Estallidos de formación estelar en Galaxias

PNAYA2004-08260-C03

J.M. Vílchez

JIP, JALA, DRP, JHF, RSJ, CMT, BCE, NC, VP …

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http://www.iac.es/proyect/GEFE/estallidos



Revisión VI Workshop Estallidos

Existe un debate abierto sobre el alcance de la influencia del entorno en la evolución galáctica (en la literatura especializada este debate se suele mencionar como *"nature versus nurture"*). Hoy sabemos que el entorno donde se localizan las galaxias tiene una influencia decisiva sobre muchos procesos que regulan la formación estelar activa.

The knowledge of how and why galaxies evolve and which are the physical processes driving this evolution remains one of the fundamental problems in Astrophysics.
Galaxy groups and clusters are places where the “normal” secular evolution of galaxies and in particular their star formation history (SFH) and star formation rates (SFR) appear affected by their environments.

Revisión VI Workshop Estallidos: Prog. 6
Principales metas propuestas en el proyecto

Finalización de la observación de la muestra completa de galaxias con formación estelar en cúmulos y grupos cercanos, con imagen muy profunda, de gran campo.
Poblaciones de objetos estelares en el campo de los cúmulos. Luz difusa.



Realización del "follow up" espectroscópico de la muestra con observaciones multi-objeto.
Caracterización espectroscópica de galaxias con líneas de emisión via observaciones multi-rango



Estudio evolutivo de los objetos detectados en las búsquedas anteriores: Determinación de metalicidades y colores; construcción de las Funciones de Luminosidad (FL) : caracterización precisa de la "cola" de baja luminosidad de la FL. Implicaciones para la formación degalaxias.



Estudio sistemático de la morfología cuantitativa de galaxias en los cúmulos observados, incluyendo a las galaxias enanas: Caracterización de las relaciones observadas en la distribución espacial de morfologías en los cúmulos en función de las predicciones de los modelos/simulaciones teóricos de su formación. Restricciones para el "Harassment" y escenarios de formación.



Caracterización de las estructuras de las zonas de formación estelar observadas en las galaxias en relación con las predicciones teóricas de los efectos del entorno.



Determinación de la TFE de las galaxias de la muestra y análisis de su distribución espacial. Estudio y evaluación de los posibles efectos del entorno en las determinaciones de la TFE del Universo.



Astronomy and Astrophysics, Volume 434, Issue 2, May I 2005

The V-band luminosity function of galaxies in A2151

Sánchez-Janssen, R.; Iglesias-Páramo, J.; Muñoz-Tuñón, C.; Aguerri, J.A L.; Vílchez, J. M.

Abstract

We present a wide field V-band imaging survey of approximately 1 deg2 (~7.2 h^{-2}_{75} Mpc^2) in the direction of the nearby cluster of galaxies Abell 2151 (the Hercules Cluster). The data are used to construct the **luminosity function (LF) down to MV ≈ -14.85, thus allowing us to study the dwarf galaxy population in A2151 for the first time.** The obtained global LF is well described by a Schechter function with best-fit parameters α = -1.29+0.09-0.08 and M_V* = -21.41+0.44-0.41. The radial dependence of the LF was investigated, with the faint-end slope tending to be slightly steeper in the outermost regions and farther away than the virial radius. Given the presence of significant substructure within the cluster, we also analysed the LFs in three different regions. We find that **the dwarf to giant ratio increases from the northern to the southern subcluster, and from low to high local density environments**, although these variations are marginally significant (less than 2σ).

Revisión VI Workshop Estallidos: Programa 6 - Algunos Resultados

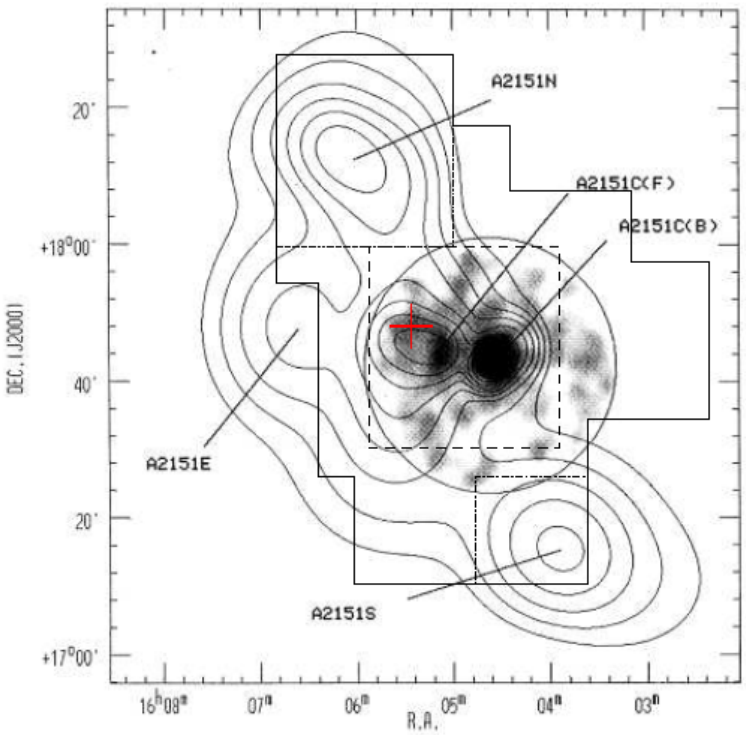


Fig. 9. X-ray emission from A2151 (grey-scale distribution) plotted together with galaxy density contours (taken from Huang & Sarazin 1996), showing the significant substructure present in this cluster. The LF presented in this paper is computed in the region within the solid lines, while the smaller squares (dashed and dotted lines) indicate the areas where subclusters' LF were computed.

