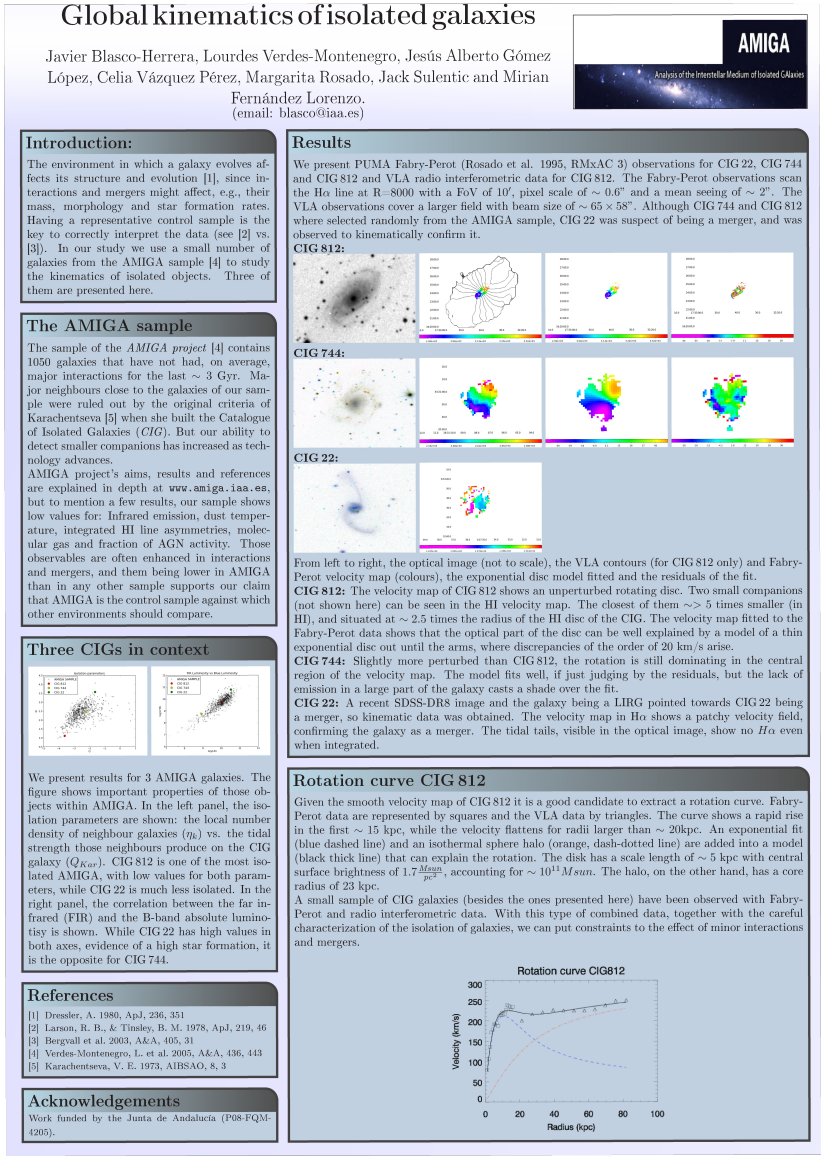
Global kinematics of isolated galaxies (#8)



Global kinematics of isolated galaxies

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AMIGA
Analysis of the Interstellar Medium of Isolated GAlaxies

Introduction:

The environment in which a galaxy evolves affects its structure and evolution [1], since interactions and mergers might affect, e.g., their mass, morphology and star formation rates. Having a representative control sample is the key to correctly interpret the data (see [2] vs. [3]). In our study we use a small number of galaxies from the AMIGA sample [4] to study the kinematics of isolated objects. Three of them are presented here.

The AMIGA sample

The sample of the *AMIGA project* [4] contains 1050 galaxies that have not had, on average, major interactions for the last $\sim$ 3 Gyr. Major neighbours close to the galaxies of our sample were ruled out by the original criteria of Karachentseva [5] when she built the Catalogue of Isolated Galaxies (*CIG*). But our ability to detect smaller companions has increased as technology advances.
AMIGA project's aims, results and references are explained in depth at `www.amiga.iaa.es`, but to mention a few results, our sample shows low values for: Infrared emission, dust temperature, integrated HI line asymmetries, molecular gas and fraction of AGN activity. Those observables are often enhanced in interactions and mergers, and them being lower in AMIGA than in any other sample supports our claim that AMIGA is the control sample against which other environments should compare.

Three CIGs in context

We present results for 3 AMIGA galaxies. The figure shows important properties of those objects within AMIGA. In the left panel, the isolation parameters are shown: the local number density of neighbour galaxies (η_k) vs. the tidal strength those neighbours produce on the CIG galaxy (Q_{Kar}). CIG 812 is one of the most isolated AMIGA, with low values for both parameters, while CIG 22 is much less isolated. In the right panel, the correlation between the far infrared (FIR) and the B-band absolute luminotisy is shown. While CIG 22 has high values in both axes, evidence of a high star formation, it is the opposite for CIG 744.

References

[1] Dressler, A. 1980, ApJ, 236, 351
[2] Larson, R. B., & Tinsley, B. M. 1978, ApJ, 219, 46
[3] Bergvall et al. 2003, A&A, 405, 31
[4] Verdes-Montenegro, L. et al. 2005, A&A, 436, 443
[5] Karachentseva, V. E. 1973, AIBSAO, 8, 3

Acknowledgements

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Results

We present PUMA Fabry-Perot (Rosado et al. 1995, RMxAC 3) observations for CIG 22, CIG 744 and CIG 812 and VLA radio interferometric data for CIG 812. The Fabry-Perot observations scan the Hα line at R=8000 with a FoV of 10′, pixel scale of $\sim$ 0.6" and a mean seeing of $\sim$ 2". The VLA observations cover a larger field with beam size of $\sim 65 \times 58$". Although CIG 744 and CIG 812 where selected randomly from the AMIGA sample, CIG 22 was suspect of being a merger, and was observed to kinematically confirm it.

