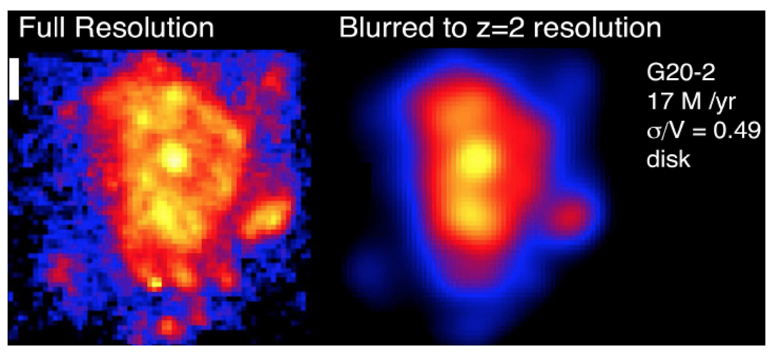
Is there structure in the velocity dispersion maps of turbulent disks?

Authors: Paola Oliva-Altamirano (poliva@astro.swin.edu.au)
David Fisher and Karl Glazebrook
Swinburne University of Technology

The DYNAMO sample

It is now established that Galaxies at z > 1 are different from galaxies at local redshifts. They have irregular morphologies with prominent star-forming clumps. However, due to the limited resolution of high-redshift observations, it is difficult to disentangle all physical processes. The DYnamics of Newly Assembled Massive Objects (DYNAMO) survey it is an ongoing multiwavelength campaign, designed to undersatand the nature of these clumps. We aim to observe local galaxies (z < 0.25) with properties similar to those at high redshift (z~2). At low redshifts we can resolve turbulent galaxies, down to Jeans-scales and study the details of secular evolution.



Fisher + submitted

Dynamics of turbulent galaxies

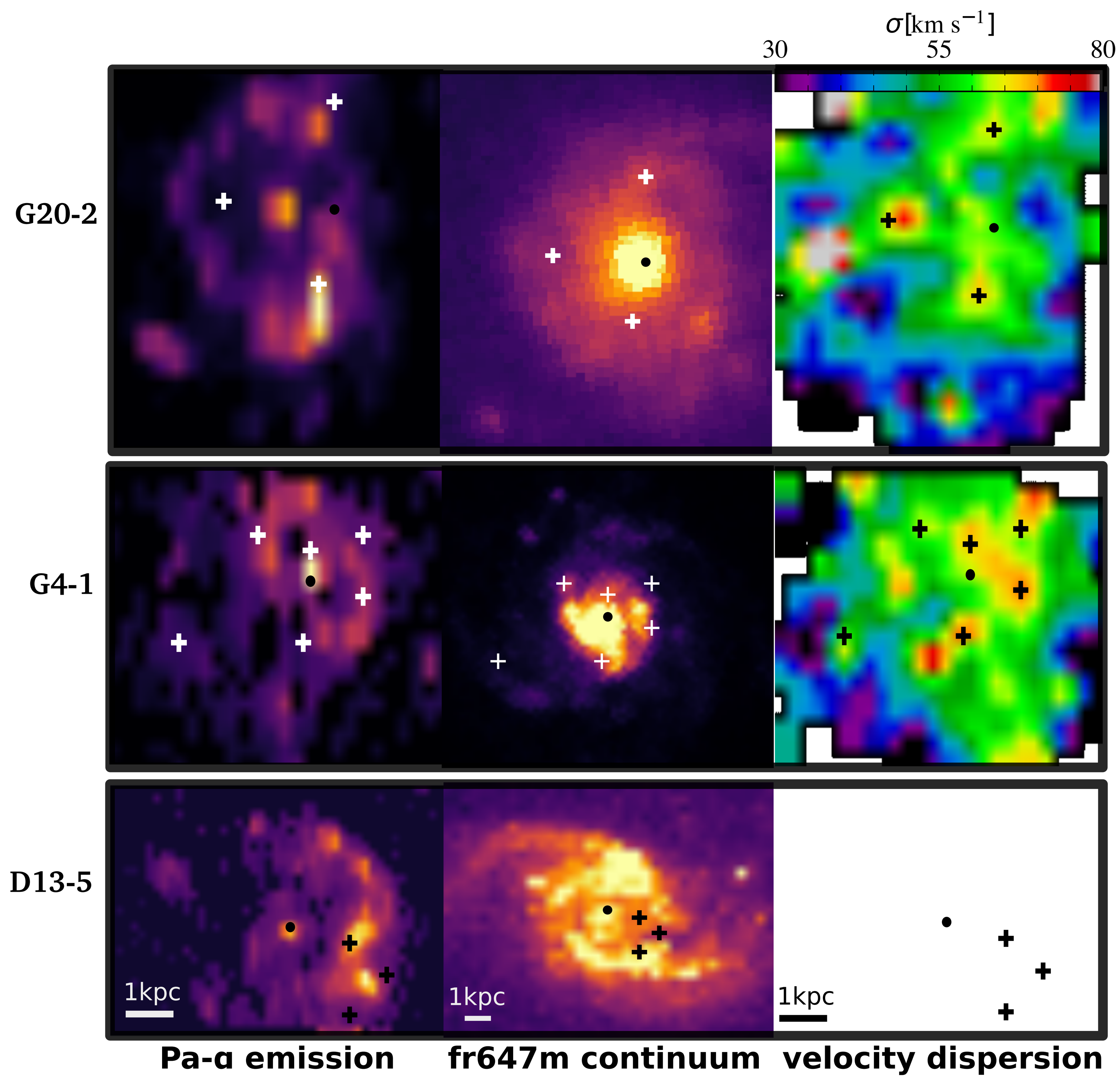
To measure the velocity dispersion (σ) profile of disk galaxies is a challenge for current observations, due to the effect of systematics, e.g. beam smearing, psf blurring, noise. High-z analyses assume a flat σ map. The DYNAMO galaxies have high σ values, analogous to high-z galaxies *(Green +2014, Bassett +2014, Obreschkow +2015, Oliva-Altamirano in prep)*. Therefore, we can study in detail their σ distribution. We find that at high resolution, and after accounting for the different sources of errors, there is significant structure in the σ maps.