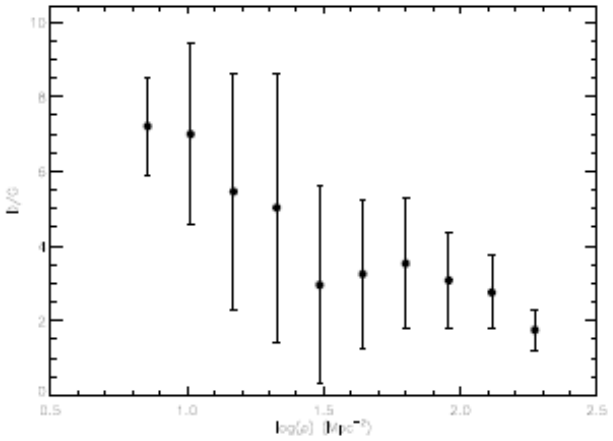
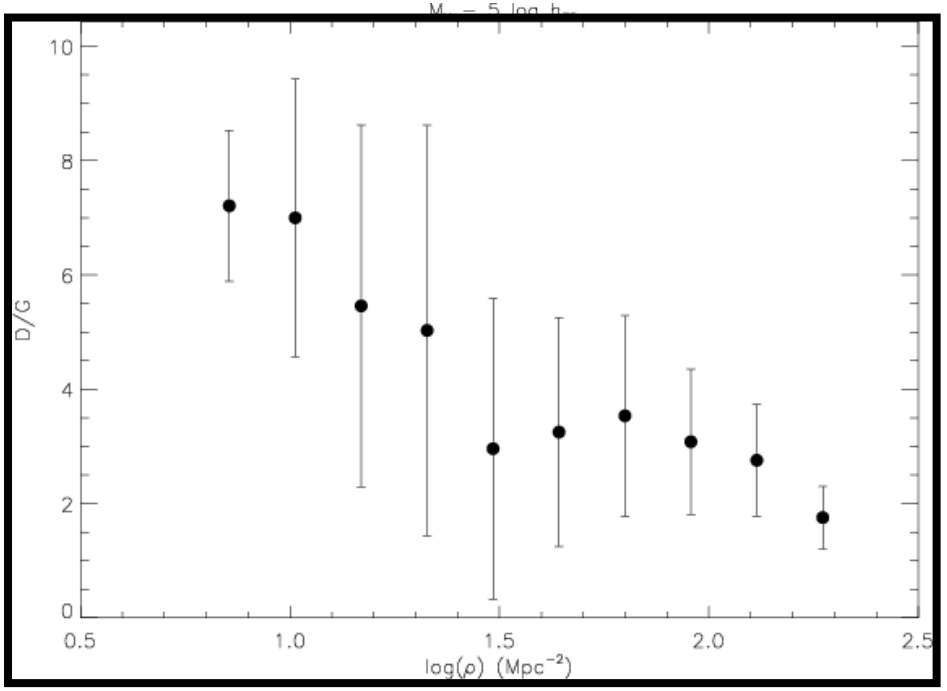


Fig. 7. Dwarf to giant ratio as a function of the projected local bright galaxy density. The data were binned in ρ to show the relation more clearly.

Función de luminosidad de A2151

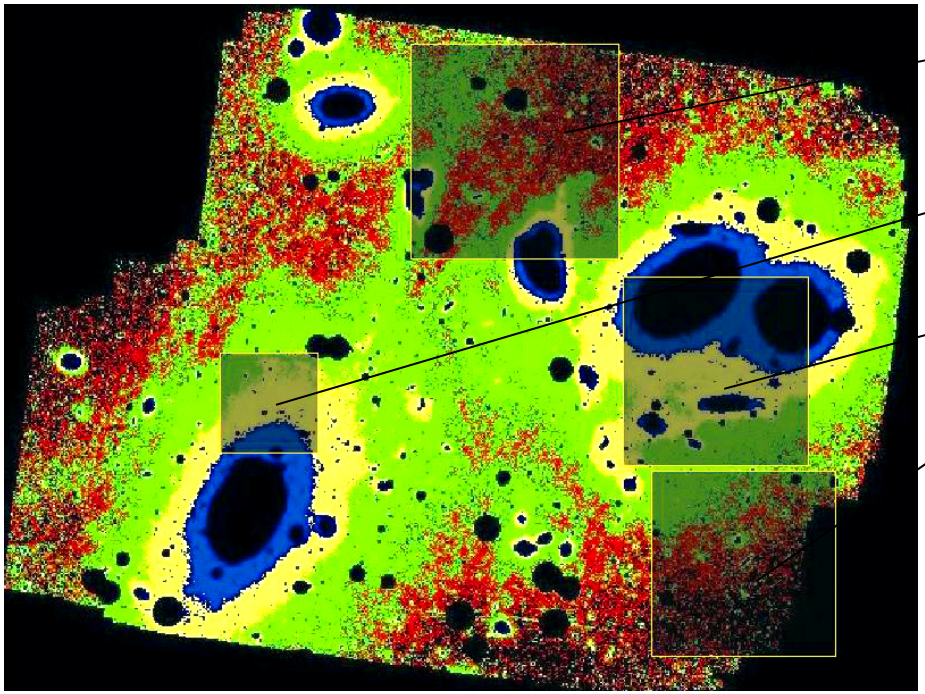
Cartografiado profundo en V de 1 grado^2 en A2151. Nos ha permitido estudiar la LF de este cúmulo hasta Mv=-14.85. Los parametros de la LF de Schechter Son: $M_V^* = -21.41^{+0.44}_{-0.41}; \alpha = -1.29^{+0.09}_{-0.08}$

Dependencia del cociente D/G con el entorno.



