Basic Tests for v0.1 with Public Catalogues

We have conducted a series of basic tests for our ALCS v0.1 HST+IRAC catalogue. Below is an example we present some validation checks for one of the Hubble Frontier Fields of Abell2744. In the tests, we utilize Shipley et al. 2018 (S18) and the Astrodeep (A16) catalogue (Merlin et al. 2016, Castellano et al. 2016). Hereafter, we will refer to our ALCS v0.1 HST+IRAC catalog as golfir catalogue.

Photometry & Colour

In Figure 1 and 2, we show comparison results of photometry and colours with S18 and A16, respectively. In the comparison with S18, we find that the H-band magnitudes and IRAC colours show good agreements, while there exists a 0.3 mag offset in the IRAC band. However in the comparison with A16, the offset is reduced significantly, and can by explained by scatter. Currently, it is hard to conclude which catalogue values are the most reliable. We thus do not apply any corrections to our v0.1 catalogue related to this offset.

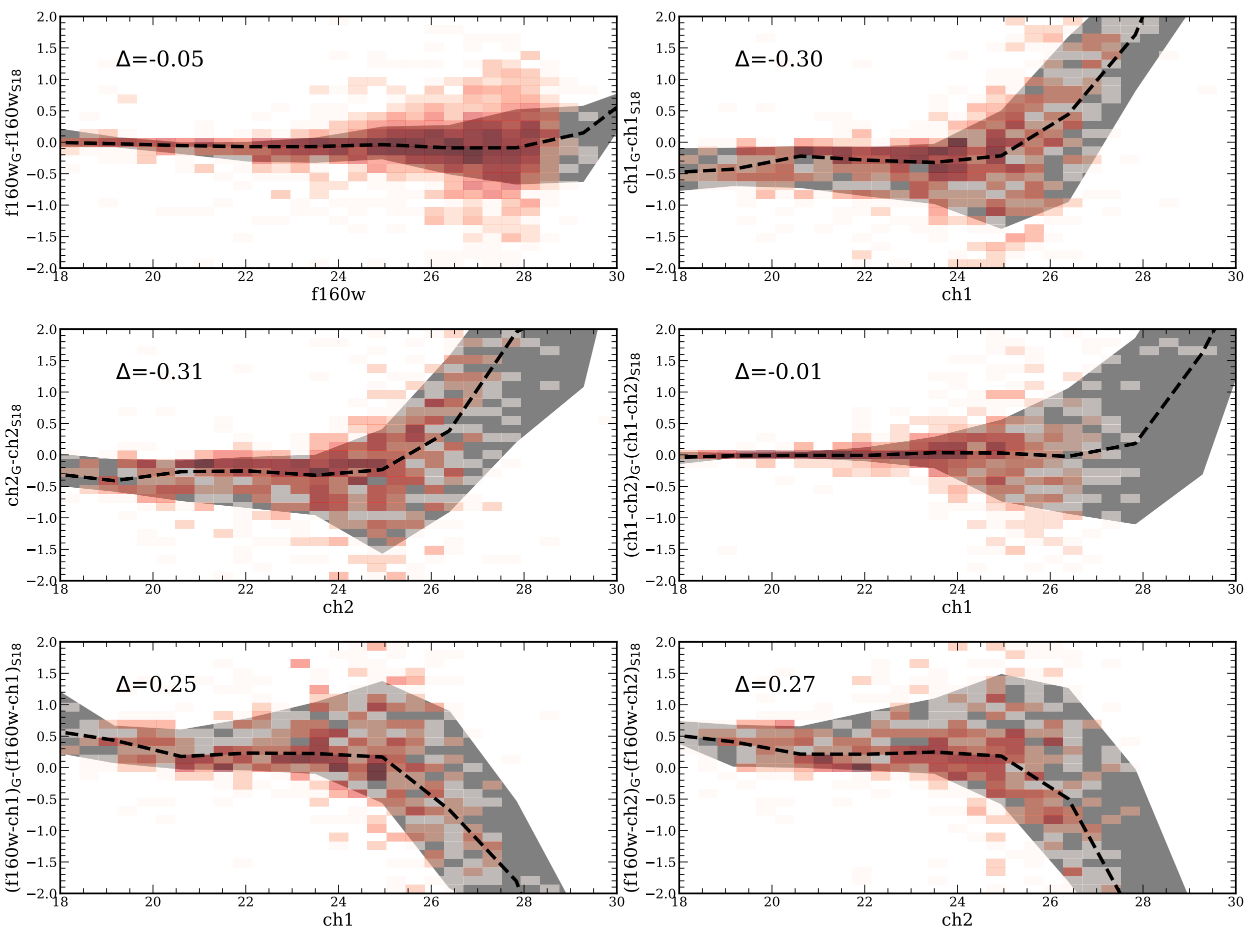

Figure 1: Colour and band comparison between matched objects in our golfir catalogue (G) and Shipley+18 (S18). The black dashed line on the plots represents the binned medians. The filled colour covers the 1 σ range. Δ parameter is the median of the difference at the bright end ($<$ 24 mag).

