Constraining formation scenarios for S0 galaxies through their Globular Cluster systems

Rubén Sánchez-Janssen

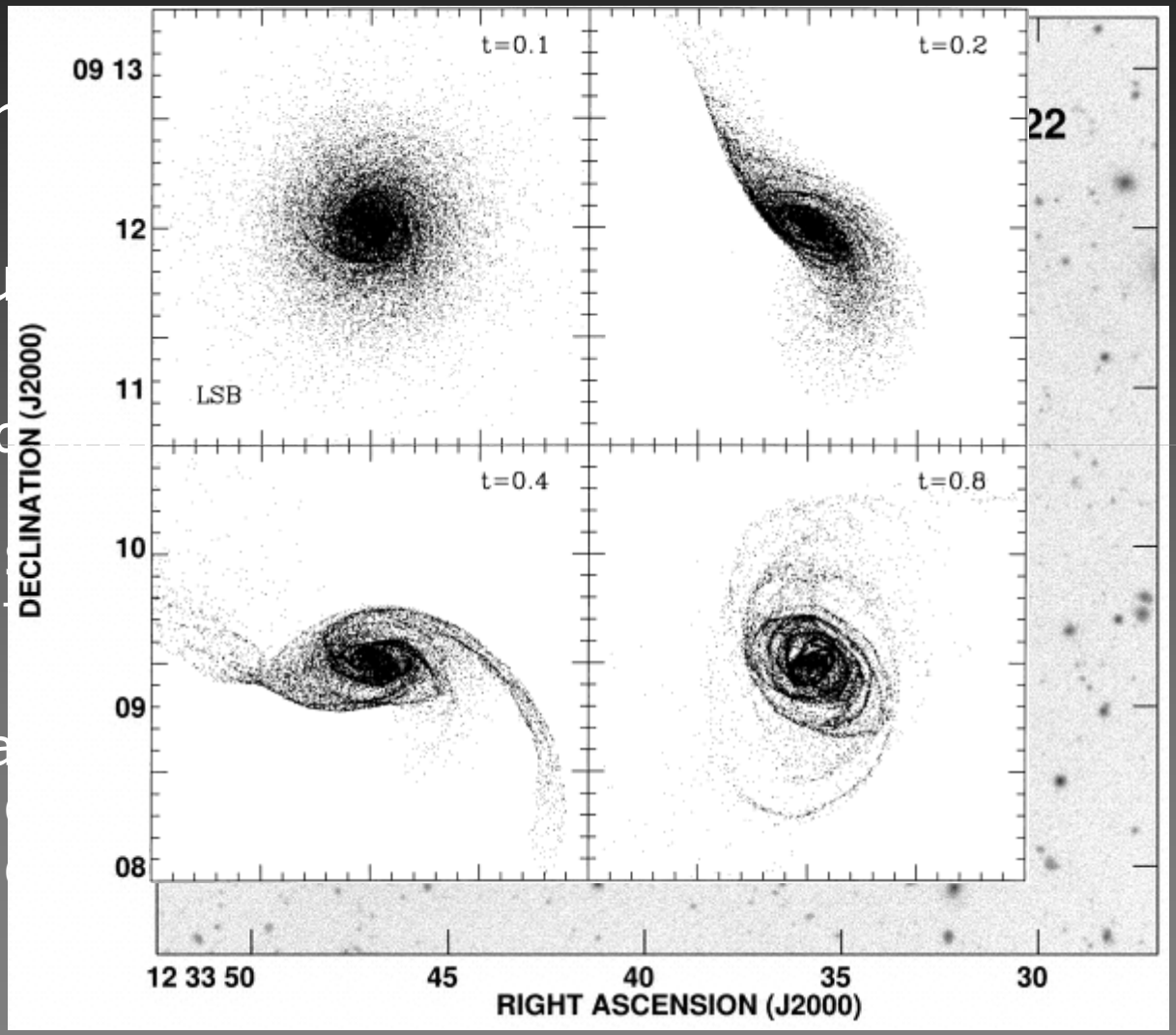
VII Workshop Estallidos

Madrid, 26 Enero 2009



Origin of cluster populations