Sanchez-Janssen et al 2005

Luz difusa en el cúmulo de Virgo



Core: 10%

FCJ: 8%

Subaru: 5%

LPC: <1%

Core de Virgo: Hasta un 10%

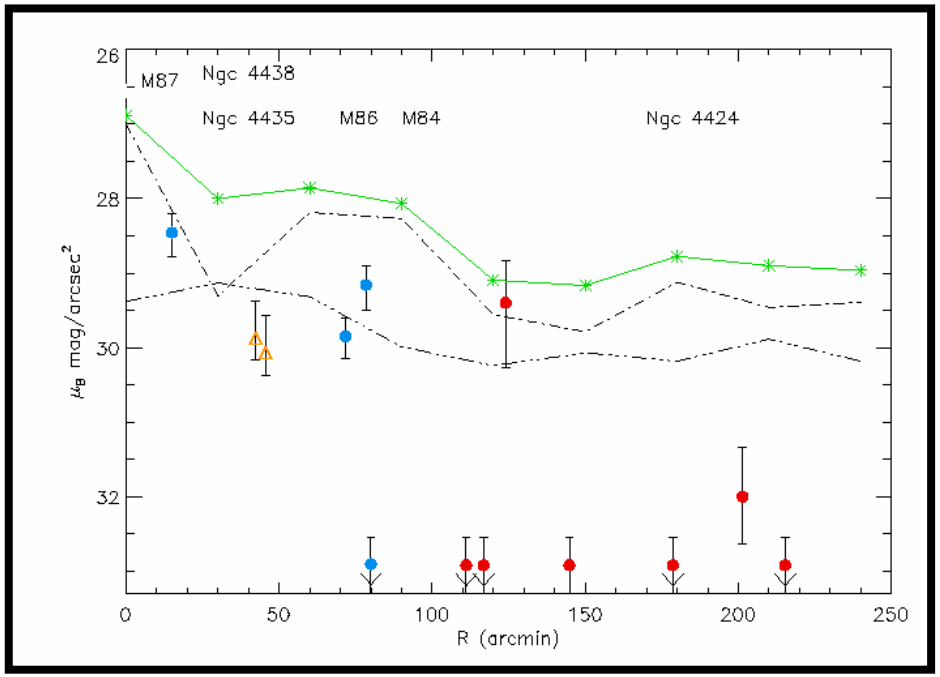
Distribución inhomogenea

Componente no relajada.
Formada hace pocos Gyr

La región central de Virgo
es dinámicamente joven

Aguerri et al. 2005;
Castro-Rodriguez et al. 2007

Luz difusa en el cúmulo de Virgo



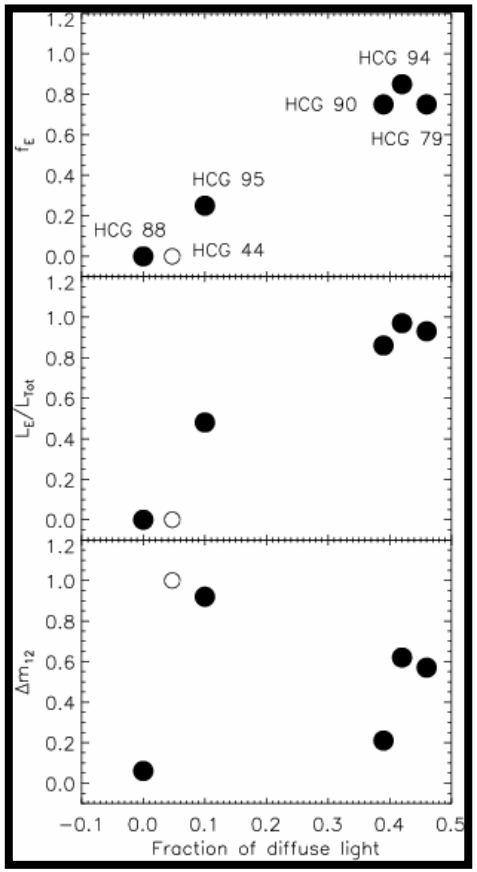
Regiones externas: No hay luz difusa!!

Asociada con los halos de las E brillantes de Virgo

La Luz difusa se forma principalmente debido a los mergers que tienen lugar en la formación de las galaxias elípticas brillantes

Aguerri et al. 2005;
Castro-Rodriguez et al. 2007

Luz difusa en grupos de galaxias



Aguerri et al. 2006

Hemos estudiado la luz difusa, mediante la detección directa de IGPNe, en dos Grupos próximos: Leo y HCG 44.

En ambos grupos los objetos con lineas de emisión resultaron ser galaxias Lyalpha de backgraound. Esto impone un limite superior para la cantidad de luz difusa en estos grupos de <1%

Completando con datos de la literatura encontramos una relación entre la fracción de galaxias E/S0 en grupos compactos y la cantidad de luz difusa de los mismos

Como en Virgo, la luz difusa esta asociada a las E

Tesis de Nieves Castro Rodriguez: “Luz difusa en grupos y Cúmulos de galaxias”, Abril 2007

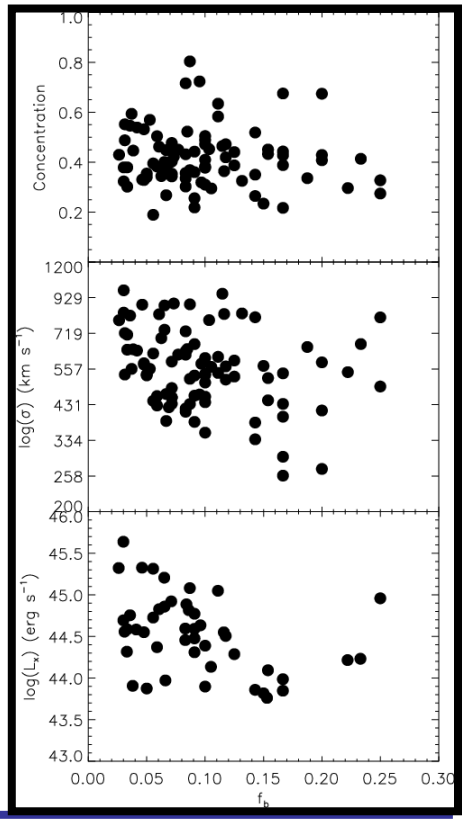
Cúmulos de galaxias en SDSS

Hemos analizado las propiedades globales de una muestra de 88 cúmulos de galaxias que estan observados en el cartografiado SDSS-DR4. Resultando ~10000 galaxias en cúmulos

La fracción de galaxias azules no depende propiedades globales de los cúmulos como concentración de galaxias o dispersion de velocidades. En cúmulos muy masivos es pequeña, mientras que cúmulos poco masivos muestran fracciones de azules grandes y pequeñas.

El entorno es importante en cúmulos muy masivos. en cúmulos poco masivos la evolución se puede dar por interacciones locales.

