OPEN DISCUSSION; SESSION III (Chairman: Bengt E. Westerlund)

WESTERLUND: I declare the discussion open.

SERRANO: I would like to comment upon one of the points raised by Richard Larson in his talk. It's about the relation between star formation and the shear of the gas. Carrasco, Roth and myself (1980: Bull. American Astron. Soc. 12, 445) have studied this, and in at least three spiral galaxies; M31, M51 and our galaxy, star formation is inversely correlated with the specific angular momentum, j, of the clouds: $SFR \propto j^{-1}$, which is related to the shear.

WESTERLUND: Any other questions?

RUBIN: I would like to make a comment that will be familiar to all of those who were at Besançon at the meeting on internal dynamics of galaxies. That has to do with the correlation of mass and velocity and the expectation that Tully and his coworkers have that the sequence of galaxies is a one-parameter sequence. What I would like to argue is that it is a two-parameter sequence. The mass of a galaxy interior to any radial distance, R, is proportional to $V^2(R)R$; this follows just from the equivalence of gravitational and centrifugal forces. Hubble pointed out many years ago that radius is proportional to luminosity. This is a fact that is rediscovered every year, but I would like to attribute it to Hubble. Therefore, we may write that the mass is proportional to V^2L. Now for V^2 you can just as well use the width of the velocity profile, V_{max}; but mass is proportional to V^2 only for galaxies of equivalent luminosity. If you drop the luminosity parameter you are loosing something about galaxies. In terms of the Hubble sequence that we're used to thinking of, velocities for Sa's are higher than velocities of Sc's. But that does not mean that masses of Sa's are larger than than masses of Sc's; a very luminous, a very large, Sc, even though V is small, can have a mass which is larger than the mass of a small Sa with a very large V Therefore I think it is a mistake to say that mass is proportional to V^2 and to neglect the luminosity. Luminosities in galaxies go over a very large factor. We've studied Sc's with luminosities that range over five magnitudes or a factor of 100. Their radii go from 4 to 100 kpc, and it is a gross approximation to say that mass is proportional to V^2.

WESTERLUND: Thank you. Any comments from the invited speakers? No. They are evidently happy.

TAYLOR: I'd like to address a comment or question to Richard Larson about the different manner in which star formation occurs in different places. I have the impression that there is certainly a qualitatiave difference between star formation in different places, in the following

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way. Whatever way you look at it, star formation is exceedingly inefficient in our Galaxy at this time. If you compare, for example, the rate at which gas goes into stars and the amount of gas that there is in giant molecular clouds, then it seems fairly clear that when giant molecular clouds form stars they don't put all their mass into stars, i.e., that a rather small efficiency occurs. Various people have done different calculations on this. I think they all come out with an efficiency of no more than a few percent of actual getting gas into stars. On the other hand, I doubt if that is true when elliptical galaxies first formed, and I doubt that is true in some of these massive bursts that we see in dwarf irregulars. I'd just ask, would you agree that there is a qualitative difference between the way in which star formation occurs in different places?

LARSON: I'm not sure whether one should talk about a qualitative difference or just a quantitative difference. After all, in present day spiral galaxies the differential rotation is rapid and the surface gas density is presumably lower than it was in the early stages of formation of an elliptical galaxy. Hence, the gas is relatively sparse and it's rapidly being wrapped up by differential rotation. Objects that manage to form in it are relatively easily disrupted, relatively extended, compared to what might have been the case if you had a larger gas density and lower shear. You can imagine that molecular clouds might have been very much more condensed, much more difficult to destroy, than, perhaps, the relatively sparse and ragged things that we see around now. I guess I was suggesting that it's more a quantitative than a qualitative difference.

TULLY: I will then say a few words in response to the points that Vera raised. Vera prefers to draw attention to differences between different morpohological types, where I am very impressed by the similarities between different morphological types in plots of luminosity to line-profile width, for example, or in plots of color to line-profile width, on color-luminosity plots. I think that in the sample that I've accumulated, the sample that Aaronson *et al.* have looked at, the sample that de Vaucouleurs and his collaborators have looked at, we find only very marginal separations as a function of morphological type in the plots that we have. As a consequence, we are taken by the fact that perpendicular to these relationships there are only marginal separations as a function of type. It's quite true, as Vera says, that calling line profile widths equivalent to mass is not an obvious thing that would necessarily follow. The reason that I take that liberty is, in fact, because of the tightness of the line-profile-width vs luminosity relationship. The fact, then, that that relationship is as tight as it is and the fact that luminosity is presumably a measure of mass permits me to use that expression. I think that the dust hasn't fully settled on these matters.

WESTERLUND: Well, I don't see any signs of anyone wanting to continue the discussion, so I will ask Dr Ken Freeman to summarize the situation with old populations that we've heard here today and to give us his own views on them, too. Ken.