Getting Precise Stellar Parameters in PLATO's first field

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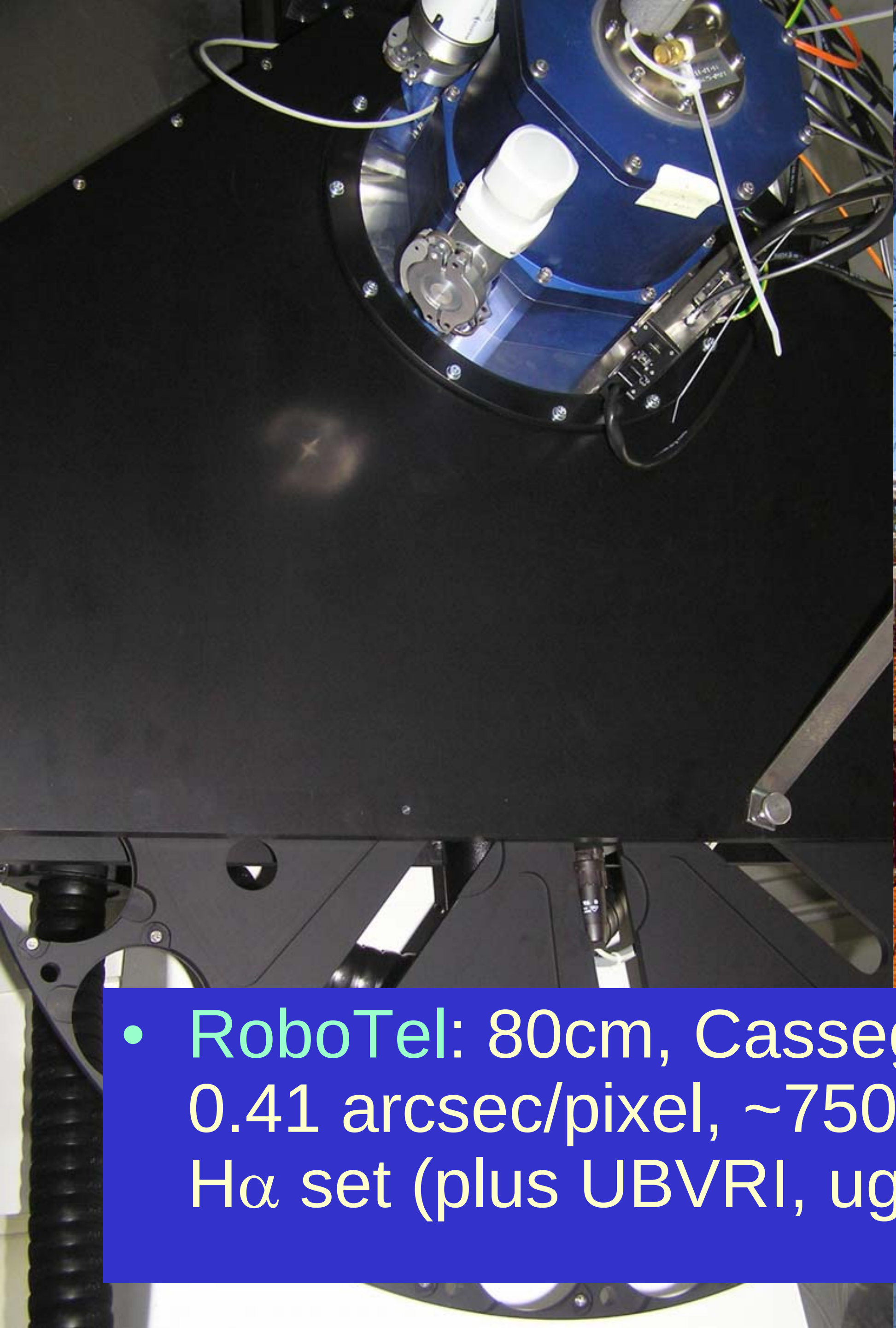