Aguerri et al. 2007



The Astronomical Journal, 130:475–495, 2005

Structural Parameters of Dwarf Galaxies in the Coma Cluster: On the Origin of dS0 Galaxies

J. A. L. Aguerri, J. Iglesias-Páramo, J. M. Vílchez, C. Muñoz-Tuñón and R. Sánchez-Janssen

ABSTRACT

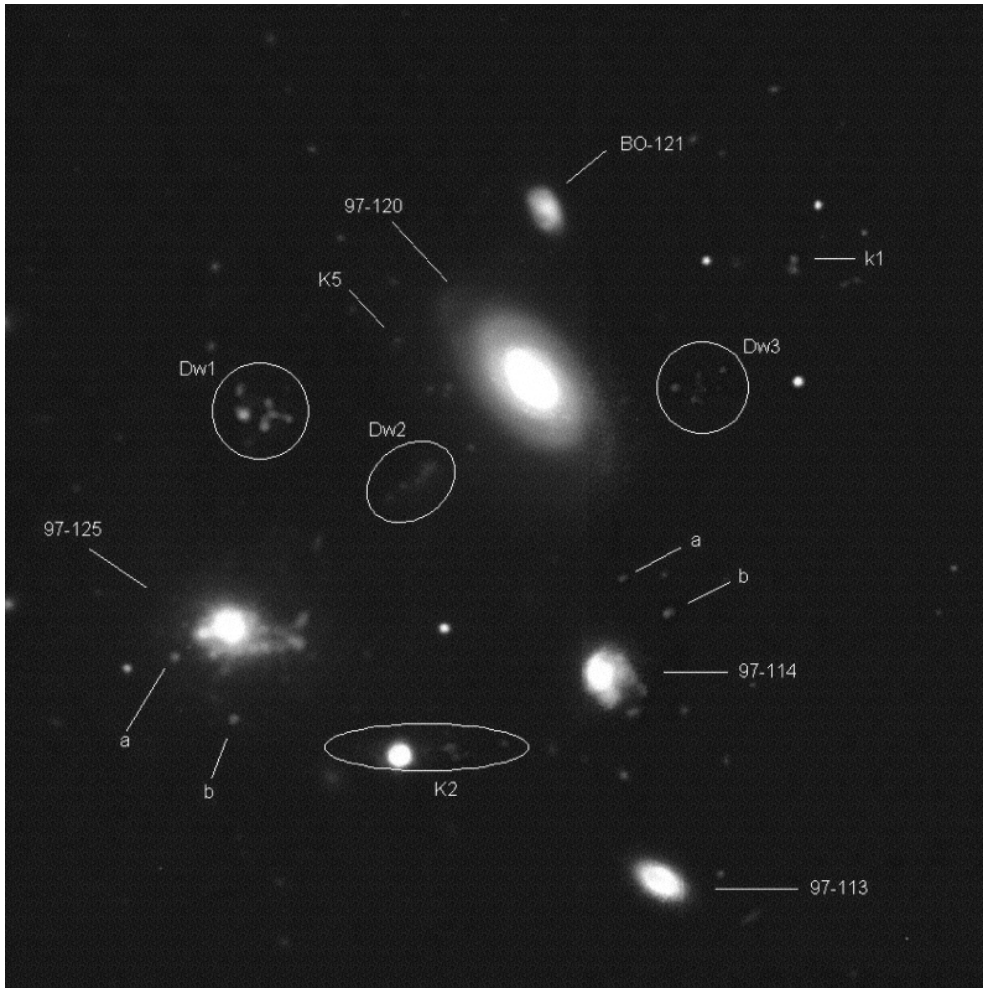
In this paper we analyze the structural parameters of the dwarf galaxies in the Coma Cluster with and classify them into two types; those with surface brightness profiles well fitted by a single Sérsic law are called dwarf ellipticals (dEs), and those fitted with Sérsic+exponential profiles are classified as dwarf lenticulars (dS0s). The comparison of the structural parameters of **the dwarf galaxies in the Coma and Virgo Clusters shows that they are analogous**. **Photometrically, the dE and dS0 galaxies in Coma are equivalent,** having similar colors and global scales. However, **the scale of the innermost parts (bulges) of dS0 galaxies is similar to that of the bulges of late-type spiral galaxies. In contrast, dEs have larger scales than the bulges of bright galaxies**. This may indicate that **dS0 and dE galaxies have different origins.** While dE galaxies can come from dwarf irregulars (dIs) or from processes similar to those that form bright E galaxies, the origin of **dS0 galaxies could be harassed bright late-type spiral galaxies.**

The Astrophysical Journal, Volume 623, Issue 1, pp. L17-L20 (2005)
The GALEX Ultraviolet Luminosity Function of the Cluster of Galaxies A1367
Cortese, L.; Boselli, A.; Gavazzi, G.; **Iglesias-Paramo, J. et al**.

Abstract
We present the Galaxy Evolution Exlorer (GALEX) near-ultraviolet (2310 Å) and far-ultraviolet (1530 Å) galaxy luminosity functions of the nearby cluster of galaxies A1367 in the magnitude range -20.3<=M_{AB}<=-13.3. **The luminosity functions** are consistent with previous (~2 mag shallower) estimates based on the FOCA and FAUST experiments, but **they display a steeper faint-end slope than the GALEX luminosity function for local field galaxies**. Using spectrophotometric optical data, we select star-forming systems from quiescent galaxies and study their separate contributions to the cluster luminosity function. We find that the UV luminosity function of cluster star-forming galaxies is consistent with the field. **The difference between the cluster and field luminosity functions is entirely due to the contribution at low luminosities (MAB>-16 mag) of non-star-forming, early-type galaxies that are significantly overdense in clusters.**

Nearby clusters:
Preprocessing in small groups
Within clusters:
A possible way to drive the evolution of cluster galaxies

Example in Abell 1367



The Astrophysical Journal, Volume 623, Issue 1, pp. L13-L16. (2005)

GALEX Ultraviolet Observations of the Interacting Galaxy NGC4438 in the Virgo Cluster

Boselli, A.; **+ Iglesias-Paramo, J.** et al.

Abstract

We present GALEX near-ultraviolet (2310 Å) and far-ultraviolet (1530 Å) images of the interacting galaxy NGC 4438 (Arp 120) in the center of the Virgo Cluster. These images **show an extended (20 kpc) tidal tail at the northwest edge of the galaxy that was previously undetected at other wavelengths**; this tail is 15-25 kpc from NGC 4438's nucleus. Except for in the nucleus, the UV morphology of NGC 4438 is totally different from the Hα + [N II] morphology, which is more similar to the X-ray emission, confirming its gas cooling origin. We study the star formation history of NGC 4438 by combining spectrophotometric data in the UV-visible-near-IR wavelength range with population synthesis and galaxy evolution models. The data are consistent with a **recent (~10 Myr), instantaneous burst of star formation in the newly discovered UV northwestern tail** that is significantly younger than the age of the tidal interaction with NGC 4435, dated by dynamical models at ~100 Myr ago. Recent **star formation events are also present at the edge of the northern arm and in the southern tail, while totally lacking in the other regions**, which are dominated by the old stellar population that was perturbed during the dynamical interaction with NGC 4435. The contribution of this recent starburst to the total galaxy stellar mass is lower than 0.1%, an extremely low value for such a violent interaction. High-velocity, off-center tidal encounters such as that observed in Arp 120 are thus not sufficient to significantly increase the star formation activity of cluster galaxies.

