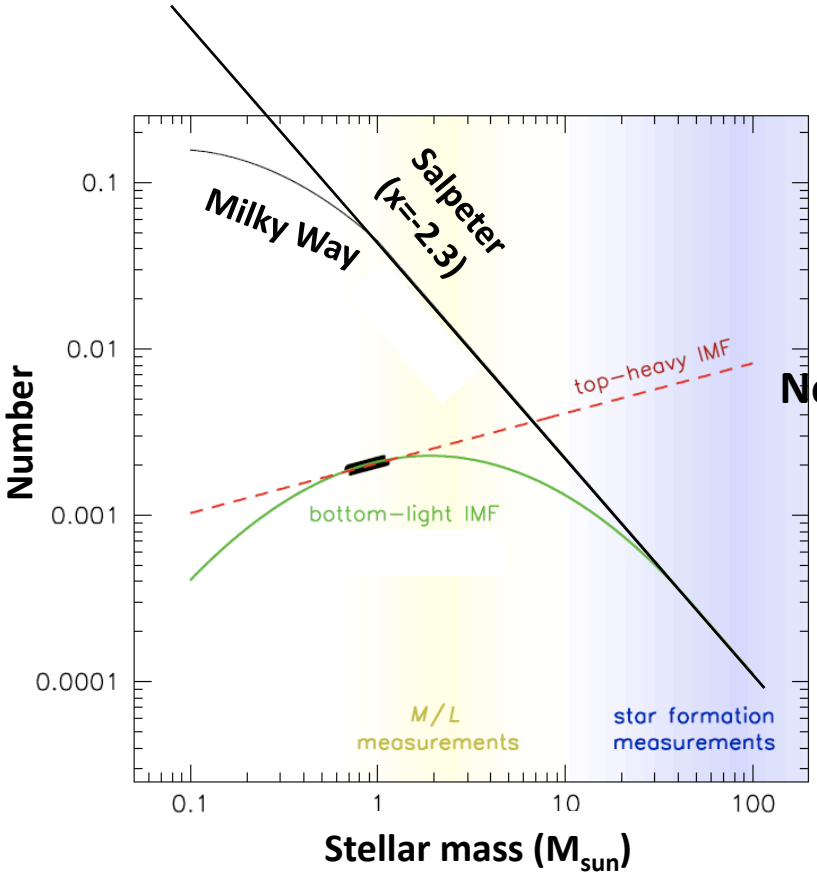
Counting Low-Mass Stars in Distant Galaxies

Charlie Conroy
(Harvard/CfA)

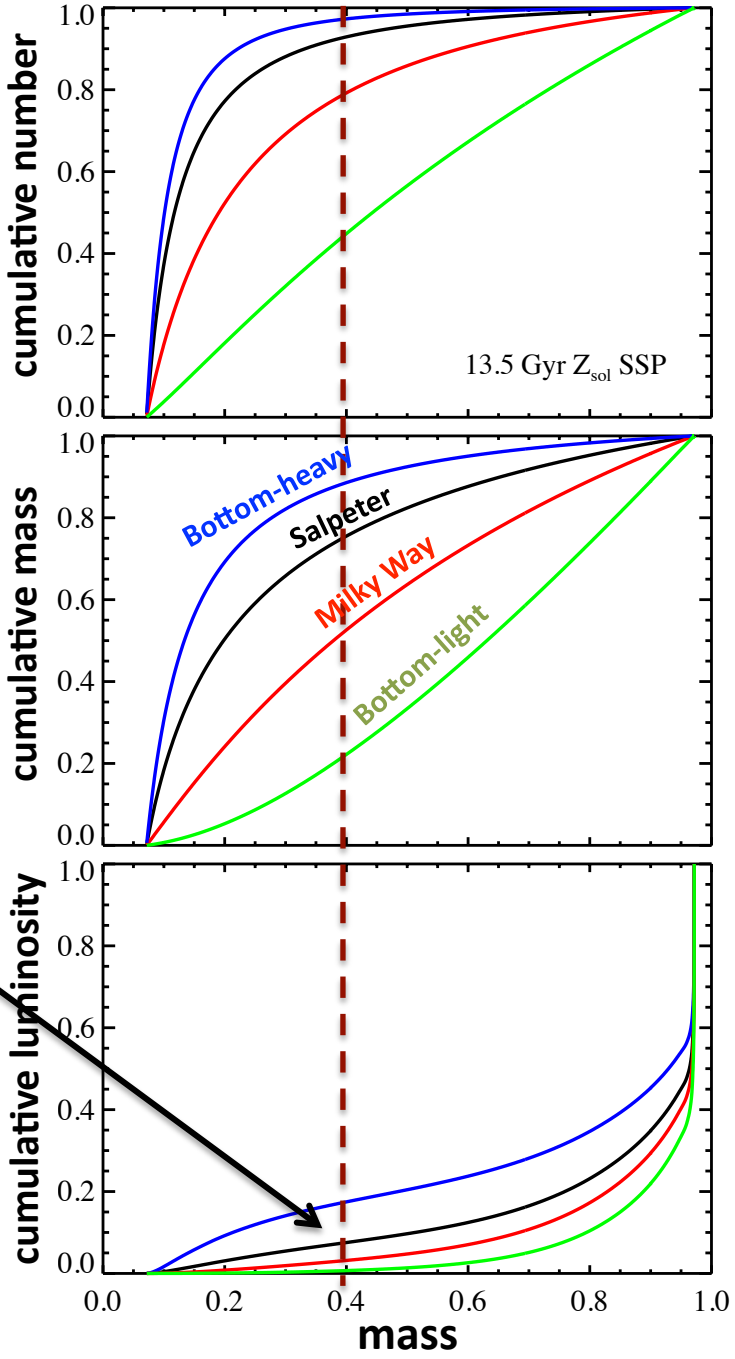
In collaboration with Pieter van Dokkum (Yale)