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- Nurtu
  - Hyc
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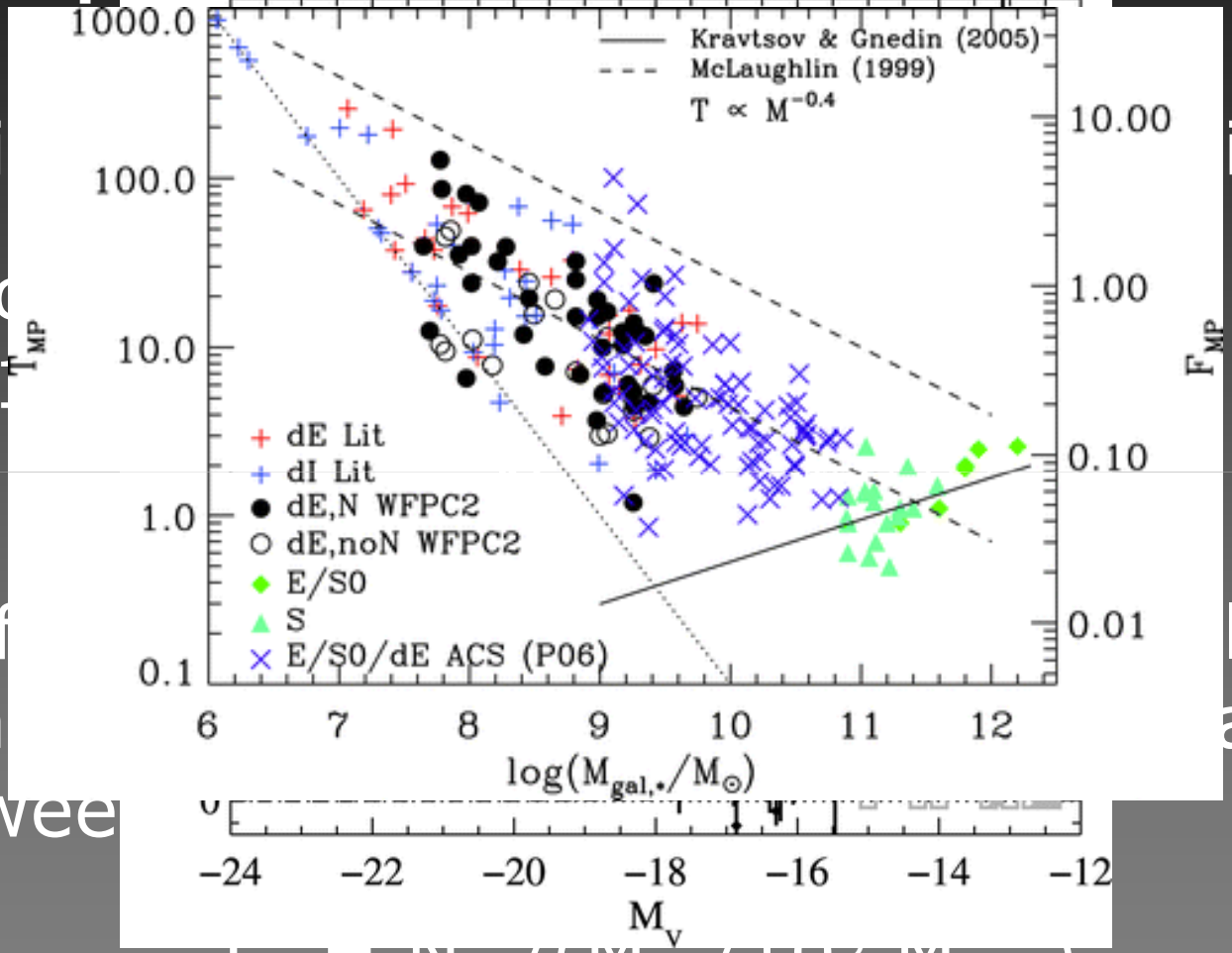
Origin of cluster populations

- Difficult to distinguish between scenarios
- Can we find a sensitive tracer?