This leads us to the following open questions:
a) Are the peaks in σ maps physically meaningful or just a stochastic effect?
b) Can we trace the life of star-forming clumps via the σ maps of turbulent disk galaxies?

Many studies have explored the **sources of variance in σ** (e.g. Genzel +2014, +2011, Wisnioski +2011, Krumholz & Dekel 2010, Genel +2010, Shapiro +2008, Elmegreen +2009) among the common hypotheses there are:

a) Collapsing clumps by definition are in areas where σ drops. Here the gravitational instability is higher and new clumps form.
b) Clump-outflows might generate high-σ spots.
c) In high-mass clumps pressure support might lead to high-σ.

This work will clarify the connection between σ structure and the physical processes that from star-forming clumps.



A subset of turbulent disks from the DYNAMO sample. The left-hand panels show Pa-α emission from OSIRIS/Keck observations. The central panels show the band filter *fr647m* from HST observations, which are a proxy of the stellar continuum. The right-hand panels show the velocity dispersion (σ) derived from Pa-α. The circles mark the highest peak on the continuum, and the crosses indicate the hot spots in the σ distribution. This figure is a good representation of the high-quality observations from the DYNAMO survey. The high spatial resolution (~300pc) of the Pa-α emission maps from OSIRIS significantly reduces the effect of beam smearing, and allows us to make reliable σ measurements.

In some cases such as G20-2 and G4-1 there is a weak correlation between the hot spots in sigma and the continuum maps, and no correlation with the emission maps (clumps). In others such as D13-5, the sigma distribution appears to be stochastic.

We are aiming to extend this resolved sample of galaxies to look for new trends in the sigma structure of turbulent disks. To date, the major source of error in our analysis comes from converting a single band flux to stellar mass. More data will allow us to break the degeneracy in mass-to-light ratios in young dusty galaxies.