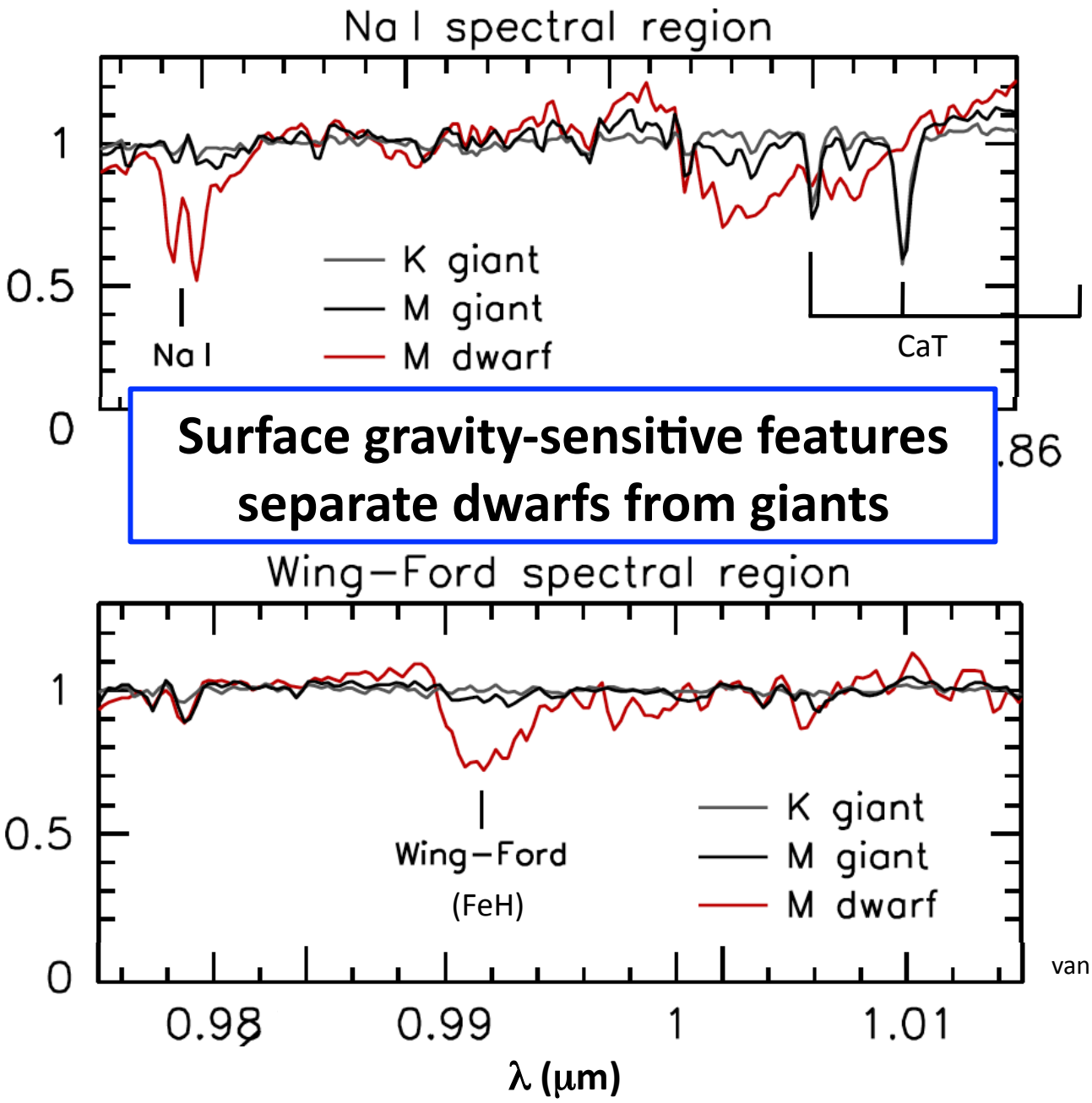
The IMF in Integrated Light

- Low-mass stars dominate the mass, but are “invisible”



Not exactly!