- Try with Globular Cluster systems:
  - They’re ubiquitous in bright galaxies
  - Old and relatively simple population
  - Sensitive tracers of environmental effects
  - Compare with theory/simulations predictions

Properties of GC systems

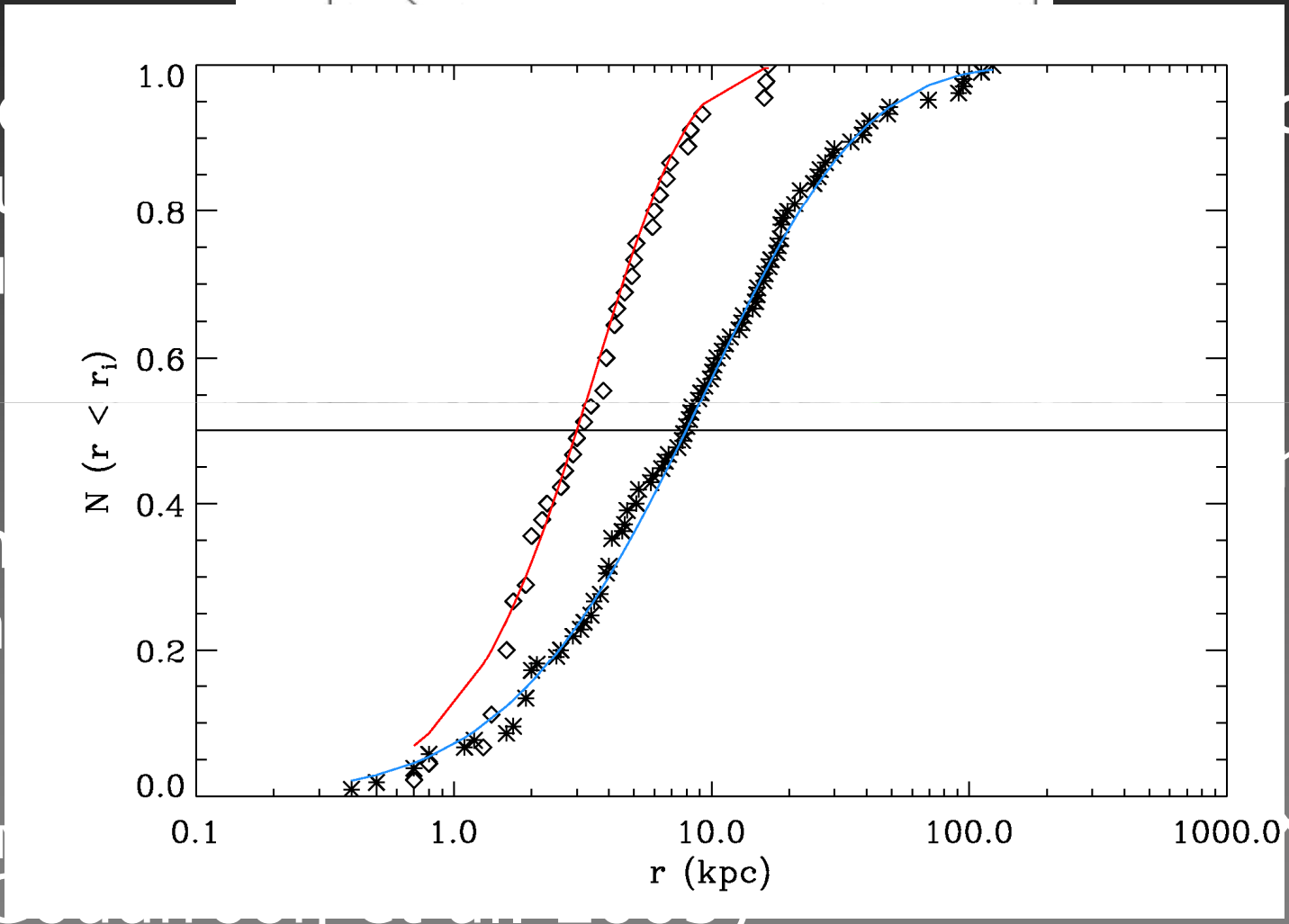
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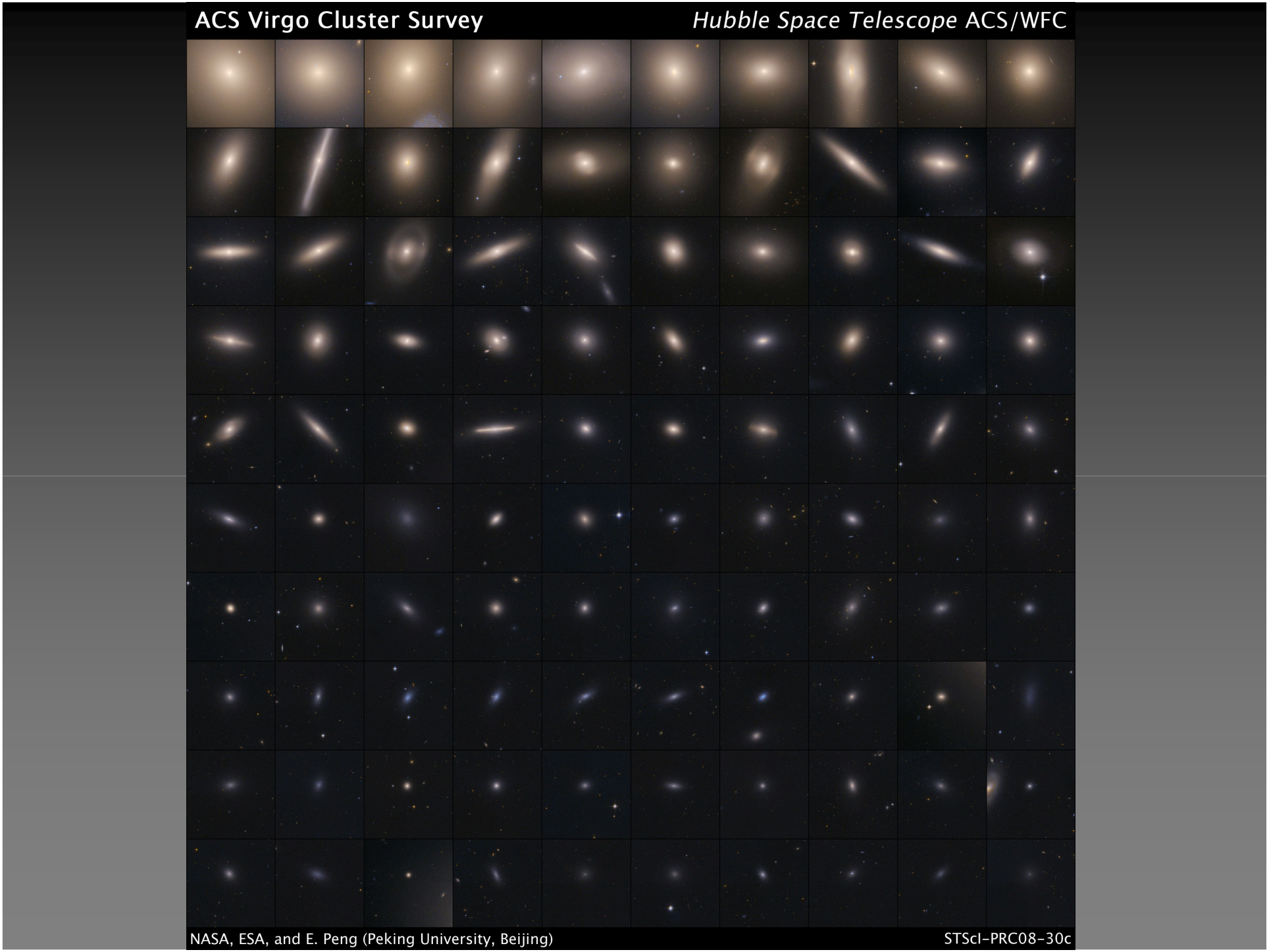


