

# The properties of galaxy disks in nearby galaxy clusters

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& the WINGS collaboration

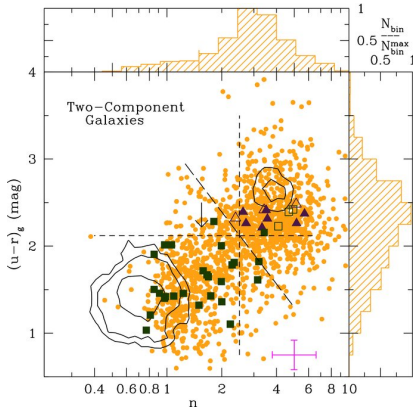


Galaxy Clusters in the Early Universe  
Pucón, November 9, 2009

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- 2 WINGS: galaxy structural parameters
- 3 Properties of galaxy disks
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# Understanding nearby galaxy populations



- Different structural components can be associated with different formation processes  $\Rightarrow$  detailed studies are needed (e.g., the MGC; Cameron et al. 2009)
- Even more critical for late-type cluster galaxies, which can be strongly affected by several interaction mechanisms.

# Evolutionary mechanisms

## Hydrodynamical interactions

(e.g., Gunn & Gott 1972)

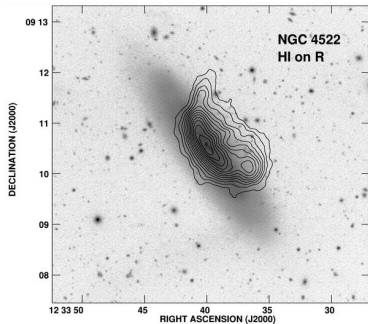
ISM-ICM  $\Rightarrow$  alter SFR

## Gravitational interactions

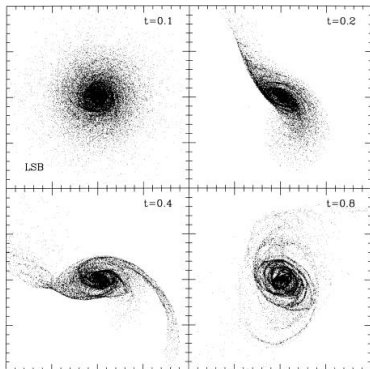
(e.g., Moore et al. 1998)

Galaxy-galaxy and galaxy-cluster potential  $\Rightarrow$  alter SFR and structure

Disks are  $\sim 30\%$  smaller in Coma than in the field (Gutierrez et al. 2004; Aguerri et al. 2004)



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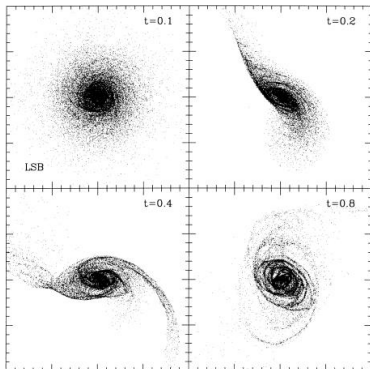
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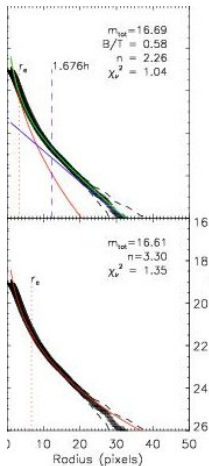
# WINGS: structural parameters



## WINGS: Wide-field Nearby Galaxy-cluster Survey (Fasano et al. 2006)

- Wide-field imaging ( $B, V$ ; Varela et al. 2009) and spectroscopic (Cava et al. 2009) survey.
- 77 X-ray selected ( $43.5 < \log(L_X) < 45 \text{ erg s}^{-1}$ ), nearby ( $0.04 < z < 0.07$ ) clusters.
- Unique combination of depth ( $V \approx 24$ ), spatial coverage ( $\sim 2.5 h_{75}^{-2} \text{ Mpc}^2$ ) and resolution (FWHM  $\approx 1 \text{ kpc}$ ).
- Exhaustive analysis of the **structural properties** of bright galaxies in a subsample of 45 clusters observed with WFC@INT