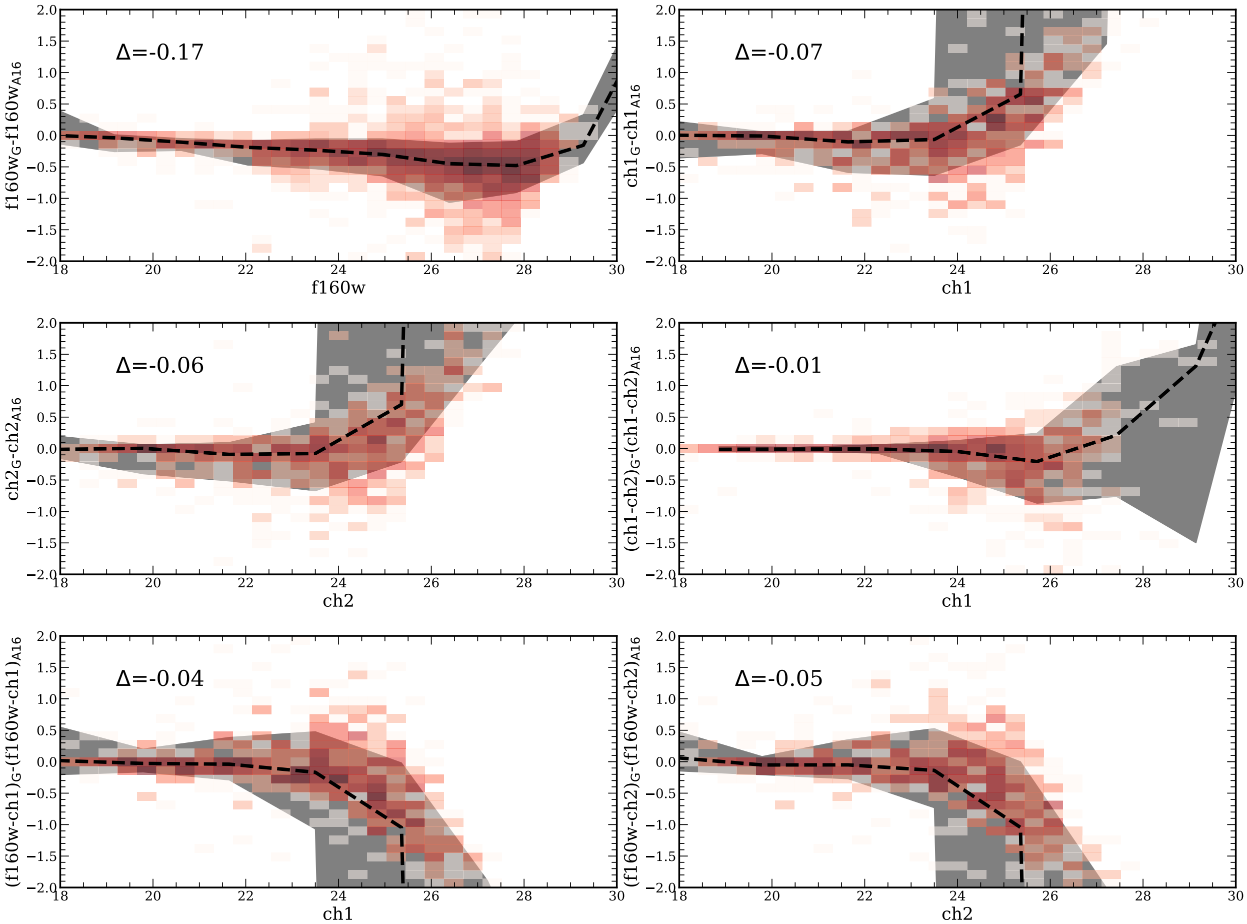

Figure 2: Colour and band comparison between matched objects in our golfir catalogue(G) and Astrodeep. The black dashed line on the plots represents the binned medians. The filled colour covers the 1 σ range. Δ parameter is the median of the difference at the bright end (< 24 mag).

Number Counts

In Figure 3, we compare the number counts in IRAC bands between our golfir catalogue and S18. We find that our golfir catalogue has fewer sources. However, when we apply S/N cuts, it turns out that a lot of the objects missing in our golfir catalog are below S/N a few.

We note that our golfir catalogue is made with the latest HST+IRAC mosaics which we have reduced and re-produced by combining all existing data in archive [1]. Owing to the increased area in the latest HST+IRAC mosaics, you may find the larger number of sources in our golfir catalog than in public catalogs, depending on the cluster fields. This comparison is performed within an overlapping area between our golfir and S18 mosaics.

