The variability of emission lines in shocked M Mira atmospheres

He. Richter, P. Woitke and E. Sedlmayr
(Institut für Astronomie und Astrophysik, TU Berlin, Hardenbergstr. 36,
D-10623 Berlin, Germany)
P.R. Wood
(Mount Stromlo and Siding Spring Observatories, Australian National University,
ACT 2611, Australia)

One of the outstanding problems concerning M Mira variables is the basic mass loss mechanism and its relation to stellar pulsation and dust formation. Theoretical works suggest that the substantial mass loss can be explained by the pulsation of the star producing shock waves which levitate the outer atmosphere and thereby trigger the dust formation, which in turn can amplify the shock waves. One way to probe the hydrodynamical conditions in different layers of the atmosphere influenced by the passing shock wave is to analyse a time resolved series of emission lines profiles. In particular emission lines appearing late in phase are good candidates to study the hydrodynamical conditions of the dust producing layers, since they appear when the shock wave has reached the outer atmosphere.

A sample of six M Miras (RR Sco, R Aql, R Car, R Leo, S Scl and R Hya), which range in period from 281 to 389 days, have been observed from maximum to minimum visible light. We obtained time resolved, high resolution spectra in the optical wavelength region (3600–5700 Å) of the Balmer emission lines H_γ, H_δ, H_ζ, H_η and several metal emission lines, namely Mg I, Mn I, Si I, Fe I, Fe II and [Fe II]. The variation with phase of the emission line profiles, the velocity shifts and fluxes are analysed in detail. Emphasis is put on metal emission lines which appear around the minimum light, in particular the [Fe II] lines, which are good candidates to probe the outermost atmospheric layers.