CIG 812:

CIG 744:

CIG 22:

From left to right, the optical image (not to scale), the VLA contours (for CIG 812 only) and Fabry-Perot velocity map (colours), the exponential disc model fitted and the residuals of the fit.
CIG 812: The velocity map of CIG 812 shows an unperturbed rotating disc. Two small companions (not shown here) can be seen in the HI velocity map. The closest of them $\sim>$ 5 times smaller (in HI), and situated at $\sim$ 2.5 times the radius of the HI disc of the CIG. The velocity map fitted to the Fabry-Perot data shows that the optical part of the disc can be well explained by a model of a thin exponential disc out until the arms, where discrepancies of the order of 20 km/s arise.
CIG 744: Slightly more perturbed than CIG 812, the rotation is still dominating in the central region of the velocity map. The model fits well, if just judging by the residuals, but the lack of emission in a large part of the galaxy casts a shade over the fit.
CIG 22: A recent SDSS-DR8 image and the galaxy being a LIRG pointed towards CIG 22 being a merger, so kinematic data was obtained. The velocity map in Hα shows a patchy velocity field, confirming the galaxy as a merger. The tidal tails, visible in the optical image, show no $H\alpha$ even when integrated.

Rotation curve CIG 812

Given the smooth velocity map of CIG 812 it is a good candidate to extract a rotation curve. Fabry-Perot data are represented by squares and the VLA data by triangles. The curve shows a rapid rise in the first $\sim$ 15 kpc, while the velocity flattens for radii larger than $\sim$ 20kpc. An exponential fit (blue dashed line) and an isothermal sphere halo (orange, dash-dotted line) are added into a model (black thick line) that can explain the rotation. The disk has a scale length of $\sim$ 5 kpc with central surface brightness of $1.7 \frac{Msun}{pc^2}$, accounting for $\sim 10^{11} Msun$. The halo, on the other hand, has a core radius of 23 kpc.
A small sample of CIG galaxies (besides the ones presented here) have been observed with Fabry-Perot and radio interferometric data. With this type of combined data, together with the careful characterization of the isolation of galaxies, we can put constraints to the effect of minor interactions and mergers.

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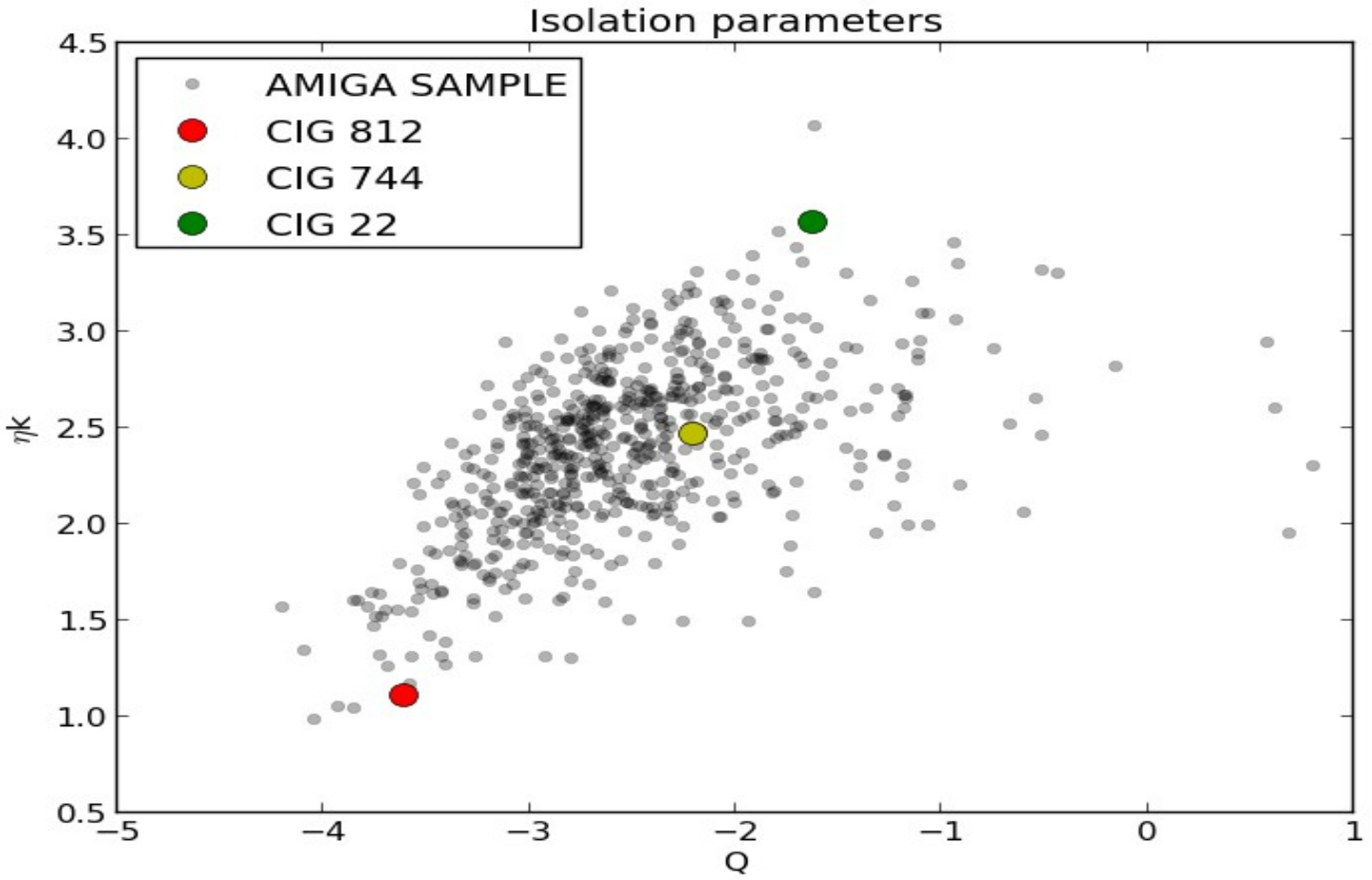
The AMIGA sample of galaxies