The Astrophysical Journal, Volume 619, Issue 1, pp. L95-L98 (2005)

Ultraviolet Emission and Star Formation in Stephan's Quintet

Xu, C. Kevin; **Iglesias-Páramo, Jorge** et al.

Abstract

We present the **first Galaxy Evolution Explorer (GALEX) UV images of the well-known interacting group of galaxies, Stephan's Quintet** (SQ). We detect widespread UV emission throughout the group. However, there is **no consistent coincidence between UV structure and emission in the optical, Hα, or H I.** Excluding the foreground galaxy NGC 7320 (Sd), most of the UV emission is found in regions associated with the two spiral members of the group, NGC 7319 and NGC 7318b, and the intragroup medium starburst SQ-A. The extinction-corrected UV data are analyzed to investigate the overall star formation activity in SQ. We find that the **total star formation rate (SFR) of SQ is 6.69+/-0.65 Msolar yr-1. Of this, 1.34+/-0.16 Msolar yr-1 is due to SQ-A. This is in excellent agreement with that derived from the extinction-corrected Hα** luminosity of SQ-A. The SFR in regions related to NGC 7319 is 1.98+/-0.58 Msolar yr-1, most of which (68%) is contributed by the disk. The contribution from the ``young tail'' is only 15%. In the UV, the young tail is more extended (~100 kpc) and shows a looplike structure, including the optical tail, the extragalactic H II regions recently discovered in Hα, and other UV emission regions discovered for the first time. The UV and optical colors of the ``old tail'' are consistent with a single stellar population of age t~=108.5+/-0.4 yr. The UV emission associated with NGC 7318b is found in a very large (~80 kpc) disk, with a net SFR of 3.37+/-0.25 Msolar yr-1. Several large UV emission regions are 30-40 kpc away from the nucleus of NGC 7318b. Although both NGC 7319 and NGC 7318b show peculiar UV morphology, their SFR is consistent with that of normal Sbc galaxies, indicating that the strength of star formation activity is not enhanced by interactions.

The Astronomical Journal, 133:705–714, 2007

Recent Star Formation in Clusters of Galaxies: Extremely Compact Starbursts in A539 and A634

D. Reverte, J. M. Vílchez, J. D. Hernández-Fernández, and J. Iglesias-Páramo

ABSTRACT

We report on the detection of two **Hα-emitting extremely compact objects** from deep images of the **A634 and A539 clusters** of galaxies. Follow-up long-slit spectroscopy of these two unresolved sources revealed that they are members of their respective clusters, showing H ii–type spectra. The luminosity and the extreme equivalent width of Hα + [N ii] measured for these sources, together with their very compact appearance, has raised a question about the origin of these intense starbursts in the cluster environment. We propose that the compact starburst in **A539 resulted from the compression of the interstellar gas of a dwarf galaxy** when entering the cluster core, while the starburst galaxy in **A634 is likely to be the result of a galaxy-galaxy interaction, illustrating the preprocessing of galaxies** during their infall toward the central regions of clusters. The contribution of these compact star-forming dwarf galaxies to the star formation history of galaxy clusters is discussed, as well as a **possible link with the recently discovered early-type ultracompact dwarf galaxies**. We note that these extreme **objects will rarely be detected in normal magnitude-limited optical or NIR surveys**, mainly due to their low stellar masses (on the order of M), whereas they will easily **show up in dedicated Hα surveys** given the high equivalent width of their emission lines.

Nearby clusters

Hα survey

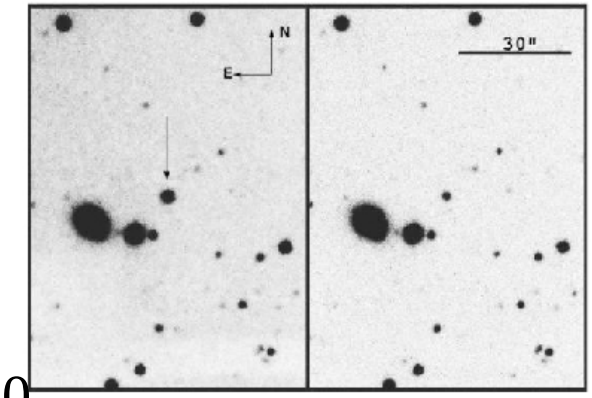
Northern

6000 <Vrad (km/s) < 9000

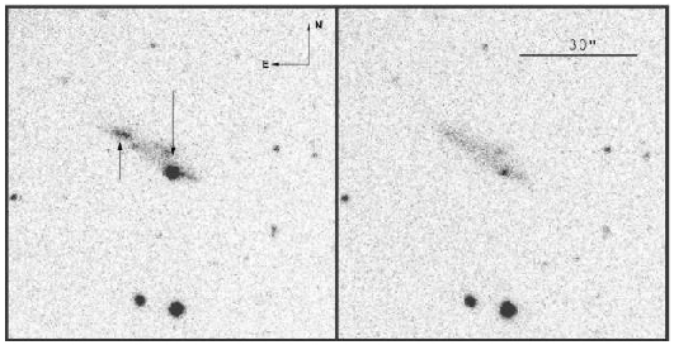
Clusters

e.g. search for compact emission:

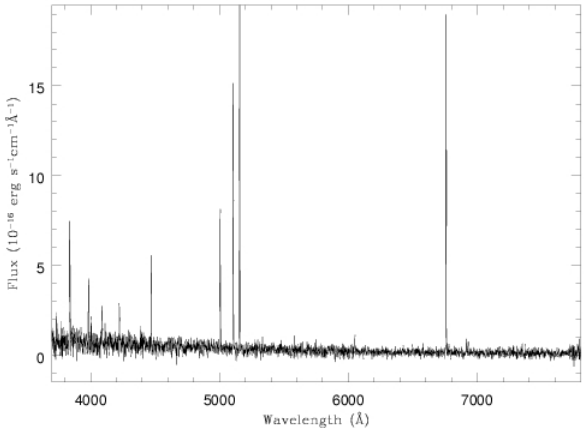
Extremely Compact Starbursts inhabiting Clusters of Galaxies?