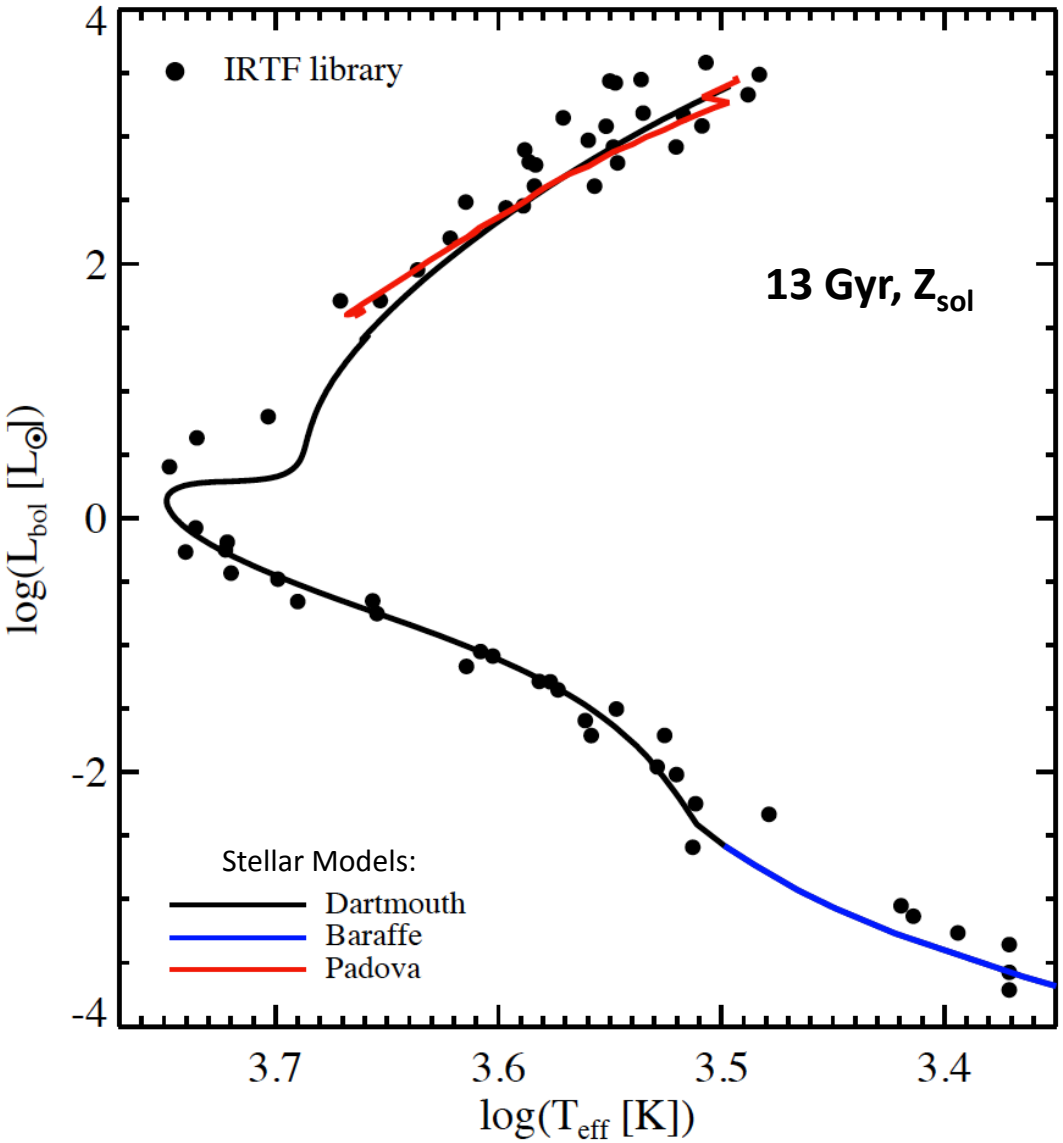




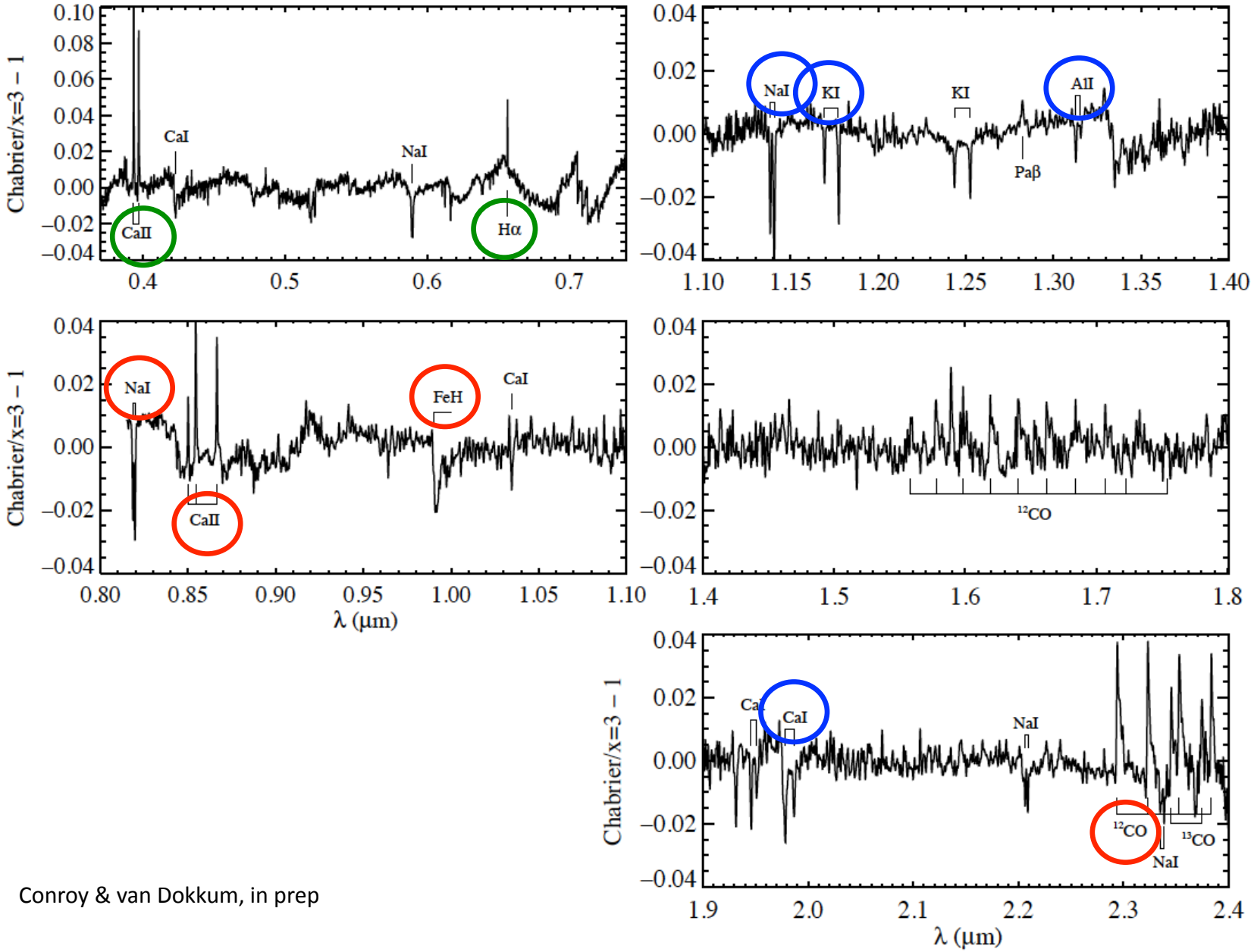
Surface gravity-sensitive features separate dwarfs from giants

Spinrad 1962
Wing & Ford 1969
Cohen 1978
Faber & French 1980
Carter et al. 1986
Hardy & Couture 1988
Schiavon et al. 2000
van Dokkum & Conroy 2010