www.amiga.iaa.es

- 1050 galaxies with **well characterized isolation criteria**, (Karachentseva 1973, Verley et al. 2007).



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FOR THE RECORD:

“FIELD” IS NOT A VERY ACCURATE DEFINITION !!

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- Galaxies with minimized nurturing effects, maximized internal secular evolution.

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www.amiga.iaa.es

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- Different **from any other sample**: lower FIR luminosity, lower molecular gas content, lower AGN activity, integrated HI asymmetries...

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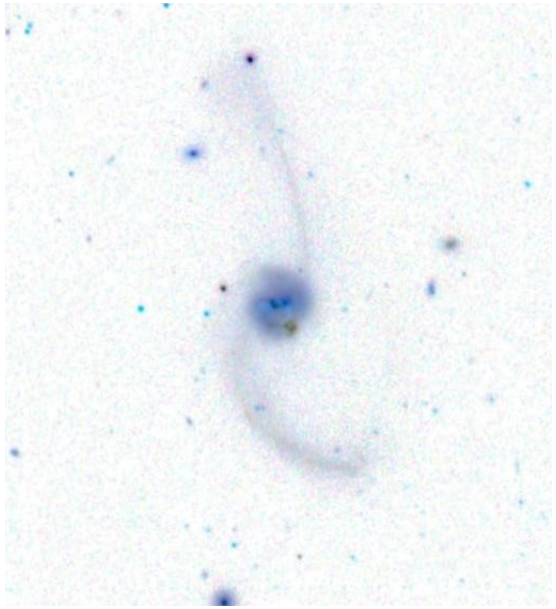
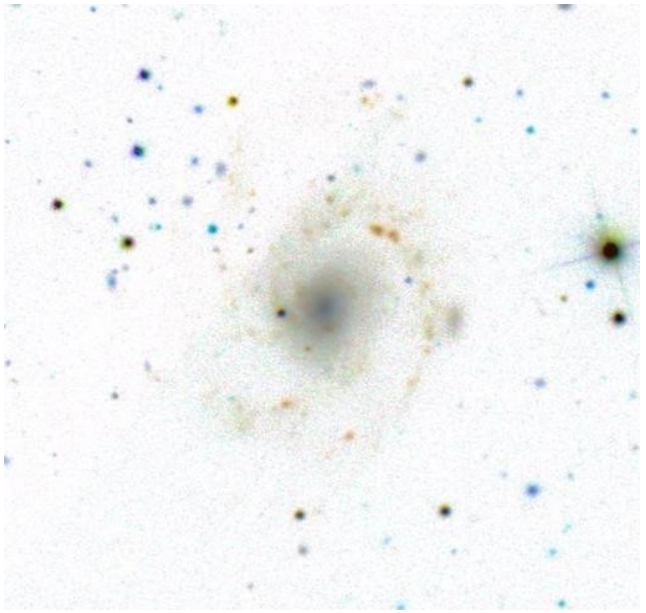
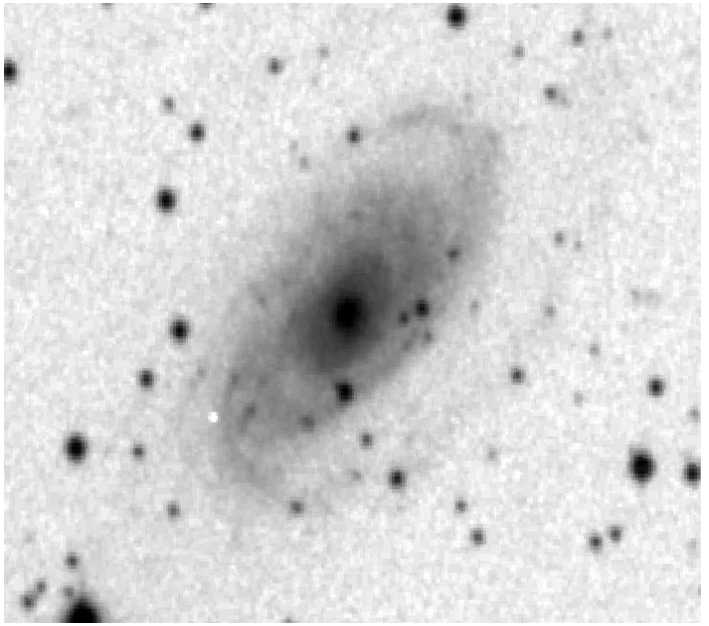
Three galaxies within AMIGA