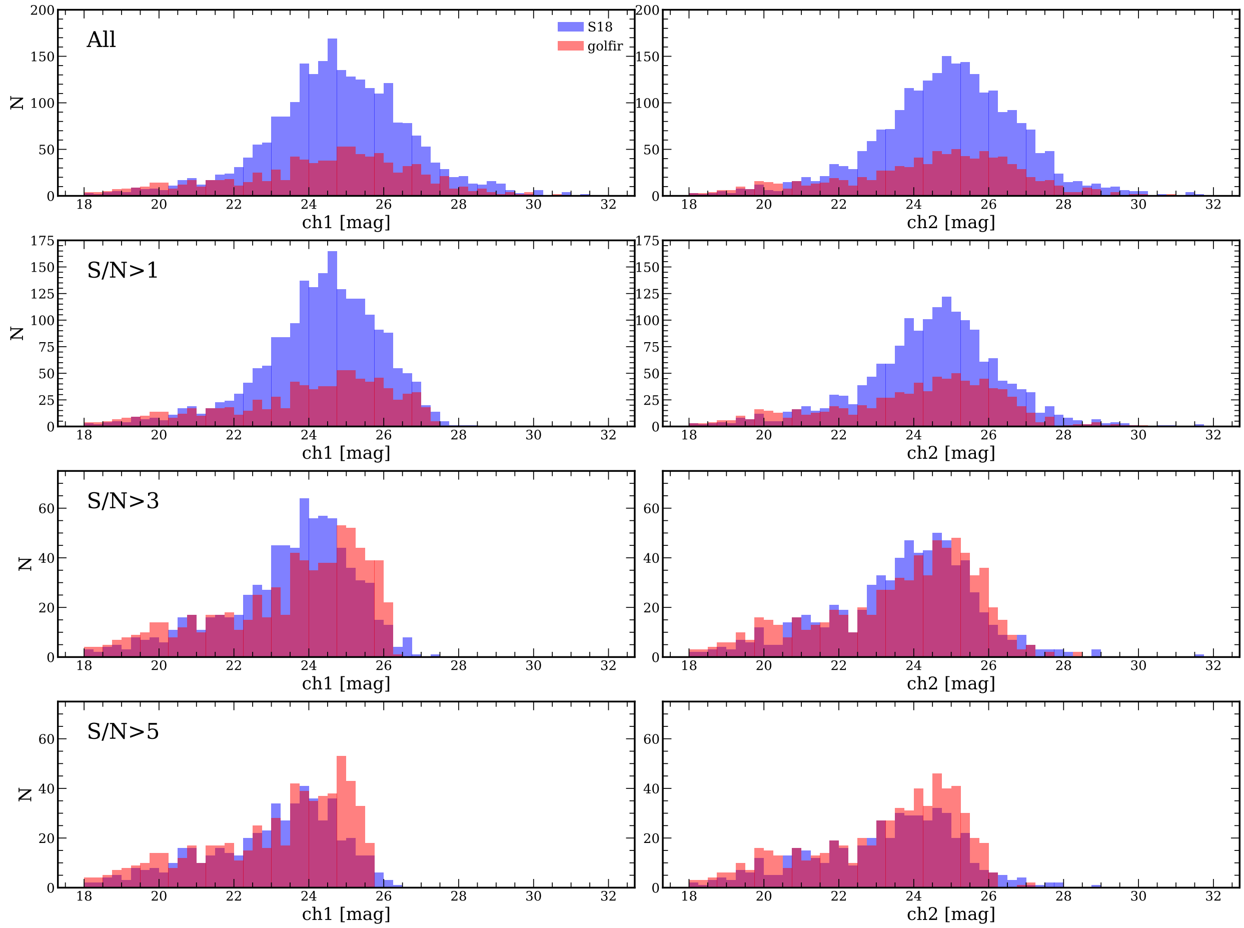

Figure 3: Number counts comparison in the IRAC ch1 (left) and ch2 in our golfir catalogue (red histogram) and S18 (blue histogram). The top panel shows the number counts without the S/N cut, while the other panels present the number counts with the S/N cut at 1 to 3.

[1]The latest HST+IRAC mosaic maps are included in the v0.1 package. You can also download them from the team wiki: https://s3.amazonaws.com/grizli-v1/Master/ALCS-Feb2020.html

Colour vs. Photometric Redshift

In Figure 4, we show the IRAC colour (ch1 − ch2) as a function of photometric redshift (photoz). For comparison, we also present the colour tracks of model templates in EAZY, where there is an unique bump feature at $z \sim 0.4$. We find that our golfir catalog show a better agreement with the unique bump feature at $z \sim 0.4$ and less scatter at $z \sim 1-4$ than S18. These results support the validation of the photoz estimates in our golfir catalogue.

