DISCUSSION: STAR FORMATION AND CLUSTERING

Paper: **Star formation in the Magellanic Clouds**
Author: ***A.R. Hyland***

HODGE: *The field 14 curve in the figure shown from my paper was lost in the printing process. It can just barely be discerned in some copies of that journal.*

DOPITA: *The flat character of the metallicity/age relationship can be explained as being the result of a long infall timescale for gas, however we do need* $\tau_{inf} \sim 8$ *Gyr to generate such flat relationships. The relative steepness of the LMC relationship in the past ~ 5 Gyr is not explained on this model, however, and we would have to associate this with the development of the Bar.*

DA COSTA: *I would point out that the Smith et al LMC age-abundance relation for clusters uses ages inferred from integrated spectra. These are not very good. In fact, at present we know only one cluster with 3<age<~15 Gyr so age-abundance is not well constrained over most of LMC life by clusters.*

LEQUEUX: *A comment for clarification - Colors of galaxies give information on the ratio of present star formation rate to the integrated star formation in the past and tell nothing about the detailed history of star formation : compatible with bursts or steady star formation etc.*

You mention that in cases where propagating star formation can be seen it seems to commence 2 - 5x10^7 *years ago. Can't that be at least in part a selection effect due to the faintness of the stars remaining from older ages?*

HYLAND: You are absolutely correct. Nevertheless the statement that the integrated colours of the LMC and SMC imply that, compared to the present, star formation has been relatively constant (in contrast to the Galaxy) still holds.

It is certainly possible that there is some selection effect, since the regions are chosen for study on the basis of youth indicators.

WESTERLUND: *You should not underestimate the star formation rate in the LMC and SMC over* 10^{10} *year ago only because the number of globular clusters is small. It is about the same percentage of mass as in the Galaxy . There appears to have been hints of star formation* 3×10^9 *and* $\sim 5 \times 10^8$ *years ago in the LMC according to Froyd and Blaucon's red giant star distribution. It is also seen in the carbon star distribution and may have been more global than thought.*

HYLAND: I agree with your second comment, but would like to reiterate that evidence for the more recent (less active) burst, refers only to a particular region (the Bar West) and may not be a global enhancement of star formation.

Paper: **The star formation histories of the Magellanic Clouds**
Author: ***H.R. Butcher***

DOPITA: *The Fujimoto and Murai orbits were derived from the requirement to produce a Magellanic Stream from purely gravitational interactions. Given that a ram-pressure stripping model seems to work better to produce the Magellanic Stream, what reliance can be placed on the Fujimoto and Murai 'epochs of interaction' in looking for epochs of interactively triggered star formation?*

BUTCHER: Because there doesn't seem to be any compelling correlation between identifiable stars forming events other than the most recent LMC one 0.1 Gyr ago, I suppose interactions may be irrelvant to the star forming history. The time scales for the various orbits and for the major star forming events are not similar, and the star forming histories in the SMC and LMC may be different. On the other hand it may simply be the case that star

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formation triggered by interaction is a minor phenomenon relative to other evolutionary effects operating in the clouds.

Paper: **Recent star formation history in the region of 30 Doradus**
Author: ***M.C. Lortet et al.***

WALBORN: *It is worth emphasising that our detailed knowledge of the most massive stellar content of the Magellanic Clouds is just beginning. Lortet et al. have found 40 new O stars, including half a dozen earlier than O5, in the region of N157B, and last year Marvey et al. doubled the number of O stars known in the SMC with their study of NGC346. The reason is that these stars are found selectively in compact clusters and multiple systems, often associated with bright nebularities and relatively higher reddenings, which results in their selective omission from objective-prism and photometric surveys.*

The only way to study them is by detailed spectroscopic and photometric programs in individual regions; only about half a dozen such regions have been so investigated to date, but many more will be in the next few years. Only then shall we have definitive information about the massive stellar content and IMF of the Magellanic Clouds.

Paper: **Star clusters in the Magellanic Clouds**
Author: ***S. van den Bergh***

FREEMAN: *There is evidence (that not all would believe) that the oldest LMC clusters lie in the disk. Have you compared the ellipticity distribution of the old LMC clusters with the ellipticity distribution of the Galactic disk globular clusters rather than the entire Galactic globular cluster sample?*

VAN DEN BERGH: Dust clouds might produce assymetric absorption which will make a cluster appear to be flattened (M19 is an example of this effect). As a result, it is difficult to compare the Σ values of low-latitude Galactic disk clusters with those of the LMC clusters.

MOULD: *Bothun and Thompson's data shown yesterday indicated that the Bar has one of the oldest and reddest stellar populations in the LMC. If the Bar is an old structure, could it be that the clusters in the Bar are short lived rather than the Bar itself?*

VAN DEN BERGH: A good question! The observations by Hodge and by Mateo show that old clusters near the dynamical center of the LMC have smaller radii than those in the outer parts of the Large Cloud. Since the Bar is close to the dynamical center one would expect the old clusters in it to have had small radii, i.e. they are not expected to be particularly "fragile". Clusters in the Bar might have been destroyed if either:

1. there was once a particularly high concentration of GMC's in the Bar region, which disrupted clusters thereon;

2. the old Bar clusters had a very flat mass spectra, so that the clusters expanded rapidly as stars evolved and lost mass.

