An Approach for Rapid Estimates of [Fe/H], [C/Fe], and [Mg/Fe] for S-PLUS Stars

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With

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Current Status

- Whitten et al. (2021) have established that use of a sophisticated neural network approach with S-PLUS filters is capable of obtaining estimates of stellar parameters (Teff, log g, [Fe/H] and [C/Fe]) based on S-PLUS narrow- and medium-band filters

- Pros:

  Appears to work extremely well, down to [Fe/H] ~ -3.5 to -4.0

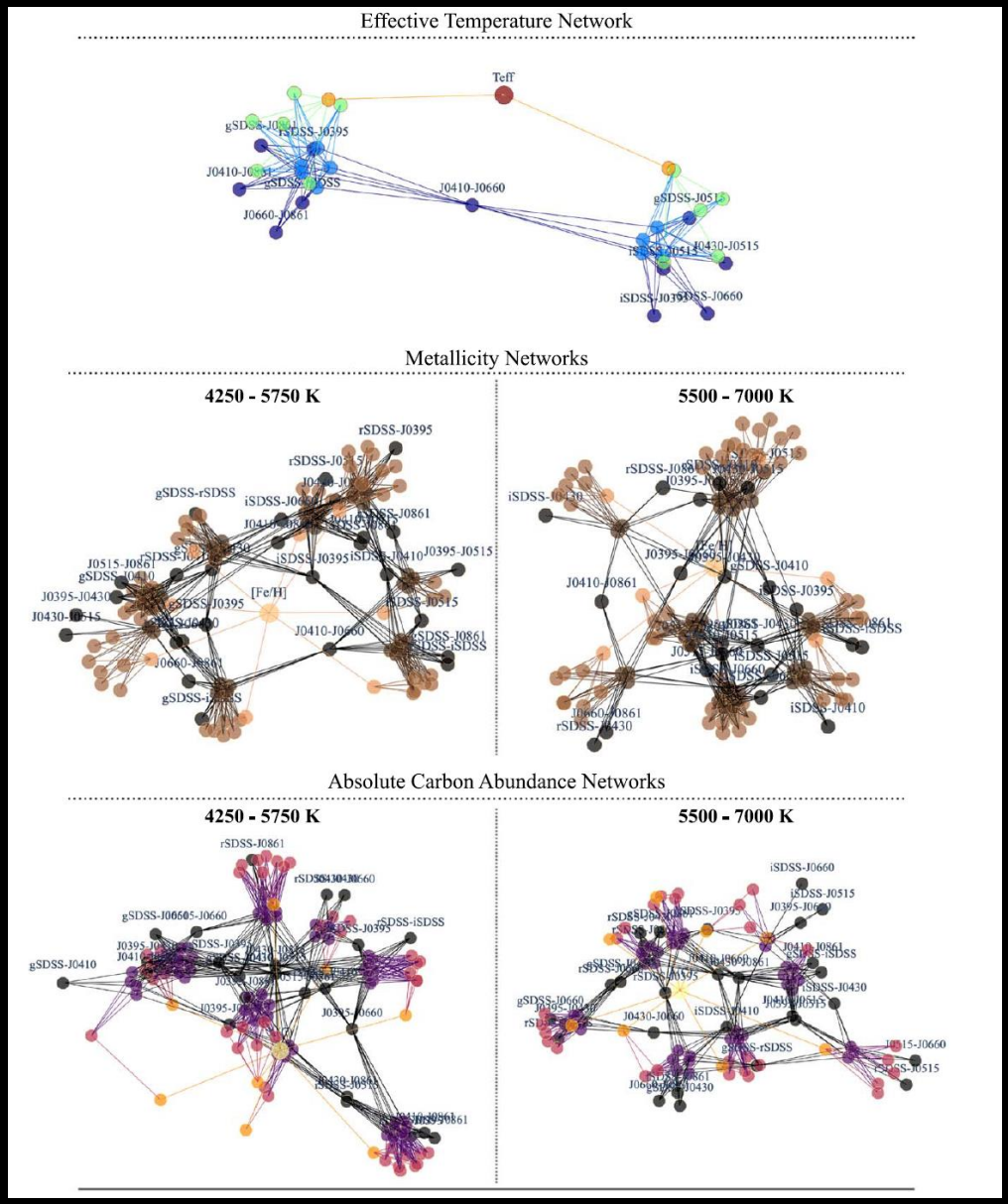
  Provides estimates that are robust to photometric errors in individual filters

