

## 9.7: Atomic hydrogen

What is meant by the oscillator strength of  $H\alpha$ ? This question may well be asked, recalling that  $H\alpha$  technically is not a single line, but consists of three transition arrays, three multiplets, seven lines, and I don't think we ever worked out quite how many Zeeman and hyperfine components.

The hydrogen atom is a two-body system, and for such a system the wavefunction and its eigenvalues (energy levels) can be worked out explicitly in algebraic terms. The same is true of the transition moments and hence the strengths of each Zeeman and hyperfine component. The strength of the entire "line" of  $H\alpha$  is then merely the sum of the strengths of all the Zeeman and hyperfine components of which it is composed. Then the weighted oscillator strength of  $H\alpha$  is merely calculated from equation 9.5.6. As for the question: What is  $\varpi$ ? – the question need not arise, since all one is likely to need is the product  $\varpi f$ . However if this has been worked out by adding the strengths of all the Zeeman and hyperfine components, it would be  $4n^2$ , which, for the lower level of  $H\alpha$ , is 8.

For the record, here are the weighted oscillator strengths,  $\varpi f$ , for the first four "lines" of the Lyman and Balmer series for H.

	Lyman	Balmer	
$\alpha$	0.555	3.139	(9.7.1)
$\beta$	0.105	0.588	
$\gamma$	0.0387	0.220	
$\delta$	0.0186	0.103	

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