Modelling stellar population in galaxies resolved in stars by Gaia

Maya Belcheva

National and Kapodistrian University of Athens, Greece

M. Kontizas & E. Livanou

National and Kapodistrian University of Athens, Greece

E. Kontizas & I. Bellas-Velidis

National Observatory of Athens, Athens, Greece

G. Nikolov

Sofia University "St. Kliment Ohridski", Sofia, Bulgaria

Outline

- Introduction
- Available data
- Results
- Conclusions

Introduction

- Gaia is expected to resolve in stars galaxies in the LG
- Our goal is to investigate the spatial distribution of stellar populations in these resolved galaxies
- Distance modulus of the Magellanic Clouds is ~18.5
- The stellar content accessible to Gaia in the MCs: *MS, RGB, AGB, supergiants*
- Gaia will also provide *positions, proper motions* (down to 20mag), *radial velocities* (down to 16mag) for these stars
- Results can be useful for improving the Gaia Universe Model

What data we used

Infrared:

2MASS

- large area
- not as deep as the optical data

Optical:

SuperCOSMOS

- limited only to the outer parts

Magellanic Clouds Photometric Survey

Zaritsky et al. (2002, 2004)

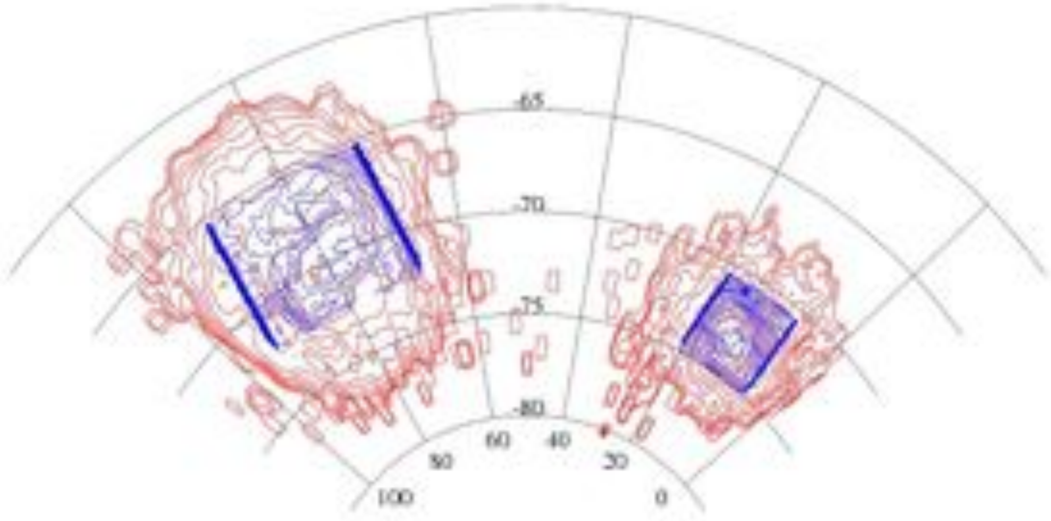
- limited only to the central parts
- complete up to V~20

Carbon stars

Kontizas et al. (2001)

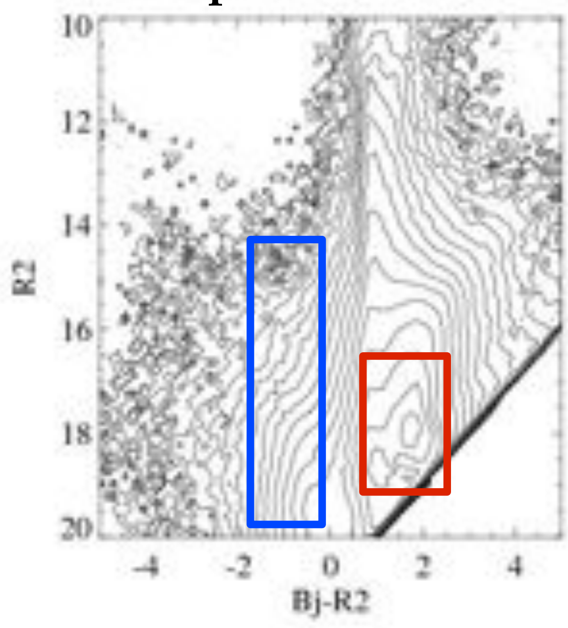
Rebeirot et al. (1993) & Morgan et al. (1995)

