

Colour-colour plots for VHzQ Selection

June 4, 2018

- 1 (z-J) vs. (J-W1)
- 2 (z-y) vs. (y-J)
- 3 (i-z) vs. (z-y)
- 4 (z-y) vs. (i-z)
- 5 (W1 - W2) vs. (z - W2)

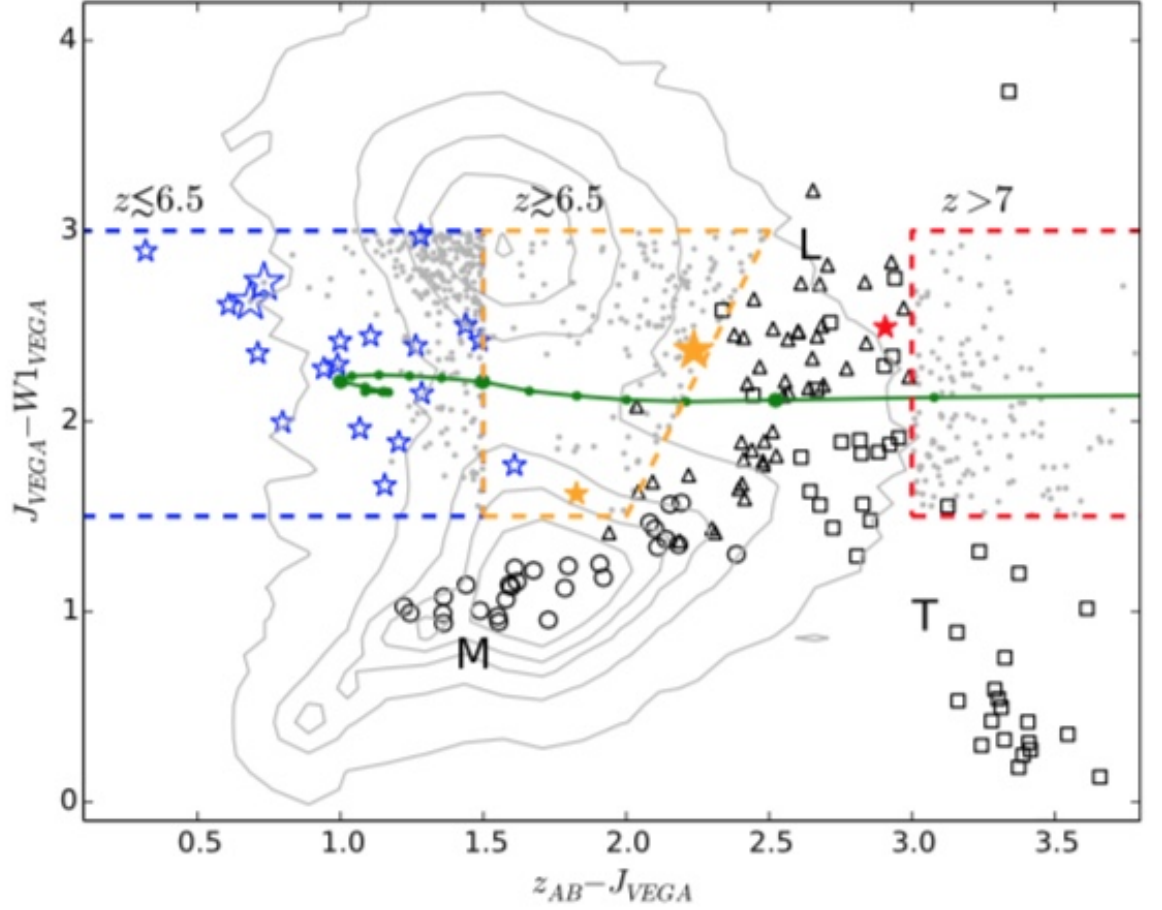


Figure 1. The $z - J$ vs. $J - W1$ color-color diagram. The green line and green filled circles represent the color- z relation predicted using simulated quasars (McGreer et al. 2013; Yang et al. 2016) from $z = 5.5$ to $z = 7.1$, in steps of $\Delta z = 0.1$. The large green circles highlight the colors at $z = 6.0$, 6.5 , and 7.0 . The smaller blue, orange, and red asterisks depict previously known $5.5 \leq z < 6.5$ quasars, $z \geq 6.5$ quasars and $z = 7.1$ quasars, respectively. The larger blue and orange asterisks represent our newly discovered $z \sim 6$ and $z \sim 6.6$ quasars. The black circles, triangles, and squares depict the positions of M, L, and T dwarfs, respectively (Kirkpatrick et al. 2011; Best et al. 2015). The horizontal and vertical dashed lines depict the broad color cuts we use to select quasars at $z \lesssim 6.5$ (blue), $z \gtrsim 6.5$ (orange) and $z > 7$ (red). The grey contours show the density distribution of actual data and the small grey points indicate selected candidates at each color box.

Figure 1: Wang et al. (2017)

