Kinematics, structure and stellar populations of disks since z=1

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We have constructed a data set of >200 field disk galaxies at redshifts up to z=1.0 with Very Large Telescope (VLT) spectroscopy and Hubble Space Telescope imaging. This is one of the largest kinematic samples of distant disks to date. We use spatially resolved rotation curves to derive maximum rotation velocities and total masses; we also investigate disk sizes, stellar population properties etc. In a recent campaign, we have enlarged our sample by a further ~60 objects with *very deep* VLT spectroscopy – 10 hours on each target. These data will help to better explore the evolution of galaxy scaling relations like the Tully-Fisher, velocity-size etc. at low masses, which are lacking in previous kinematic samples at these redshifts.

Our observations were carried out with the FORS instruments of the VLT (spectroscopy) and the Advanced Camera for Surveys of the HST (F814W imaging). Additionally we rely on deep multi-band optical/NIR photometry (VLT, NTT, WHT). The derivations of the disks' rotation velocities take into account all geometrical and observational effects including seeing and optical "beam smearing" (Böhm et al. 2004, A&A, 420, 97; Böhm & Ziegler 2007, ApJ, 668, 846).

At a given maximum rotation velocity, the distant galaxies on average are smaller than their counterparts in the local universe. This discrepancy becomes larger towards higher redshifts, reflecting the growth of disks with ongoing cosmic time (see Fig.1), in accordance with theoretical predictions by, e.g., Mao et al. (1998, MNRAS, 297, 71) or models by, e.g., Dutton et al. (2011, MNRAS, 410, 1660). This evolution is contrasted by a down-sizing of the stellar populations (Ferreras et al. 2004, MNRAS, 355, 64).

We recently took very deep spectra (10 hours per target, P.I. A. Böhm) of ~60 distant spirals in the low- and high-mass regimes, see Fig.2. We will combine these data with our existing sample to investigate the evolution of disk galaxy scaling relations like e.g. the Tully-Fisher and velocity-size with much more robustness than feasible so far at these redshifts. With the relatively bright, high-mass objects, we will also study bulge growth over cosmic time, conduct a detailed modelling of their star formation histories and a mass decomposition into Dark Matter Halo, disk and bulge.