- intermediate mass stars
- almost complete sample

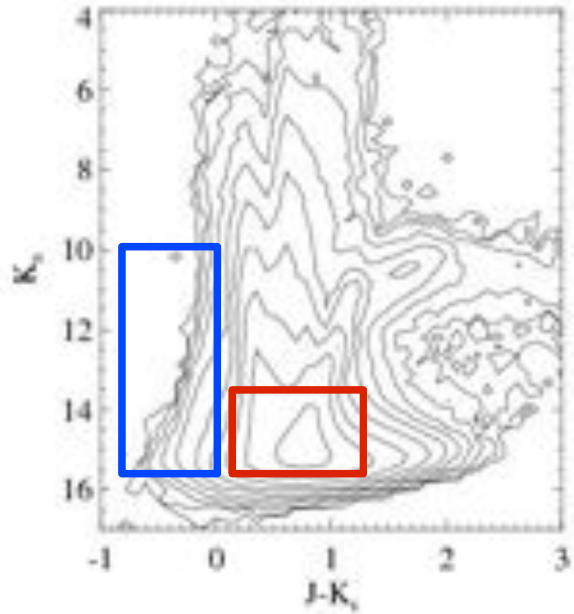


How we used it

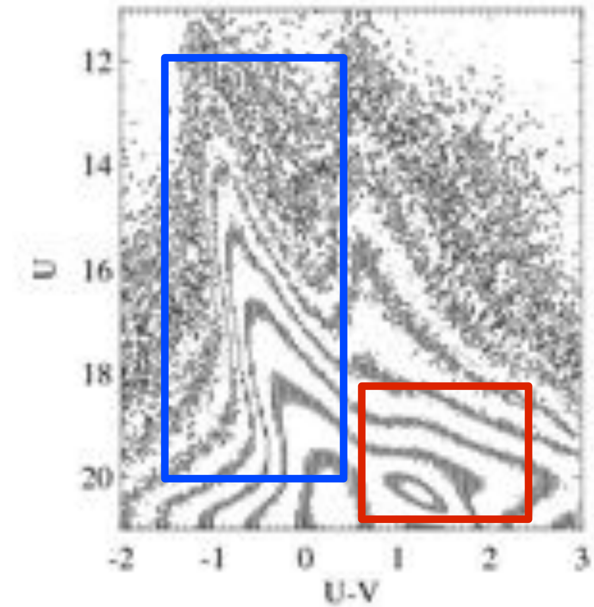
SuperCOSMOS



2MASS



MCPS



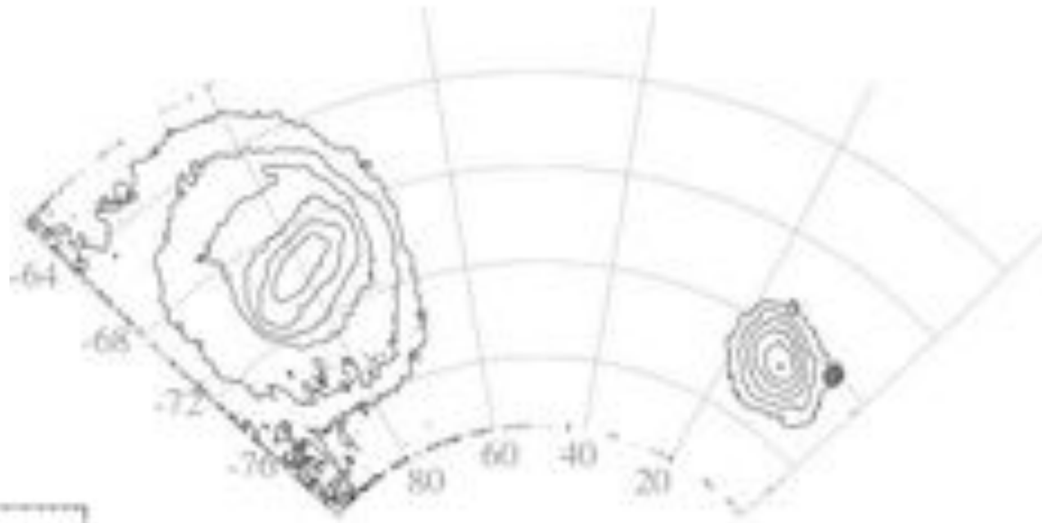
- Isodensity contour maps
  - shape
  - size
  - distribution
- Radial Density Profiles fitted by
  - Exponential model

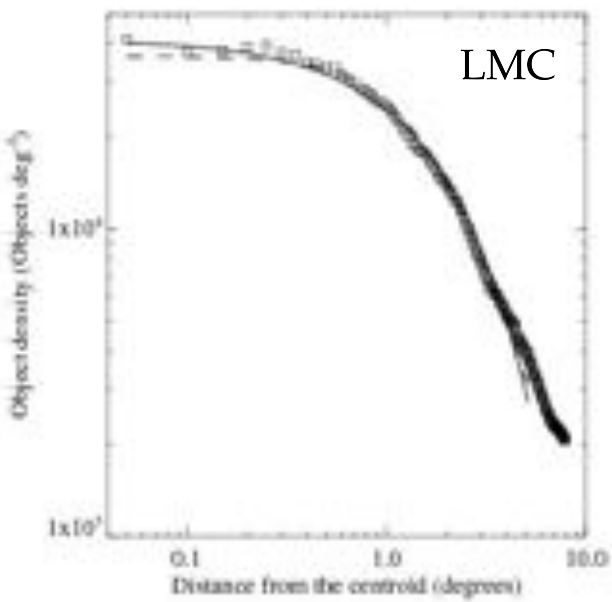
$$\sigma(R) = \sigma_{0D} \times e^{-\frac{R}{h_D}}$$

  - King model

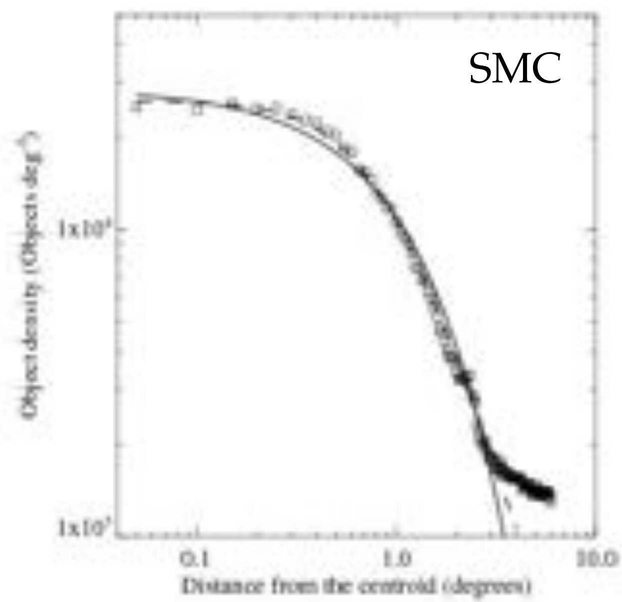
$$\sigma(R) = \sigma_{0K} \left(\frac{1}{\sqrt{1 + \frac{R^2}{R_c^{\,2}}}} + \frac{1}{\sqrt{1 + \frac{R_t^{\,2}}{R_c^{\,2}}}} \right)^2$$