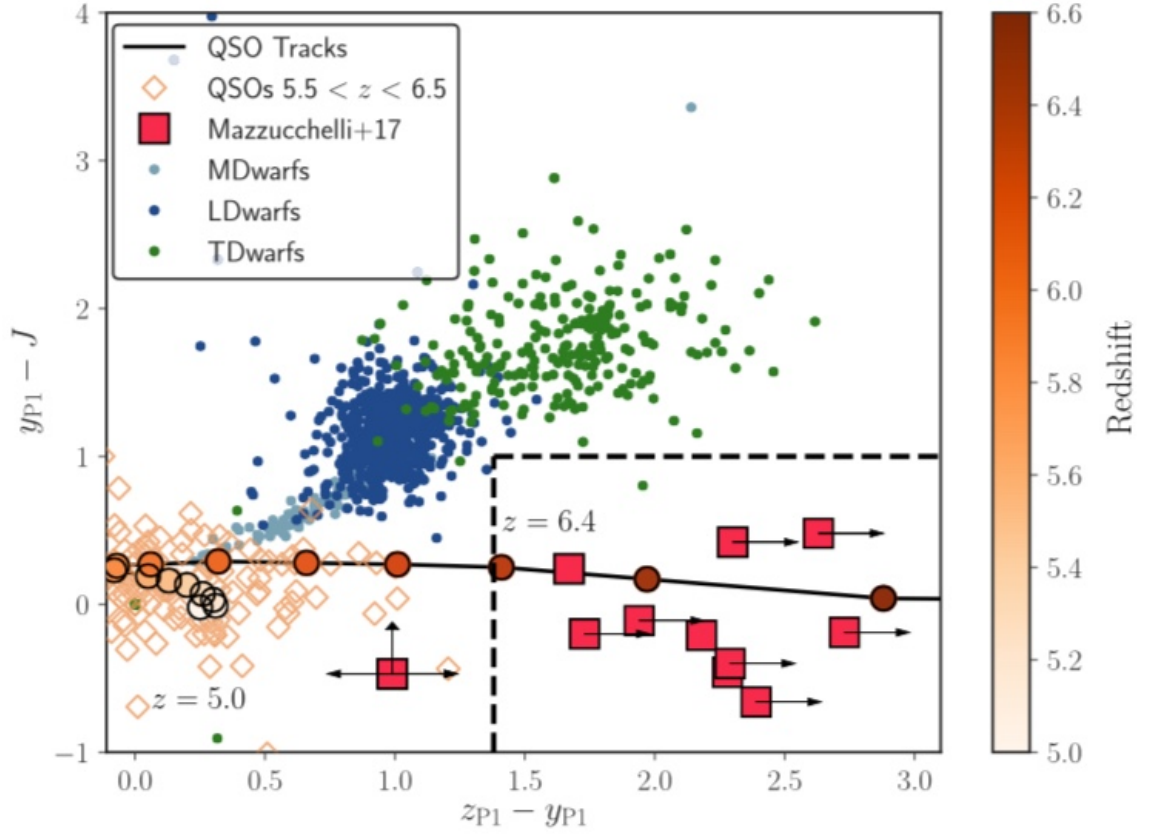


Figure 1. Color–color diagram ($y_{P1} - J$ vs. $z_{P1} - y_{P1}$) used in our search for high-redshift quasars. We show the predicted quasar track (black solid line and circles color-coded with respect to redshift, in steps of $\Delta z = 0.1$), obtained by convolving the high-redshift quasar composite template reported by Bañados et al. (2016; see also Section 2.4) with the filters considered here. Observed colors of L/T dwarfs, taken from the literature (see text for references), are reported with blue and green filled circles, while we consider for M dwarfs the colors calculated convolving a collection of spectra with the filters used here (see Section 2.4). We