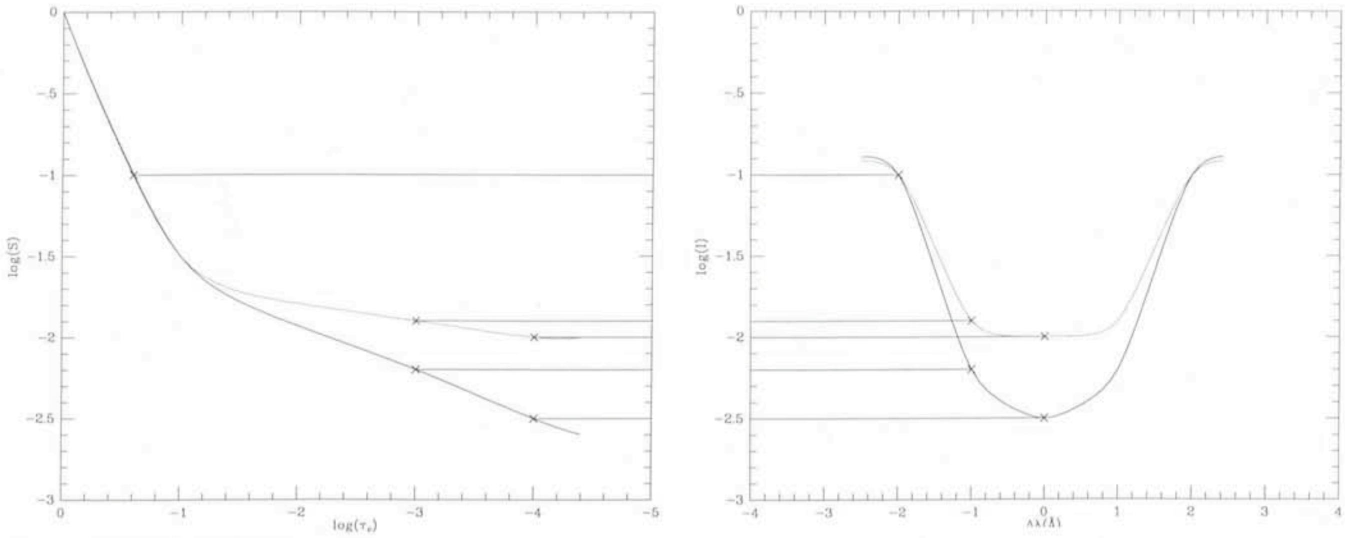

Fig. 3: *A schematic representation of the Eddington-Barbier relation in a spectral line and how an atmospheric perturbation can give rise to an emission feature in the ratio plots of Fig. 2. On the left are LTE source functions for a quiet (lower) and active (upper) star, with various line optical depth points marked. The way these translate to the line profile is shown on the right; the active star yields a brighter line core which appears as a positive ratio feature. The situation in a real star has a number of additional complications.*

lines. It is not caused by too low a zero level in the T Tauri UV spectra, since there are cases of lines with equal strength in the standard spectra of which only some appear as emission features in the ratio spectra (e.g. 4215 Å). The same effect is also seen in the red frames for which there is no question about the zero level. The stronger features are even apparent in the IDS spectra at much lower resolution. It is gratifying to note that the ratio spectra bear a close resemblance to solar chromospheric limb spectra. The lines which show up are those expected to be formed above the deep photosphere in the stellar atmosphere.

The qualitative explanation of this behaviour is straightforward: since the strong absorption lines probe a region further away from the stellar surface, this effect is presumably due to a differential increase of the source function at a given optical depth. Suppose one were to overlay a plot of the source function against optical depth (see Fig. 3) for a standard star and a T Tauri star (assuming that all lines share the same depth dependent source function, i.e. LTE). Then, for example, the residual intensity at the core of each line should reflect the value of this source function at approximately unit line center optical depth in each line. If we suppose the T Tauri star is identical to the standard star deep in the photosphere, and that its source function becomes increasingly larger as we move outward above a certain depth, then lines which become optically thick below that point will look the same in both stars, while lines formed above that point should have brighter cores in the T Tauri star. Thus, the depth of formation of lines which just begin to show up in the ratio plot is the depth at which the atmosphere of the T Tauri star is significantly perturbed relative to its main sequence counterpart. The fact that the weak lines are absent in the observed ratio spectra is proof that if you look deeply enough into a T Tauri star it looks "normal". By studying the excess emission as a function of depth, one obtains quantitative measures of the non-radiative heating structure of the atmosphere. Comparison of ratio plots for different stars gives an immediate useful characterization of the activity levels. Of course the real situation is not nearly as simple as outlined above; in the end one must take the presence of a feature in the ratio plot as a guide that detailed physical analysis of that line will be profitable. One must also keep in mind the possible circumstellar contributions especially in the very strong lines.