2MASS: *0.2 < J-K < 1.2 & 13.5 < K < 15.5*

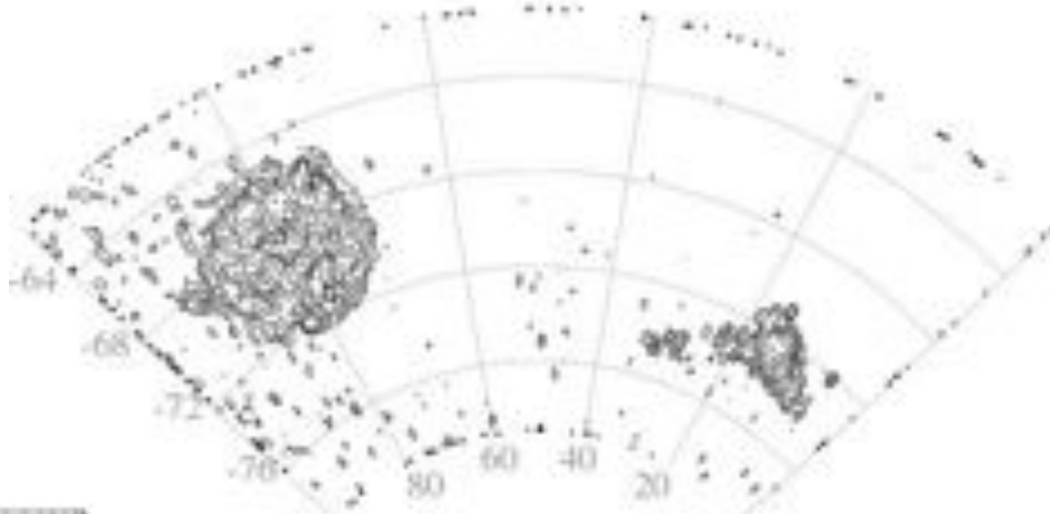


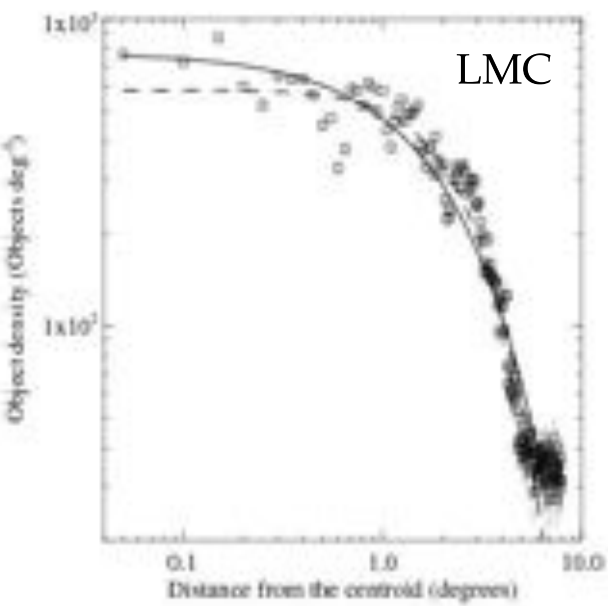


LMC	radius	SMC
1.89 ± 0.02	R_D	1.03 ± 0.02
1.58 ± 0.02	Rc	0.82 ± 0.01
--	Rt	--

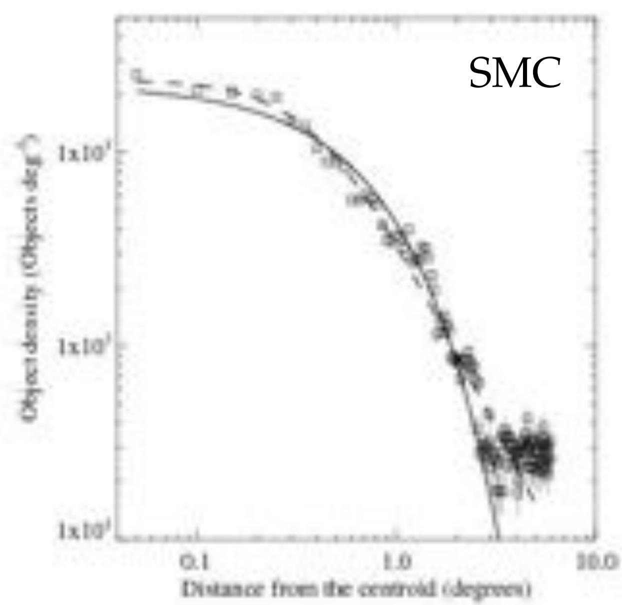


2MASS: $-0.5 < J-K < 0.2$ & $K \leq 15$

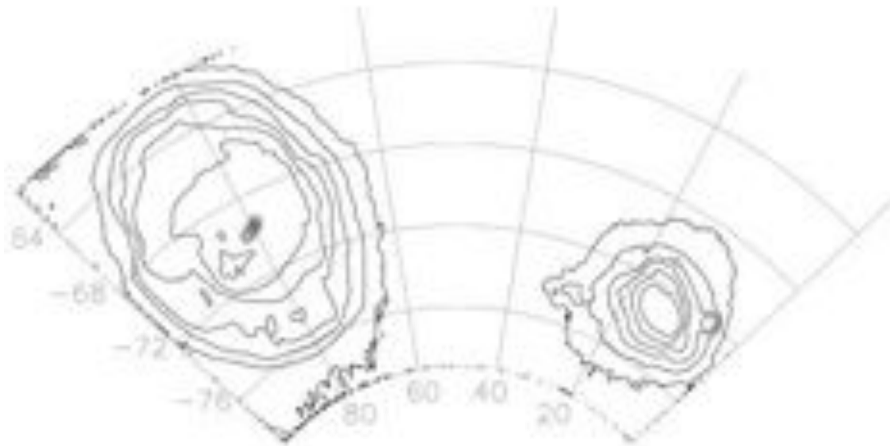


