The MAGPI Survey: The Chicken or the Egg, velocity disturbances causing feedback or stellar feedback causing velocity disturbances?

R.S.Bagge[1,2]
[1]School of Physics, University of New South Wales, Kensington, NSW,2032, Australia
[2]ARC Centre of Excellence for All Sky Astrophysics in 3 Dimensions (ASTRO 3D)
Email:r.bagge@unsw.edu.au

The MAGPI Survey

10 billion years ago, galaxies were very different to what we observe today; but what is driving this change is not immediately obvious. The Middle Ages Galaxy Properties in Integral Field Spectroscopy (**MAGPI**) Survey aims to bridge the gap between high-redshift and low-redshift by looking at galaxies in the cosmic 'middle ages'. Signatures of **galaxy evolution** remain in **kinematics of galaxies.** By studying the disturbances in the **line−of−sight−velocity−distribution** (LOSVD), we can better understand which physical processes contribute to **galaxy evolution.**

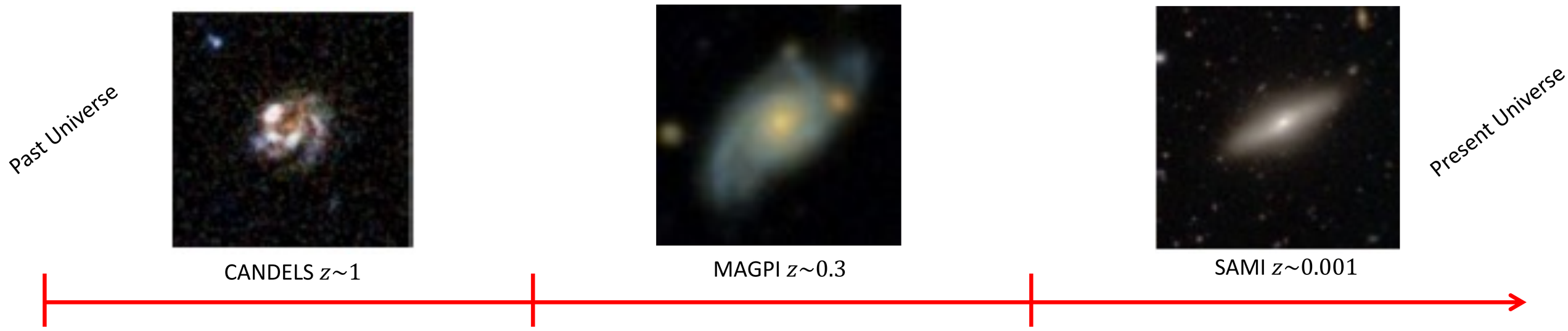

Fig.1 *(Top Left):* An image of a high-redshift CANDELS galaxy (Grogin+11). *(Top Right)*: An image of low-redshift SAMI (Bryant+15). *(Bottom left)*: An image of a **MAGPI** galaxy (Foster+21). MAGPI targets a representative sample of galaxies in the cosmic 'middle ages' to help understand how galaxies transform across cosmic time.

KINEMATIC ASYMMETRIES

KINEMETRY (Krajnovic+07) is an 2D−tilted−ring fitting algorithm that fits a Fourier Series along a series of ellipses, such that $\mathrm{V}(\theta) = B_1 \cos\theta$, and non-circular motion is encoded as higher-order Fourier coefficients, these higher terms are used to compute the asymmetry, $v_{asym} = \frac{k_2+k_3+k_4+k_5}{4k_1}$. But **what drives the asymmetry?** It has been linked to star-formation, environment and internal processes (e.g., Shaprio+08, Krajnovic+11, Bloom+17, Feng+22) but these studies have largely limited to the Local Universe ($z < 0.1$), **with MAGPI we can go further back!**