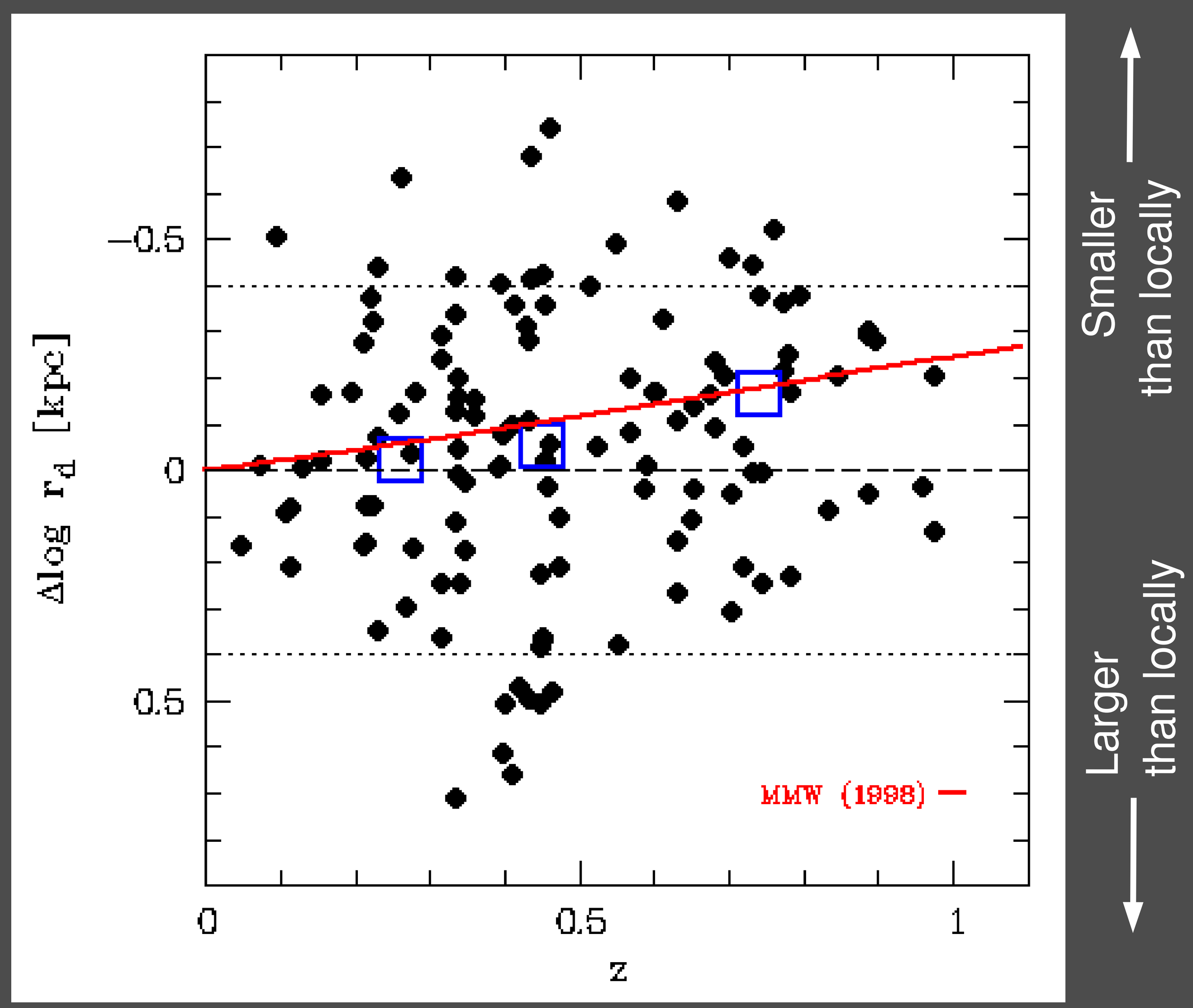

Fig.1: Deviations of the distant galaxies from the local velocity-size relation as a function of redshift. On average (blue squares show median values in three redshift bins), the distant galaxies are smaller than locally ($\Delta \log r_d < 0$), reflecting disk growth via minor mergers and accretion since z=1.

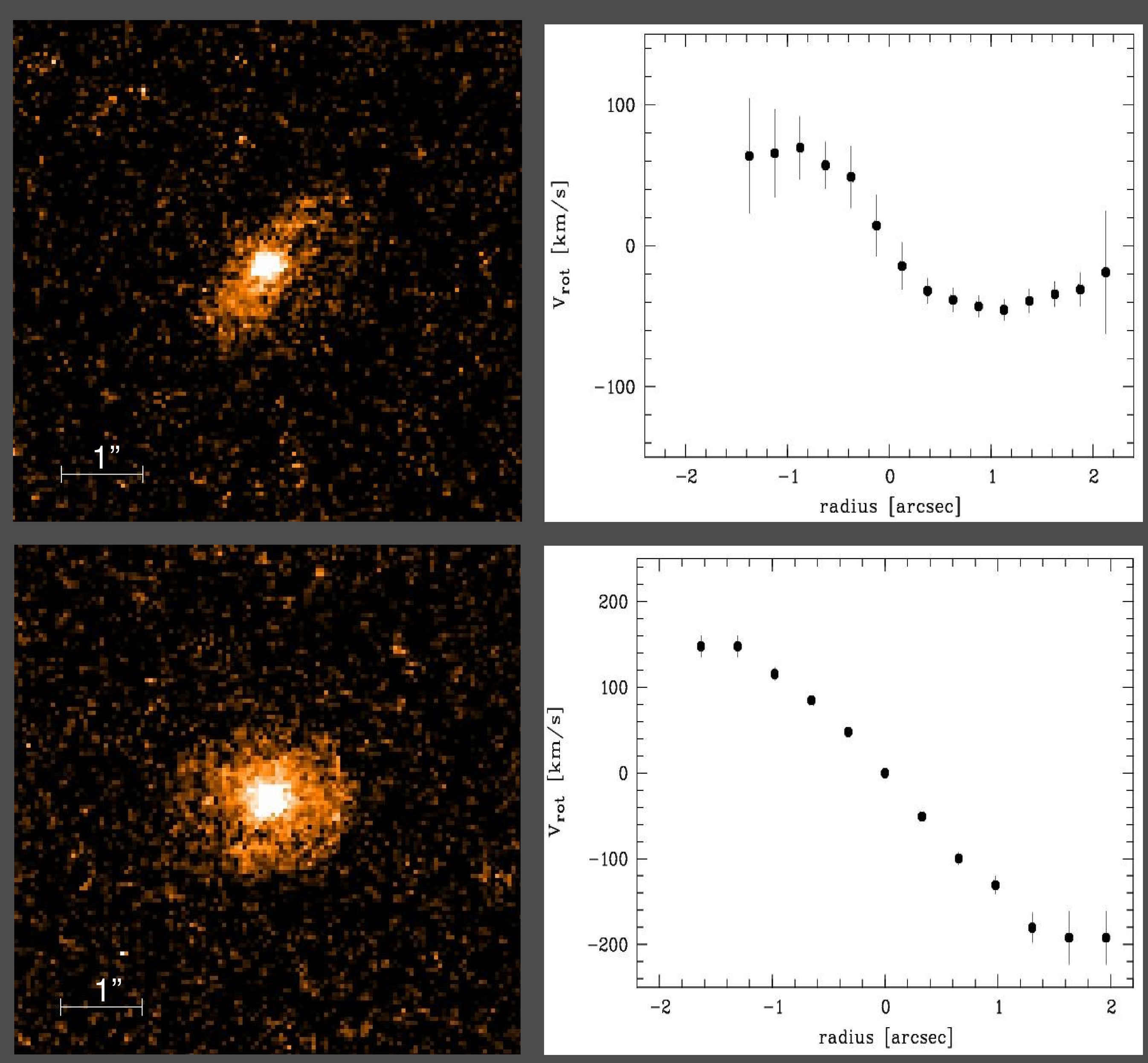

Fig.2: Two examples from our new data set (left: HST/ACS image, right: rotation velocity as a function of radius). Both galaxies are at z≈0.4 and have low absolute magnitudes $M_B \approx -18$. Note that the rotation curve extent is about twice as large as the optical stellar disk on the single-orbit HST images.