# Methodology



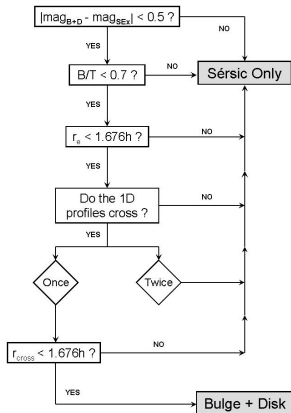
## 2D-fits

- GASP2D (Méndez-Abreu et al. 2008)
- Automatic determination of optimal **initial conditions**
- Two models: single Sersic and bulge+disk (Sersic+exponential)

## Simulations

- Artificial galaxy images with one and two components and variety of structural parameters
- No biases or systematic trends
- Structural parameters are reliably determined down to  $V = 19$  ( $\sim 150$  galaxies/cluster)

# The logical filter

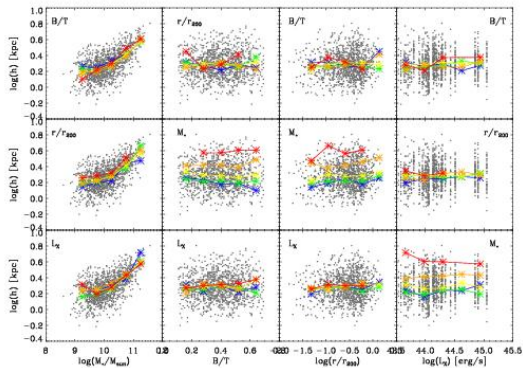


- Purpose: select the most **physically-meaningful** model by means of a decision tree
- Criterium: B+D systems must be disk-dominated at large galactic radii
- 7602 galaxies brighter than  $V = 19$  in 45 cluster fields
- 43% B+D systems

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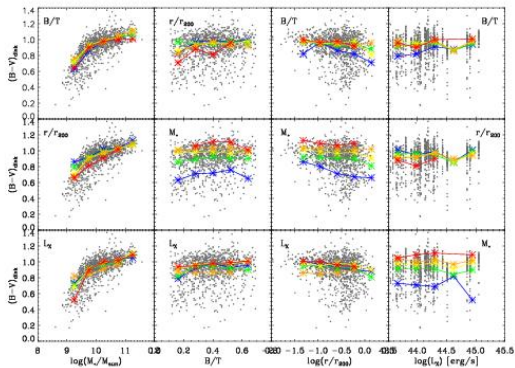
# Properties of galaxy disks

- Which parameters determine galaxy disks properties?
- Two internal (B/T and  $M_*$ ) and two external ( $r/r_{200}$  and  $L_X$ ) parameters



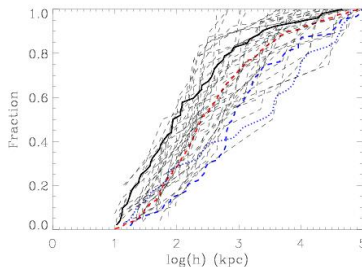
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# Properties of galaxy disks

- Large variance in disk scale-length distributions in the subsample –from Coma (Aguerri et al. 2004) to field (Graham 2001).
- KS test suggests lack of high velocity dispersion clusters ( $\sigma > 800 \text{ km s}^{-1}$ ) having scale-length distributions compatible with field galaxies.