Stellar Population Synthesis



New Empirical Models

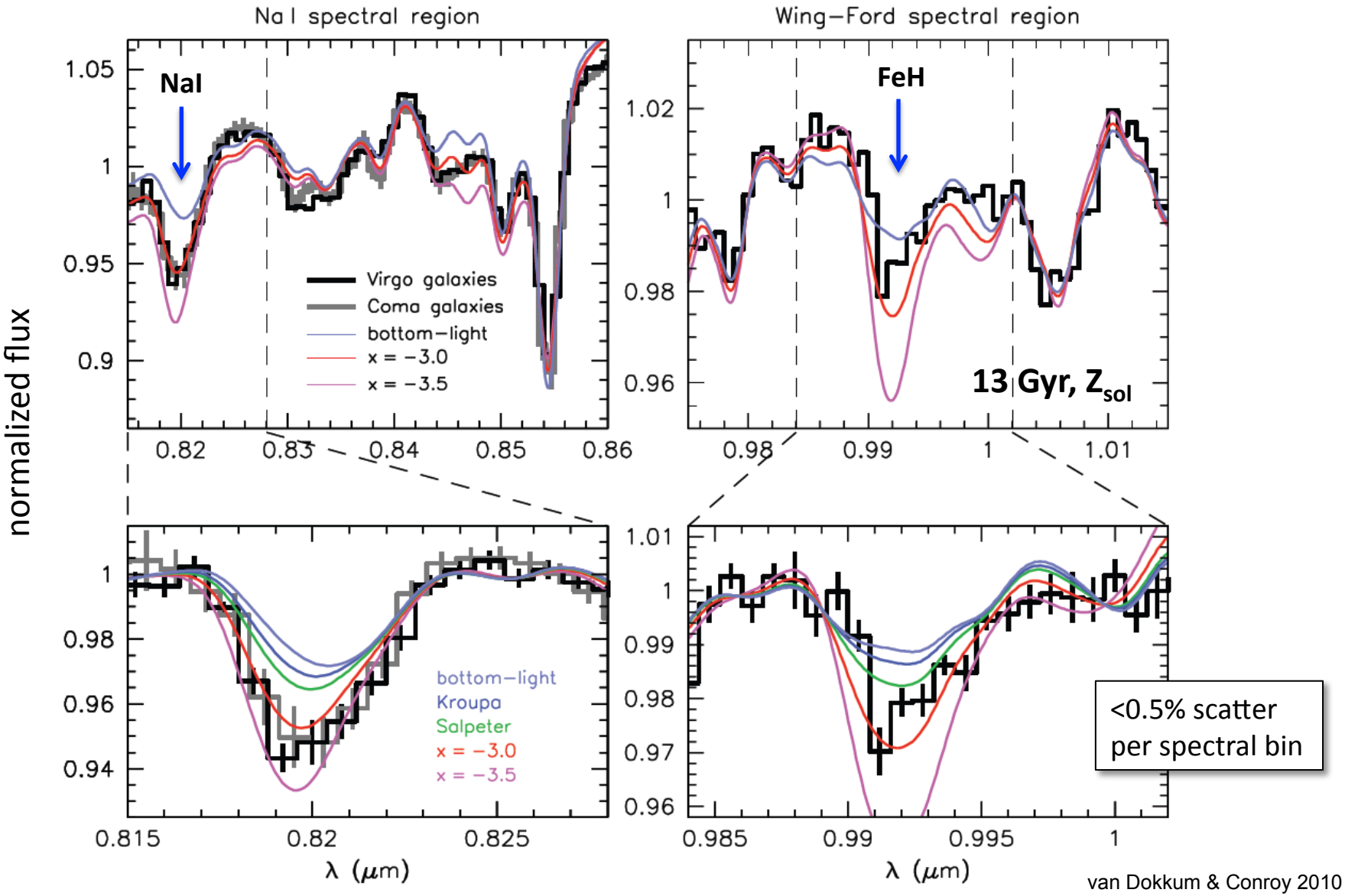


Conroy & van Dokkum, in prep

- Keck LRIS spectra of the 8 most massive (σ>250 km/s) Es in Coma & Virgo (excluding M87)

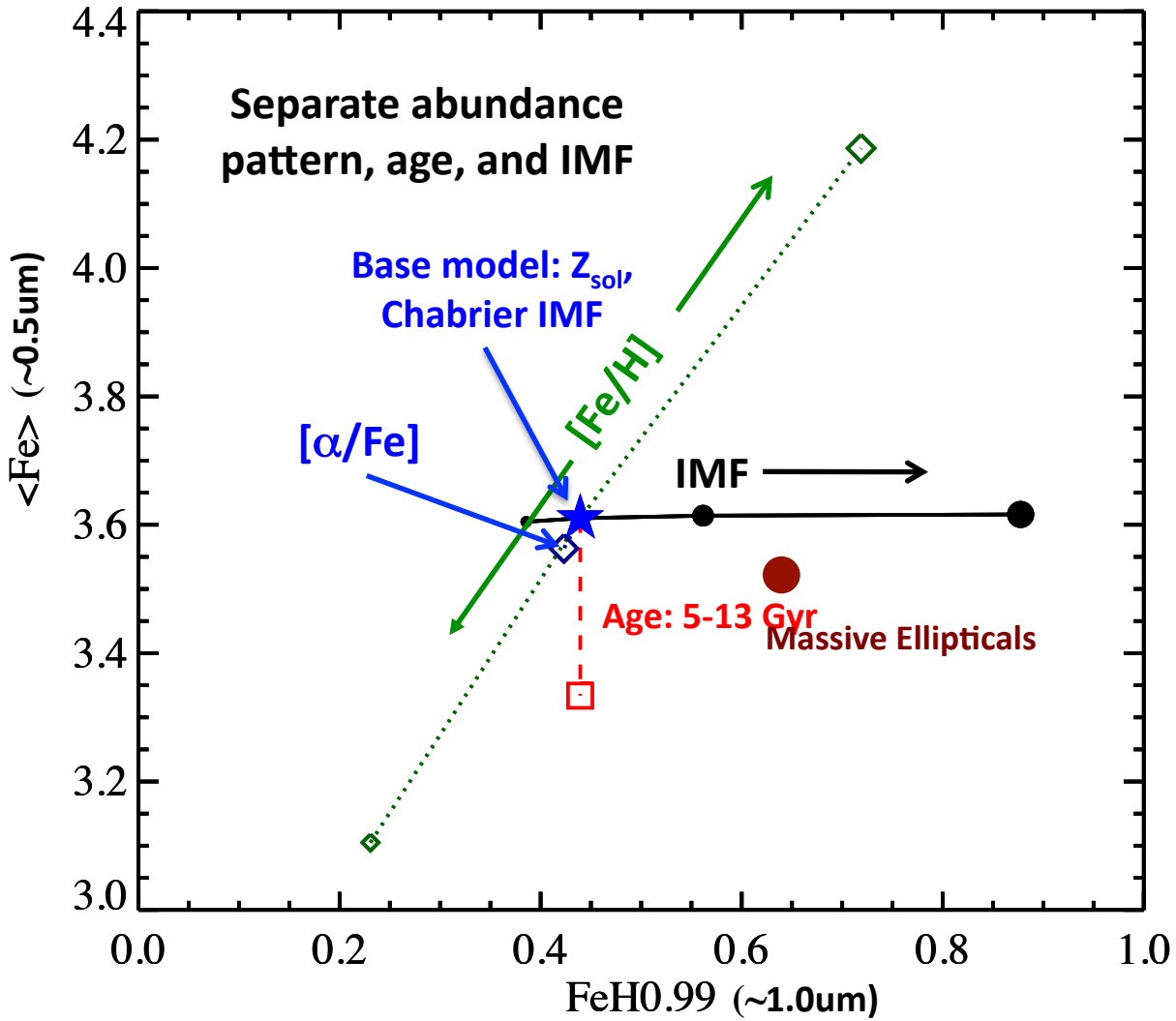
  only 12m exposure per galaxy

  spectra obtained within the central 4" = 0.6 R_e (Coma), 0.02 R_e (Virgo)



