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The host galaxies of Active Galactic Nuclei with powerful relativistic jets

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SCIENTIFIC BACKGROUND

Tight empirical relations between the black hole mass (M_{BH}) and properties of its spheroid (e.g. Kormendy & Ho 2013) suggest a connection between the black hole and its host galaxy. However, details on the mechanisms allowing nuclear activity to play a role on the formation and evolution of its host galaxy remain elusive. Bearing this in mind, one may envision a close coupling between the relativistic jet launched by some black holes and their host galaxies. So, the question arises:

- ***Is there any relation between the host galaxy (its black hole) and the jet it launches?***
- ***Are there any consequences on the host galaxy evolution because of launching a powerful jet?***

In this work we report the properties of galaxies hosting high-luminosity blazars being resolved with our NIR imagery and we compare the properties of our sample with those reported in the literature for blazar sources.

THE SAMPLE

Our sample consists of 19 blazars (all classified as Flat Spectrum Radio Quasar, *FSRQs*) with redshifts 0.3 < z < 1.0 observed with the NIR camera NOTCam on the Nordic Optical Telescope (NOT). Additionally to these sources (this work), we performed a large compilation of blazars (78 BLLacs and 7 FSRQs; literature sample) with host galaxy detection, redshifts 0.0 < z < 1.3 and 1.4 GHz flux density measurements reported in the literature. We avoid the BLLac/FSRQ classification (Fig. 1, top histogram) and instead we use the bimodality in the $L_{1.4GHz}$ distribution (Fig. 1, bottom histogram, to divide our sample in ***low-luminosity blazars (LLBs, sources with $L_{1.4GHz} \geq 10^{26} WHz^{-1}$) and high-luminosity blazars (HLBs, those sources with $L_{1.4GHz} \geq 10^{26} WHz^{-1}$).***

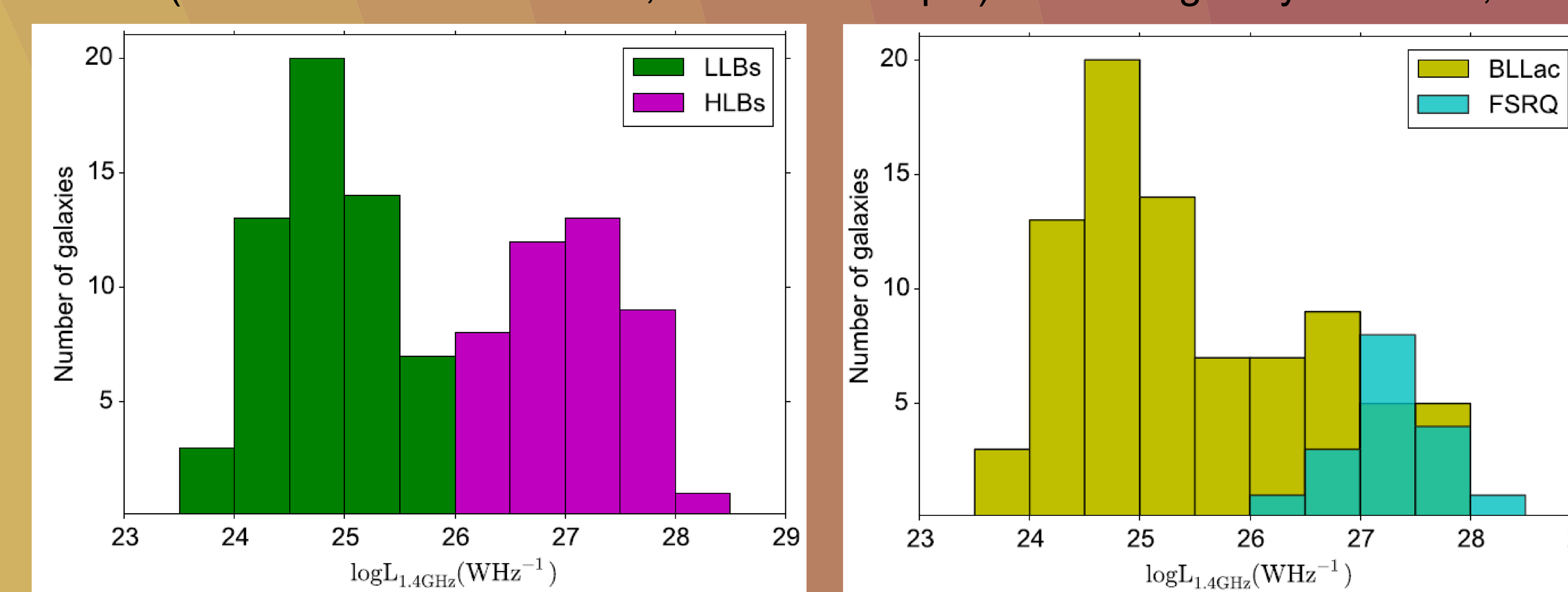

Figure 1. Distribution of the 1.4 GHz luminosities of the combined sample.

