PROFILE FITTING BY MARQUARDT ALGORITHM

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ABSTRACT. Many of the stellar and nebular spectroscopic problems need the inputs of the line flux (or equivalent width if the line is in absorption) and the wavelength of the line peak. These input parameters are then used in the analysis for obtaining physical parameters like electron temperature, electron density, abundances of the elements, radial velocities etc.

The problem of extracting spectral line fluxes is not straightforward if the lines are blended which is most often the case in low resolution spectra. The author has developed a FORTRAN program incorporating the algorithm due to Marquardt to handle such problems. A good illustration of this algorithm can be found in Bevington (1969).

The program is particularly useful to deblend the lines in a blend and to extract the flux in each of them. A linear combination of Gaussian and Lorentzian profiles can be fitted to the lines. The continuum can be fitted with a Zeroth order or first order polynomial. The test of goodness of fit used is the x^2 test. Blends of upto ten lines can be fitted at a time.

Following Crivellari and Morossi (1982) the fitting function adopted in the Program is

$$y(x,a) = \sum_{i=1}^{N} \sum_{k=1}^{L} \{ f \left[a_{1k} \exp \{-\ln 2 [2(x_i - a_{2k})/a_{3k}]^2 \} \right] + (1-f) \left[\frac{a_{1k}}{1 + \{ \frac{2(x_i - a_{2k})}{a_{3k}} \}^2} \right] \} + a_4 + a_5 x_i$$

Where

a_{1k} = Central height of the emission line above continuum for the k^{th} line
a_{2k} = the position (x-coordinate) of the line peak
a_{3k} = FWHM of the line
a_4, a_5 are coefficients representing the background Continuum
$f = 1$ Corresponds to pure Gaussian profile
$f = 0$ Corresponds to pure Lorentzian profile

The starting values of the parameters a_{1k} have to be specified in the input. This can be done using the observed spectrum. After the best fit is made, the output contains the best fit parameters a_{1k}, the uncertainties in each of them and the fluxes in the lines. Finally the program stores the best fit computed spectrum as well as the individual lines as determined from the best fit parameters. The observed spectrum and the computed spectrum can be plotted to the same scale on the video display unit and superposed (See figs.1,2 and 3). Improvement to the fitting method like constraining the relative fluxes, linewidths and separations of certain lines-based on the astrophysics of the situation (apart from the x^2 test), in the manner of Shaw and Bidelman (1987), is being planned.

ACKNOWLEDGEMENTS

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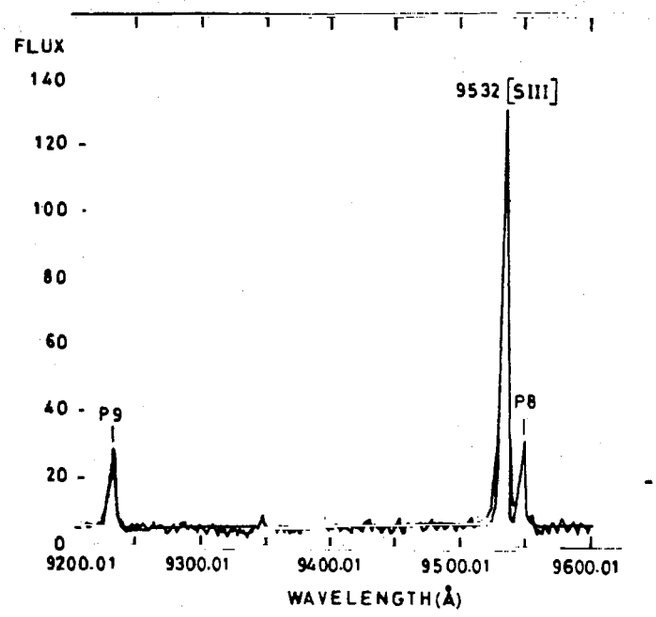

Figure 1

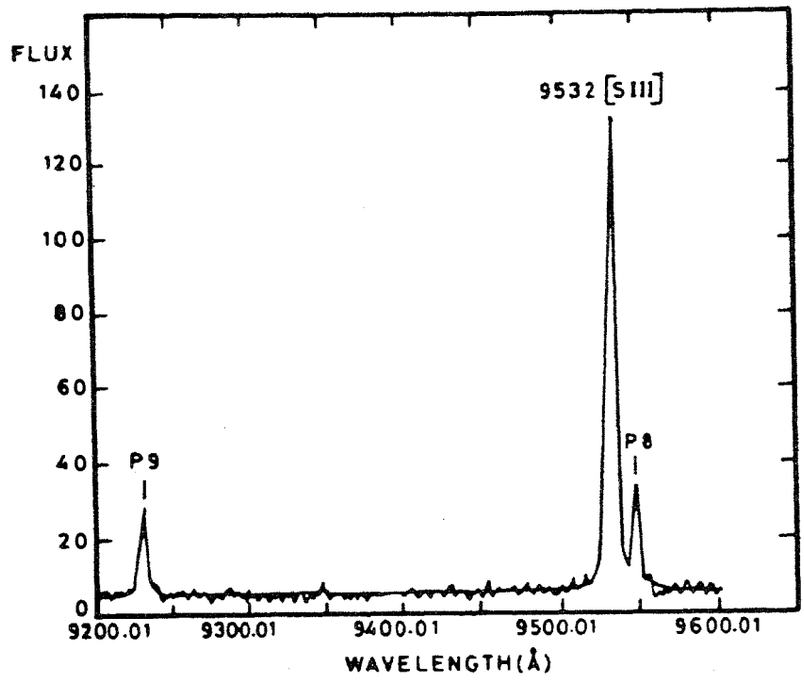

Figure 2

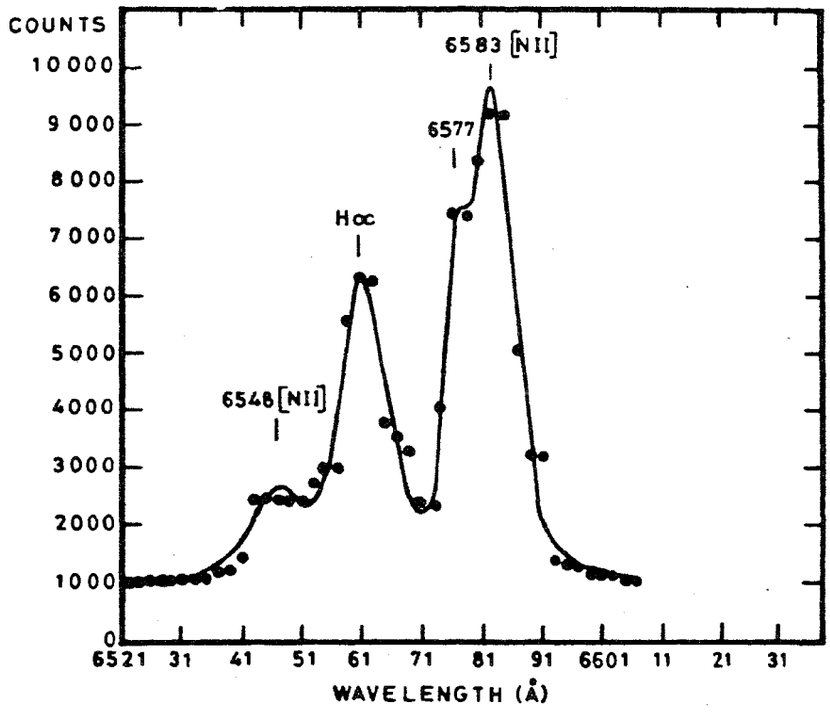

Figure 3