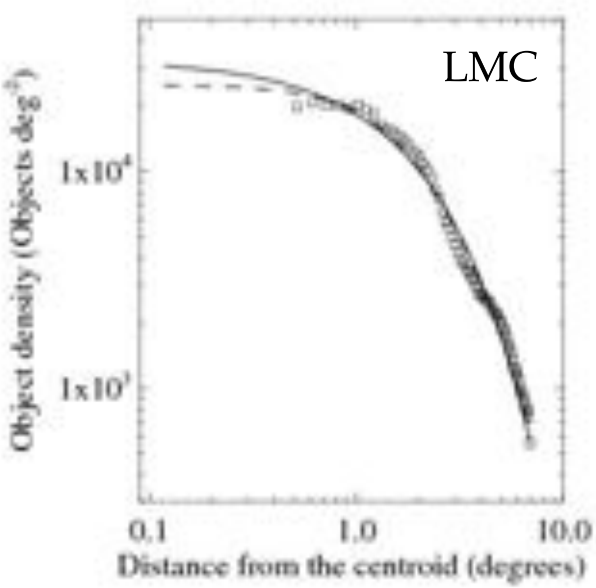


LMC	radius	SMC
2.01 ± 0.05	R_D	0.60 ± 0.01
2.9 ± 0.2	Rc	0.40 ± 0.01
--	Rt	--

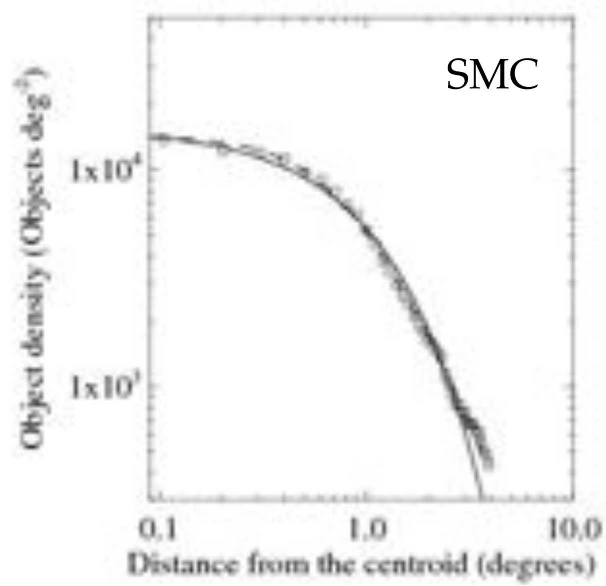


SuperCOSMOS: *1.2 < Bj-R< 2.5 & 17 < Bj < 19*

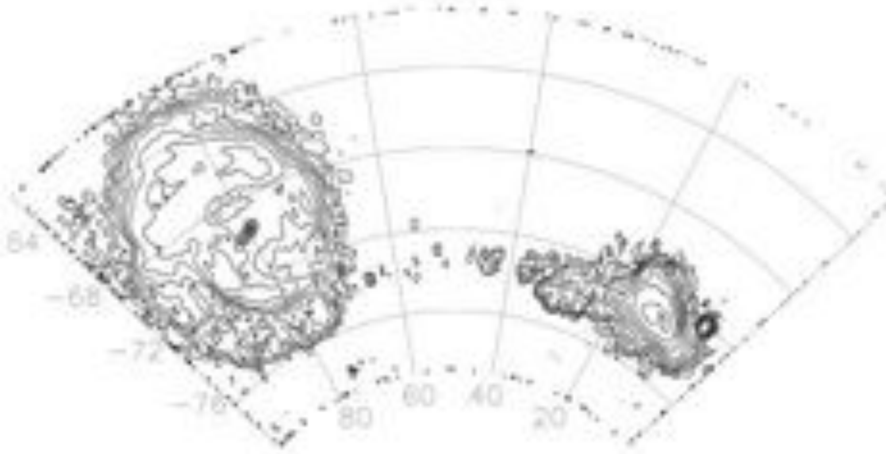


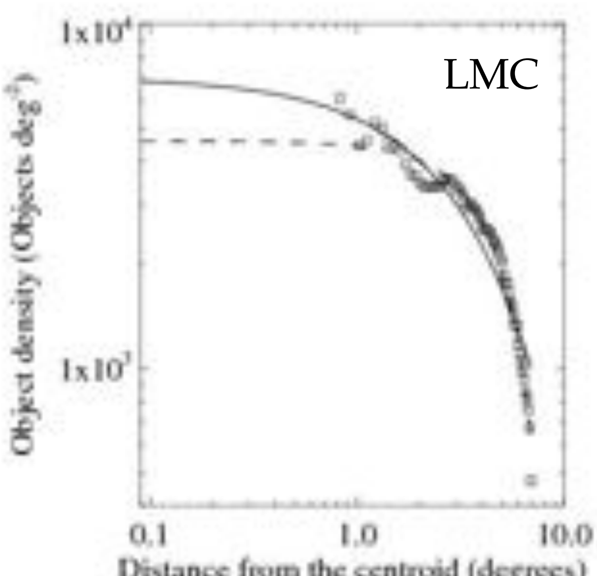


LMC	radius	SMC