show also the location of known quasars at $5.5 < z < 6.5$ (orange open diamonds; see Section 5.2 for references) and the objects studied in this work (red squares, with black right-pointing arrows in case they only have lower limits in the z_{P1} band from the PS1 PV3 catalog; see Table 3). We do not show quasars from the VIKING survey, which are not present in the PS1 catalog, and PSO 006+39, for which we do not possess J -band photometry. For HSC 1205 we use the 3σ limits in z_{P1} and y_{P1} obtained from the forced photometry on the PS1 PV3 stacked images. Our selection box is highlighted with dashed black lines.

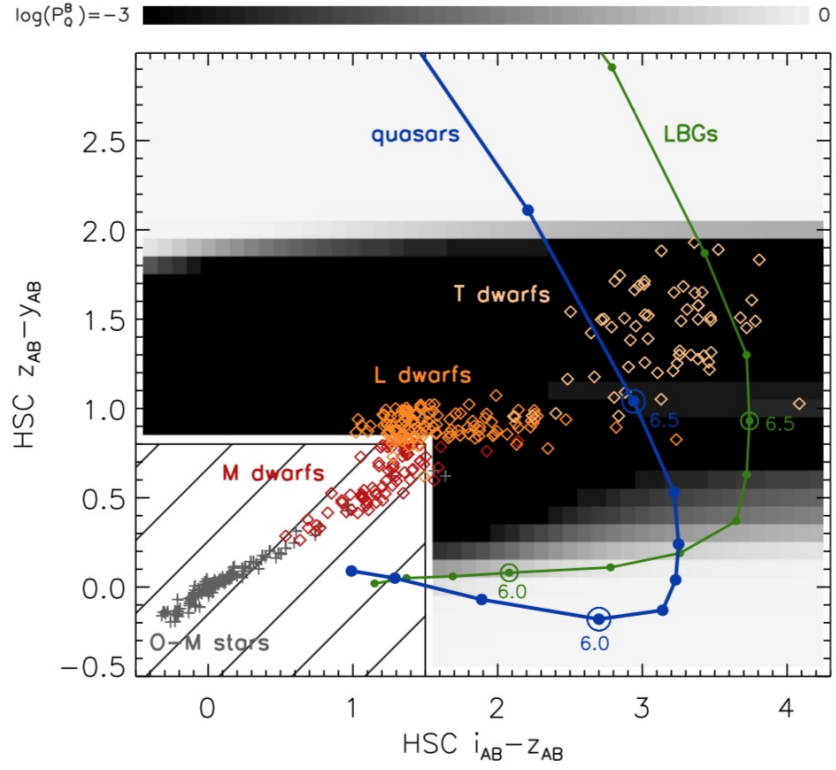
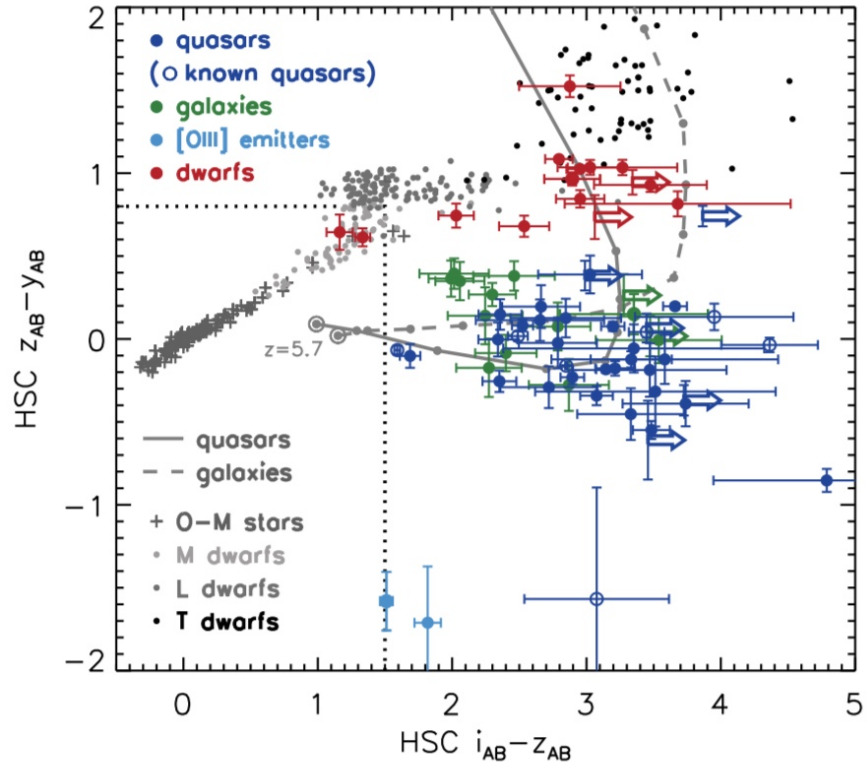


