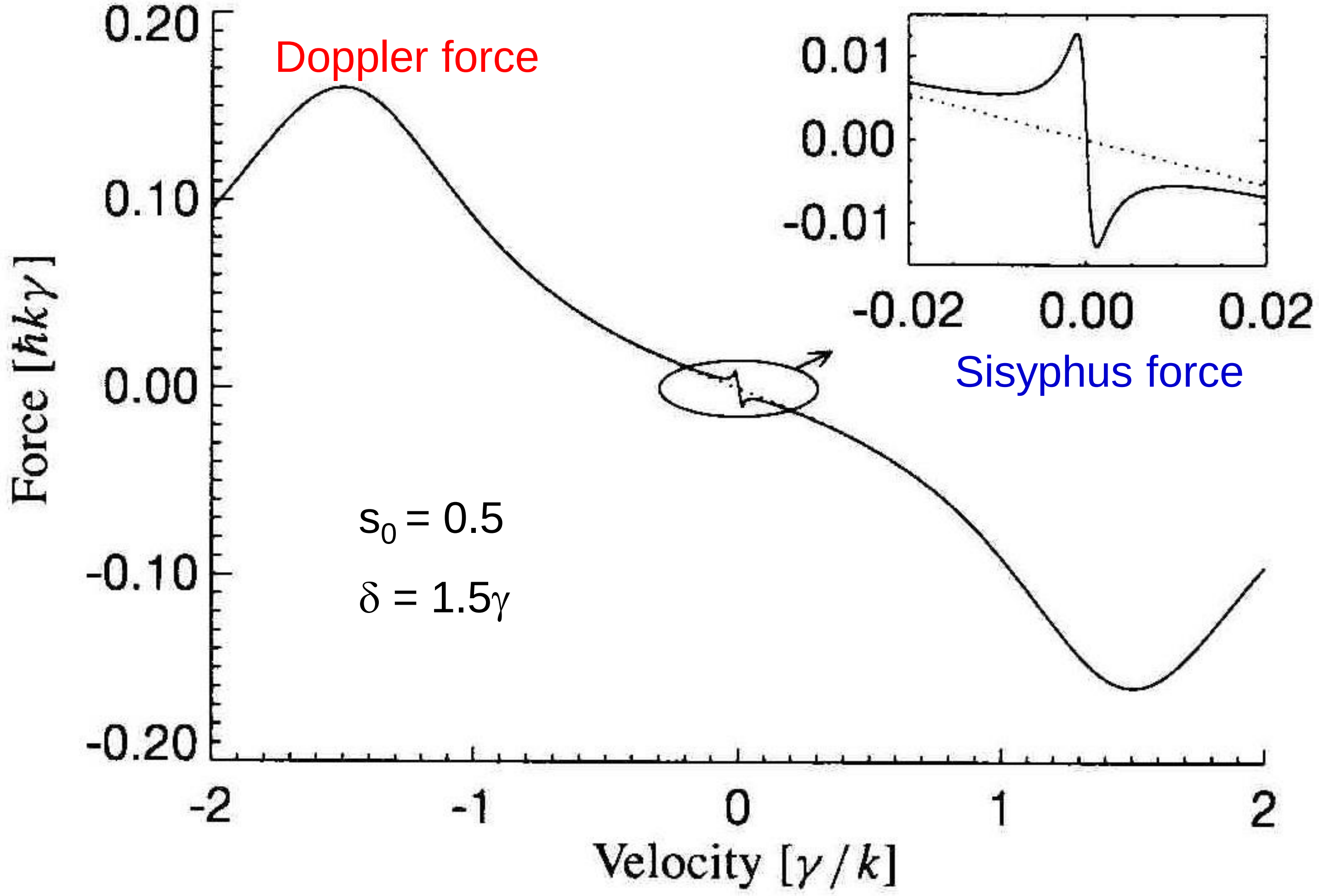


Atoms travel **uphill** most of the time

→ cooling

[figure adapted from *Atomic Physics* by C. Foot, Oxford U. Press (2006)]

Cooling Force (Doppler + Sisyphus)



[figure adapted from *Laser Cooling and Trapping* by H. Metcalf and P. van der Straten, Springer (1999)]