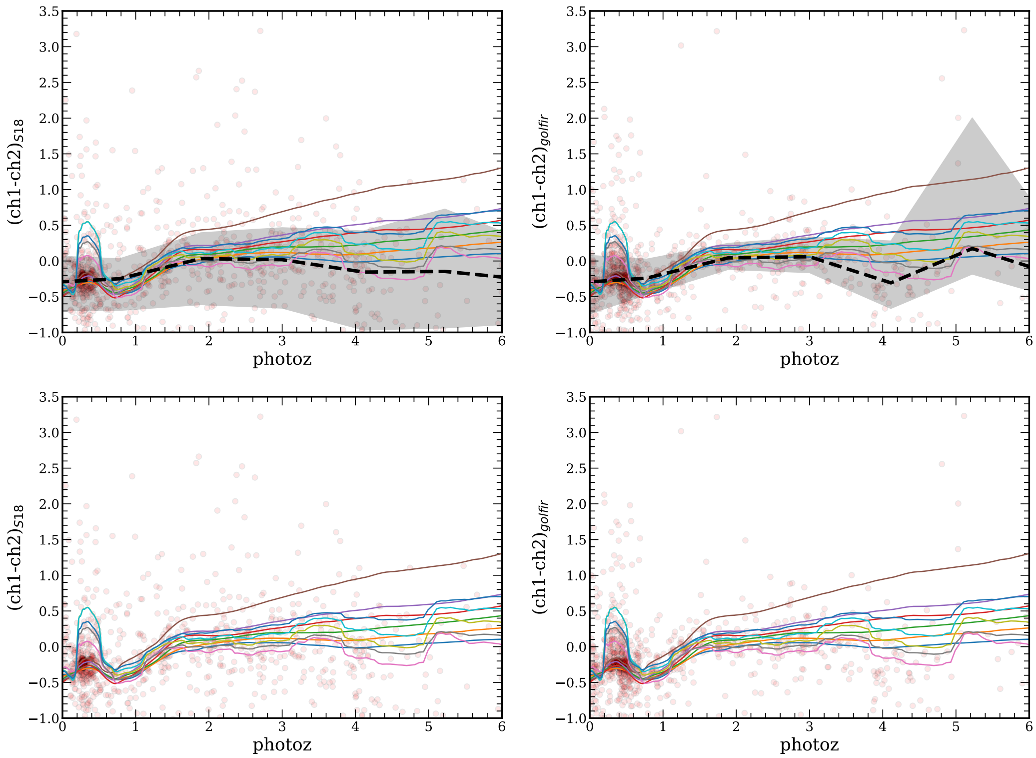

Figure 4: Colour-photoz for S18 and our catalogues. Top row and bottom row are the same with the exception of an added median line. The coloured lines represent the ch1-ch2 colours taken from the EAZY templates.

Photometric vs. Spectroscopic Redshift

In Figure 5, we compare our zphot estimates with spectroscopic redshift (zspec). We adopt the zspec values from S18. We identify 345 sources in our golfir catalog with the zspec values. In the left panel, we find that our zphot estimates are well consistent with zspec. Although we also find that there are several