figure 1. $i - z$ and $z - y$ colors of high- z quasars (blue line) and galaxies (green line), as well as Galactic stars and brown dwarfs (crosses and diamonds). The SED models for quasars and brown dwarfs are described in Section 3.1. The galaxy colors are calculated with the spectral templates taken from González et al. (2012), while the colors of O-M stars are computed with the Pickles (1998) library. The dots along the blue and green lines represent redshifts in steps of 0.1, with $z = 6.0$ and 5 marked by the large open circles. The hatched area in the lower left indicates the color space excluded from the HSC-SSP database query in the first step of our quasar selection (Section 3.2). For example, the grayscale represents the Bayesian quasar probabilities P_Q^B (Equations (1) and (2)); the color bar is at the top) over this plane. Note that the P_Q^B distribution changes in response to the source and limiting magnitudes; here we assume a source magnitude of $z_{AB} = 24.0$ mag and the 5σ limiting magnitudes of $(i_{AB}, z_{AB}, y_{AB}) = (26.5, 25.5, 25.0)$ mag. Galaxy models are not included in the Bayesian algorithm at present.

Figure 3: Matsuoka et al. (2016)



g. 11. HSC $i_{AB} - z_{AB}$ and $z_{AB} - y_{AB}$ colors of the SHELLQs quasars (blue dots), galaxies (green dots), [O III] emitters (light blue dots), brown dwarfs (red dots), and the previously-known quasars recovered in our HSC survey (blue open circles). The grey crosses and dots represent Galactic stars and brown dwarfs, while the solid and dashed lines represent models for quasars and galaxies at $z \geq 5.7$; the dots along the lines represent redshifts steps of 0.1, with $z = 5.7$ marked by the large open circles. All but the two sources at $z > 6.5$ (which have no reliable i_{AB} and z_{AB} measurements) discovered in [Paper I](#) and this work are plotted.

Figure 4: ?