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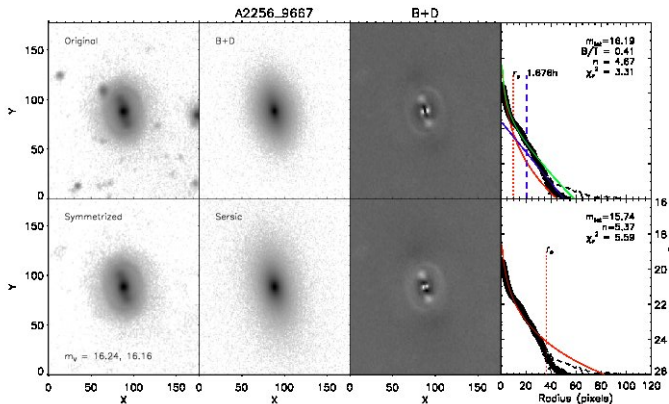


# Conclusions

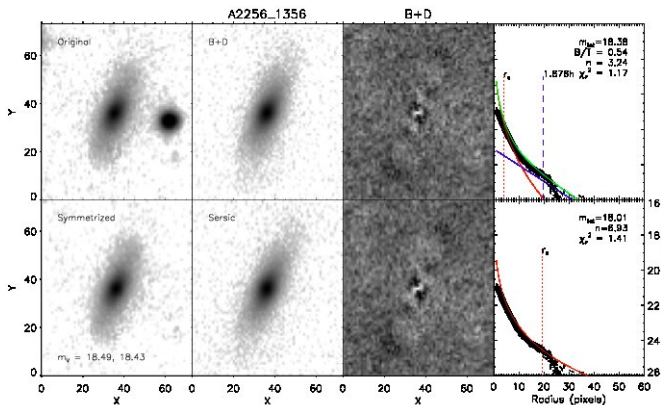
- Galaxy **stellar mass** is the most determinant parameter governing galaxy disks properties: at fixed  $M_*$  there are no dependencies with the remaining parameters.
- Colour of fainter galaxies might show the only significant trend with clustercentric radius (see also Sanchez-Janssen et al. 2008).
- Second-order environmental dependence: lack of large disks in cluster galaxies, and this effect is more pronounced in more massive clusters.

Mechanism(s) preventing formation of large disks doesn't depend strongly on cluster mass and/or must have been taking place since early cluster evolution.

# Ongoing: frequency of bars



# Ongoing: occurrence of disk truncation



# Two-component galaxies: what determines disk properties?

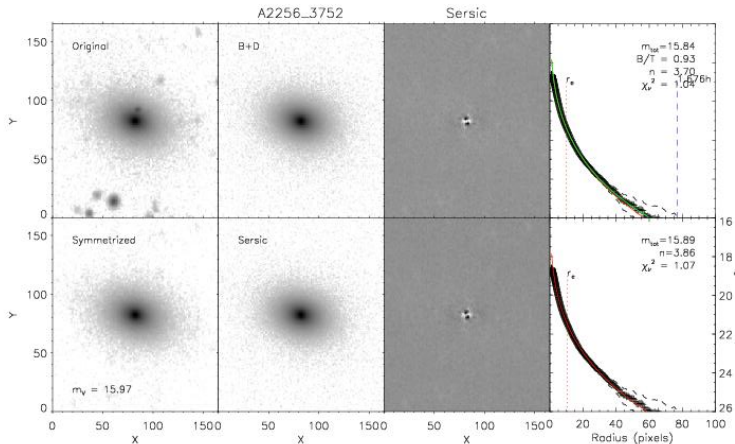
## Disk colours

Disk colours are computed using the following approximation:

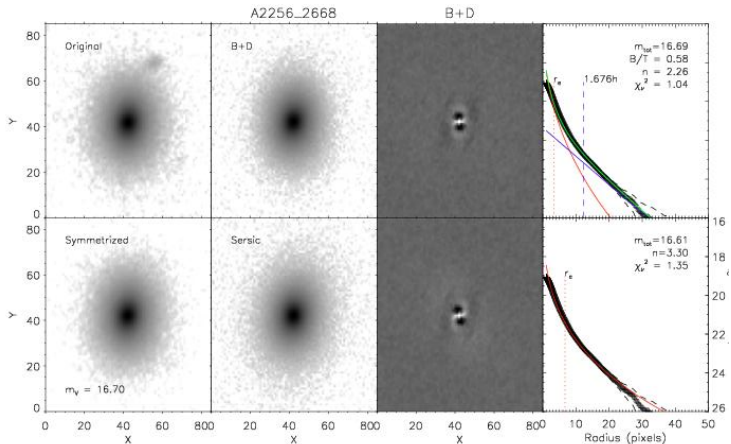
$$(B - V)_d = \frac{10^{(B-V)} - (B/T) 10^{(B-V)_b}}{1 - B/T}, \quad (1)$$