3.6 ± 0.1	R_D	0.75 ± 0.02
9.3 ± 0.5	Rc	0.85 ± 0.05
10.7 ± 4.4	Rt	5.3 ± 0.5

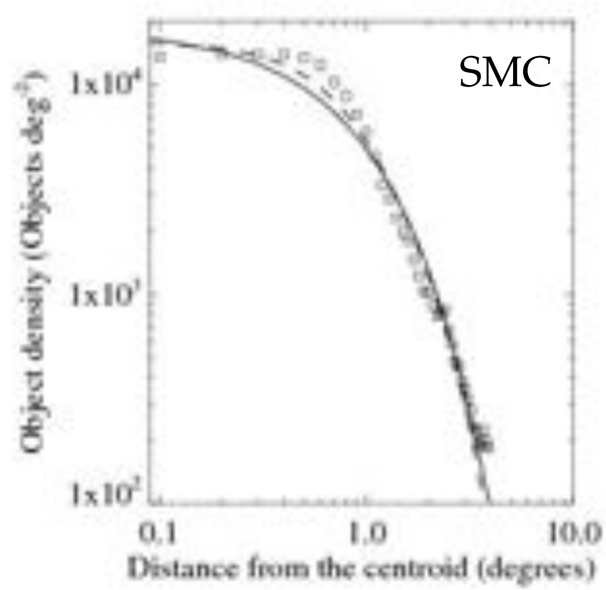


SuperCOSMOS: *-1 < Bj-R< 0 & 15 < Bj < 20*

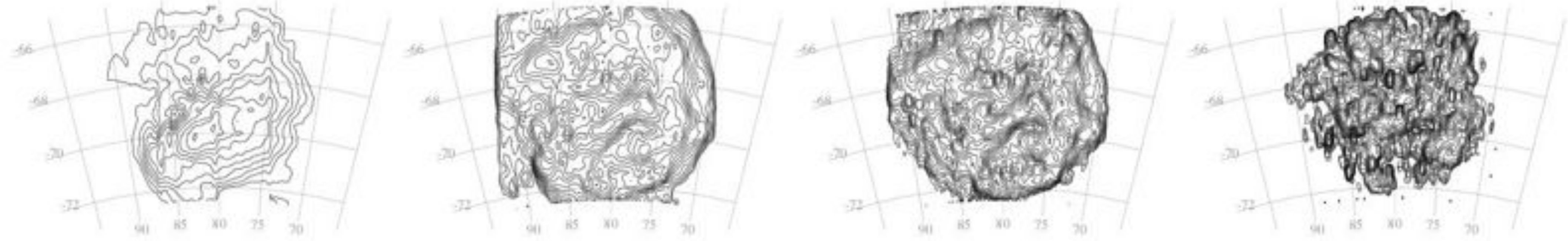




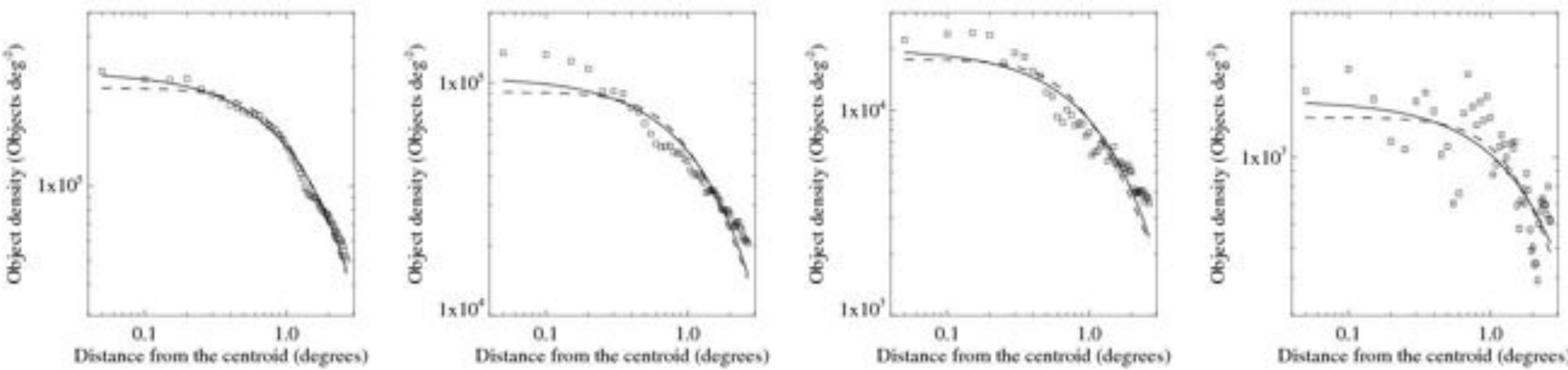
LMC	radius	SMC
1.71 ± 0.03	R_D	0.92 ± 0.02
1.89 ± 0.08	Rc	0.76 ± 0.02
15.5 ± 1.5	Rt	33 ± 11