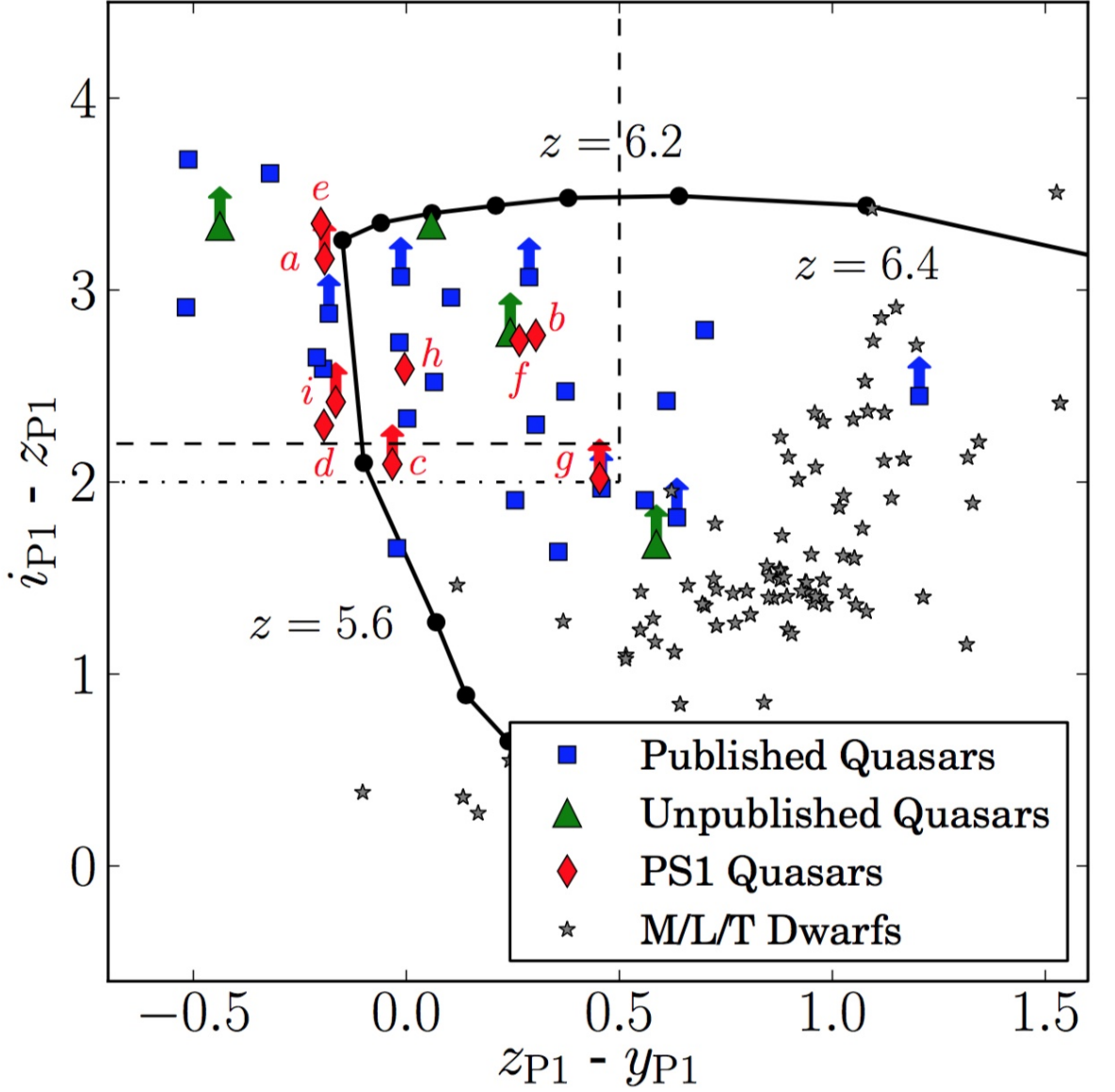


Figure 5: Bañados et al. (2014). Right: colorcolor diagram showing the criteria used to select quasar candidates (long-dashed line, upper left corner). The dot-dashed line is used for candidates with upper limits in the i_{P1} band. The thick black line shows the expected color of the quasar template from $z = 5.0$ to $z = 6.5$ in steps of $\Delta z = 0.1$ (see left panel). The M/L/T dwarfs from $z = 5.7$ to $z = 6.4$ that have a PS1 counterpart are shown with stars. Blue squares are published quasars at $5.7 \leq z \leq 6.4$ satisfying our S/N and coverage criteria. Fourteen of them were included in our candidate list. Green triangles represent the PS1 colors of unpublished spectroscopically confirmed $z \geq 6$ quasars (S. J. Warren et al., in preparation). Three of them were part of our candidate list (see Tables 4 and 5). The red diamonds are the new quasars presented in this paper (see Table 2). They are labeled with the following letters: a = PSO J340.204118.6621 ($z = 6.00$), b = PSO J007.0273+04.9571 ($z = 5.99$), c = PSO J037.970628.8389 ($z = 5.99$), d = PSO J187.3050+04.3243 ($z = 5.89$), e = PSO J213.362922.5617 ($z = 5.88$), f = PSO J183.299112.7676 ($z = 5.86$), g = PSO J210.872212.0094 ($z = 5.84$), h = PSO J215.151416.0417 ($z = 5.73$), and i = PSO J045.184022.5408 ($z = 5.70$).