Both of these explanations are, of course, entirely *ad hoc*.

GASCOIGNE: *Has anyone looked at the possibility of interchange of clusters between the Clouds and the Galaxy during a close approach between the two?*

VAN DEN BERGH: Clusters as flattened as Cloud globulars do not exist in the Galactic halo. This suggests that our Galaxy has not captured a significant number of LMC or SMC globulars.

MATEO: *I wish to expand on J. Mould's point. There are at least 3 clusters in the bar (NGC 2005, 2019 and 1916) with photometric integrated colors that suggest they are very old.*

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However, these objects are so compact and the fields are so crowded that they do not yet have CMDs and I am unaware of any RR Lyr searches.

MATEO: *Could the absence of old clusters in the Bar of the LMC be due to selection effects?*

VAN DEN BERGH: Perhaps. Observers might have discriminated against old clusters in crowded Bar fields. On the other hand, novae, which could have been discovered in the LMC Bar, are also observed to avoid the Bar region.

Paper: **Magellanic Cloud globulars as cosmological tools**
Author: ***Alvio Renzini***

VAN DEN BERGH: *You point out that some populous cloud clusters have masses that are almost as large as those of typical Galactic globular clusters. This does not, however, mean that real globulars are now being formed in the Clouds. It strikes me as being remarkable that clusters were formed with the same luminosity function in the LMC, the Galaxy and the giant ellipticals in Virgo during the globular cluster forming era 15 Gyr ago.*

RENZINI: Concerning your first point, let me emphasise again that LMC has been able to make a cluster with a mass close to the average of Galactic globulars, during just the last 10^8 yrs, i.e. during a fairly short time. Moreover, rather than comparing the present mass distribution of young MC clusters to the present distribution of Galactic globulars, we should allow for an extensive cluster production (several Gyrs), for their ageing (~15 Gyr) and only after that compare them with Galactic globulars.

Paper: **The kinematics and abundances of star clusters in the LMC**
Author: ***R.A. Schommer***

TOBIN: *How were the flat fields obtained for such a large field of view?*

SCHOMMER: Twilight skies were used to flatten the frames. Flattening to ~3% was achieved. I believe the R & I frames had larger residual flattening errors.

HUGHES: *Can the statement "little evidence of 10 Gyr stars contributing to surface brightness" be quantified?*

SCHOMMER: Very difficult to decide the contribution from old stars on the basis of colour alone.

CANNON: *How many stars did you observe in each cluster, and to what extent are your results liable to be affected by contamination by non-members?*

SCHOMMER: Typically 2 stars per cluster. The velocities and abundances generally agree quite well for these pairs, and contamination is not much of a problem for the outer clusters.

Paper: **Young star clusters in the MCs**
Author: ***K.C. Freeman, R.A.W. Elson***

MATEO: *There may be a strong selection effect against finding, or at least studying, young clusters with large core radii. One candidate of this sort of NGC2010 which has a low central sub brightness, large core radius, but is quite young (~80 - 100 x 10^6 years).*

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Paper: **The age-abundance relations and age distributions for the star clusters of the Magellanic Clouds**
Author: *G.S. da Costa*

HATZIDIMITRIOU *The flat age-metallicity relationship found for SMC clusters with ages between ~2 Gyr and ~10 Gyr was generally confirmed from the colour-magnitude diagrams of field populations in the NE and SW outer parts of the SMC. The CMDs cover an area of 48 square degrees, at radial distances larger than 2 Kpc from the centre of the SMC and were constructed on the basis of COSMOS measurements of UKST plates.*

DA COSTA: I'm glad to hear this confirmation since the SMC Age-Abundance relation is defined by only a small number of clusters in this age interval.

MOORE: *Doesn't the 3 Gyr change in slope in the SMC age-abundance graph coincide with the burst of cluster formation in the LMC and thus indicate that the influence may have been external rather than internal?*

DA COSTA: I agree that the upturn in the SMC age-abundance relation coincides roughly with the apparent burst of cluster formation in LMC. However, there does not seem to be a corresponding increase in the numbers of SMC clusters at this time.

MATEO: *In our paper on ESO 121-SCO3, we speculated that this cluster may have been swapped from the SMC to the LMC. Does ESO 121-SCO3 lie on the [Fe/H]-age relation of the SMC any better than it lies on the AMR of the LMC?*

DA COSTA: ESO 121-SCO3 "defines" the AMR of the LMC in the 3 to 15 Gyr range! It is however, somewhat more metal rich, by 0.4 .dex or so, than SMC clusters of the same age. So, it wouldn't lie on SMC AMR but with few clusters we have no idea of what the dispersion about the SMC AMR is.

Paper: **Mass-to-light ratios of Magellanic Cloud star clusters**
Author: *M. Mateo et al.*

FREEMAN: *What were the curves superimposed on your M/L - age diagram?*

MATEO: Those lines are the predicted (M/L) - Age relations from the simple models given in your paper on the structure of young LMC Clusters. I show them simply to illustrate that the empirical behaviour is similar to the predicted behaviour. However, I would hesitate to infer anything about the IMF from this comparison because both the data and models are uncertain or simplistic (note that the models don't account for the Globular cluster (M/L) ratios).

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