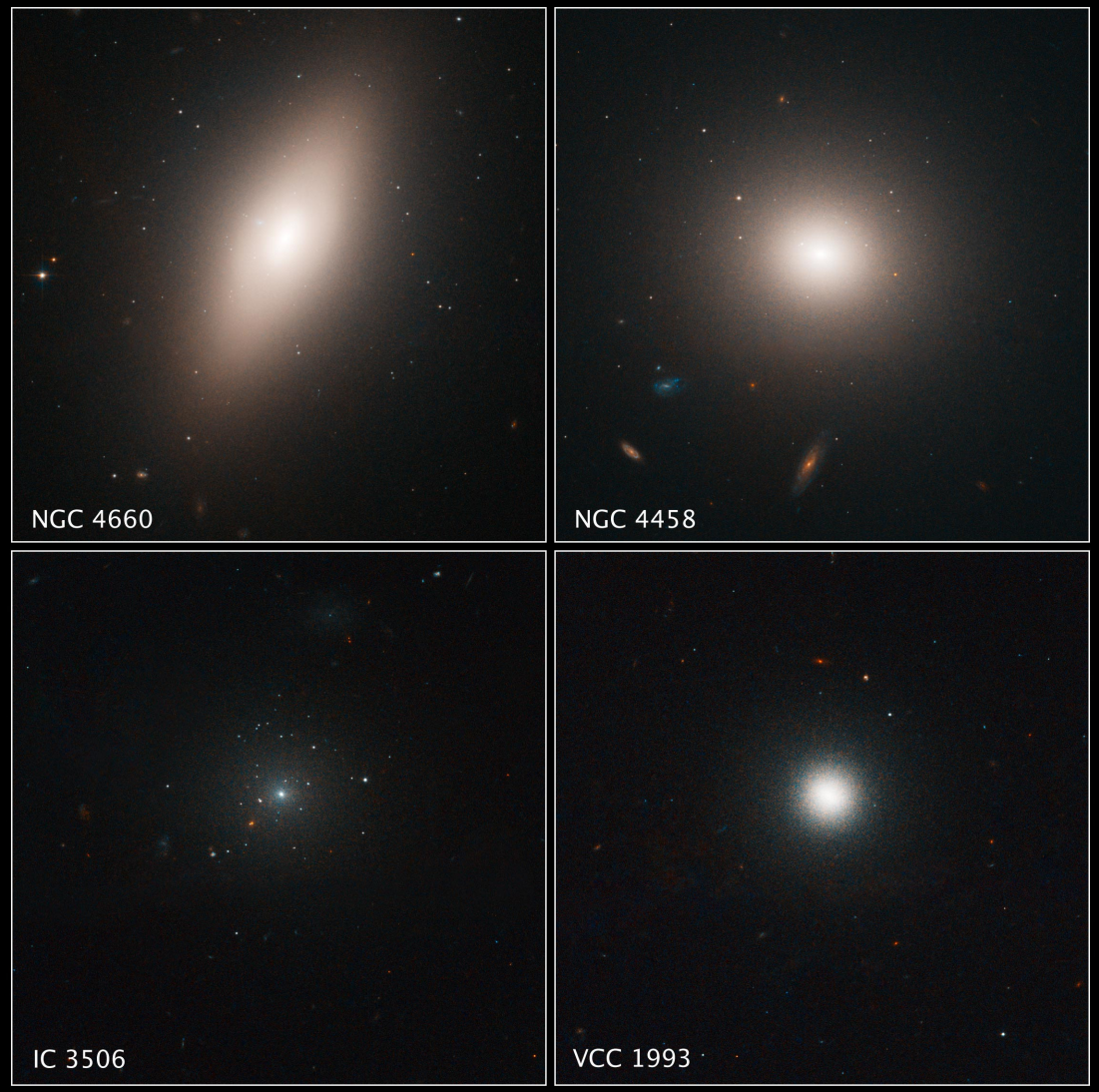
$T_N = N_{gc}/(M_{g*}/10^9\ M_{sun})$

Properties of GC systems

- C… …dal, bu… lu…
- M… …n m… …for la…
- S… …kies (C… …)




ACS Virgo Cluster Survey
Hubble Space Telescope ACS/WFC
NASA, ESA, and E. Peng (Peking University, Beijing)
STScI-PRC08-30c



ACS Virgo Cluster Survey
Hubble Space Telescope ACS/WFC

NASA, ESA, and E. Peng (Peking University, Beijing)

STScI-PRC08-30a

The spiral-S0 connection

- Aragón-Salamanca et al. (2006):

$\langle S_N \rangle_{S0} / \langle S_N \rangle_{Sp} = 3.7/1.2 = 3.1$
$(3.3/0.9 = 3.6)$

- Sp fade a… nsform into S0, consis… assumes no GCs loss …

- "…strongl… t S0 galaxies w… se SF was cut off, pr… environm…

Table 1. Spiral and S0 absolute magnitudes and global globular cluster specific frequencies from Ashman & Zepf (1998).

Spiral Galaxies			S0 Galaxies		
Name	M_V^T	S_N	Name	M_V^T	S_N
MW	−21.3	0.5 ± 0.1	NGC 524	−22.5	3.3 ± 1.0
LMC	−18.4	0.6 ± 0.2	NGC 1387	−20.4	2.7 ± 0.8
M31	−21.8	0.9 ± 0.2	NGC 1553	−21.3	1.4 ± 0.3
M33	−19.4	0.5 ± 0.2	NGC 3115	−21.3	1.6 ± 0.4
NGC 253	−20.2	0.2 ± 0.1	NGC 3384	−20.4	0.9 ± 0.5