- Cons:

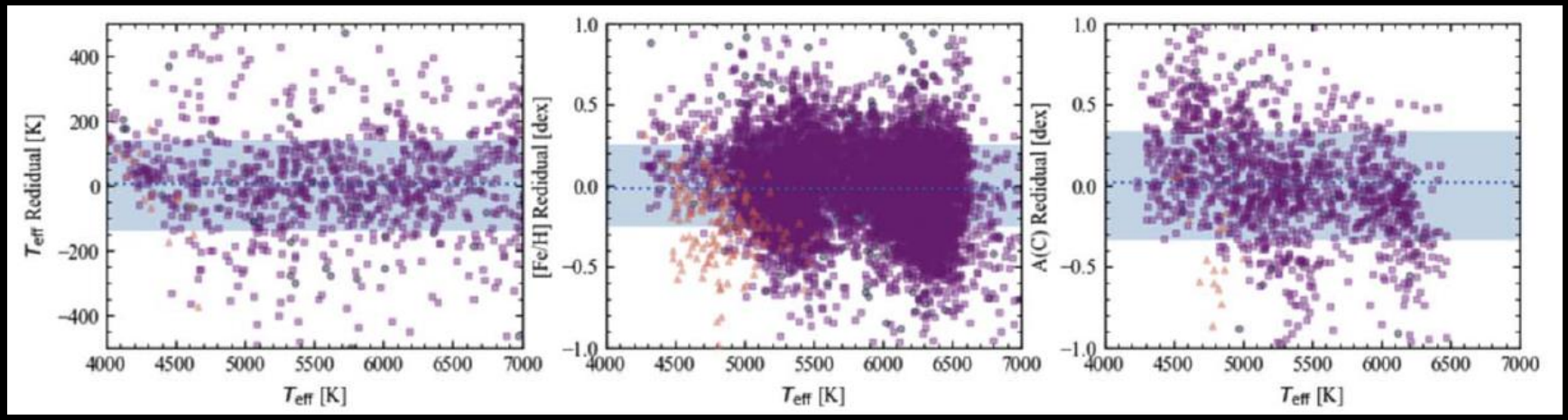
  Somewhat complex

  Yet to be extended to other elements

WHITTEN ET AL. (2021)



WHITTEN ET AL. (2021)



Distribution of residuals in Teff, [Fe/H], [C/Fe]
with respect to Teff

An Alternative Approach

- Huang et al. (2021) have established that a combination of narrow- or medium-band filters from SkyMapper (e.g., *v* or *u*) with Gaia broad-band color (G_{BP}- G_{RP}) can provide accurate estimates of Teff and [Fe/H] based on polynomial fits

- Pros:

  Precision of Gaia colors is extremely high

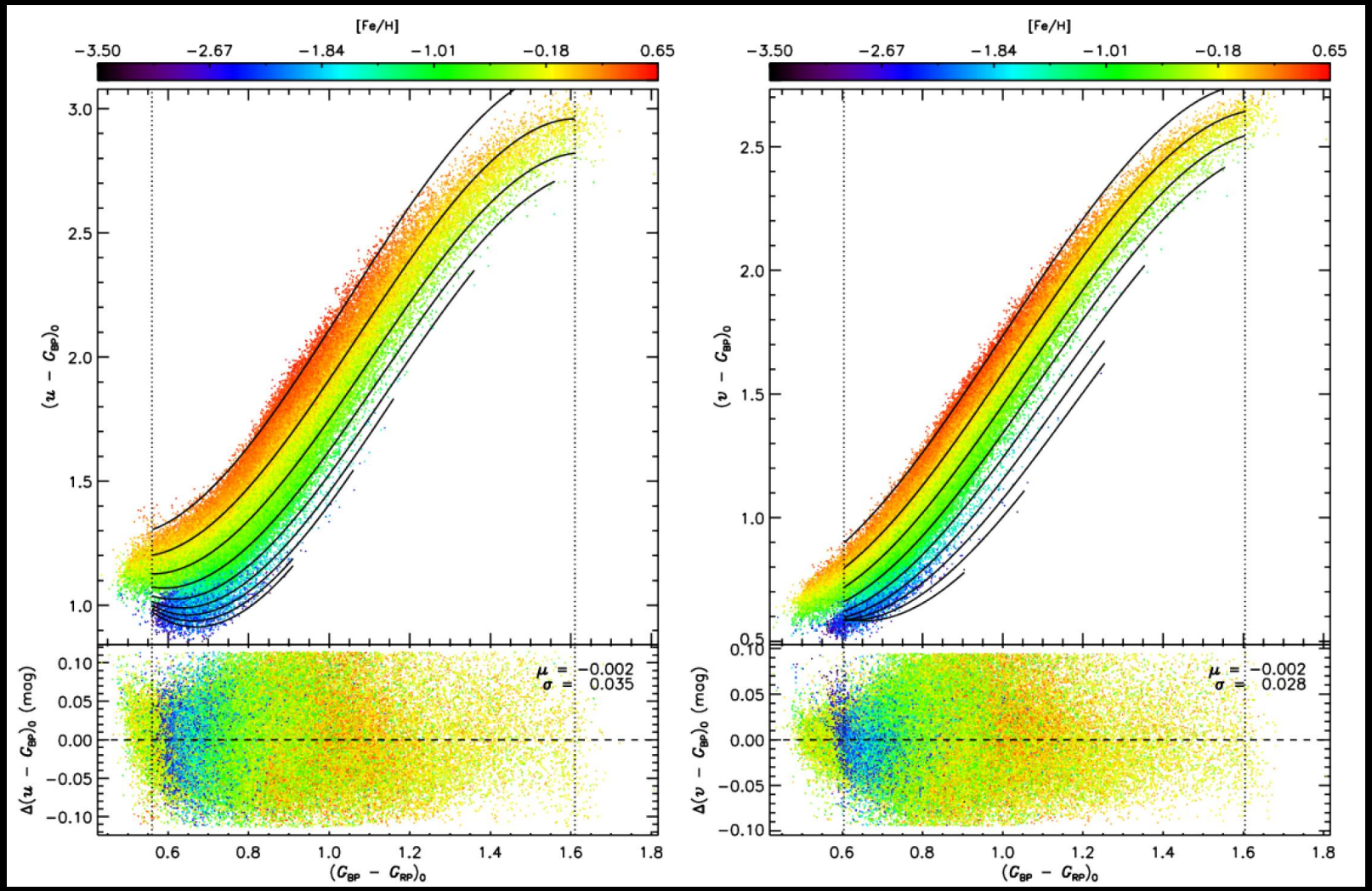
  Appears to work extremely well, down to [Fe/H] ~ -3.5

  Inherently simpler to apply, once filters are properly zero-pointed

- Cons:

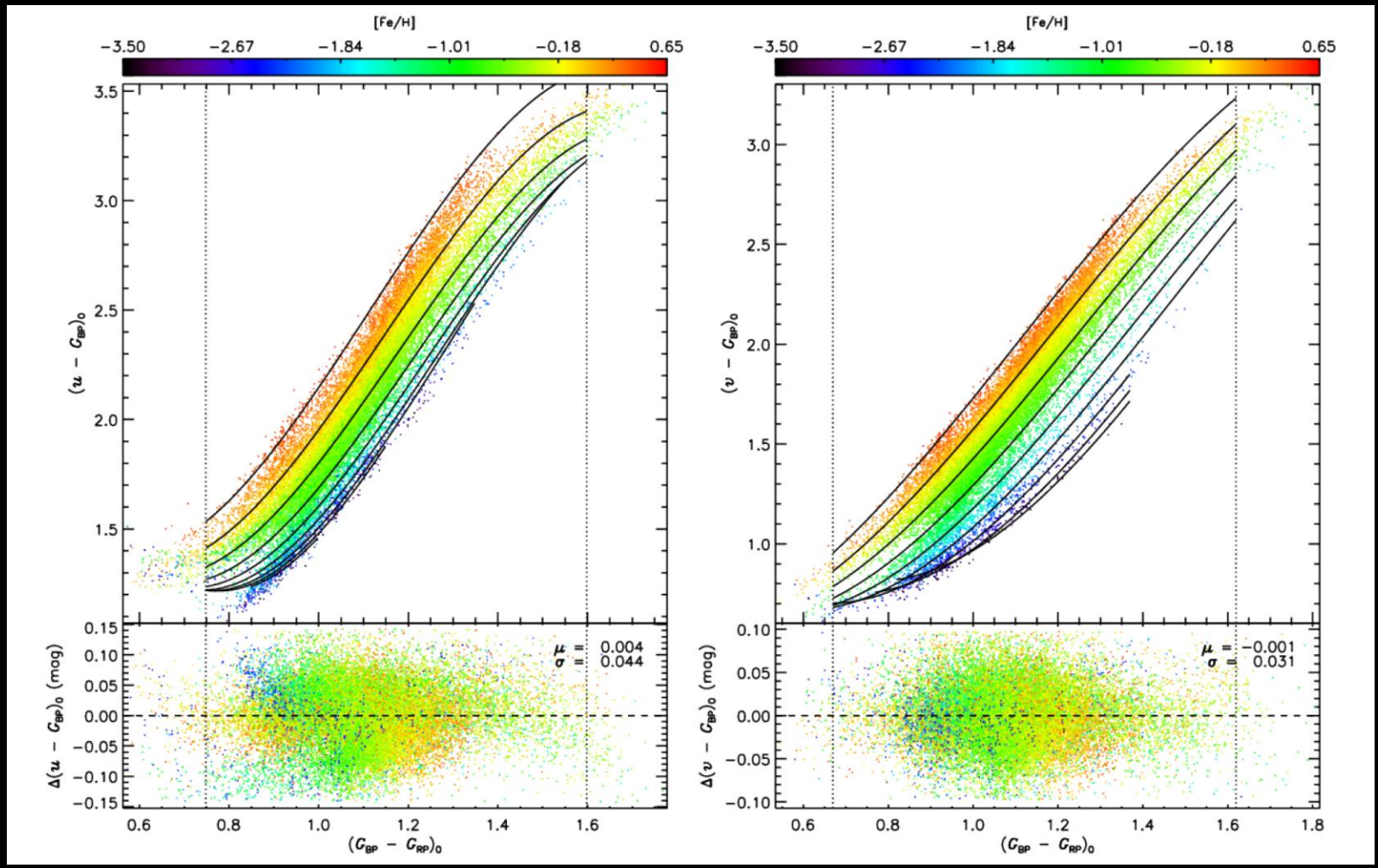
  Yet to be extended to other elements

HUANG ET AL. (2021)



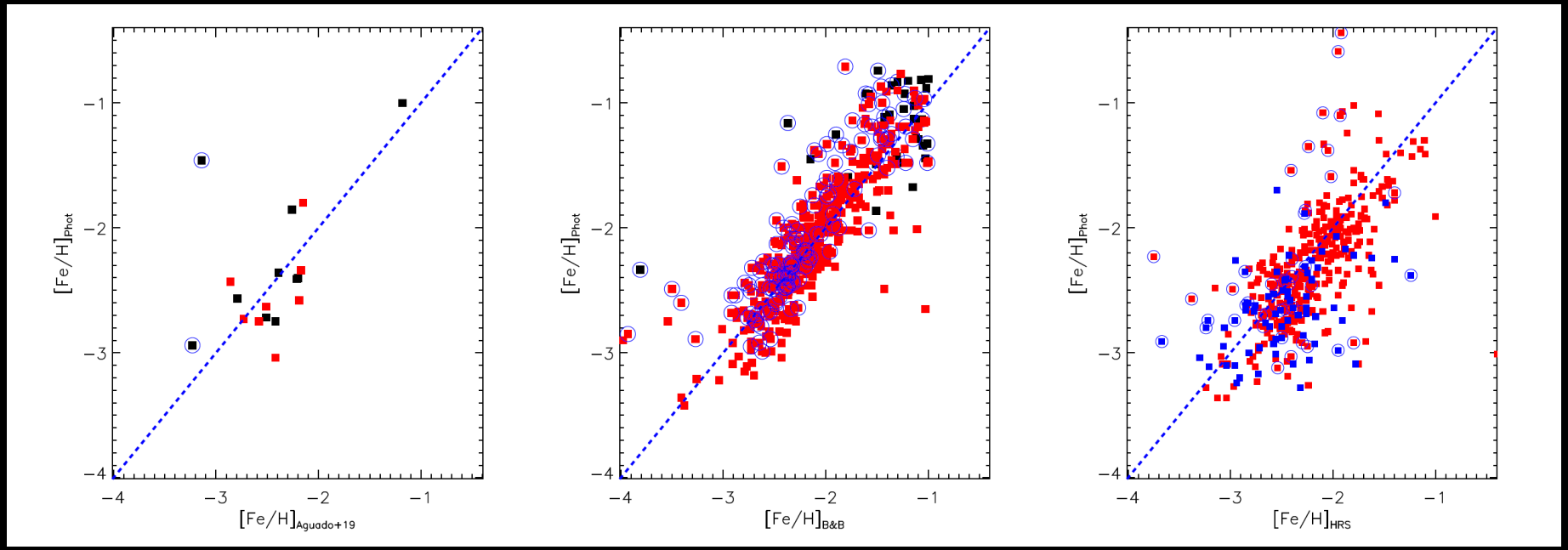
Dwarfs

HUANG ET AL. (2021)