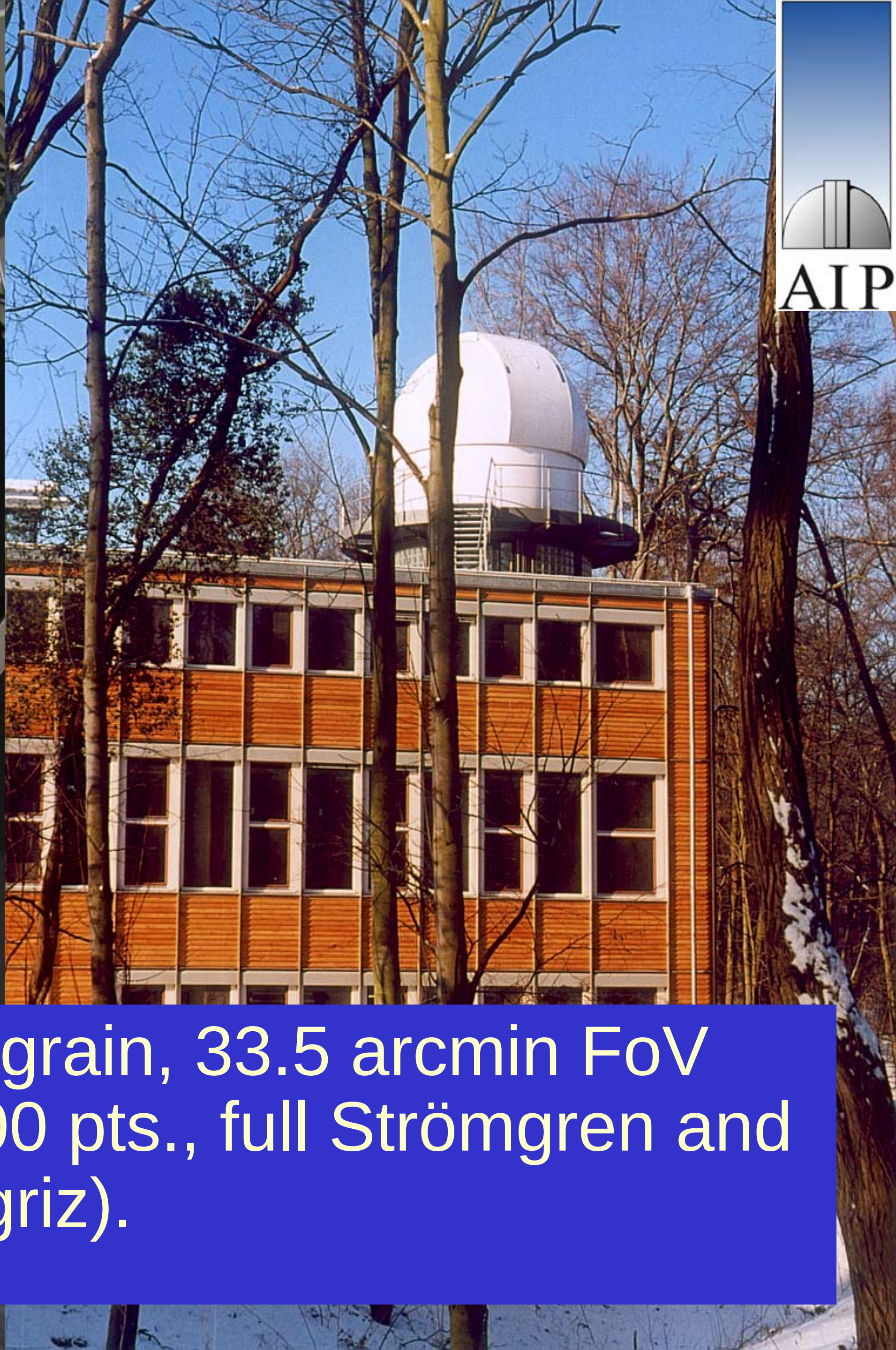
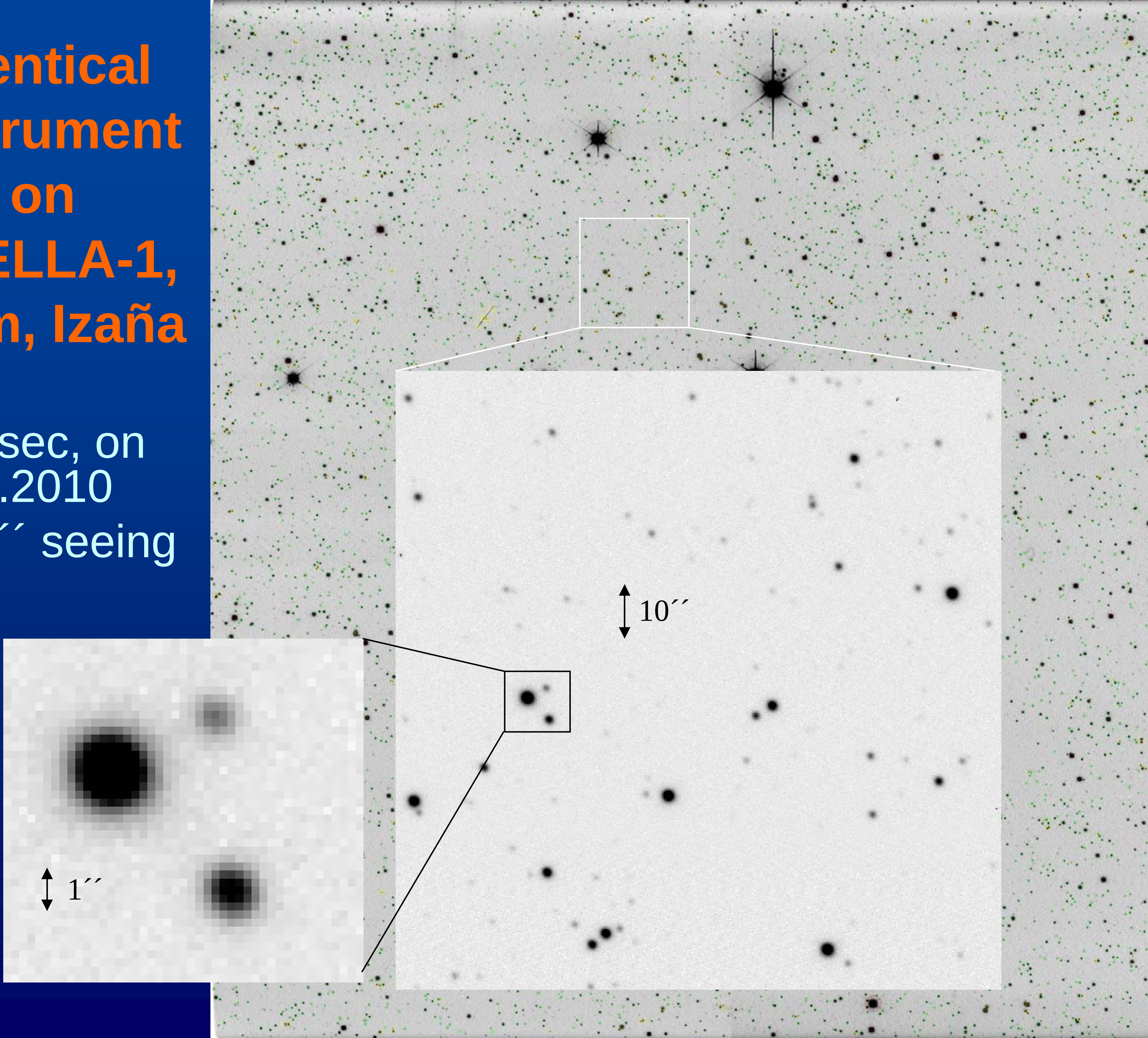