CIG 22

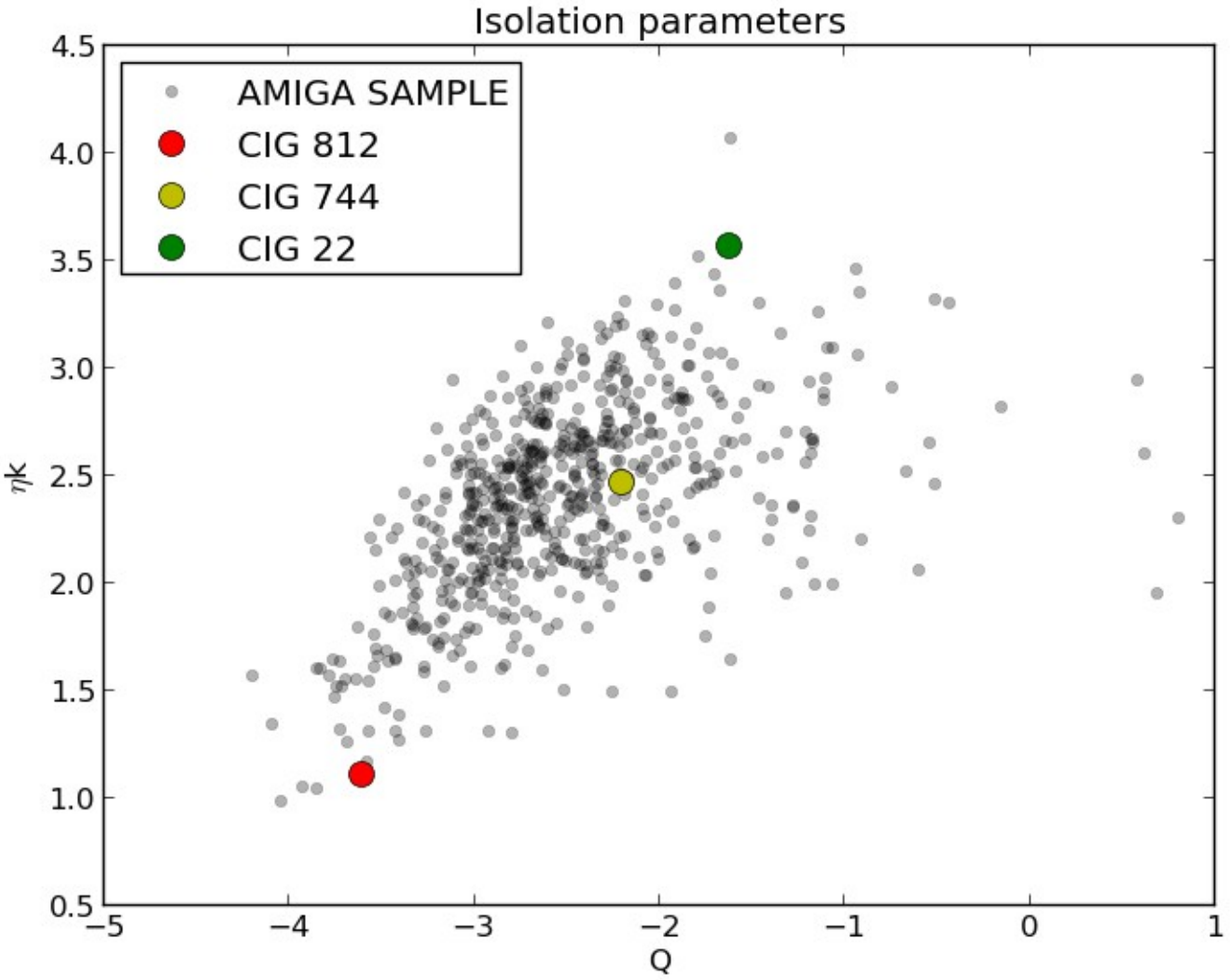


CIG 744



CIG 812

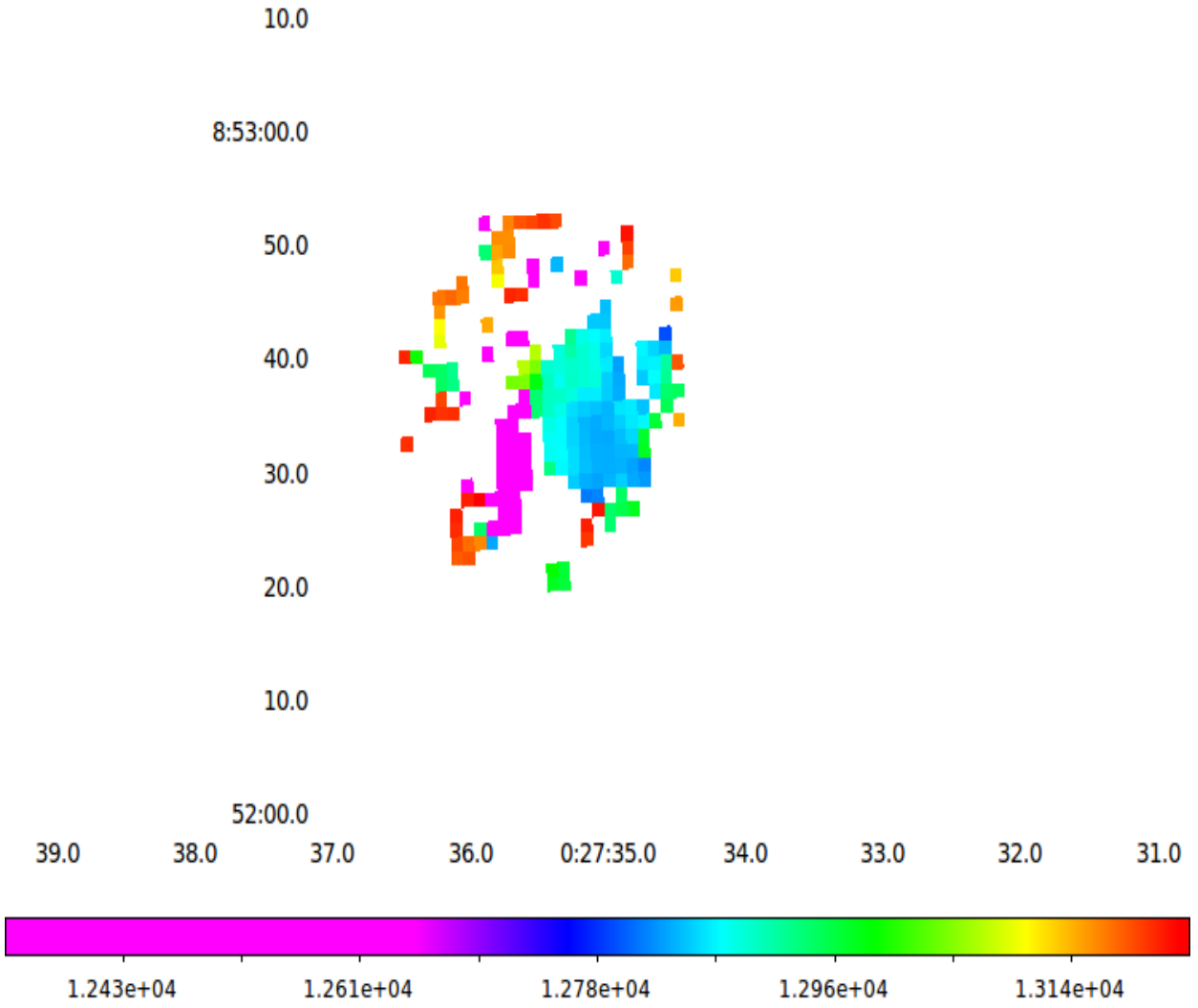
Three galaxies within AMIGA



PUMA Fabry-Perot data

