DISCUSSION (Michaud)

STĘPIEŃ: What is the mechanism for the uniform mass loss you have introduced for the stars in your computations?

MICHAUD: I treated it as an arbitrary parameter, because it is clear from the very large number of abundance anomalies that there must be an additional parameter which is important. For example, the λ Boo stars are more rapidly rotating than the Am-Fm stars, and it is possible that the hypothetical mass loss is related to the rotation rate. In the He-rich stars it may be driven by radiation pressure. In cooler stars, especially when convective zones are present, weak coronae are also possible. We can only consider an additional parameter, because the parameter free model explains many properties.

KROLL: Is the assumption of mass loss that starts at the top of the atmosphere not in contradiction with the assumption of no turbulence?

MICHAUD: If the process driving the mass loss is radiation pressure, then it need not cause any turbulence. If there is a convection zone in the atmosphere as in the Am-Fm stars, the existence of a turbulent corona need not cause problems. The separation in these stars only takes place below the convection zone. Even in the Sun, there is an apparent underabundance of He in the solar wind, by a factor 2.5, so that somehow the solar wind succeeds in carrying less He than (presumably) there is in the bulk of the Sun.

COWLEY: If one tries to enhance the abundances of heavy elements at the surfaces of stars by adding differentiated planet-like (or Earth-like) material, one has the problem of making Ca and Sc underabundant. Could the diffusion process for these two elements act rapidly enough to deplete them relative to the other heavy species that have been added to the atmosphere?

MICHAUD: This would, more or less, be the reverse of the mass loss process. Accretion rates comparable to the proposed mass loss rates would probably be required, perhaps 10^{-15} or 10^{-14} $M_\odot$ per year. But, since we know that stars lose mass down to the lowest rates we can measure, why should stars stop losing mass at the level we stop being able to measure? The reason to prefer winds to accretion is that it gives far less arbitrary results. We have no observational evidence of planetary accretion. Of course, by having accretion and later differentiating it on the star you could explain a lot of things!! However, the model already explains a large number of the properties of these objects.

DROBYSHEVSKI: Why do you think that the convective envelope mass for a star with $M \approx 1$ $M_\odot$ will be only $M_c/M \sim 10^{-4}$? It is widely believed that for the Sun $M_c/M \sim 10^{-2}$, and that stars with $M \lesssim 1.5$ $M_\odot$ (about F5) have $M_c/M \gtrsim 10^{-3}$; this ratio is much smaller ($\sim 10^{-8}$ to 10^{-10}) in the range 1.5-3.0 $M_\odot$.

MICHAUD: I agree that the depth of the convection zone in the Sun is likely to be of the order $M_c/M_\odot \sim 10^{-2}$. The only reason for the smaller values I gave was that I only had with me, in Paris, results from models with α=1.0 and no helium. The exact value of the convection zone at F5 is very sensitive to α.

C. R. Cowley et al (eds.), Upper Main Sequence Stars with Anomalous Abundances, 477–478.

DISCUSSION (Drobyshevski)

MICHAUD: I have two questions. First, what is the observational evidence for the existence of such planetesimals in binary systems? Second, how much mass transfer (in $M_\odot$) do you expect on to the Am or Ap star?

DROBYSHEVSKI: The main observational evidence is a very nice detailed correlation between abundances in the uppermost layers of an igneously differentiated body (e.g., the lunar crust) and abundances observed on Am stars. The mass expected to be transferred from one component to another in a close binary system containing A-type components is of order 1-2 $M_\odot$. There may be thousands of these moon-like bodies in such a system.

MICHAUD: There have been small companions observed by Wolff (**Ap. J.**, 222, p. 556, 1978) around B stars and all these stars turn out to be normal.

DROBYSHEVSKI: In some close binaries, especially those with hot components, there will be no planetary bodies. If the gas temperature is more than about 2000 K, condensation does not take place and planetoids would not form.

DOLGINOV: If the main difference between normal A stars and Ap stars is the absence or presence of the planetesimals, how can the strong helium deficit in Ap stars be explained?

DROBYSHEVSKI: The He anomalies may be explained in the planetoidal impact model if one takes into account the magnetocosmochemical processes in matter streaming from one close binary component on to the other, when this matter transports magnetic field. Electric-discharge-like phenomena take place leading, for instance, to the isotope separation effect. In such discharges H may be well ionized, whereas He, due to its high ionization potential, is not. In such a case the process of He-H separation may proceed quite effectively. Similar ideas were developed by H. Alvén.