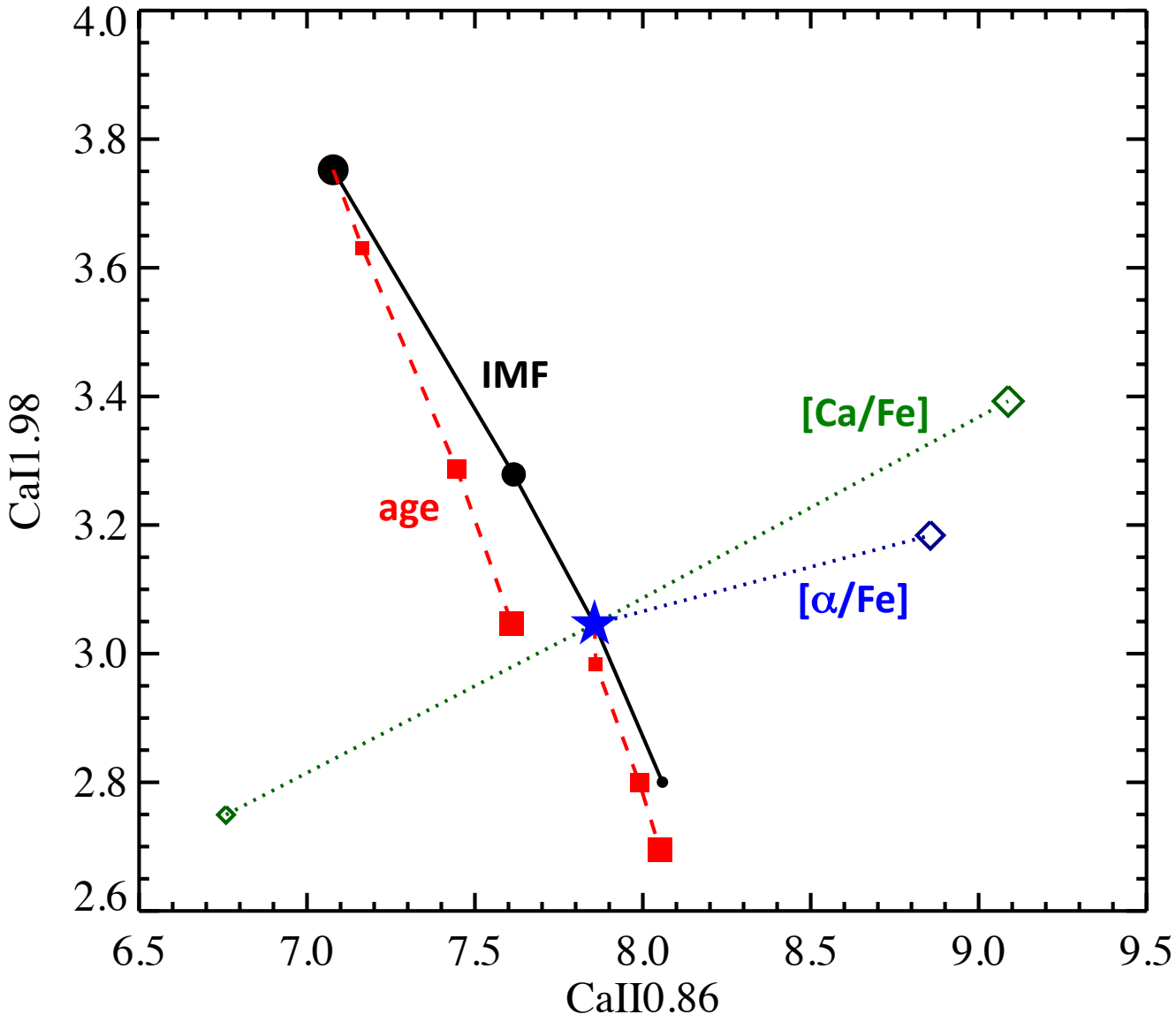
van Dokkum & Conroy 2010

Models with Arbitrary Abundance Patterns



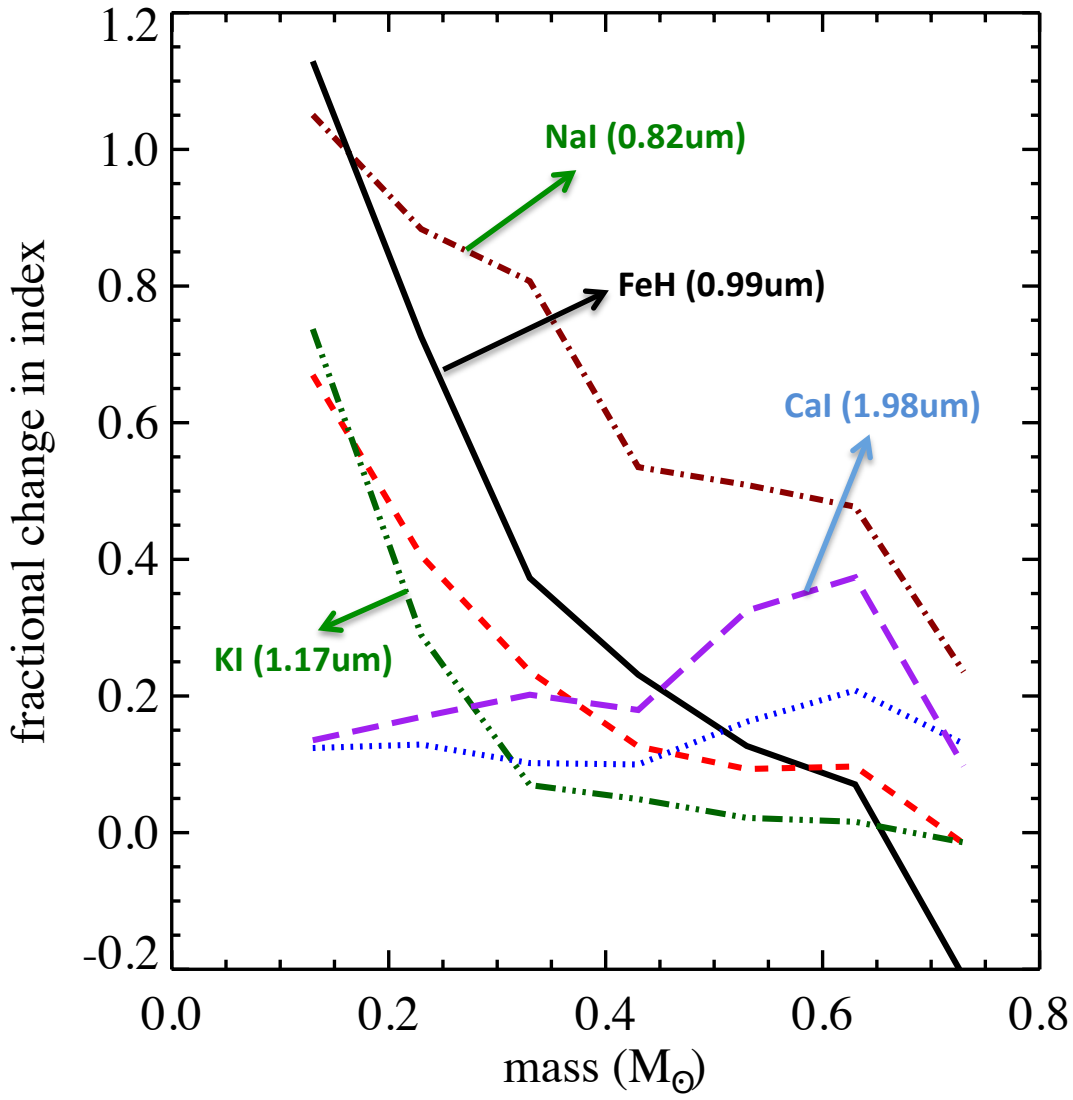