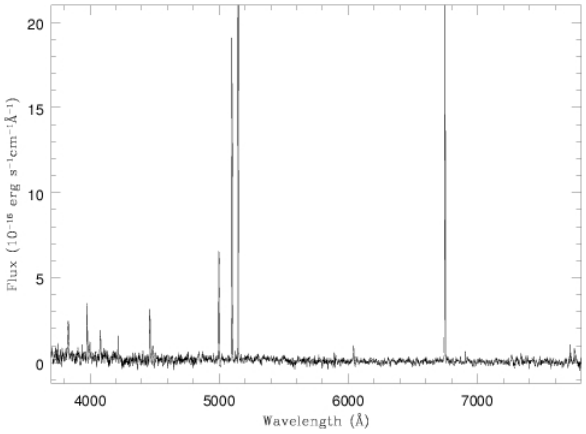


ON-band Continuum



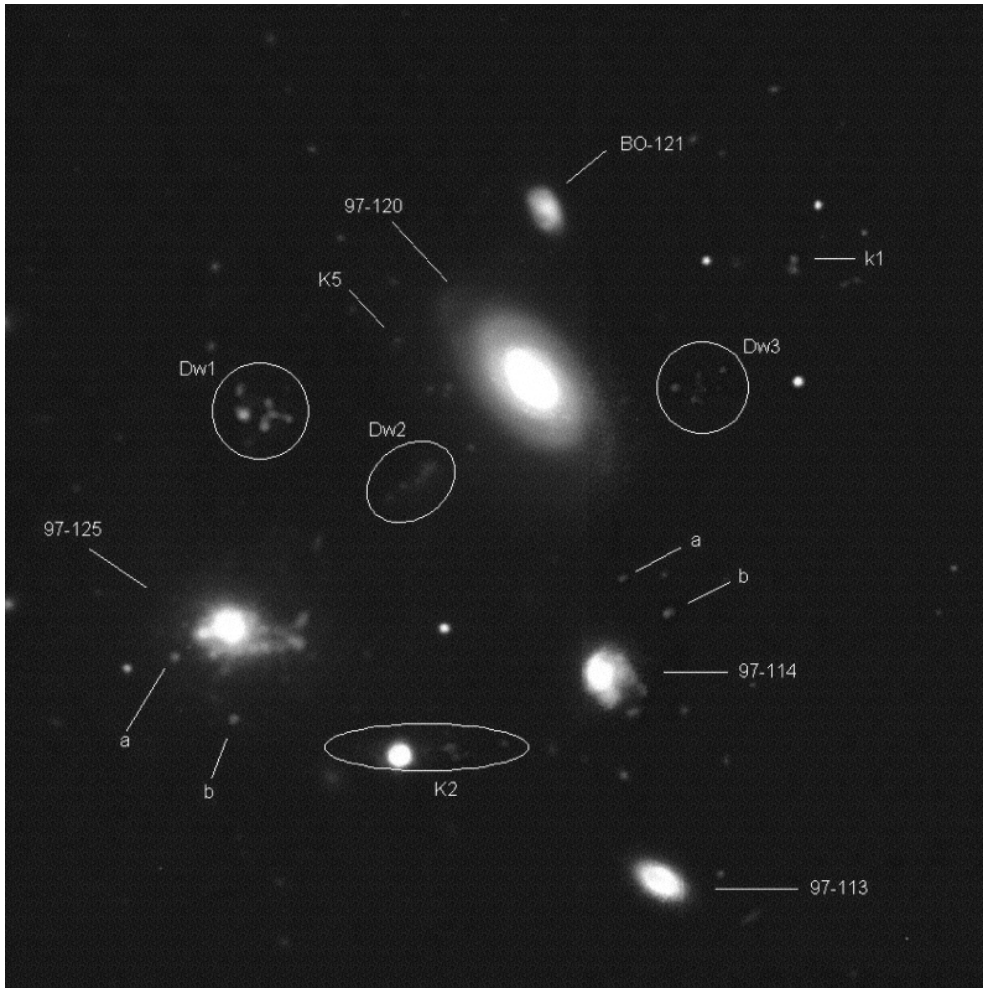
ON-band Continuum





Nearby clusters:
Preprocessing in small groups
Within clusters

Example in Abell 1367



2007 AAS/AAPT Joint Meeting, American Astronomical Society Meeting 209, #211.13;
Bulletin of the American Astronomical Society, Vol. 38, p.1192

Grism Selected Emission Line Galaxies in the Field Of Abell 1689

Meurer, Gerhardt R.; Benítez, N.; Coe, D.; **Vilchez, J. M.;** Frye, B. L.; Ford, H. C.; Illingworth, G. D.; Gronwall, C.; ScienceTeam, ACS