METHOD

We analyse the structure of the host galaxies in our sample by modeling their surface brightness using the 2D image decomposition code GALFIT (Peng et al. 2011). We first perform a PSF modeling by simultaneously fitting (using a number Gaussians and exponential functions) the highest number of stars in the field as possible (Fig.2). Our PSF (see Fig. 3). model is then used to represent the unresolved nuclear emission (AGN contribution) in our images and to convolve it with a Sérsic profile in order to model the galaxy bulge.

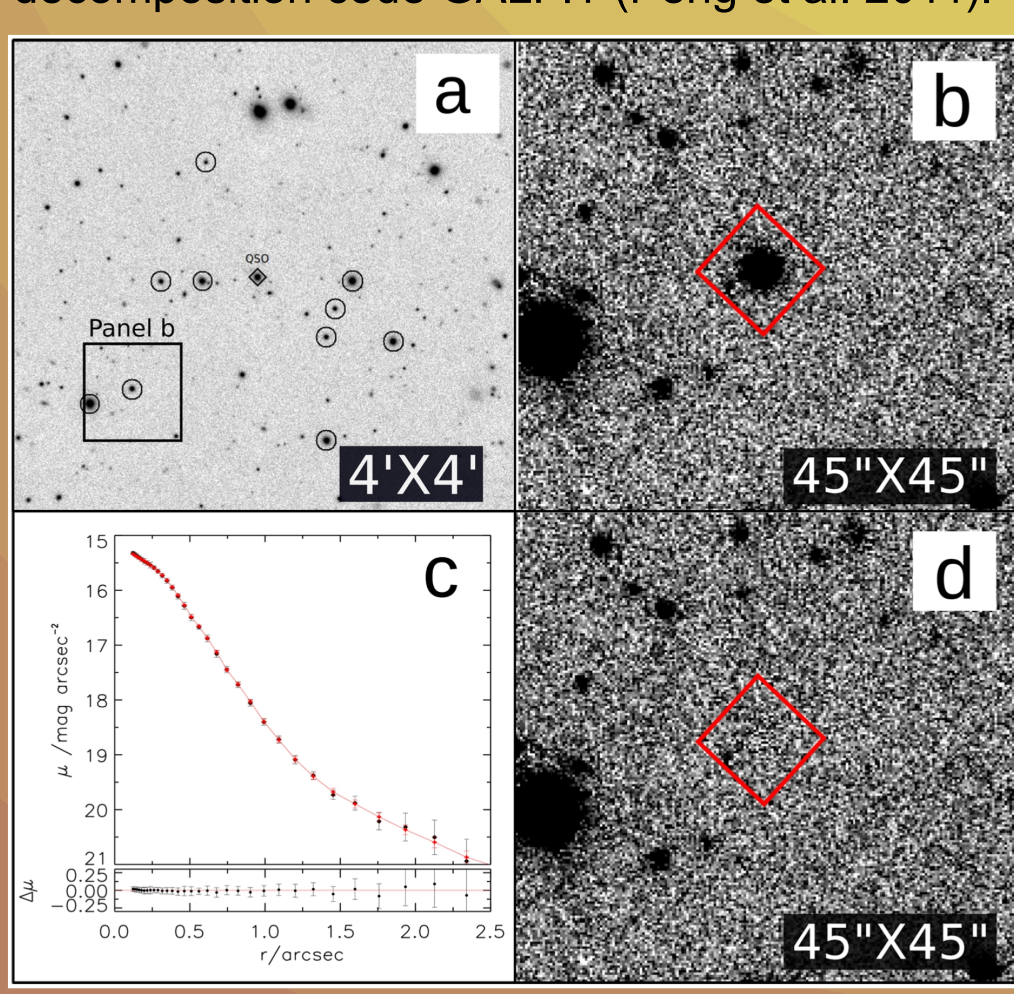

Figure 2. PSF model procedure. a) The target (1828+487, rhombus) and the selected stars to make the PSF model (circles). b) Example of a random star (red rhombus) from the field used to test the PSF model. c) Surface brightness profiles of the random star (black data points) and the PSF model (red solid line). d) Subtracted PSF model residuals.