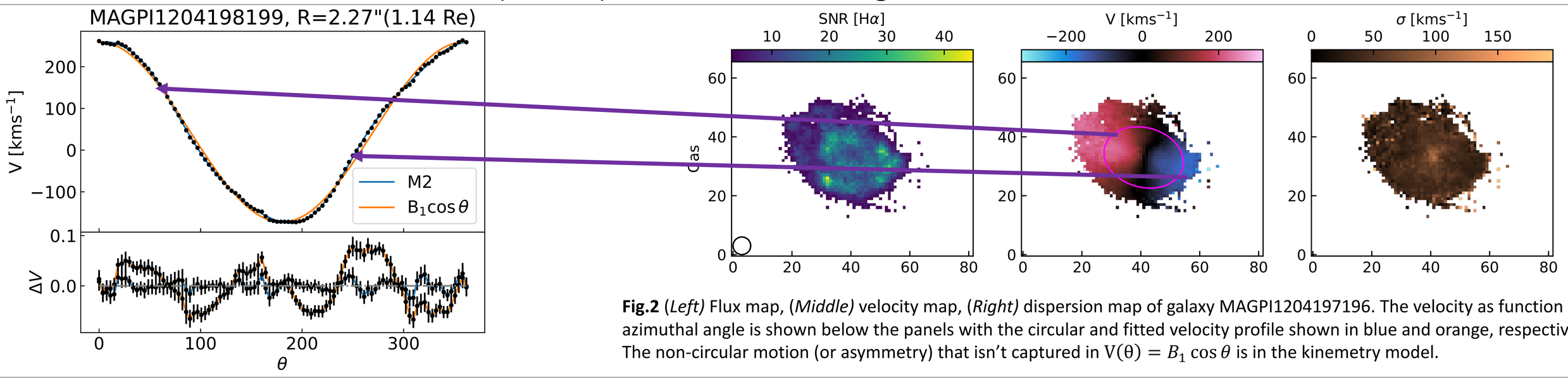

Fig.2 (*Left)* Flux map, (*Middle)* velocity map, (*Right)* dispersion map of galaxy MAGPI1204197196. The velocity as function of azimuthal angle is shown below the panels with the circular and fitted velocity profile shown in blue and orange, respectively. The non-circular motion (or asymmetry) that isn't captured in $\mathrm{V}(\theta) = B_1 \cos\theta$ is in the kinemetry model.

STAR FORMATION AND STELLAR MASS

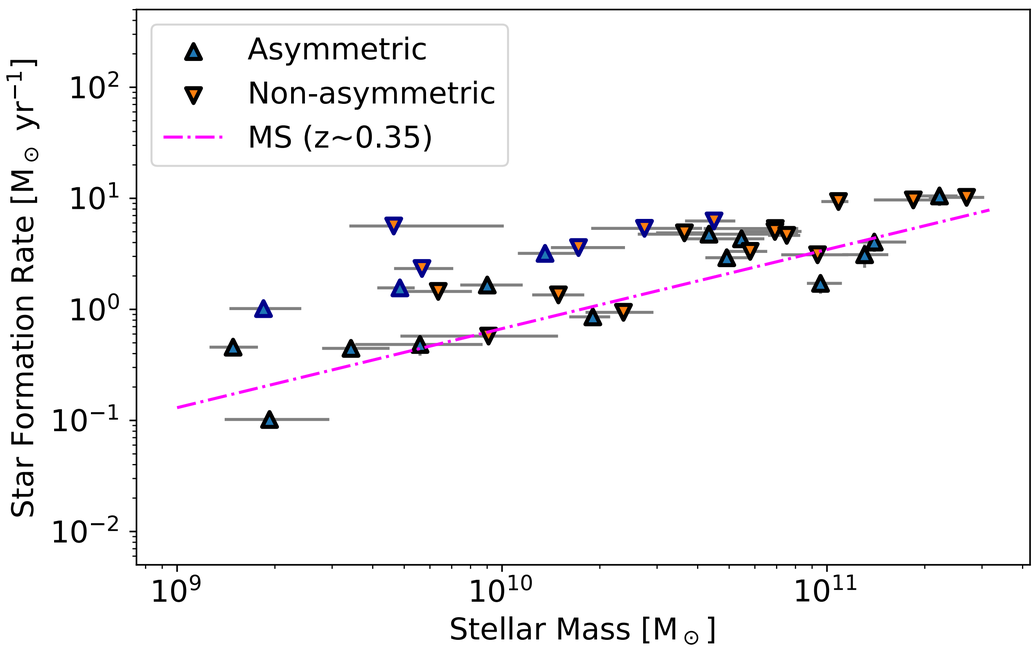

Fig. 3 Star Formation Rate vs. Stellar Mass for a subsample of MAGPI galaxies; asymmetric galaxies are those with upwards pointing triangle, while those with downward point triangle are non-asymmetric