- PUMA Fabry-Perot
- R ~ 8000 at Halpha
- 10' FoV

PUMA Fabry-Perot data

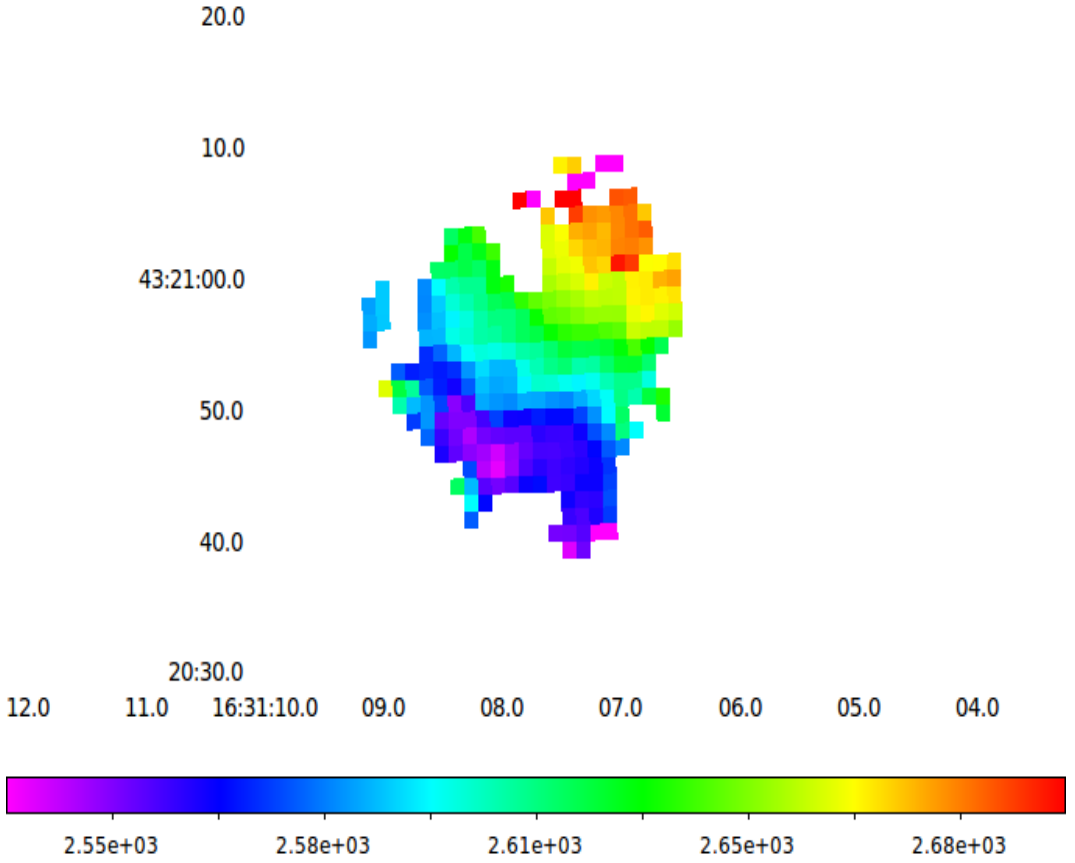


CIG 22:

Clearly a merger.