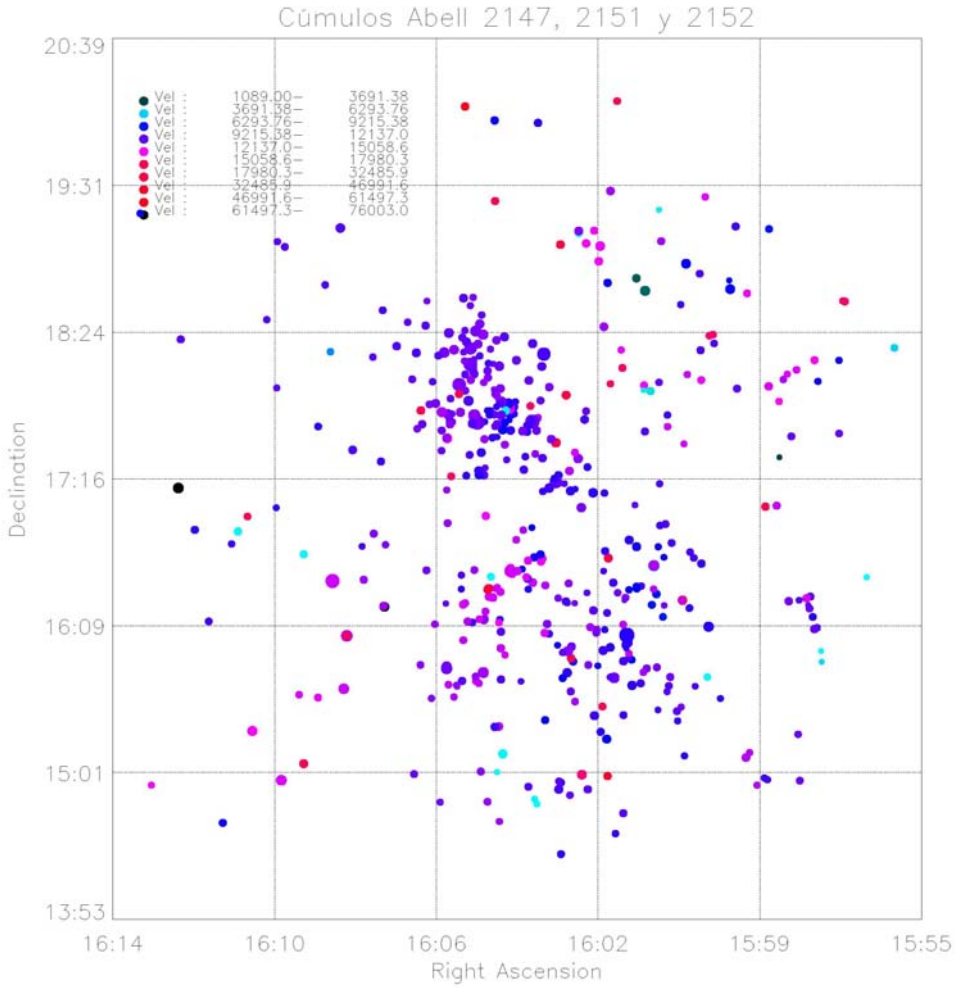
Abstract

Massive clusters of galaxies are the earliest cosmic structures to form. Deep images show a strong overdensity of galaxies in the cluster as well as gravitationally lensed background field sources. We have observed **Abell 1689, one of the most massive clusters in the nearby universe, using the Wide Field Camera and G800L grism of the Advanced Camera for Surveys onboard the Hubble Space Telescope**. Here we present a catalog of Emission Line Galaxies (ELGs) identified in this field. This **field is about 70% richer in ELGs compared to a "blank" field observed to a comparable depth. About half of the over density in ELGs results from H-alpha emitters at or near the cluster redshift.** Background galaxies are also detected including a spectacular example of a strongly magnified galaxy displaying line emission over much of its distorted face. The **ELGs are predominantly blue, although we do find some cases of line emitters on the Red Cluster Sequence**.

Revisión VI Workshop Estallidos
Algunos Resultados

The Hercules Cluster is among the most massive structures in the local universe and can be still in the process of collapsing (Barmby & Huchra 1998, Dickey 1997). Moreover, it presents at least three subclusters with varying dwarf to giant galaxy ratio (Sánchez-Jansen et al. 2005).

Taking into account that the luminosity of the Hα line is the best tracer of the SFR in the optical range (Kennicutt 1998), we have intended to study the environmental processes that can modify the SFR of the galaxies in Hercules cluster by making use of a database of Hα imaging.



Hércules: en Hα

Project objectives:

- **Complete Census of the Halpha emission sources of the Hercules cluster**
- Calibrate the **cluster luminosity function and the present day SFR**
- Derive the **distribution of structural/morphological parameters versus the star formation activity** class of galaxies
- Constrains the role of the environmental mechanism that induce **inhibition and/or triggering of the SFR**
- Unveil the **low mass star-forming galaxy population** of the clusters.

Observations:

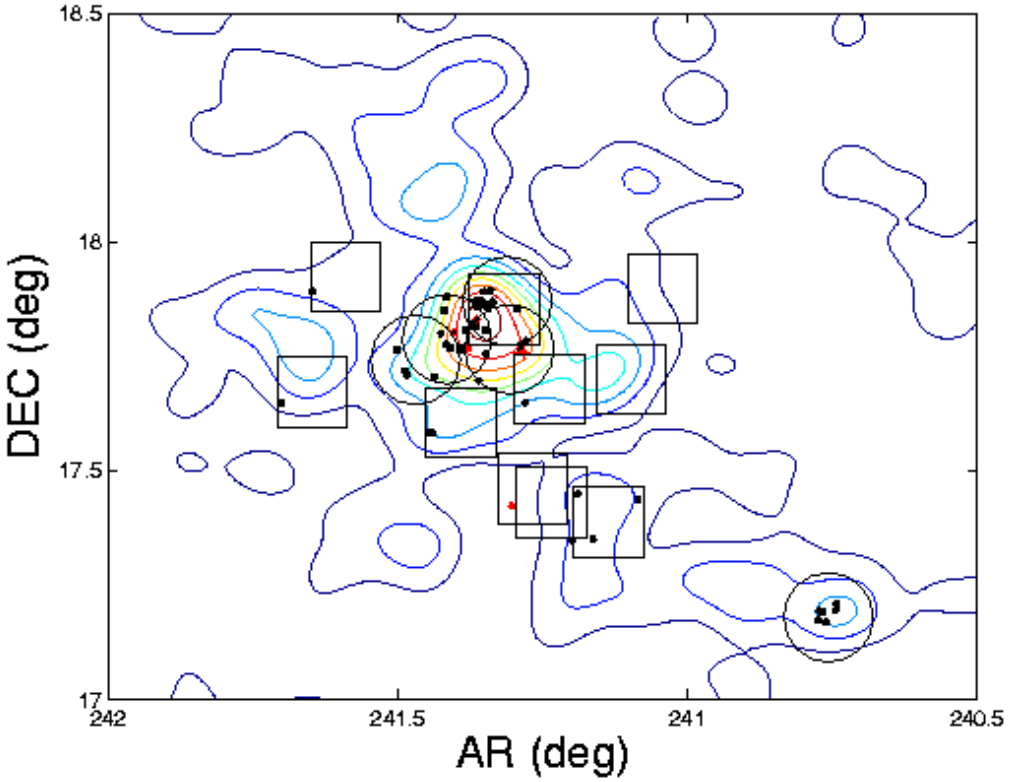
The data were obtained during two runs: from 6 to 7 May 2003 at NOT with ALFOSC in direct imaging mode and from 4 to 5 of June 2003 at WHT with prime focus imaging.

We obtained 16 pointings, covering about 473 arcmin^2 in total.

All the data was flux calibrated and corrected of the contribution of the [NII]λλ6548,84 lines and the galactic extinction.