outliers in the regimes of (zphot, zspec) = (∼0.2–0.5, ∼3–4) and (∼3–4, ∼0.2–0.5), these are generally explained by the degeneracy between Lyman and 4000Å break features.

To compare redshifts we use a relative measure called the normalised median absolute deviation (NMAD), which can be written as:

$$\mathrm{NMAD} = 1.48 \times \mathrm{med}\Big(\frac{|\Delta \mathrm{z}|}{1 + \mathrm{zspec}}\Big) \tag{1}$$

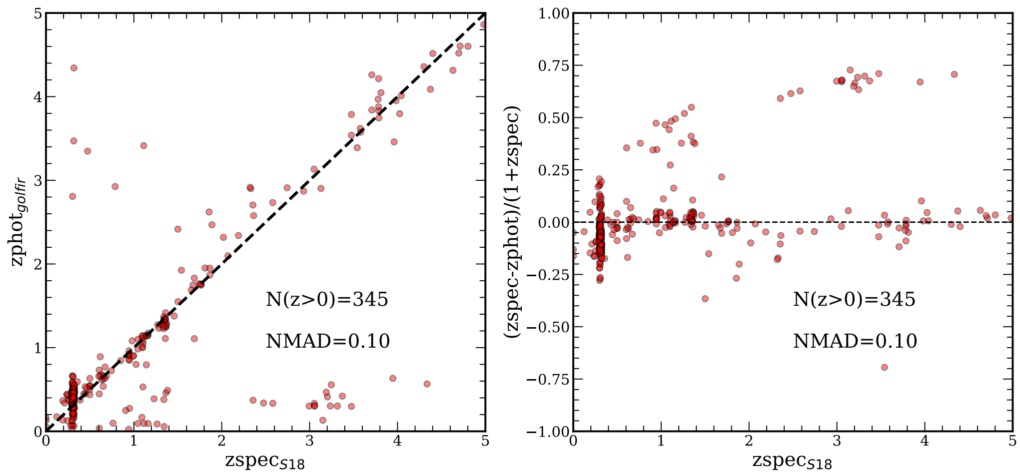

Figure 5: Redshift comparison. The left and right panels show our zphot estimate and its offset from zspec normalized by (1+z) as a function of zspec, respectively.