No Halpha in arms

PUMA Fabry-Perot data



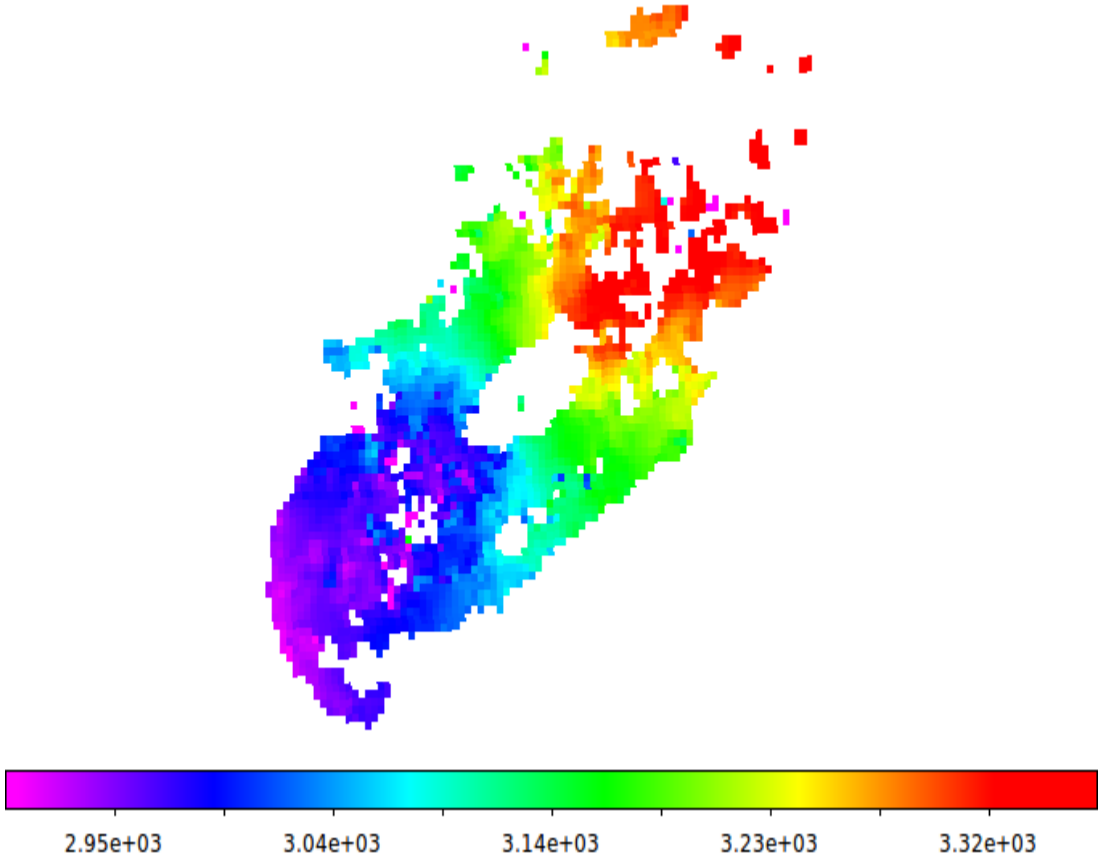
CIG 744:

Rotating galaxy, (~150 km/s velocity range)

Halpha not extender beyond the very centre.

Work still in progress!

PUMA Fabry-Perot data



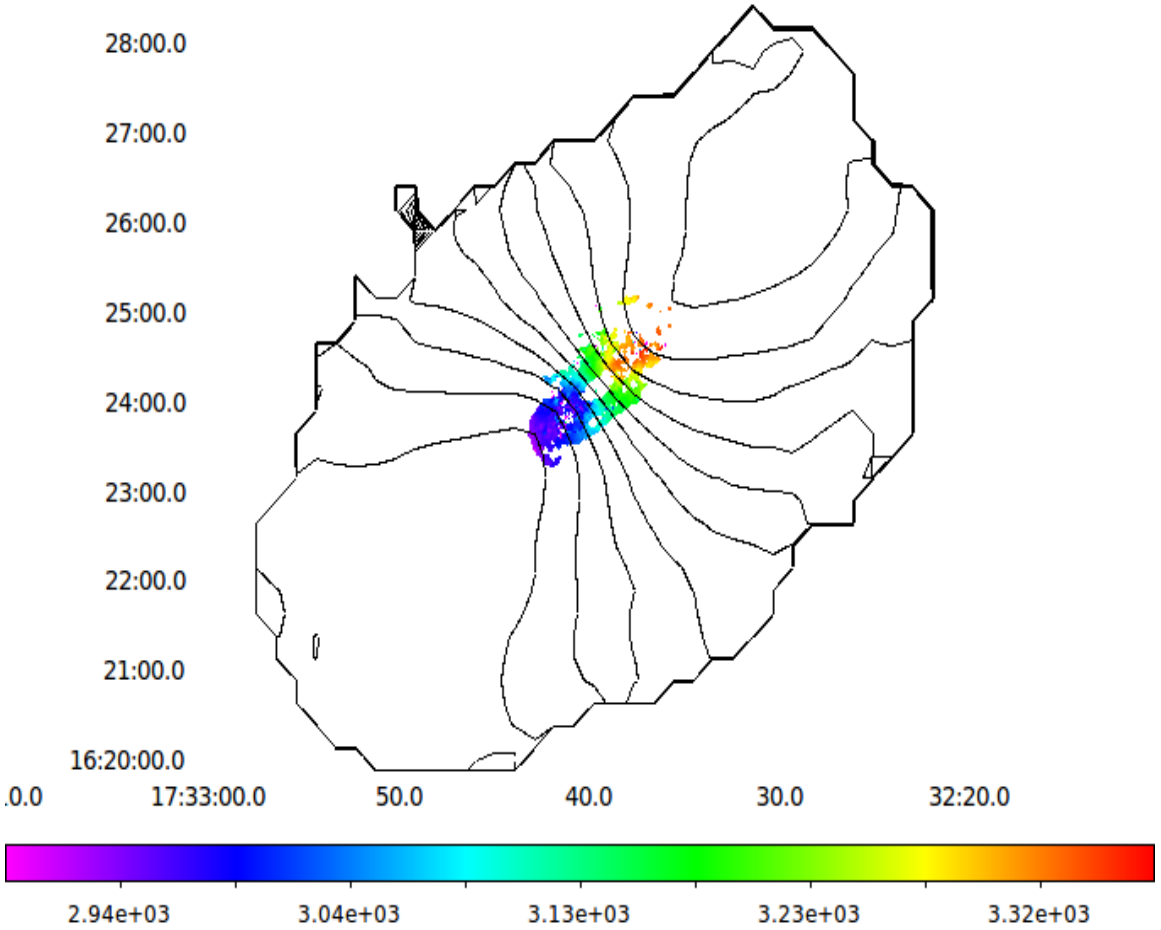
CIG 812:

Smooth rotation curve (~380 km/s velocity range)

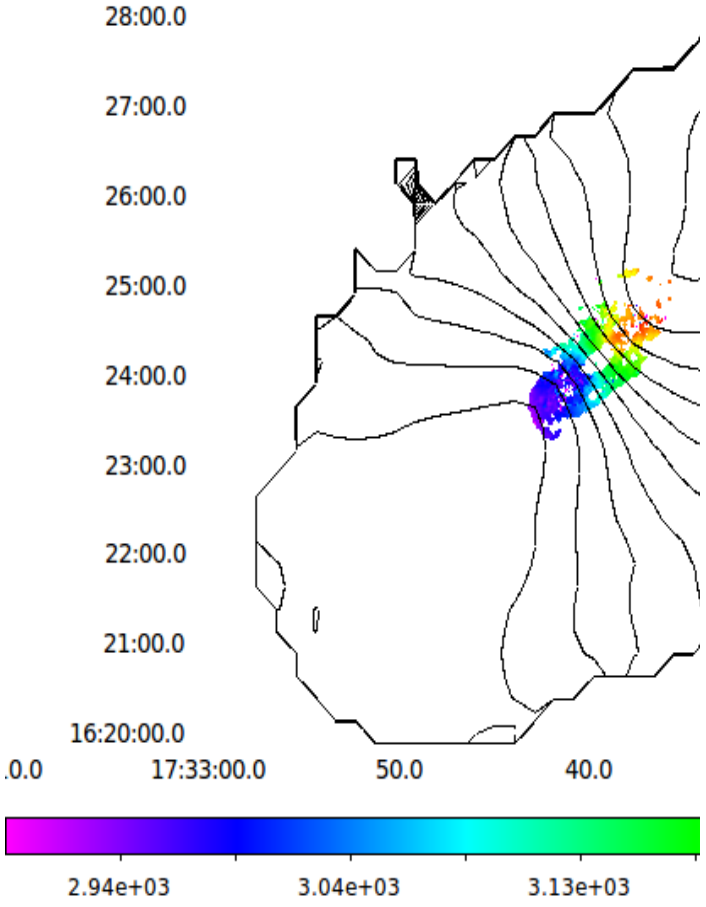
Halpha extends to the start of arms.

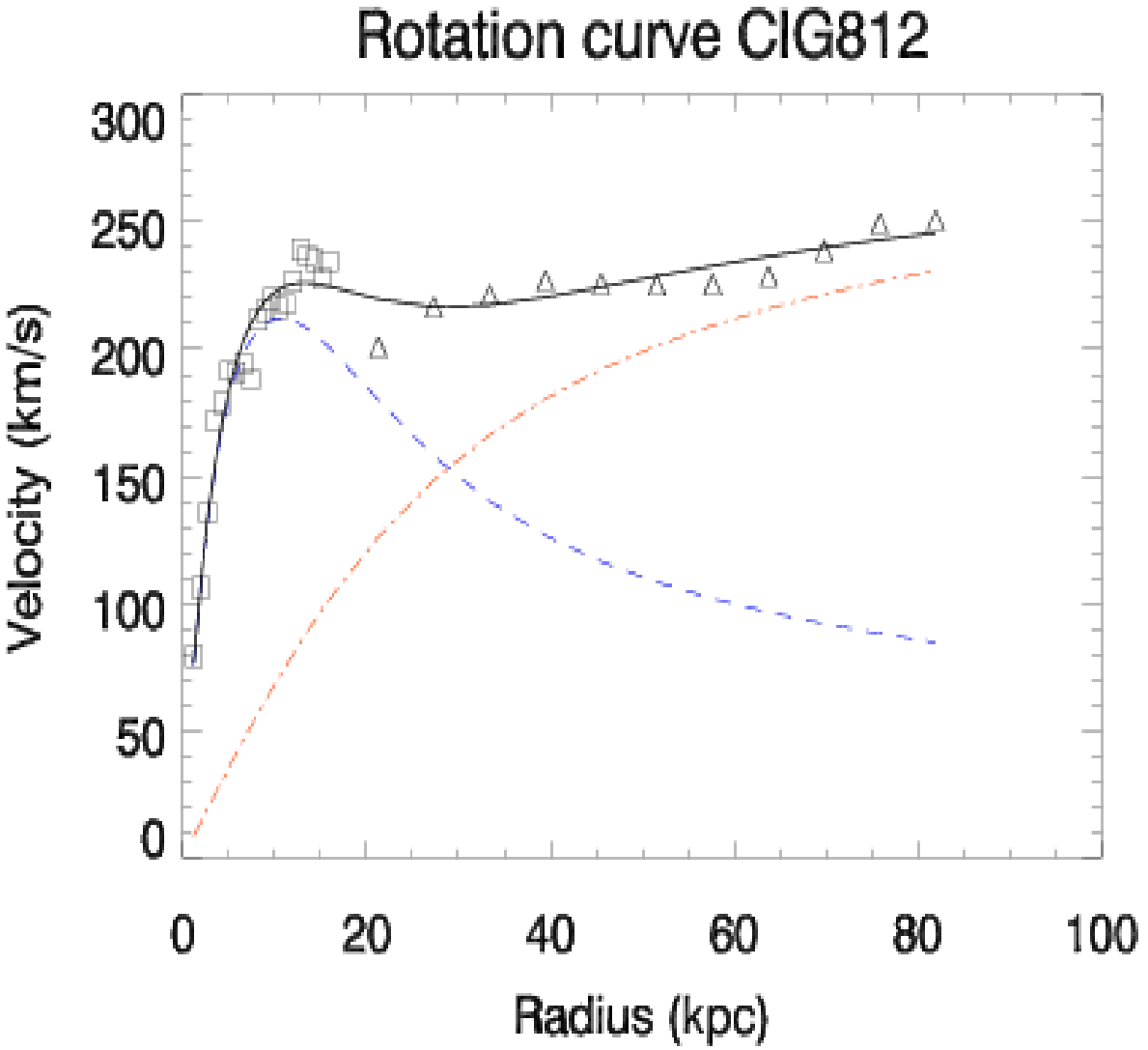
Work still in progress!