NGC 3031	−21.1	0.7 ± 0.1	NGC 3607	−20.9	3.5 ± 2.6
NGC 2683	−20.8	1.7 ± 0.5	NGC 4340	−19.9	8.5 ± 3.1
NGC 4565	−21.5	0.5 ± 0.1	NGC 4526	−21.4	7.4 ± 2.2
NGC 4216	−21.8	1.2 ± 0.6			
NGC 4569	−21.7	1.9 ± 0.6			
NGC 4594	−22.2	2.0 ± 1.0			
NGC 5170	−21.6	0.9 ± 0.3			
NGC 7814	−20.4	3.5 ± 1.1			
Average		1.2 ± 0.3			3.7 ± 1.1

The spiral-S0 connection

- Aragón-Salamanca et al. (2006):

$\langle S_N \rangle_{S0} / \langle S_N \rangle_{Sp} = 3.7/1.2 = 3.1$
$(3.3/0.9 = 3.6)$

- Sp fade a factor of 3 (~1.2mag) to transform into S0, consistent w/ Tully-Fisher offset (assumes no GCs loss has occured!).

- "…strongly support the hypothesis that S0 galaxies were once normal spirals whose SF was cut off, presumably due to a change of environment"

The spiral-S0 connection

But, is this a reasonable assumption?

1. 2/8 S0s have higher number of GC than any spiral in the sample.

2. $S_{N,S0}/S_{N,Sp} = (N_{gc,S0}/N_{gc,Sp})x10^{0.4(Mv,s0-Mv,sp)}$

   $= (775/355)x10^{0.4(-20.9+21.3)}$

   $= 2.2x1.4 = \mathbf{3.1}$

Main contribution of the ~3 factor arises from N_{gc} difference (at least in their sample!)