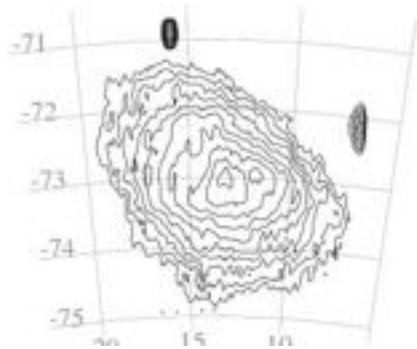
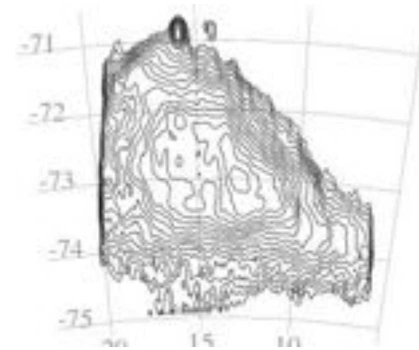
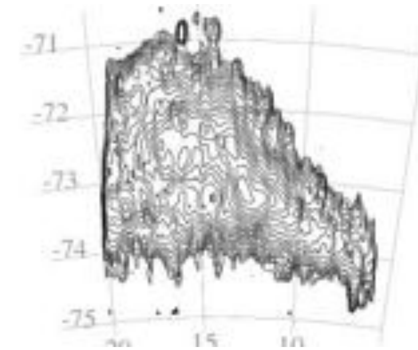
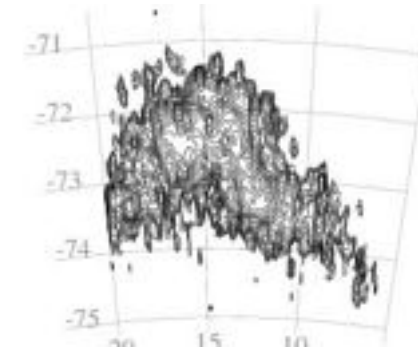
MCPS: *LMC*



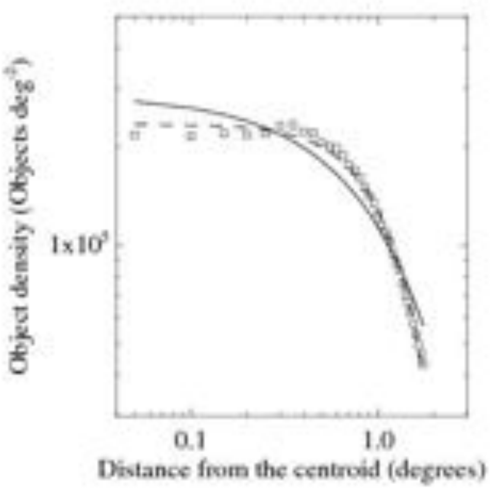
> 2 Gyr	170 – 400 Myr	12 – 170 Myr	< 8 Myr
$R_D = 1.43 \pm 0.02$	$R_D = 1.35 \pm 0.06$	$R_D = 1.25 \pm 0.07$	$R_D = 2.4 \pm 0.3$
$Rc = 1.23 \pm 0.03$	$Rc = 1.48 \pm 0.06$	$Rc = 1.01 \pm 0.06$	$Rc = 1.9 \pm 0.2$