Conroy & van Dokkum, in prep

Calcium, sodium, carbon, …

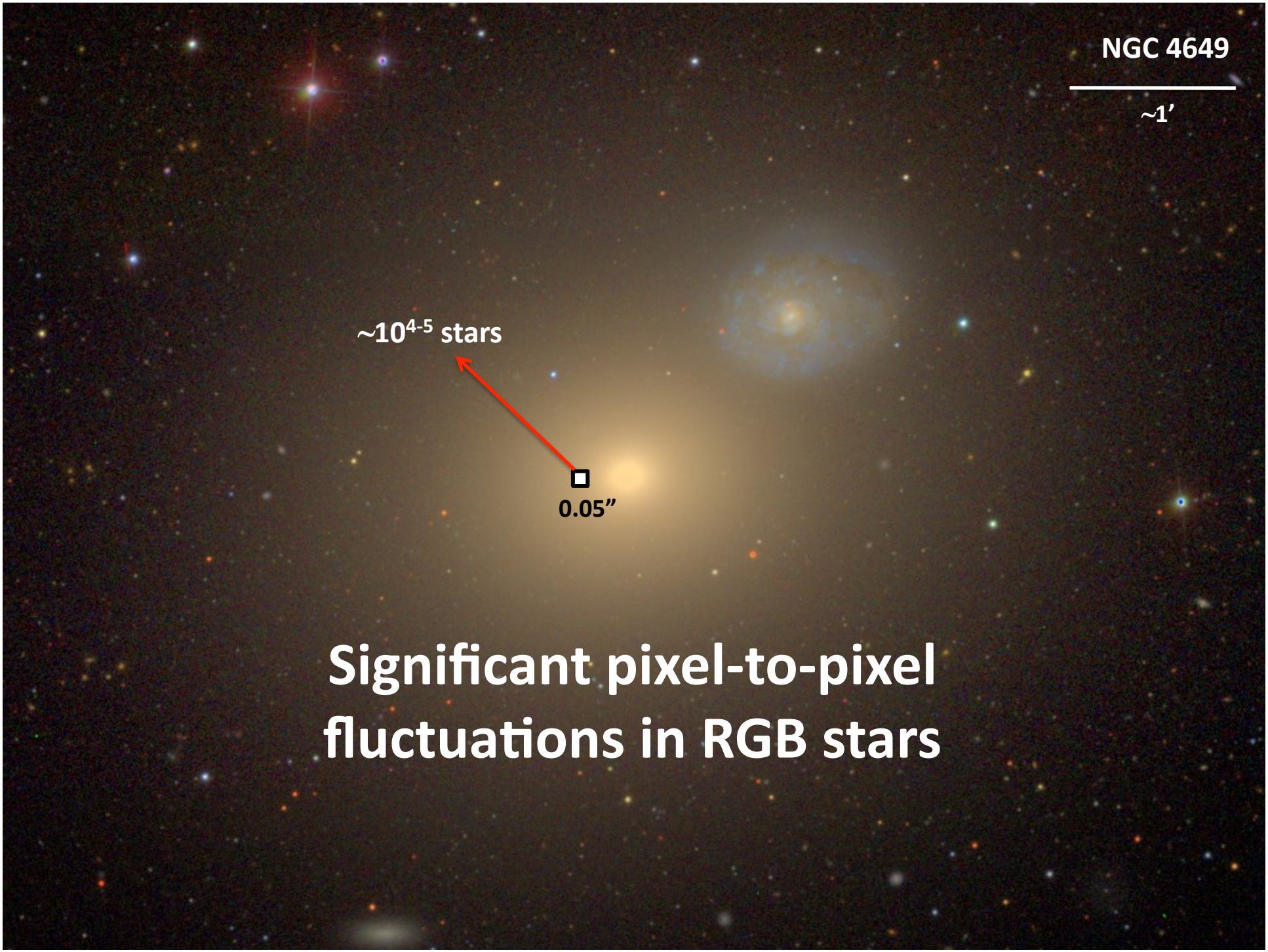