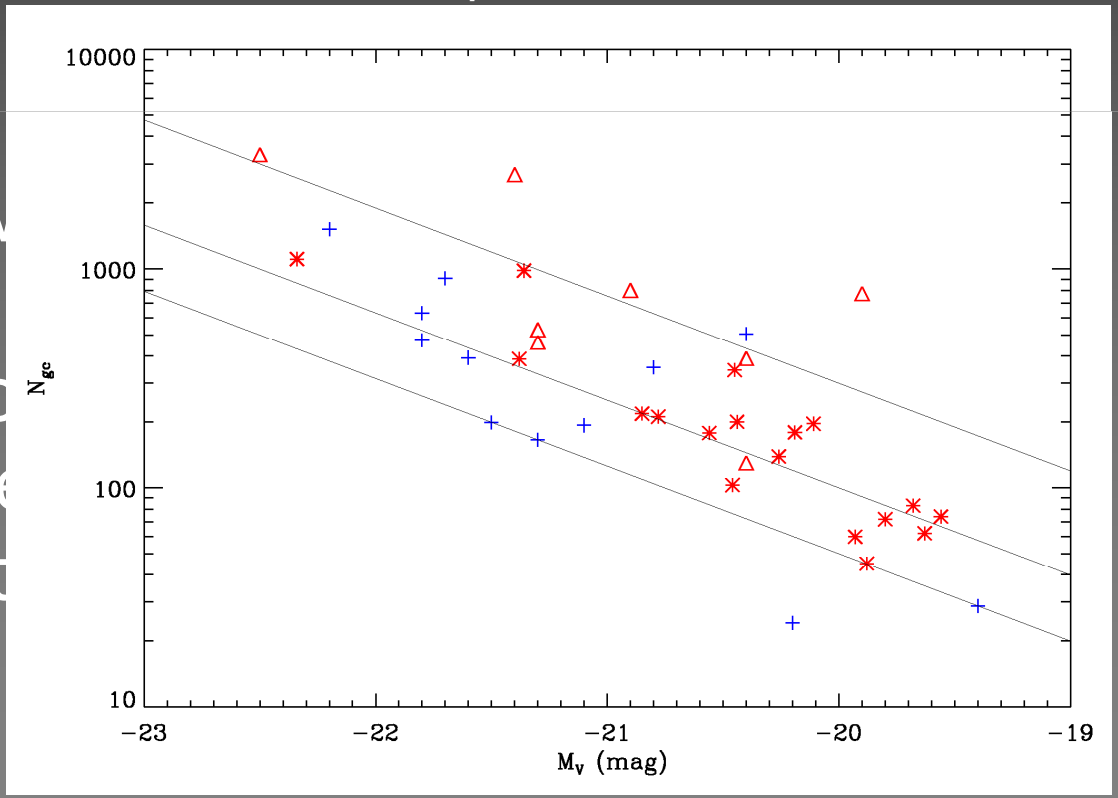
Bright disk galaxies

- ACSVCS S0s (Peng et al. 2008):

$$\langle S_N \rangle_{S0} / \langle S_N \rangle_{Sp} \sim 1.3/0.9 \sim 1.4 \text{ !!}$$