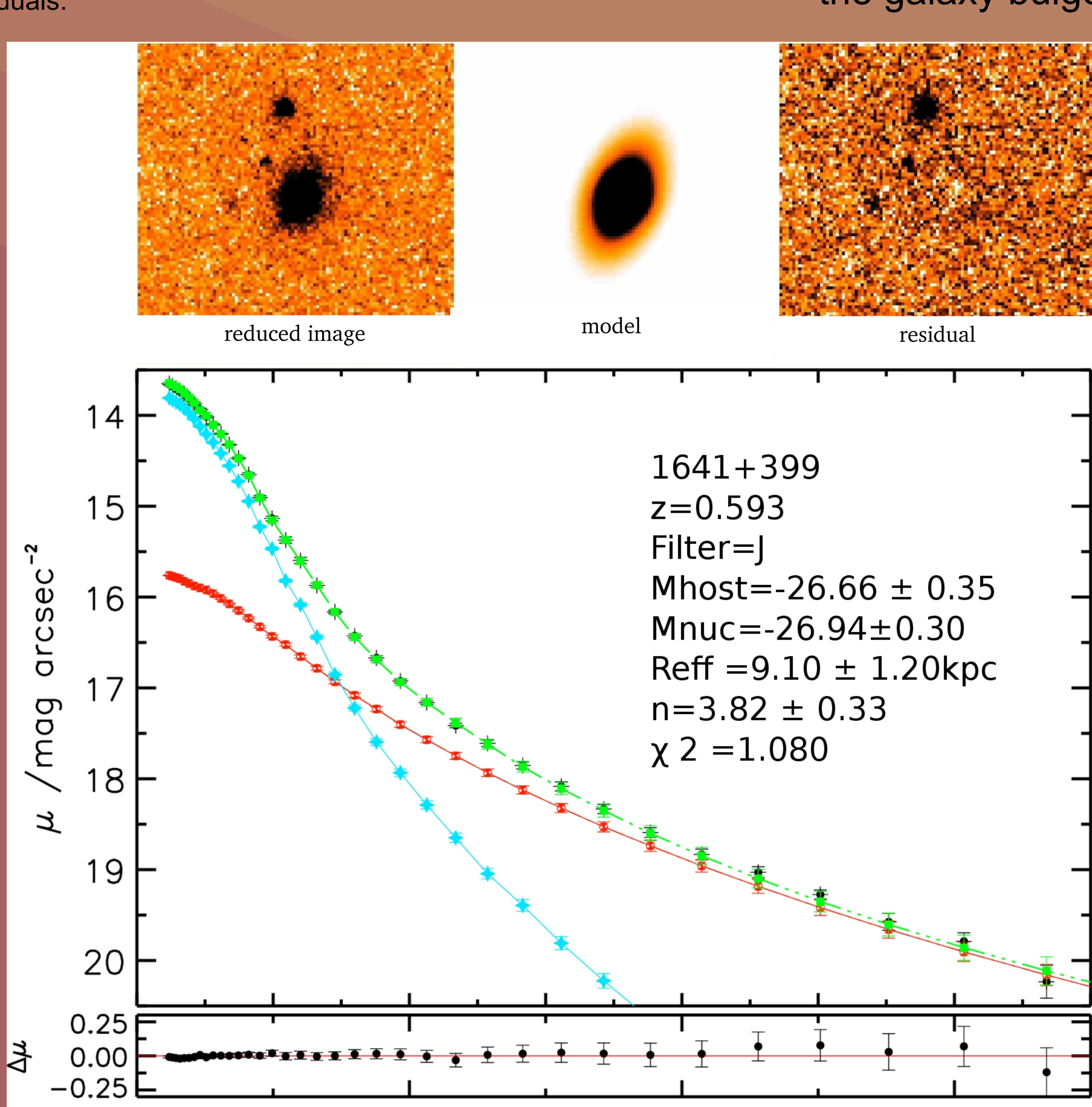

Figure 3. Observed surface brightness profiles for the blazar (solid black data point), the scaled PSF model (cian rhombus), the Sérsic model convolved with the PSF (red circles) and the fitted PSF+Sérsic model profile (green squares).