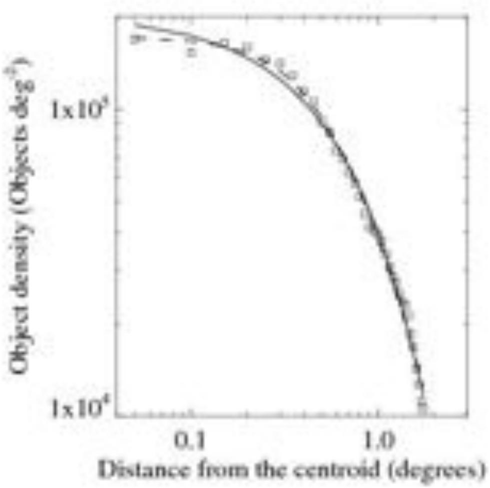


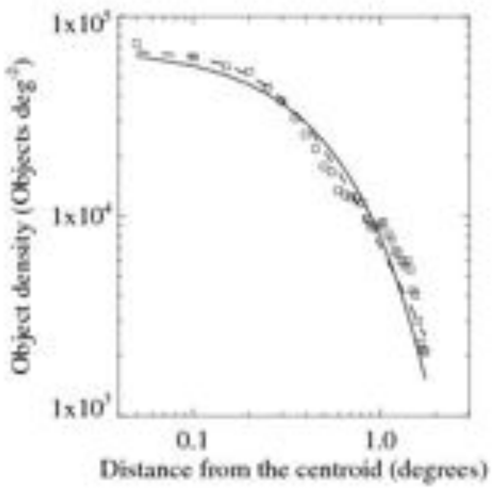
MCPS: *SMC*

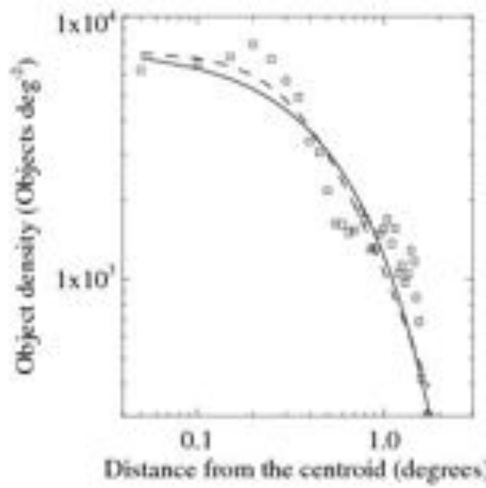





> 2 Gyr	170 – 400 Myr	12 – 170 Myr	< 8 Myr
$R_D = 1.08 \pm 0.06$	$R_D = 0.61 \pm 0.01$	$R_D = 0.46 \pm 0.02$	$R_D = 0.55 \pm 0.04$
$R_C = 1.8 \pm 0.2$	$R_C = 0.57 \pm 0.02$	$R_C = 0.34 \pm 0.01$	$R_C = 0.41 \pm 0.03$