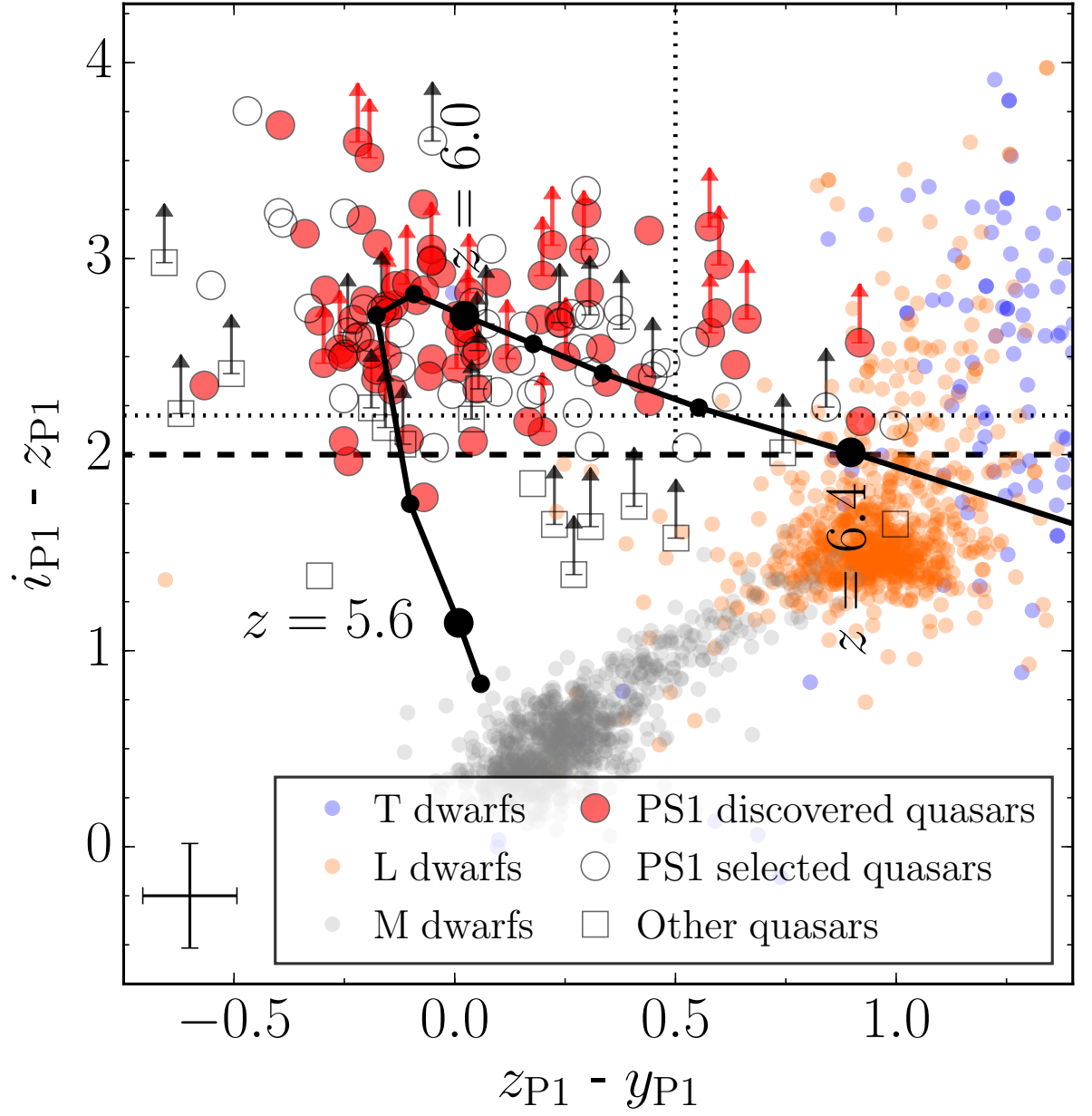


Figure 6: Bañados et al. (2016).