RESULTS

1. We report ***15 new host galaxy detections*** which increases the number of detected and resolved FSRQ host galaxies by a factor of 2 (Kotilainen et al. 1998A; Nilsson et al. 2009).
2. The properties of the detected host galaxies are consistent with previous findings (Falomo et al. 2014); they are hosted by luminous M_K~-26 and bulge dominated (n~4) galaxies that ***follow the Kormendy relation (Fig. 4).***
3. As predicted by semi-analytical models (Gutcke et al. 2015, Hickox et al. 2014), ***in the $M_{nuclear}$ vs M_{bulge} plot, LLBs and HLBs follow different behaviors (Fig. 5).*** While LLBs cover a narrow range of magnitudes, ***HLBs follow a statistically significant positive correlation (τ=0.53; p=8 X 10⁻⁷).*** This is consistent with positive AGN feedback scenario (Bower et al. 2006) wherein the more powerful the jet, the more significant the effect caused on its host galaxy.

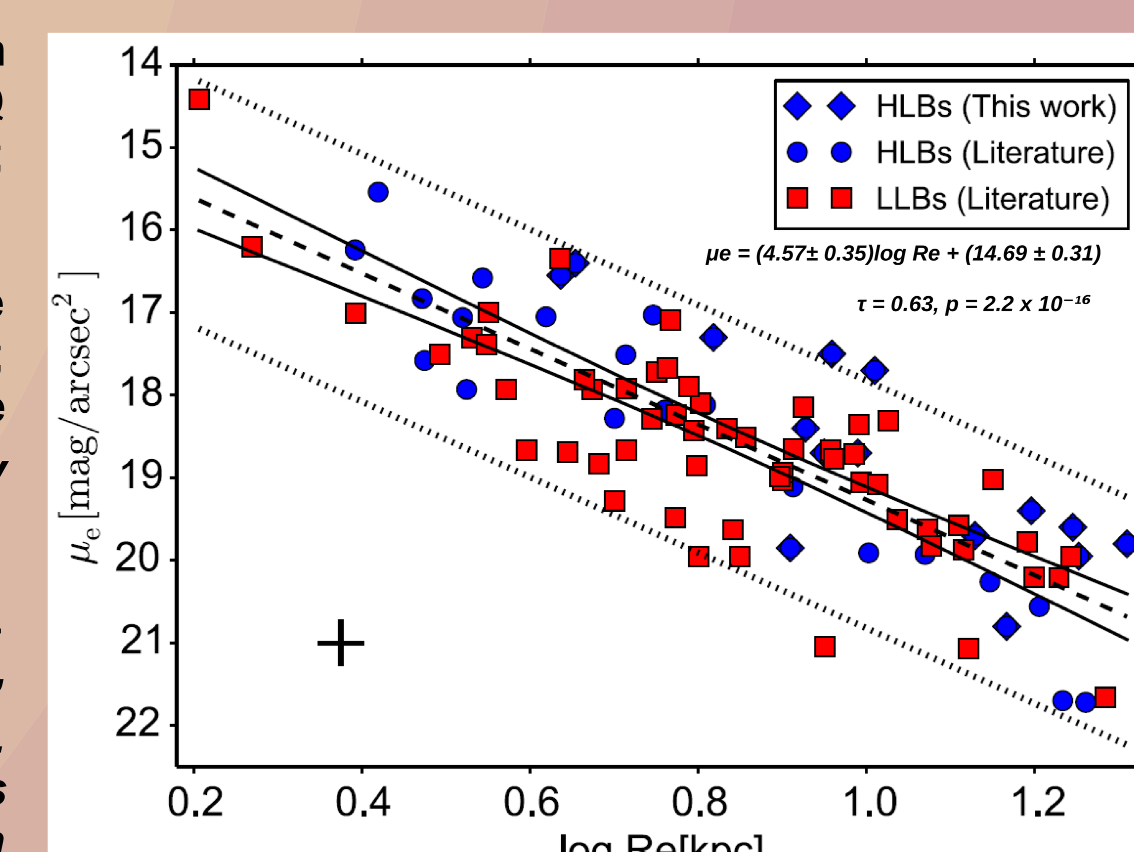

Figure 4. The Kormendy relation. We show the 95 per cent prediction bands (dotted lines) and the 95 per cent confidence intervals (solid lines). A typical error bar is shown in the lower left corner.