PUMA + VLA for CIG 22



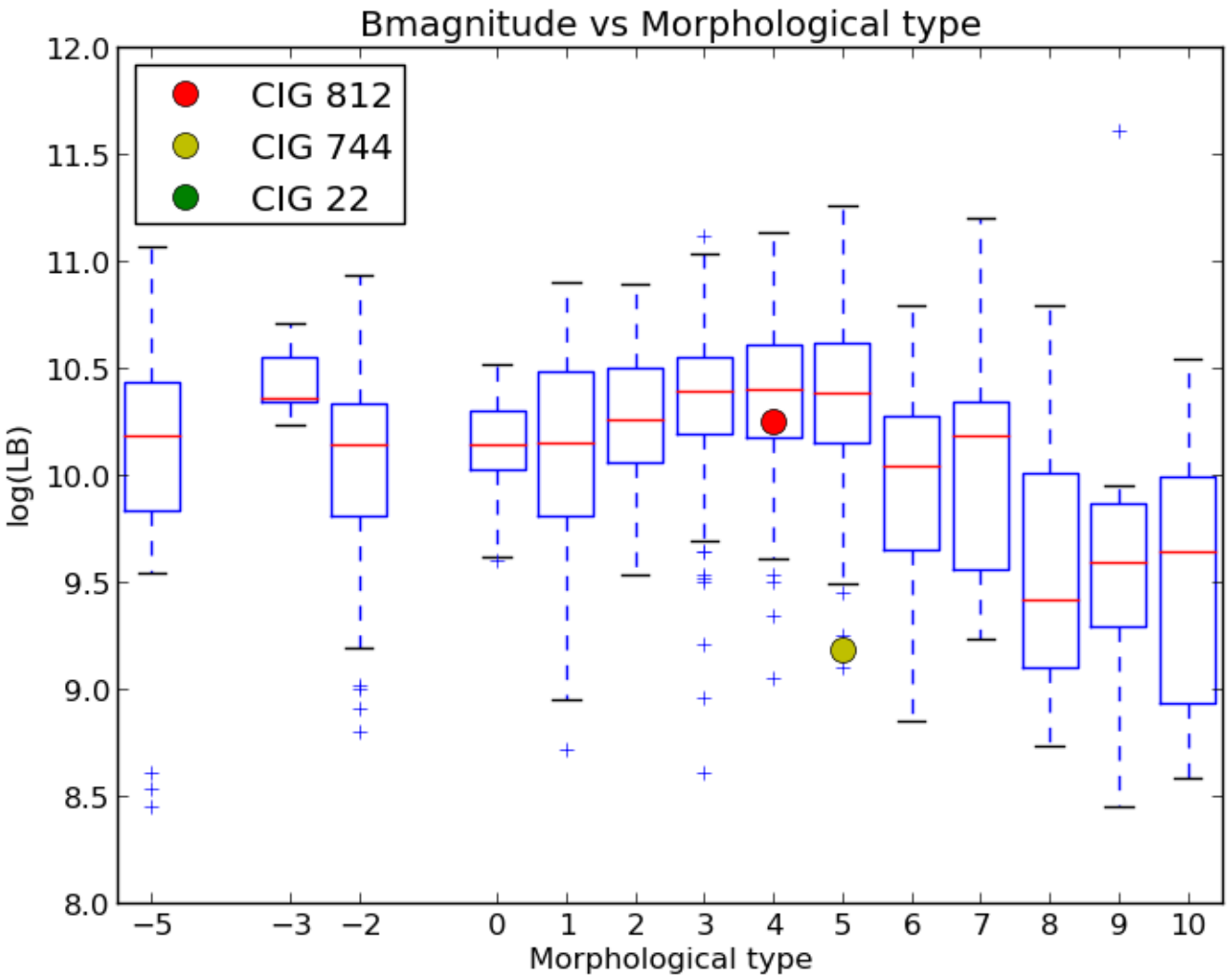
PUMA Fabry-Perot data





Thanks!
(and visit the poster!)

Three galaxies within AMIGA



Three galaxies within AMIGA