Giants

HUANG ET AL. (2021)



Distribution of residuals in $[Fe/H]_{phot}$ with respect to $[Fe/H]_{spec}$ for medium- and high-resolution determinations

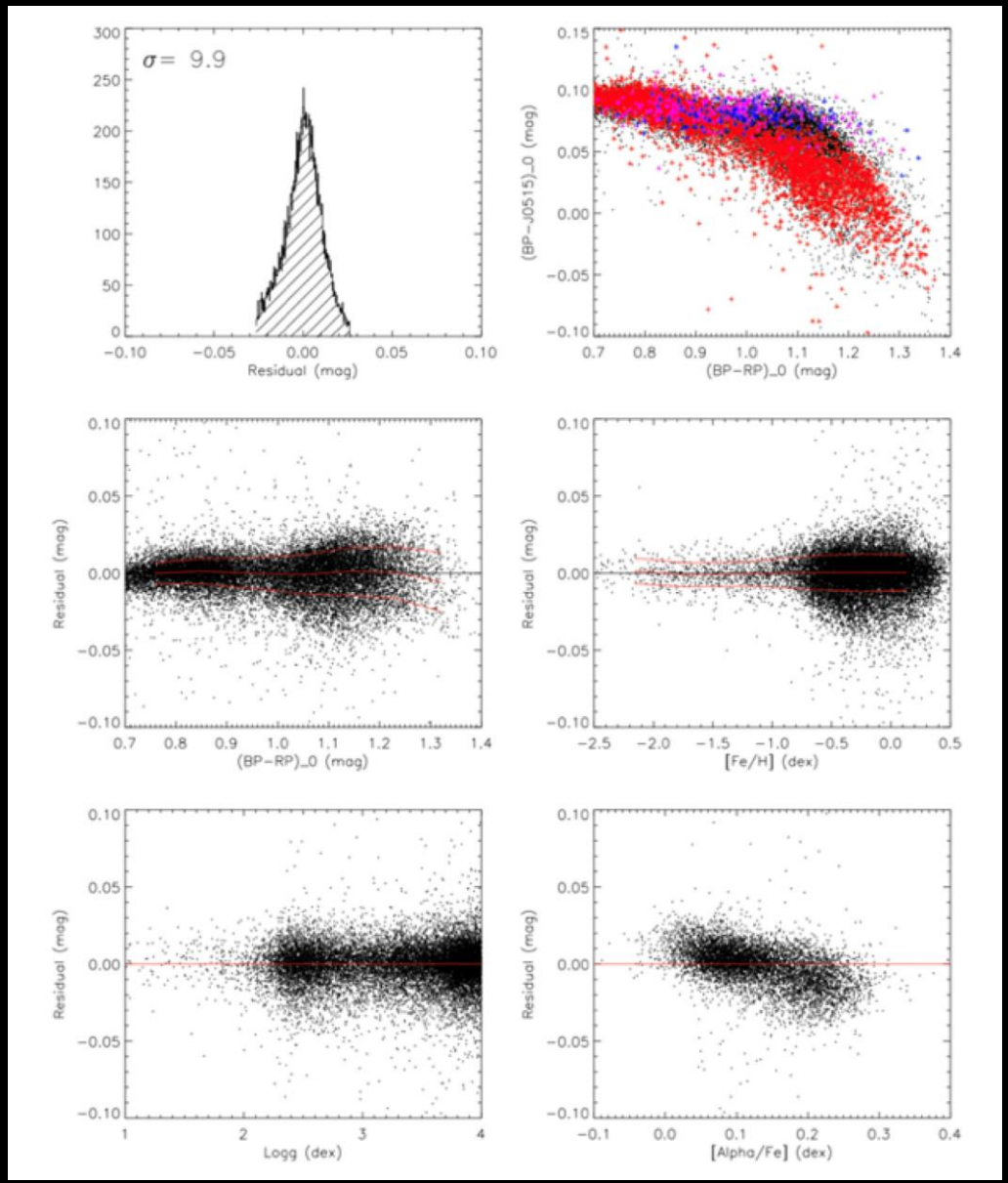
A Proposal

- Extend the Huang et al. techniques to S-PLUS for determinations of Teff, [Fe/H], [C/Fe], [Mg/Fe]

- These are the most important elements for tracing the nature of the underlying stellar populations, and can be used in constructing “population blueprints” as in the An & Beers series of papers.