- RoboTel: 80cm, Cassegrain, 33.5 arcmin FoV 0.41 arcsec/pixel, ~7500 pts., full Strömgren and Hα set (plus UBVRI, ugriz).

Identical Instrument on STELLA-1, 1.2m, Izaña

- 40 sec, on 5.8.2010
- 1.3´´ seeing



AIP

Bochum-University
at base of
Cerro Armazones

~50% seeing < 1”

~350 clear nights

Image: R. Chini

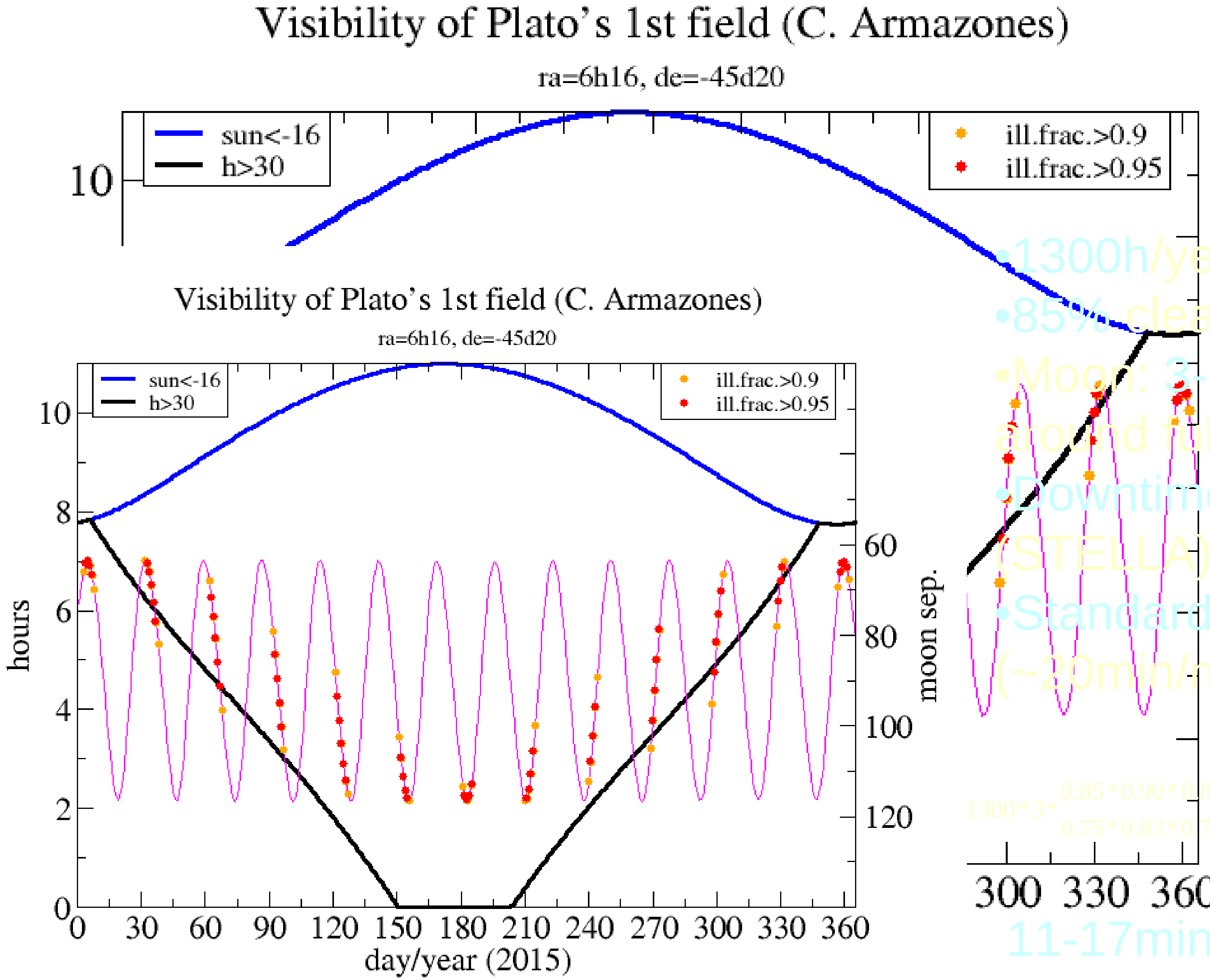
Strömgren indices

(b-y)	for eff. Temperature
m1=(v-b)-(b-y)	for line blanketing
c1=(u-v)-(v-b)	for Balmer discontinuity

For late-type (FGKM) stars (dwarfs), m1 is a good proxy for metallicity, c1 for log(g)

The calibrations used for error analysis are from:

Holmberg et al., A&A 475, 519
Ramirez & Melendez, ApJ 626, 446
Árnadóttir et al., A&A 521, A40