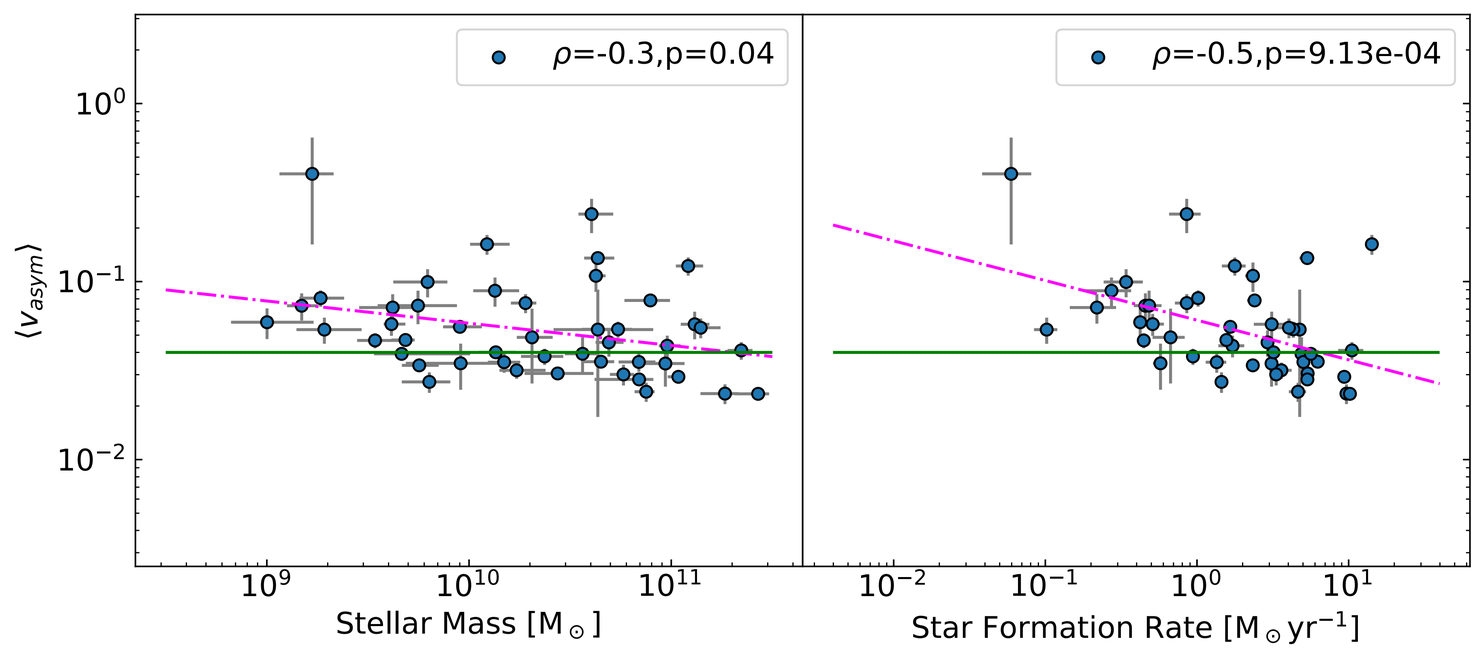

Fig. 4 Luminosity Weighted v_{asym} vs. Stellar Mass and Star Formation Rate for the same subsample of MAGPI galaxies; v_{asym} anti-correlated with both quantities, but slightly stronger with SFR, Is the asymmetry more coupled to SFR or the stellar mass of a galaxy?

Low stellar mass, star-forming galaxies tend to be more asymmetric than than high stellar mass, star-forming counterparts. The global v_{asym} of galaxies is anti-correlated with both star-formation rate and stellar mass. This could be evidence of stellar and supernovae feedback causing velocity disturbances in the disks of low stellar mass galaxies, which has smaller gravitational potential. Or was the gas ***already*** disturbed previously and it is no longer rotating within the disk of the galaxy, consequently it is no longer able to form stars, and the measured star-formation rate is lower? Asymmetries measured from tracers with longer timescales are need to disentangle the source of the asymmetry. **MAGPI** has resolved spectra of gas ***and*** stars; looking at the asymmetries stellar velocity maps, in which asymmetries will stay longer, will help solve this cosmic riddle of the chicken or the egg.

References: Bryant et al., 2015, RAS, MNRAS **447,** 2857–2879, Bloom et al., 2017, RAS, MNRAS, **465**, 1, 123-148, Feng at al., 2022, ApJ, **262,** 1, e6}, 6 pages, Foster et al., 2020, PASA, **38,** e031, 24 pages , Grogin et al., 2011, ApJ, **197,** 35, 39 pages, Shapiro et al., 2008, ApJ, **682**, 1, 231-251, Krajnovic et al., 2006, RAS, MNRAS **366,** 3, 787–802, Krajnovic et al., 2011, RAS, MNRAD, **414**,4, 2923-2949