- Can be obtained quickly, essentially as soon as S-PLUS data are taken and reduced, for quick estimates of these parameters that can also be used to identify stars of greatest interest for high-resolution follow-up

Haibo Yuan et al. (In Prep.)



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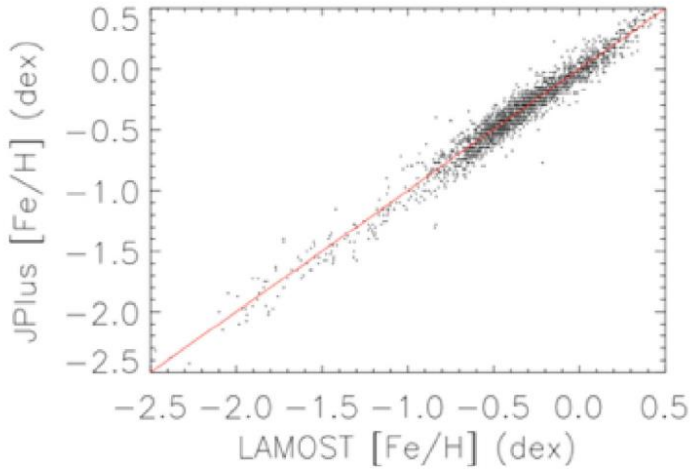
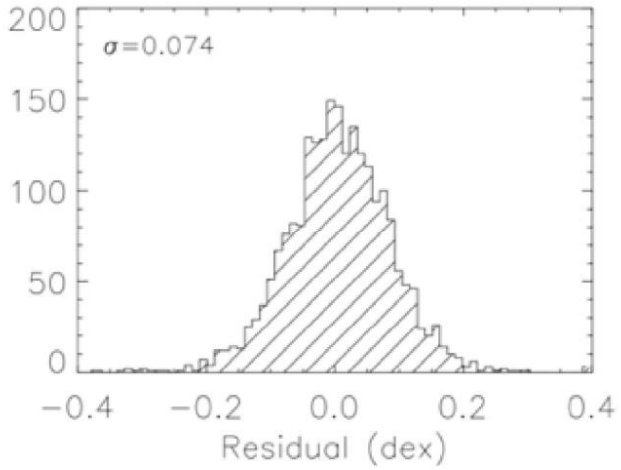
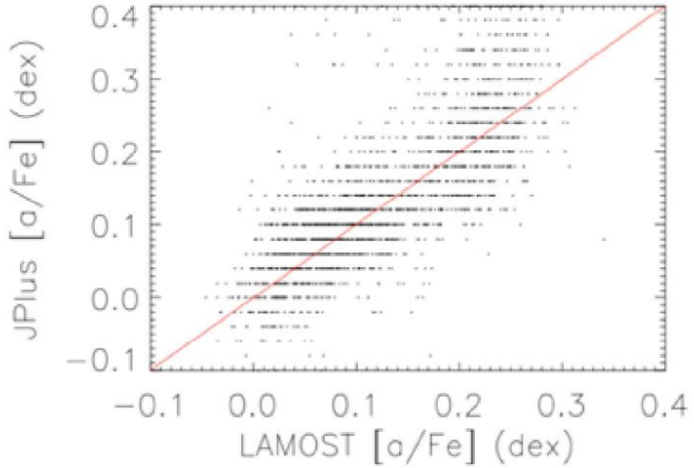
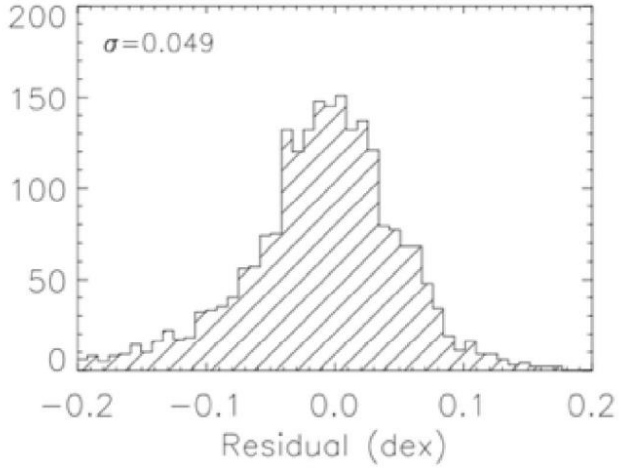








Why Does This Work ?