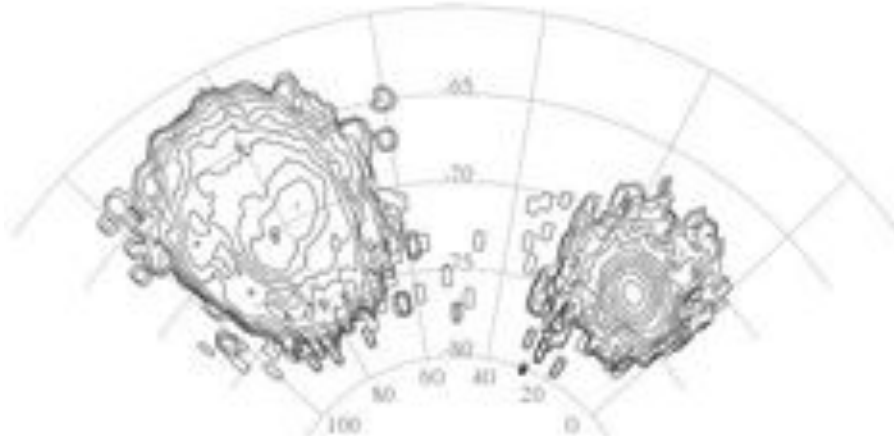


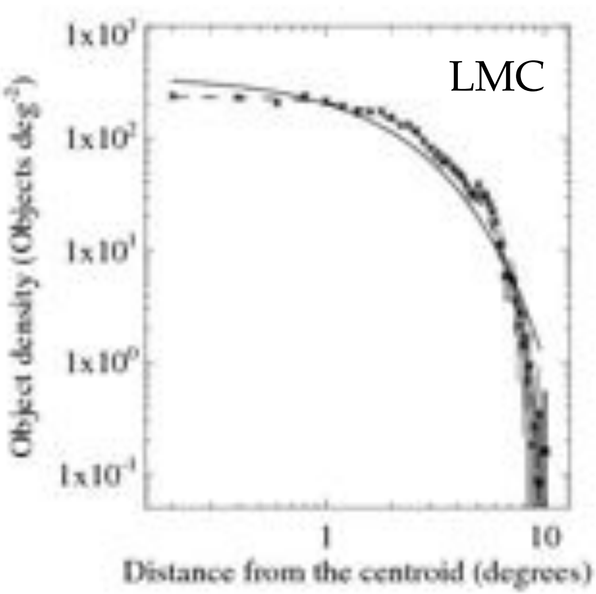






Carbon Stars





LMC	radius	SMC
1.69 ± 0.06	R_D	0.69 ± 0.02
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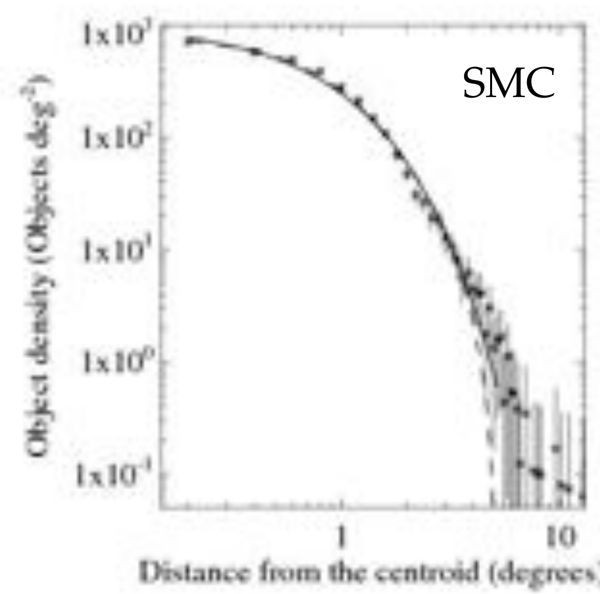
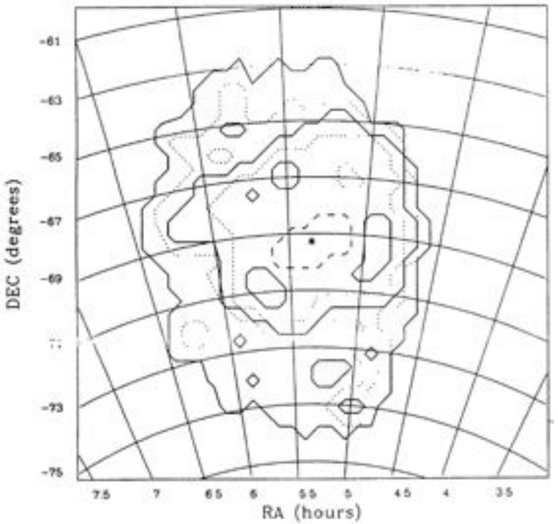
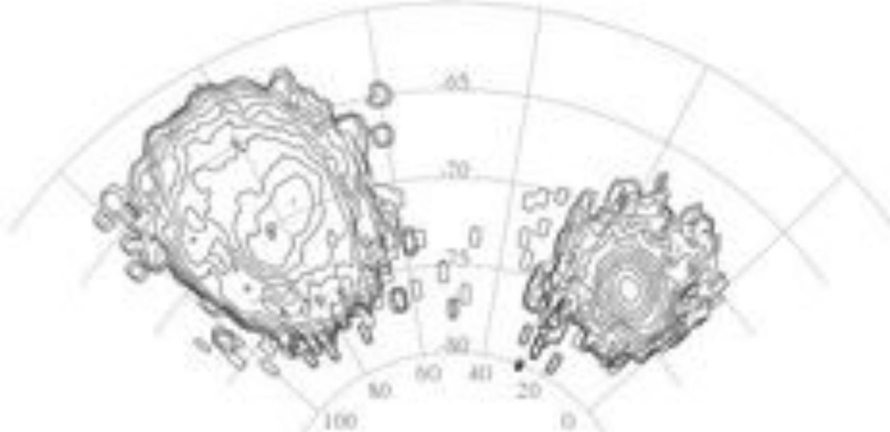
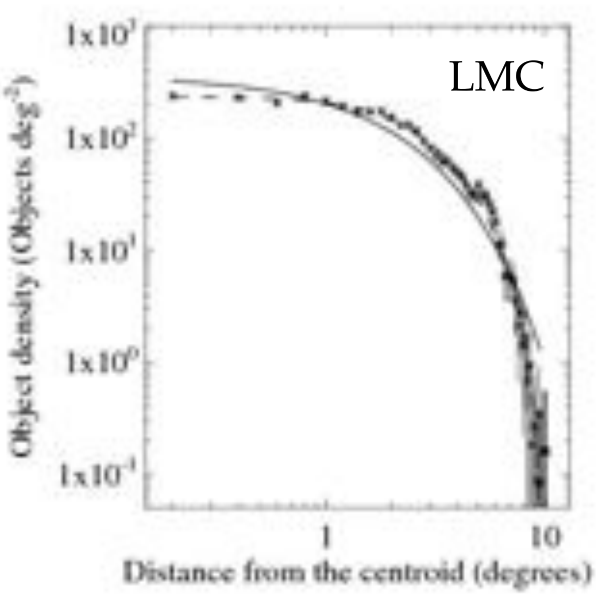
9.7 ± 0.2	Rt	5.2 ± 0.3



Carbon Stars







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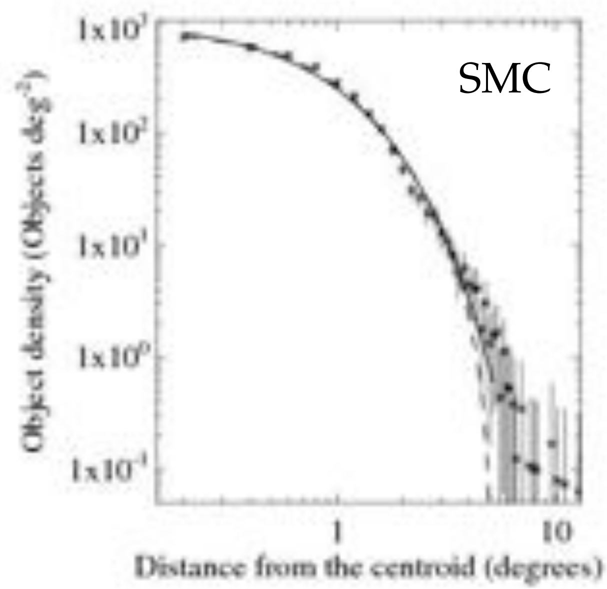

Summary & Conclusions

- Carbon stars reach the outermost parts of both Clouds and in the same time does not seem to suffer from crowding effects
- LMC displays two subsystems with different orientation (seen the carbon stars distribution, as well as in 2MASS data)
- Structural parameters are obtained from RDPs fitting with Exponential disk and King models

Gaia is very important for our understanding of the relationship between our Galaxy and the Magellanic System!

The MCs & The Gaia Universe Model

- Adopted the most appropriate optical data set down to Gaia's detection limit – *Magellanic Clouds Photometric Survey*
- For each star we provided the astrophysical parameters, such as *luminosity class, spectral type, temperature, log g* using stellar evolution models
- For other parameters, such as *metallicity, radial velocities, distance, proper motions,* were adopted as reasonable values as were available

R.A.	Declination	B	V	I	Mv	Sp. Type	Teff	log g
6.70	-73.82	13.79	13.19	12.52	-5.78	G5	5010	1.01
6.70	-73.85	15.52	14.56	13.47	-4.41	K0	4720	1.83
6.71	-74.27	15.58	14.04	12.72	-4.93	M0	3660	1.06
6.71	-72.99	15.19	14.11	12.56	-4.86	K1	4580	1.40
…	…	…	…	…	…	…	…	…

Image courtesy of NOAO/AURA/NSF