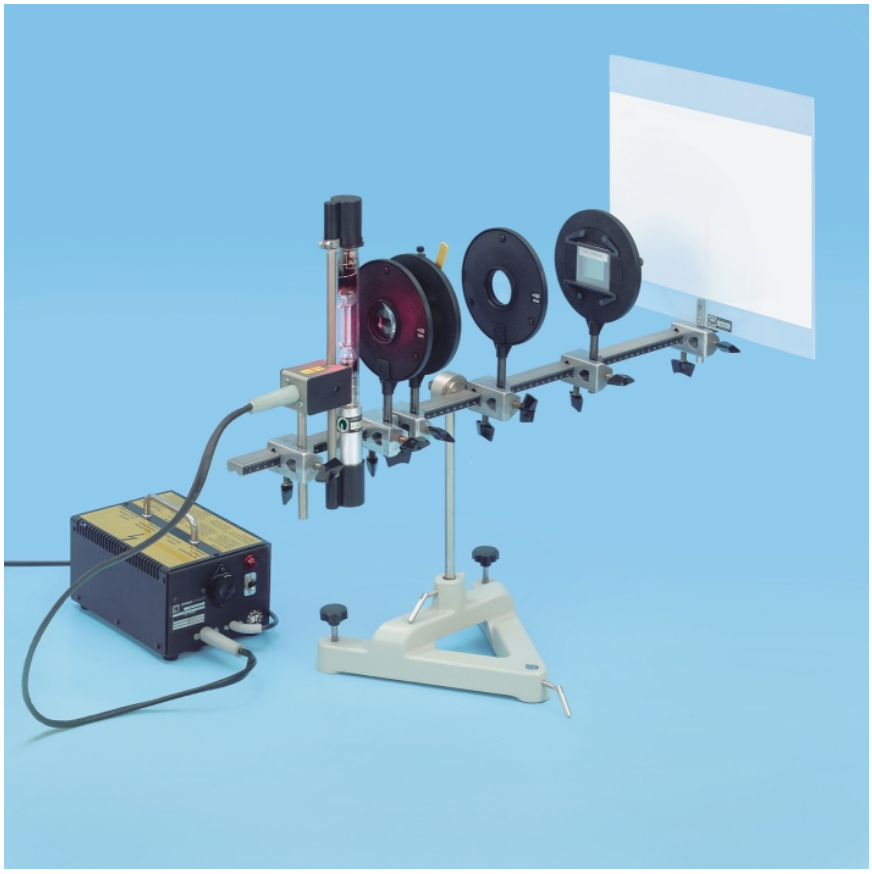
P 6.2.1

The Balmer series of hydrogen

P 6.2.1.1 Determining the wavelengths H_α, H_β and H_γ from the Balmer series of hydrogen

P 6.2.1.2 Observing the Balmer series of hydrogen using a prism spectrometer



Determining the wavelengths H_α, H_β and H_γ from the Balmer series of hydrogen (P 6.2.1.1)

In the visible range, the emission spectrum of atomic hydrogen has four lines, H_α, H_β, H_γ and H_δ; this sequence continues into the ultraviolet range to form a complete series. In 1885, *Balmer* empirically worked out a formula for the frequencies of this series

$$\nu = R_\infty \cdot \left(\frac{1}{2^2} - \frac{1}{m^2}\right), \quad m\text{: } 3, 4, 5, \ldots$$

$R_\infty = 3.2899 \cdot 10^{15}\ s^{-1}$: Rydberg constant

which could later be explained using Bohr's model of the atom.

In this experiment, the emission spectrum is excited using a Balmer lamp filled with water vapor, in which an electric discharge splits the water molecules into an excited hydrogen atom and a hydroxyl group. The wavelengths of the lines H_α, H_β and H_γ are determined using a high-resolution grating. In the first diffraction order of the grating, we can find the following relationship between the wavelength λ and the angle of observation ϑ:

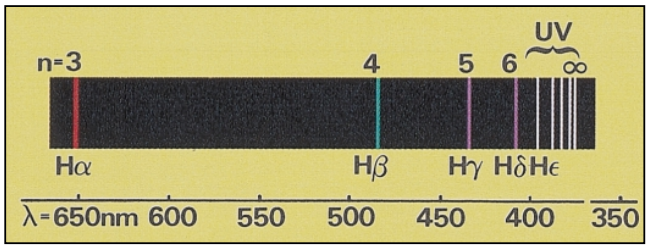
$\lambda = d \cdot \sin \vartheta$

d: grating constant

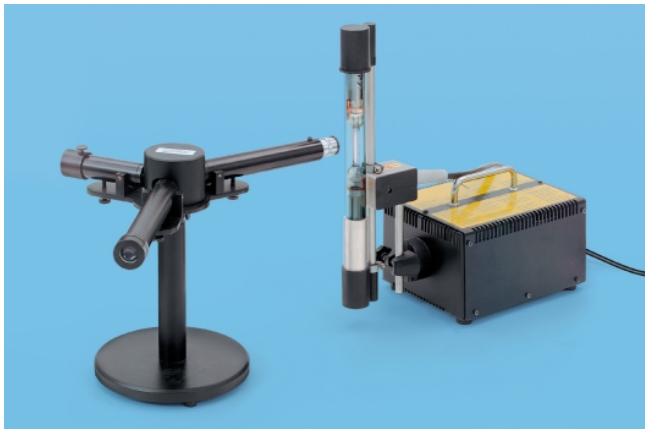
The measured values are compared with the values calculated according to the Balmer formula.

In the second experiment the Balmer series are studied by means of a prism spectroscope (complete device).

Cat. No.	Description	P 6.2.1.1	P 6.2.1.2
451 13	Balmer lamp	1	1
451 14	Power supply unit for Balmer lamps	1	1
471 23	Copy of a Rowland grating, approx. 5700 lines/cm	1	
311 77	Steel tape measure, 2 m	1	
460 02	Lens f = + 50 mm	1	
460 03	Lens f = + 100 mm	1	
460 14	Adjustable slit	1	
460 22	Holder with spring clips	1	
441 53	Translucent screen	1	
460 43	Small optical bench	1	
300 01	Stand base, V-shape, 28 cm	1	
301 01	Leybold multiclamp	6	
467 112	School spectroscope		1



Emission spectrum of atomic hydrogen



Observing the Balmer series of hydrogen using a prism spectrometer (P 6.2.1.2)