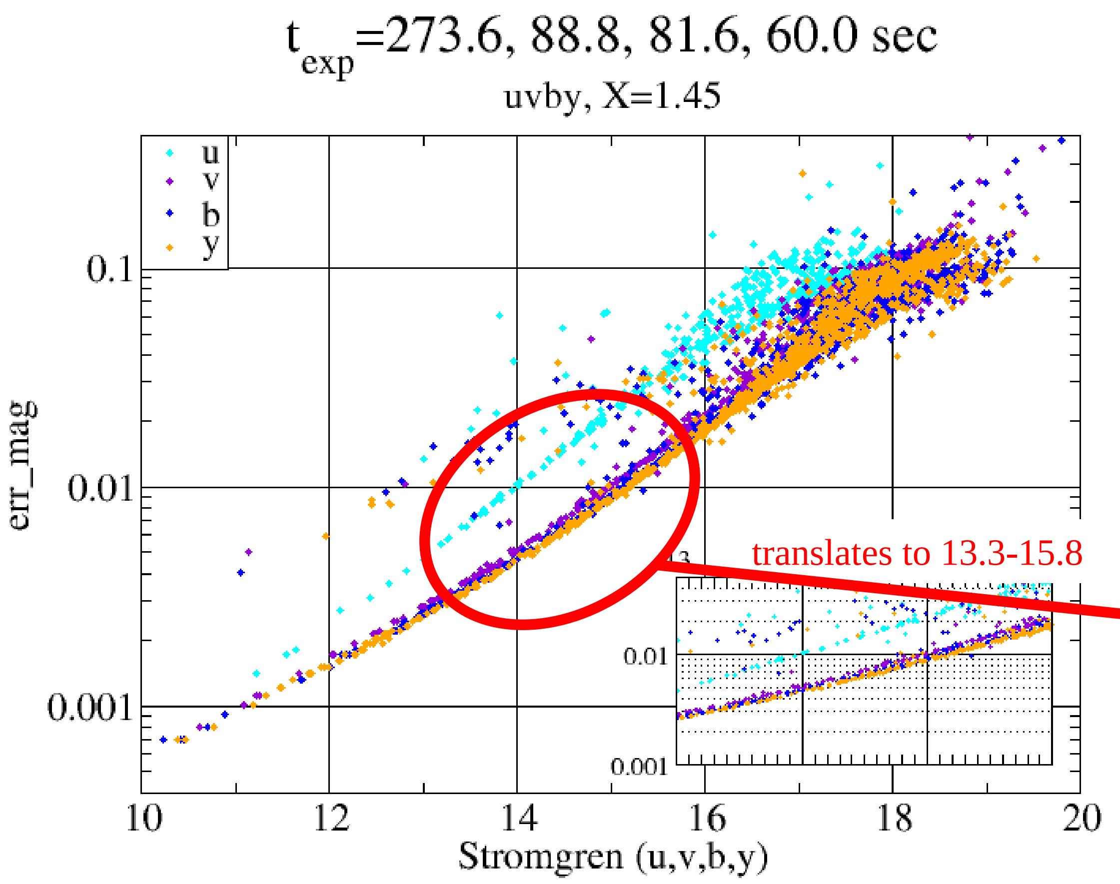
- 1300h/year h>30
- 85% clear nights
- Moon: 3-5 days around full moon
- Downtime <20% (STELLA)
- Standards? (~20min/night)

$$1300*3*\frac{0.85*0.90*0.85}{0.75*0.83*0.72}=\frac{2535}{1755}-365=\frac{2170}{1390}h$$

11-17min/pointing

Photometric precision

STELLA-1 (1.2m)!



Including slewing/read-out overhead, effective exposure times in y are

- 10.3-23.7 sec. (8 filters)
- 20.1-40.7 sec. (6 filters)
- 52.6-97.2 sec. (4 filters)

σ_{ybv} = 3.5-15 mmag,
σ_{u} = 8-30 mmag

…but only in the standard system

Transformation to account for different filter curves (α_i, ε_i) and atmospheric conditions (k'_i, ζ_i)

$$
\begin{aligned}
(b-y)_{std} &= \alpha_{by} \cdot (b-y)_{ins} + k'_{by} X + \zeta_{by} \\
m_{1,std} &= \alpha_m \cdot m_{1,ins} + \varepsilon_1 (b-y)_{std} + k'_m X + \zeta_m \\
c_{1,std} &= \vdots
\end{aligned}
$$

varies slowly

nightly

…determined by observation of standard fields, with errors σ_k, σ_α, σ_ε, σ_ζ.

Reddening?