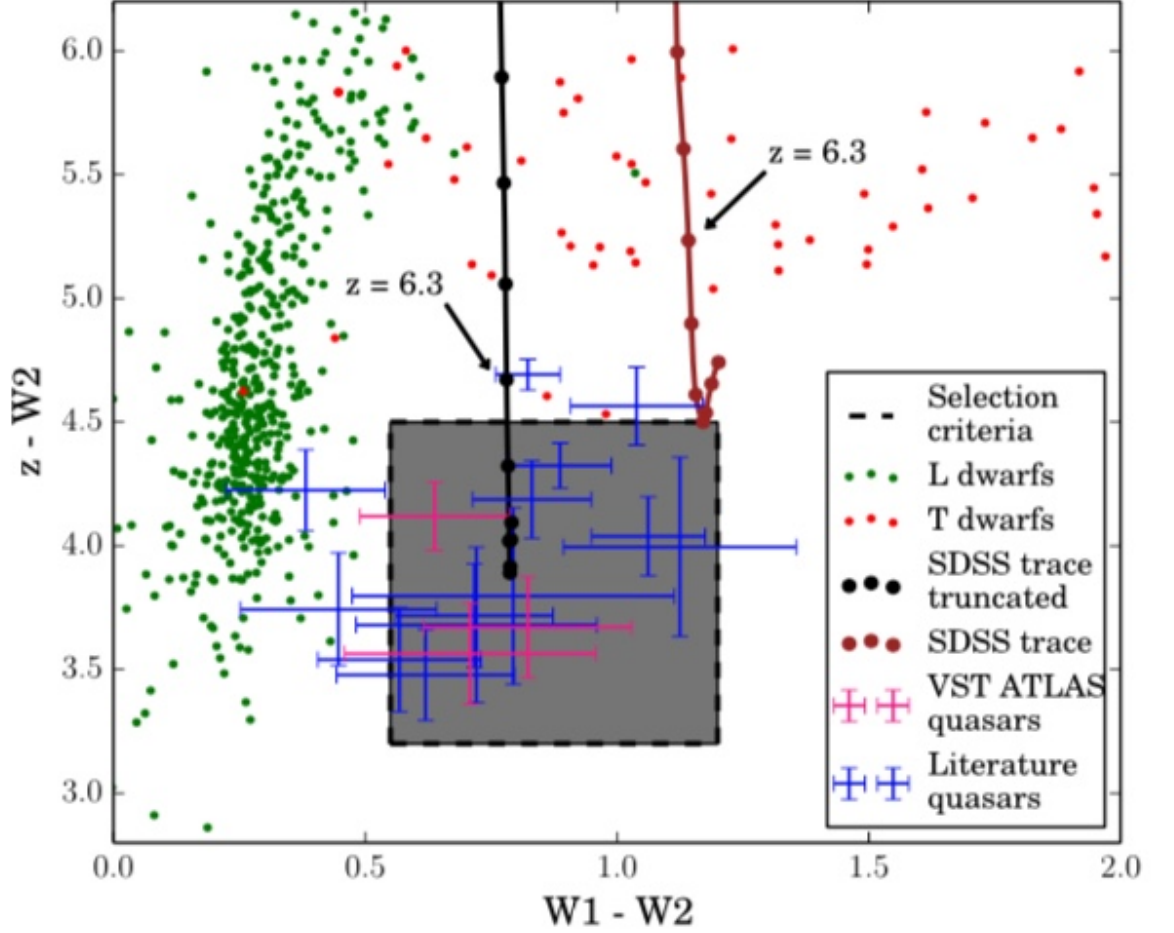


Figure 1. Colour diagram for separating dwarf stars from high redshift quasars. The shaded region denotes our selection criteria. L and T dwarfs are plotted in green and red, respectively. The quasar trace based solely upon the SDSS composite is plotted in brown and the truncated, power law extended trace in black (see Section 2.3). Both have points at $\Delta z = 0.1$ intervals, starting from $z = 5.7$. The 13 published quasars with $z > 5.7$, $z_{AB} < 20.0$ and $W1, W2$ SNR > 3.0 are plotted in blue. The three high redshift quasars detected in VST ATLAS (Table 1) are plotted in pink.

Figure 7: Bañados et al. (2016).