Constraining the *shape* of the IMF

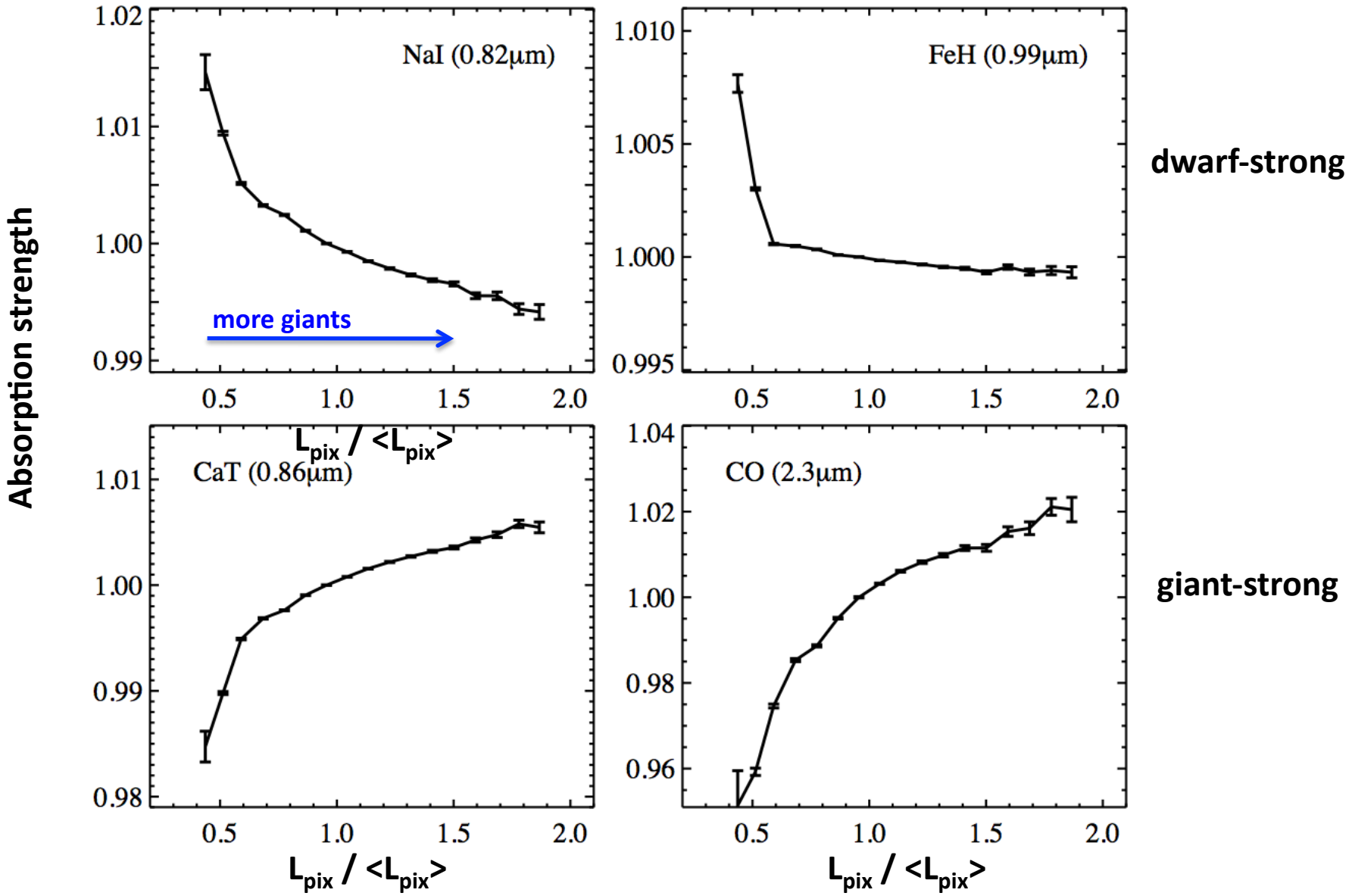
- Spectral features are sensitive to different mass intervals