where  $(B - V)_b = (B - V)_{2kpc}$ . They are therefore only correct when the bulge dominates the light profile out to  $\sim 2$  kpc, which occurs in majority of cases.

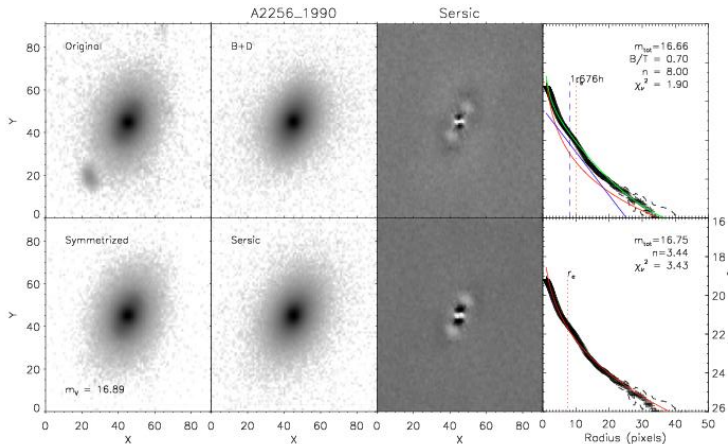
# Sersic example



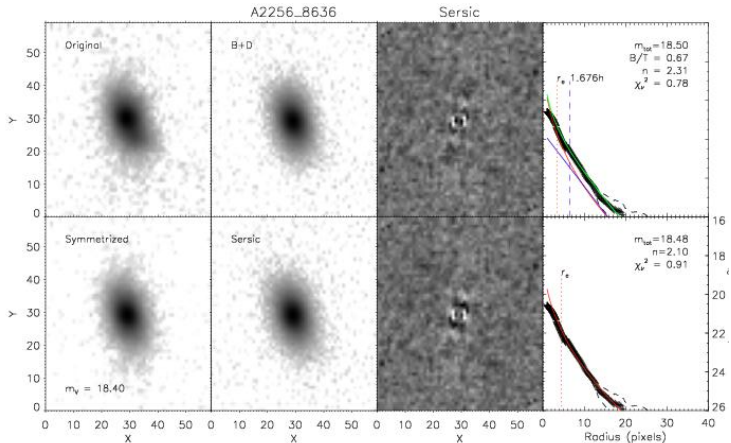
# Bulge+disk example



# Two-cuts example

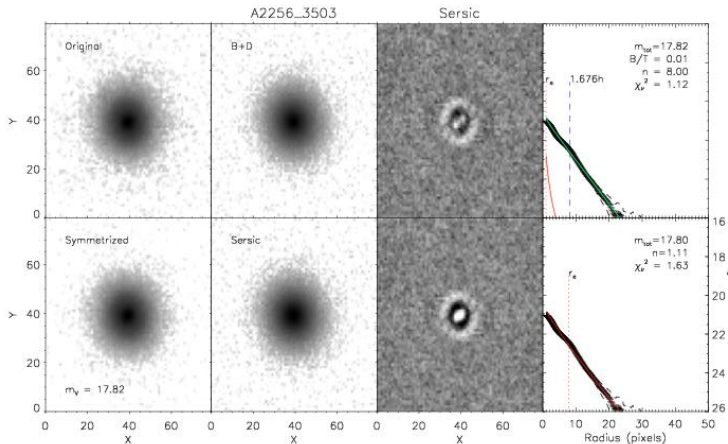


# Outer crossing example





# Embedded bulge example



# $r_e > 1.676 h$ example