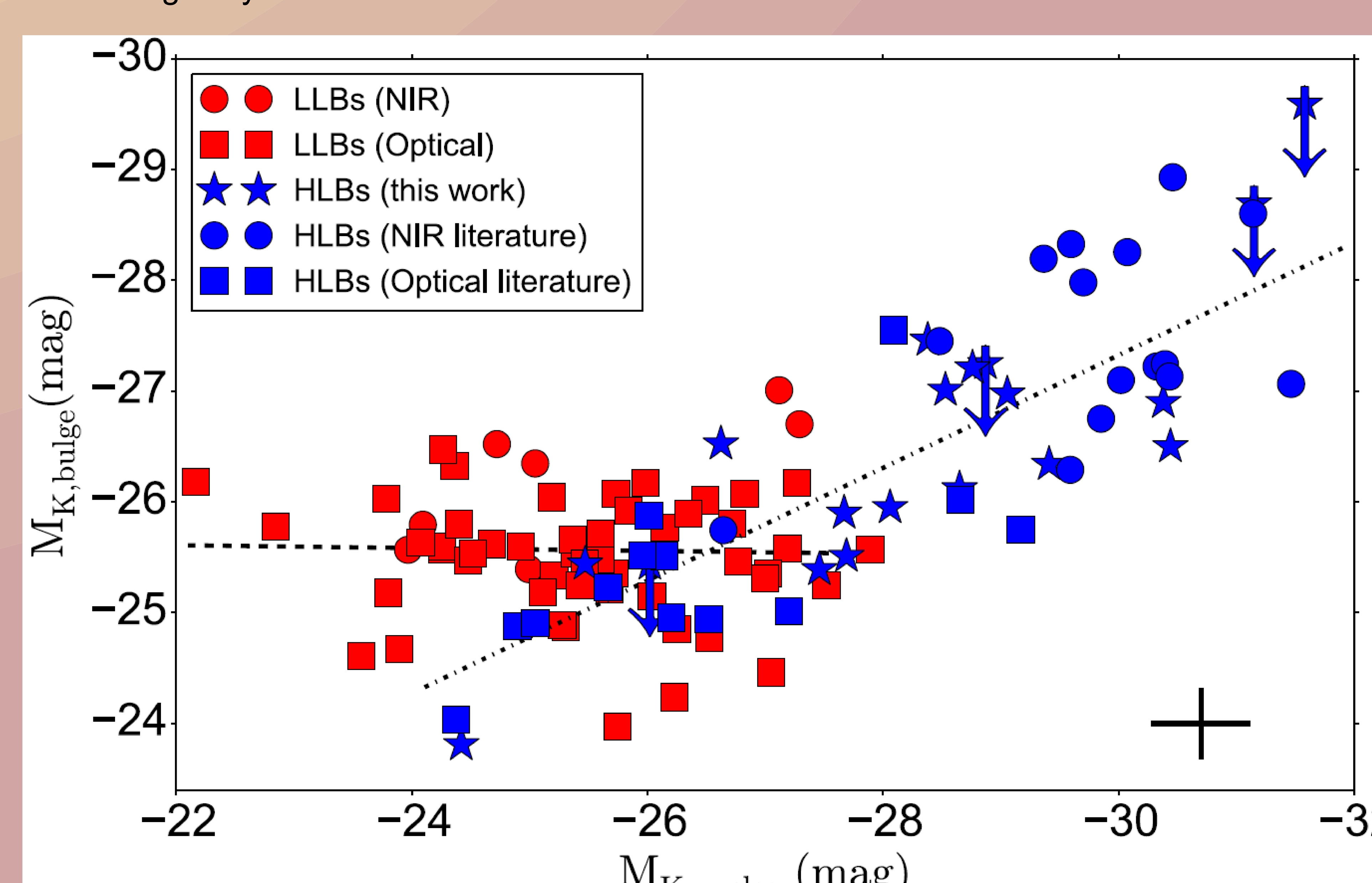

Figure 5. Plot of the nuclear K-band magnitude versus the bulge K-band magnitude. We show the best linear fits for LLBs and HLBs (dashed and dot-dashed lines, respectively). A statistically significant partial correlation (τ = 0.53, p = 6.6 × 10 −7) is found for HLBs. Upper limits for unresolved galaxies analysed in this work are shown as down arrows. A typical error bar is shown in the lower right corner.

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