Physics of Galaxies
Hand-in exercises 2018

Instructions: These are the three problems you need to solve to pass the course if you have already actively participated in the three exercise sessions. In case you failed to participate in either of these, you should contact the teacher for additional problems to solve in order to pass the course. Hand-written solutions are quite acceptable, but submission via email is highly encouraged (and will allow for a swifter evaluation), so please consider scanning your solutions (or taking photos of them) and submitting them in electronic format. The deadline for handing in solutions to these problems is **June 14, 2018**.

1. *Cosmic star formation.* How many stars are there in the observable Universe? Make an order-of-magnitude estimate of this, quantify the uncertainty and make a top-3 list of the most important shortcomings/simplifications that are likely to affect your estimate (and clearly explain why this is so).

2. *Population synthesis.* Use the table of stellar parameters below to generate a simple population synthesis model. Assume that the stellar population of your model galaxy only consists of three types of stars (O5, A0 and M0), all formed at the same time, and that the relative number of stars of each type is given by the Salpeter IMF.

a) What is the (B-V) colour and M/L_V ratio of this population at an age of 1 Myr?

b) Assuming that the population has aged sufficiently for all the O stars to die (and no longer contribute to the light emitted), what is the (B-V) colour and the M/L_V ratio (where M is defined as $M = M_{\rm stars} + M_{\rm gas} + M_{\rm remnants}$)?

Table 1: Stellar parameters

Stellar type	Mass ($M_\odot$)	Luminosity in V ($L_{\odot,V}$)	(B-V)	Main sequence lifetime (yr)
O5	40	2.5×10^5	-0.35	$1.6{\times}10^6$
A0	4	80	0.00	$5.0{\times}10^8$
M0	0.5	0.06	1.45	$7.9{\times}10^{10}$

3. *Surface brightness.* Derive an expression which converts surface brightness in units of mag arcsec^{-2} to $L_\odot$ pc^{-2} and show that surface brightness is independent of distance (as long as redshift dimming is neglected).

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