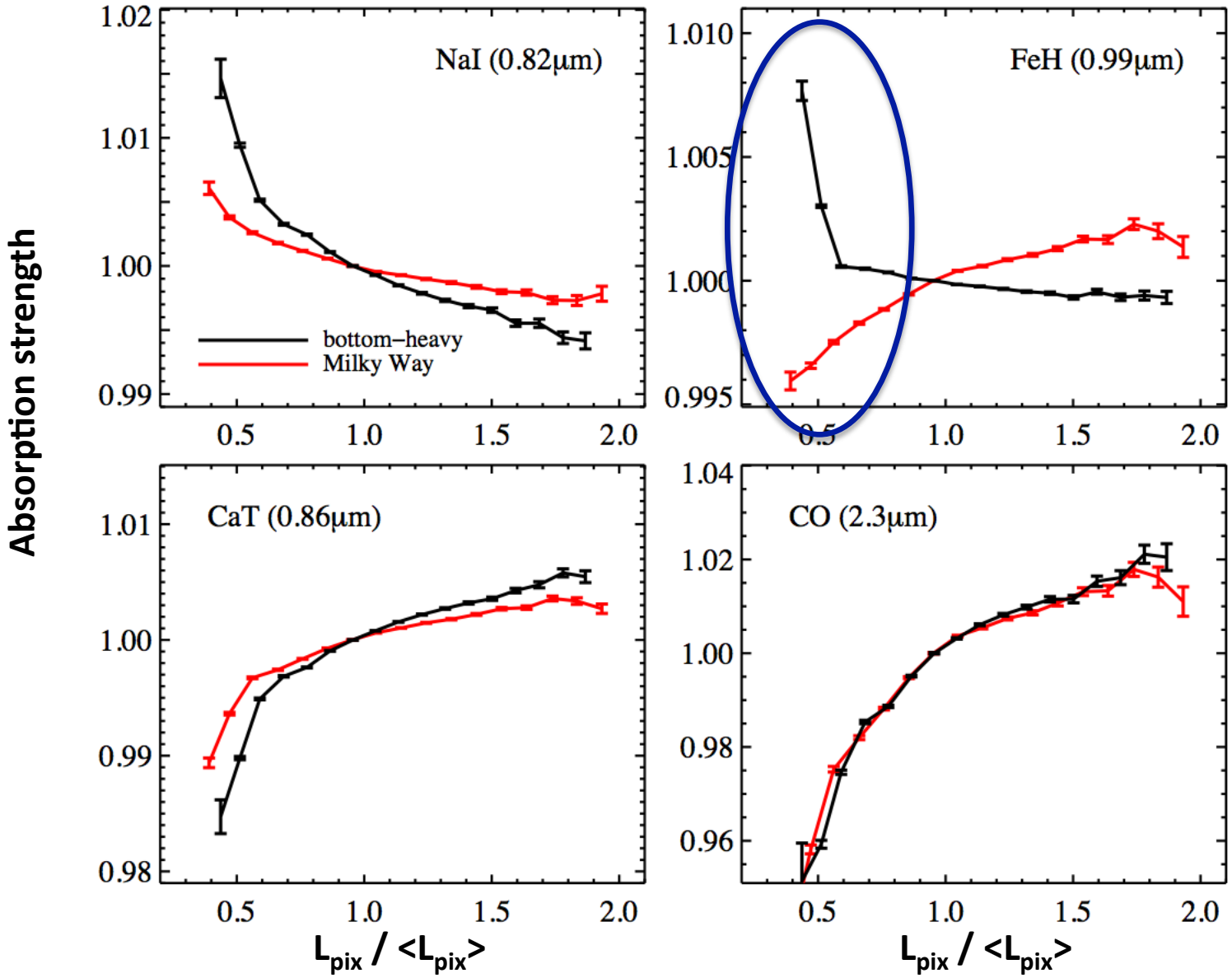
Conroy & van Dokkum, in prep


NGC 4649
~1’
~10^4-5 stars
0.05”
Significant pixel-to-pixel fluctuations in RGB stars

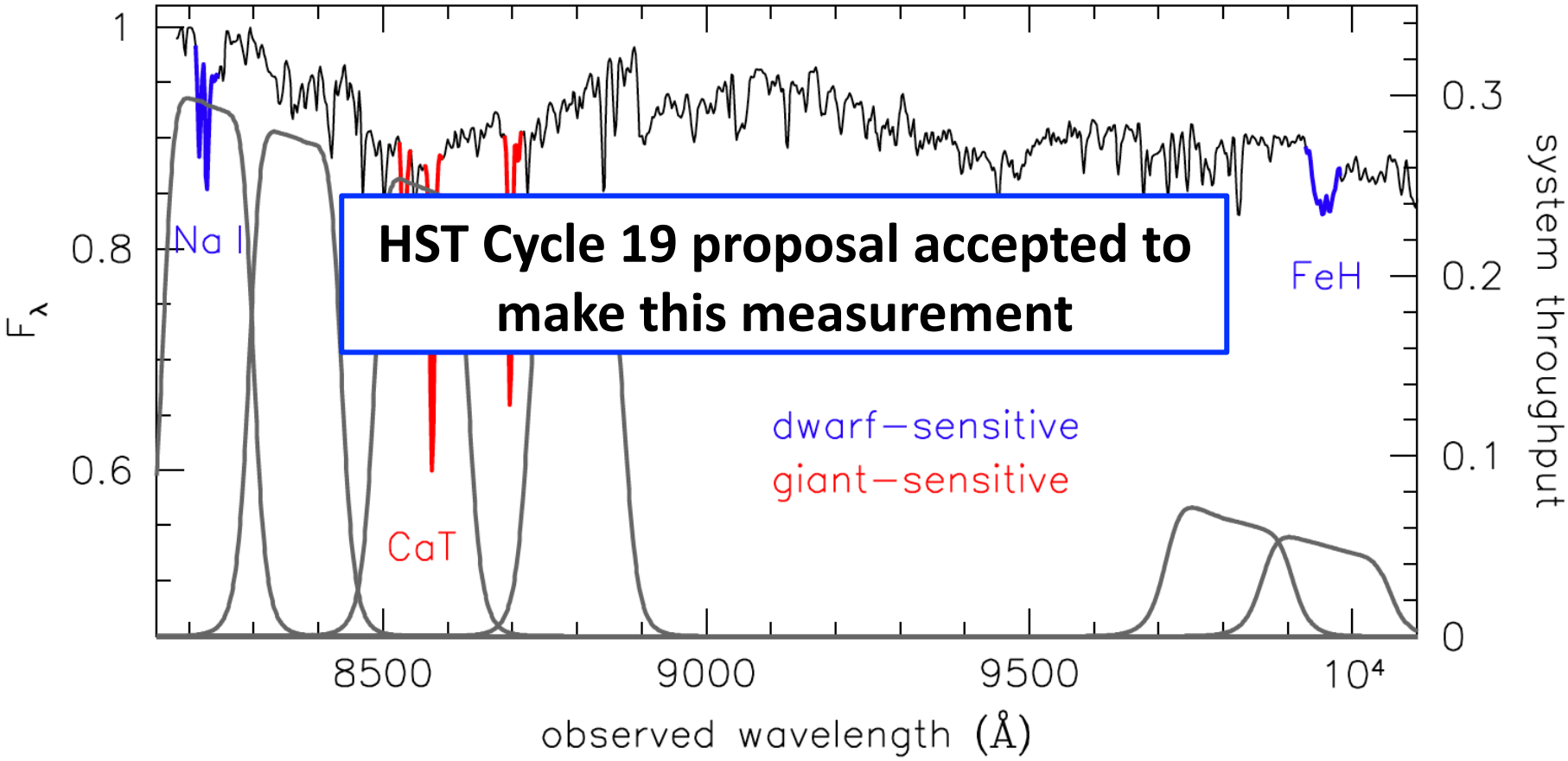
Dwarfs vs. Giants



… & the IMF


Absorption strength
NaI (0.82μm)
FeH (0.99μm)
CaT (0.86μm)
CO (2.3μm)
bottom–heavy
Milky Way
1.02
1.01
1.00
0.99
1.010
1.005
1.000
0.995
1.04
1.02
1.00
0.98
0.96
0.5
1.0
1.5
2.0
L_pix / <L_pix>

HST narrow-band tunable filters:



Summary

1. *The low-mass IMF can be directly constrained from the integrated light of old stellar populations*
   - Even the *shape* of the IMF can be measured

2. Spectral fluctuations is a novel technique for measuring the IMF

3. Bottom-heavy IMF still favored for massive ellipticals.