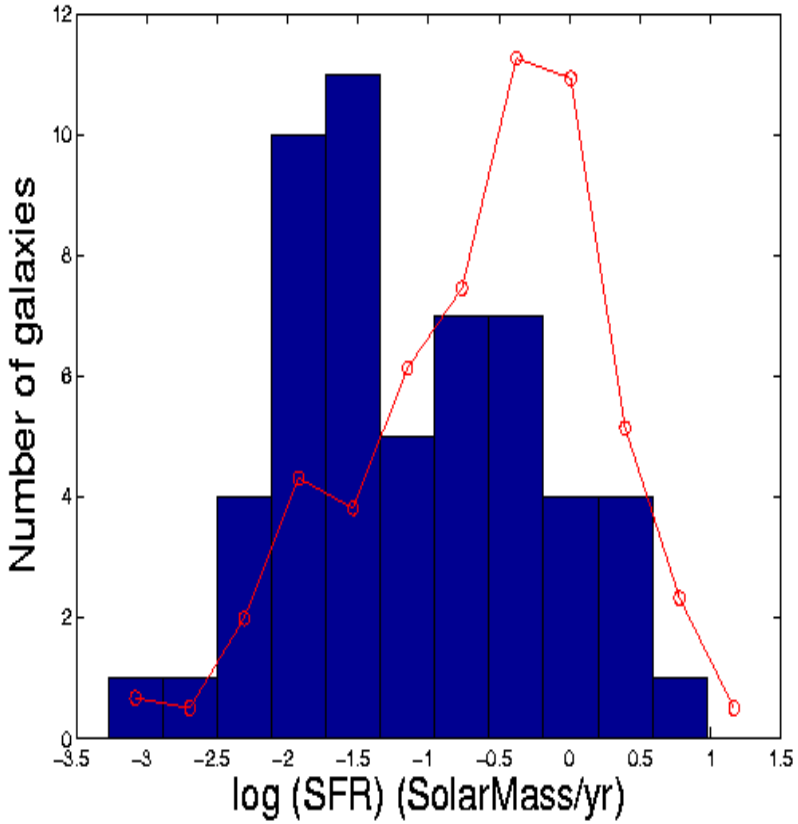
In total, 55 galaxies with emission were detected.

Hércules: en Hα



Galaxy density contours (from 2MASS), detected galaxies in the Hercules Cluster (black dots) and approximated positions and FOV (black circles for NOT and black squares for INT) for the pointings employed in the survey. The red dots are the positions of the galaxies employed as examples in the poster.

Hércules: en Hα



Histogram of the logarithm of SFR derived from our galaxies (blue columns) and the logarithm of SFR derived for galaxies in the field (from James et al. 2004) (red line and red circles). The number of galaxies from the field has been normalized to the number of galaxies in our sample to make the comparison. The Hercules cluster is clearly deficient in galaxies with SFR>0.1 $M_{\odot}$/yr when compared to isolated galaxies. This inhibition in the SFR may be due to the depletion of the gas reservoir (stripped by the ram pressure exerted by the intergalactic medium) (e.g. Kennicutt 1983, Gavazzi et al. 2002).



Prog. 6 : Tesis en Marcha

-- Daniel Reverte Payá (prevista Enero-Febrero 2008)

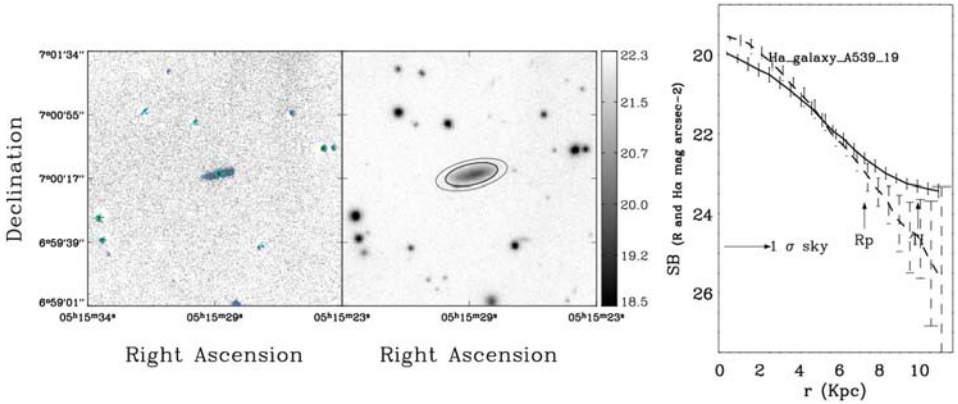
-- Ruben Sanchez Janssen

-- Jonatan Hernández Fernández

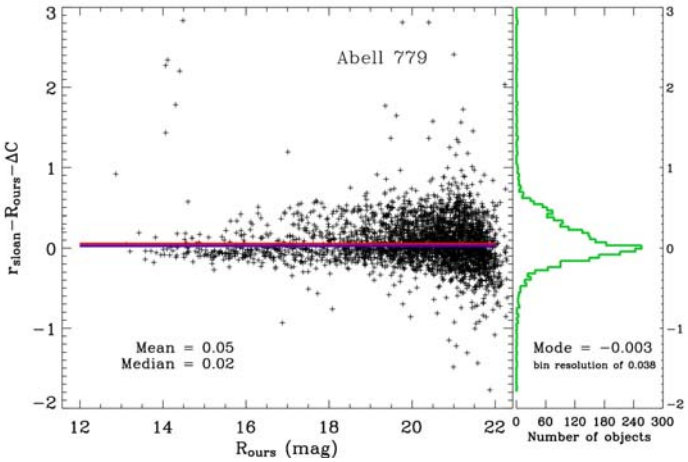
-- Vasiliki Petropoulou

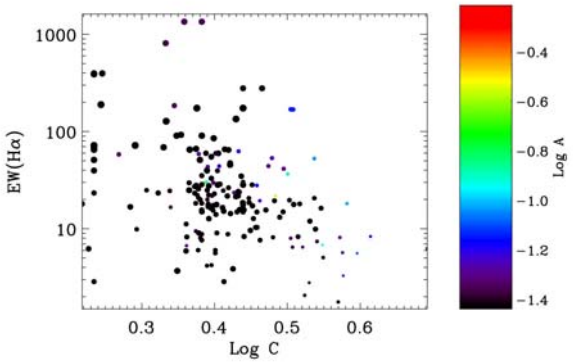
Dani's PhD

Truncamiento del disco en Halpha



Comparación Fotometria






Hα and U Band for WINGSurvey
Daniel Reverte
Jorge Iglesias
José M. Vílchez
Jesús Varela
Mariano Moles
Alessandro Omizzolo
Daniela Bettoni
Bianca Poggianti
Giovanni Fasano
CSIC
CSIC
INAF



Gracias !!