References

- Bañados E., et al., 2014, *AJ*, 148, 14
- Bañados E., et al., 2016, *ApJS*, 227, 11
- Matsuoka Y., et al., 2016, *ApJ*, 828, 26
- Mazzucchelli C., et al., 2017, *ApJ*, 849, 91
- Wang F., et al., 2017, *ApJ*, 839, 27

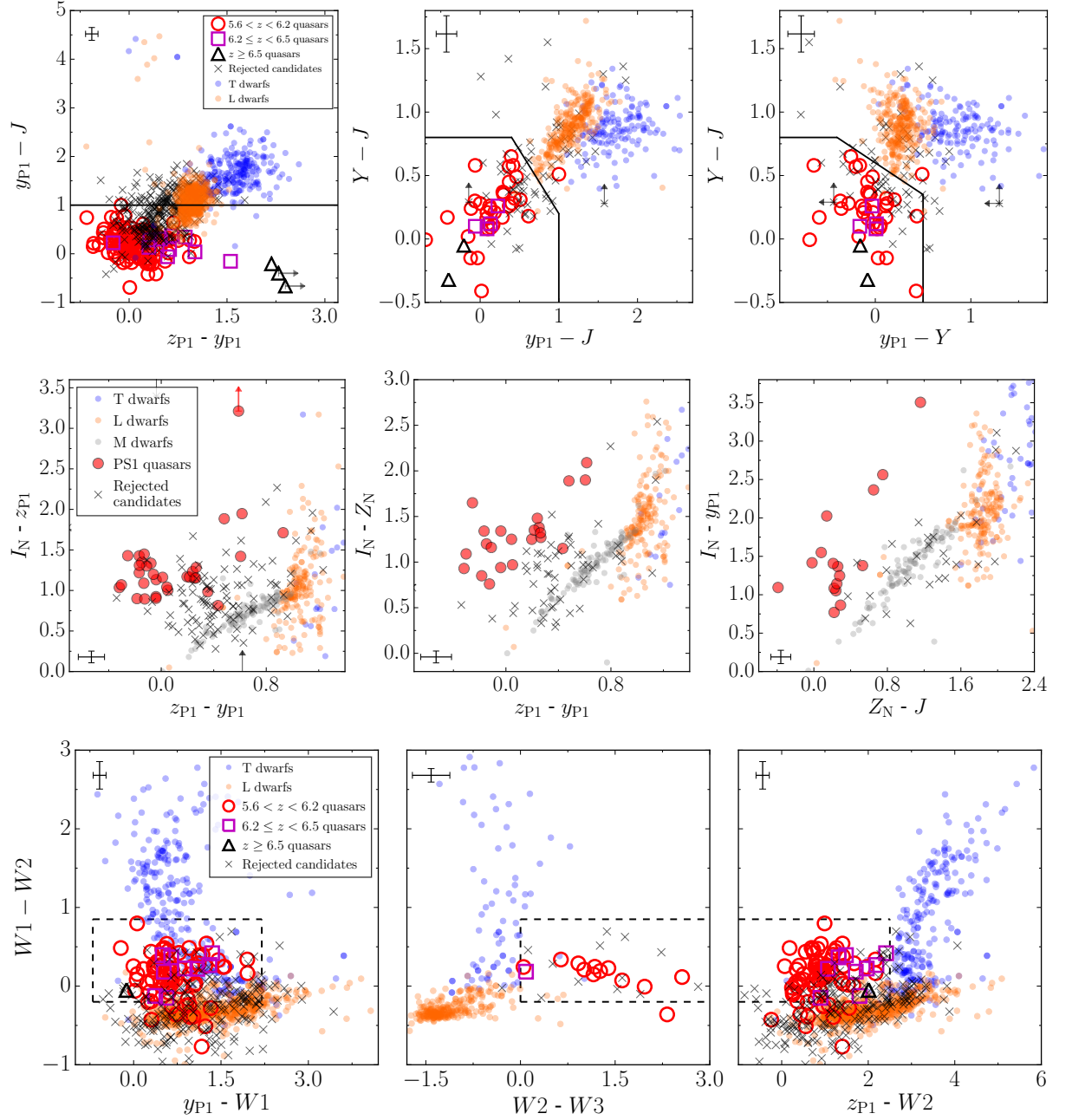


Figure 8: Bañados et al. (2016).