- Determination of [Fe/H] based on S-PLUS narrow-band filter around the CaII H & K lines is relatively insensitive to surface gravity (log g)
- Do not have to DETERMINE log g for each star, just make the relatively trivial split into dwarf and giant classification based on Gaia CMD and [Fe/H]
- The elemental abundances [C/Fe] and [Mg/Fe] ARE sensitive to gravity, BUT they are monotonic individually with color (in different ways) for dwarfs and giants

Next Steps

- Extend the Huang et al. techniques to S-PLUS for determinations of Teff, [Fe/H], [C/Fe], [Mg/Fe] to lower [Fe/H] using spectroscopic params from LAMOST / SDSS obtained with the SSPP
- Currently finishing up final inspection of some 50K / 60K stars from LAMOST and SDSS with -4.5 < [Fe/H] < -1.8
- Use as test cases to compare with possibly improved determinations from, e.g., Whitten et al. (2021) approach for these elements
- Apply to S-PLUS !

SMSS Shallow Survey (DR2)

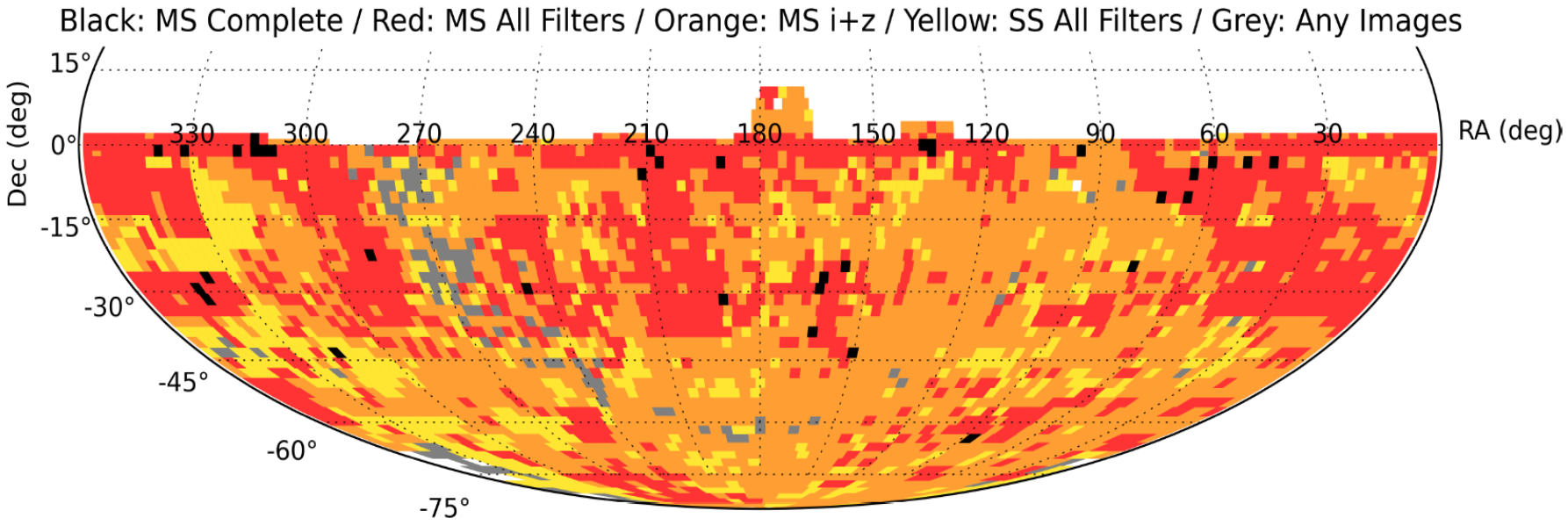
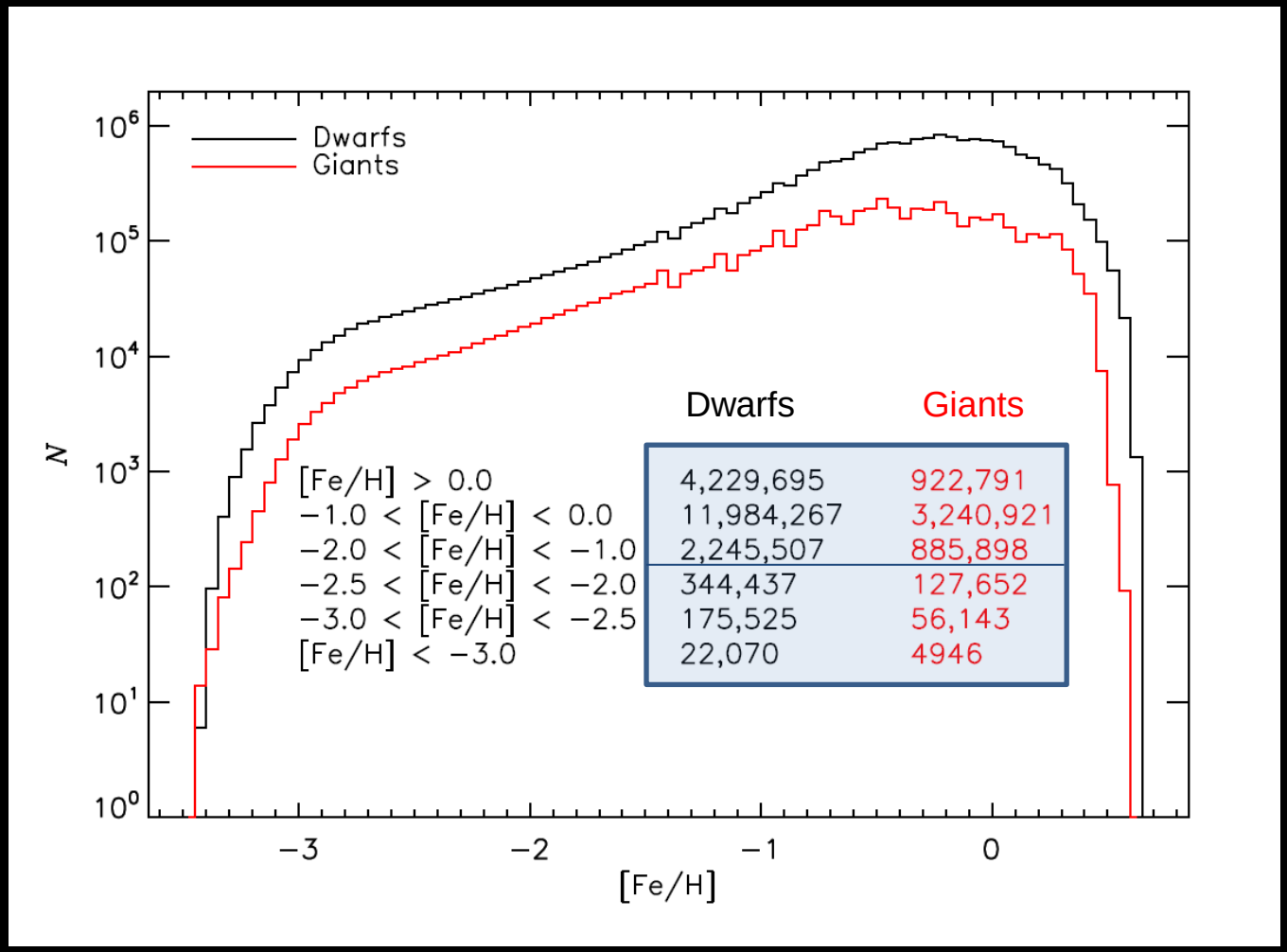


Figure 1. Coverage of SkyMapper DR2, colour-coded to indicate the progress on different fields: (*black*) complete Main Survey coverage in all six filters; (*red*) at least one Main Survey image in all six filters; (*orange*) Main Survey images in *iz* filters; (*yellow*) Shallow Survey images in all six filters; (*grey*) any images. Main Survey images have exposure times of 100 s in each filter, while the Shallow Survey exposures in u, v, g, r, i, z are 40, 20, 5, 5, 10, 20 s.

The SkyMapper Survey of the Southern Hemisphere

HUANG ET AL. (2021)

BEYOND SPECTROSCOPY: METALLICITIES, DISTANCES, AND AGE ESTIMATES FOR OVER TWENTY MILLION STARS FROM SMSS DR2 AND GAIA EDR3



Questions ?