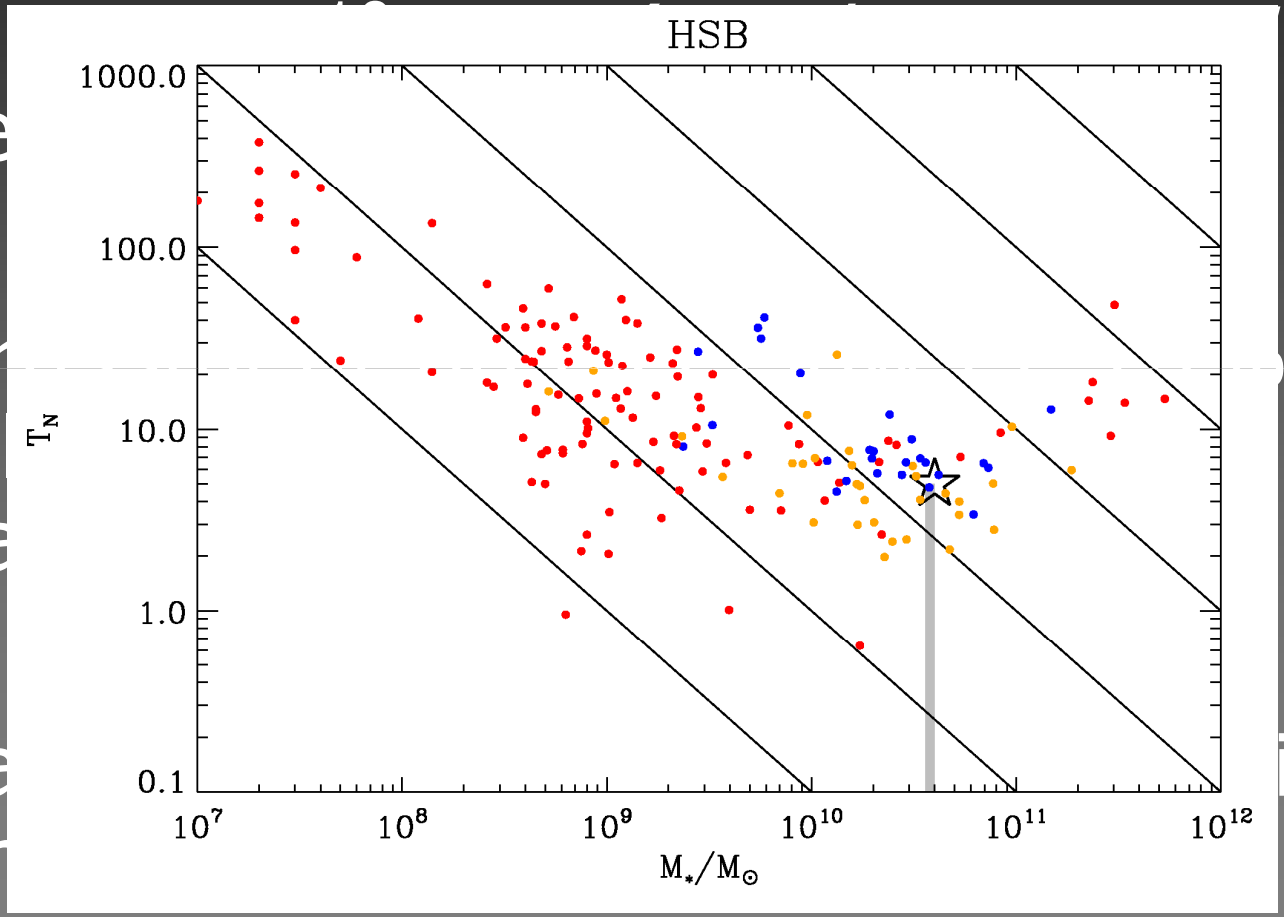
But now

- Enviro
- Differe
- Select



Harassment acting on HSBs

- M_* -like
- Har ste hea)
- Gra min ing



Future

- Sps do not fade a factor ~3 to transform into S0s (at least in Virgo).
- GCs provide unique clues and offer new and unexplored possibilities.
- Requirements:
  - Homogeneous determinations of GCs specific frequencies and radial distributions along the Hubble sequence, from giants to dwarfs, and in different environments – spectroscopic confirmation!
  - Better understanding of environmental effects through numerical simulations: simulate harassment including a GC population (w/ César González-García)
  - Precise determination of intracluster GC abundance (Marín-Franch et al., Jordán et al.)



(Real) Future

- ESO@Chile starting august/september 2009-(2013?)
- Estallidos should take advantage!! (service time)
- IX Workshop…@ Chile?? ☺