Ultimately, our purpose is to apply the full NLTE treatment of semi-empirical modeling to the data. We have, for example, calibrated line profiles for the Ca I, II resonance lines and Ca II IR triplet obtained at the same time. A model atmosphere which produces the desired synthetic profiles for these diagnostics can then be tested for consistency with the Balmer, Na D, Mg I B, etc. lines. Each line contributes a unique set of constraints to the emerging model. The model should also be able to explain the ratio spectrum and any UV continuum excess. We can hope to separate the near surface and circumstellar contributions to the spectrum and understand each with such detailed analysis. In the process, we will understand the relation of the pre-main sequence activity to its main sequence counterpart, and bring the level of ignorance about T Tauri stars to that for more studied examples of stellar activity.

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Following a successful first test on the 3.6 m telescope it is now expected that IRSPEC will be available for Visiting Astronomers in Period 38. This instrument is a cooled grating infrared spectrometer capable of achieving a maximum resolving power of 2.10^3 with a 6×6 arcsecond entrance aperture. It is currently equipped with a 32 element array detector sensitive between 1 μm and 5 μm, and any desired spectral region within this range can be covered by stepping the grating under computer control. As the test only ended in early December it is too early to provide detailed performance figures here. These will be made available via a formal announcement and/or more extensive article in the *Messenger* before the April proposal deadline. In the meantime however, the two accompanying spectra illustrate the type of spectrum display available on-line at the telescope.

A. MOORWOOD

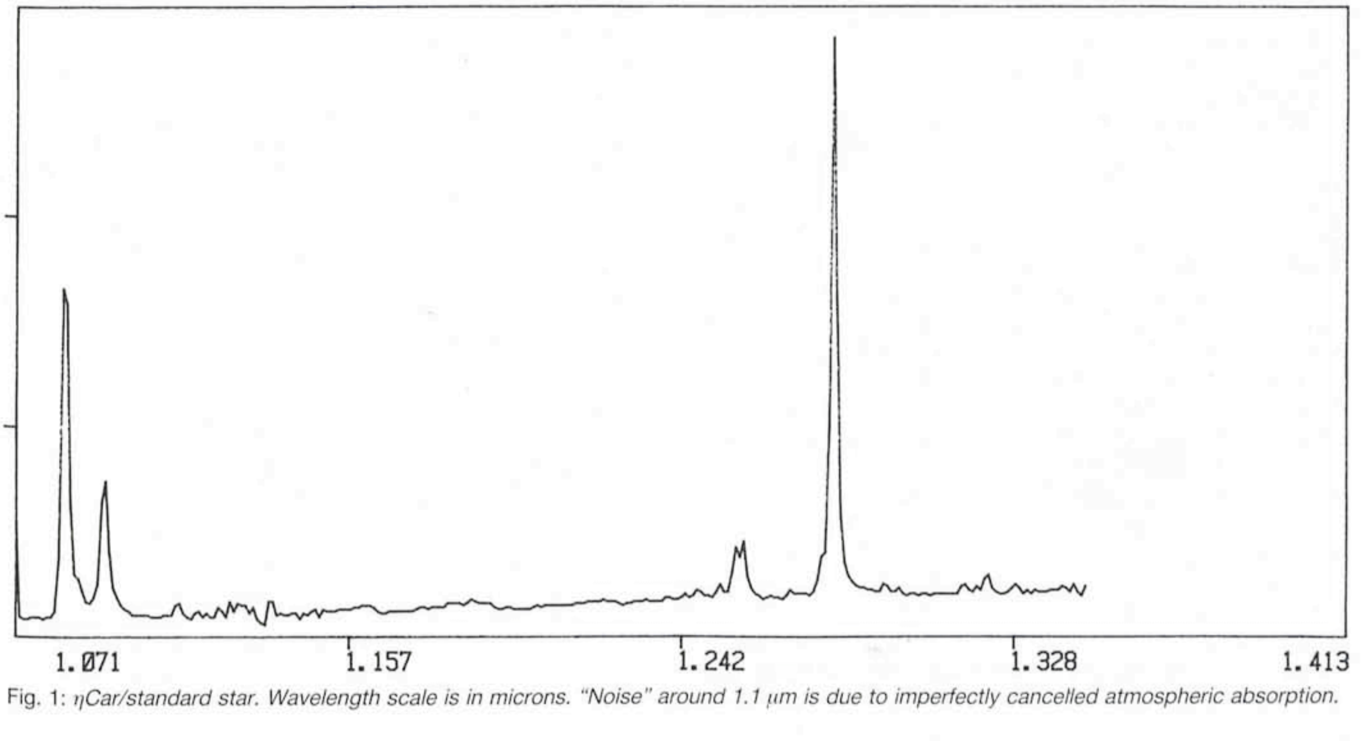

Fig. 1: *ηCar/standard star. Wavelength scale is in microns. "Noise" around 1.1 μm is due to imperfectly cancelled atmospheric absorption.*