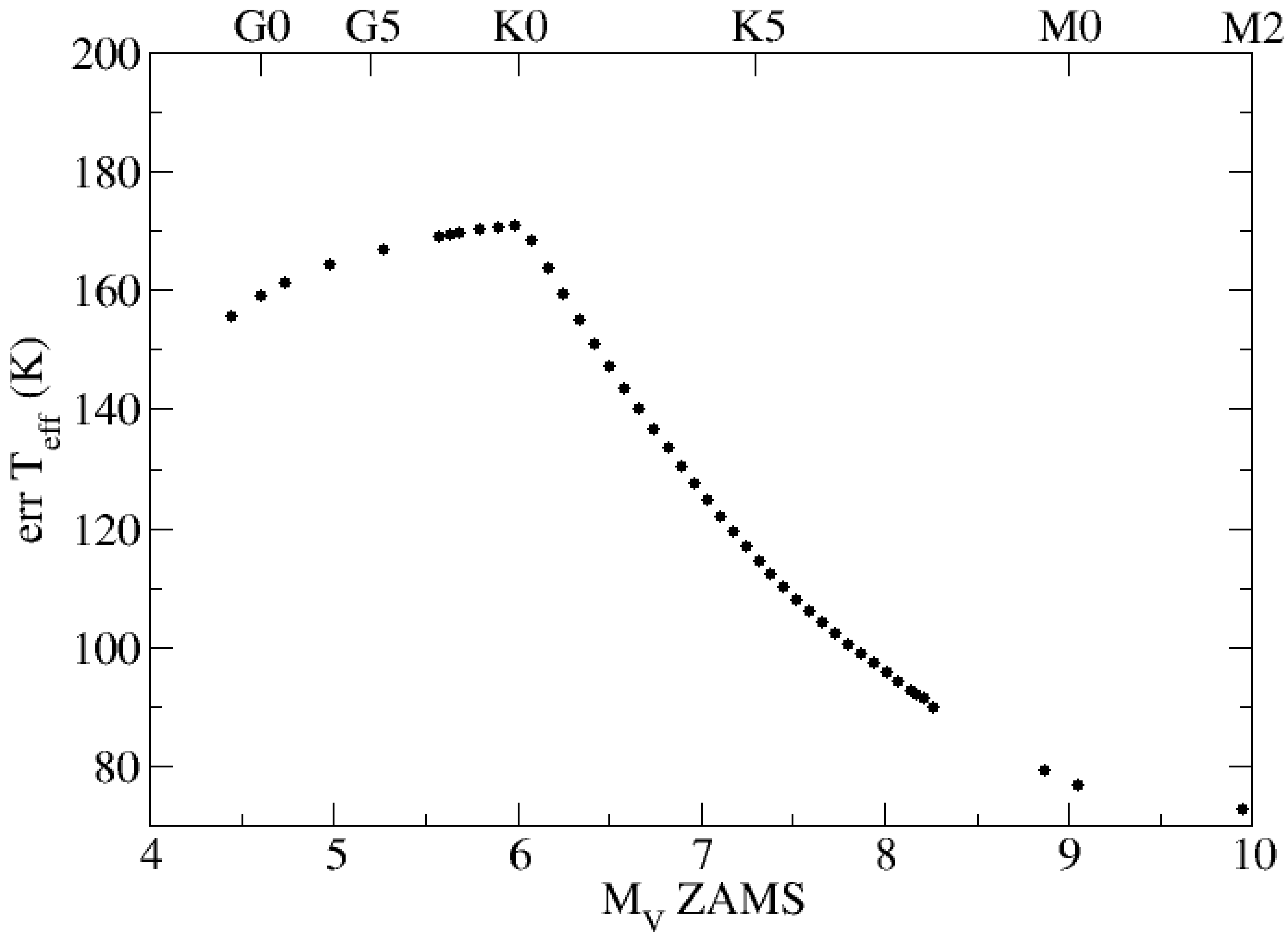
Plato field at moderate galactic latitude, chosen also for little reddening...

Use ß–index, independent of reddening (same λ).
According to Crawford (AJ 80, 955)

$$E(b-y) = (b-y)_{std} - 0.222 + 1.11\Delta\beta + 2.7\Delta\beta^2 + O(m1, c1)$$

…again one notch on your error budget

T_{eff} (b-y)



b-y:

$\sigma_{\alpha,\varepsilon}$=0,

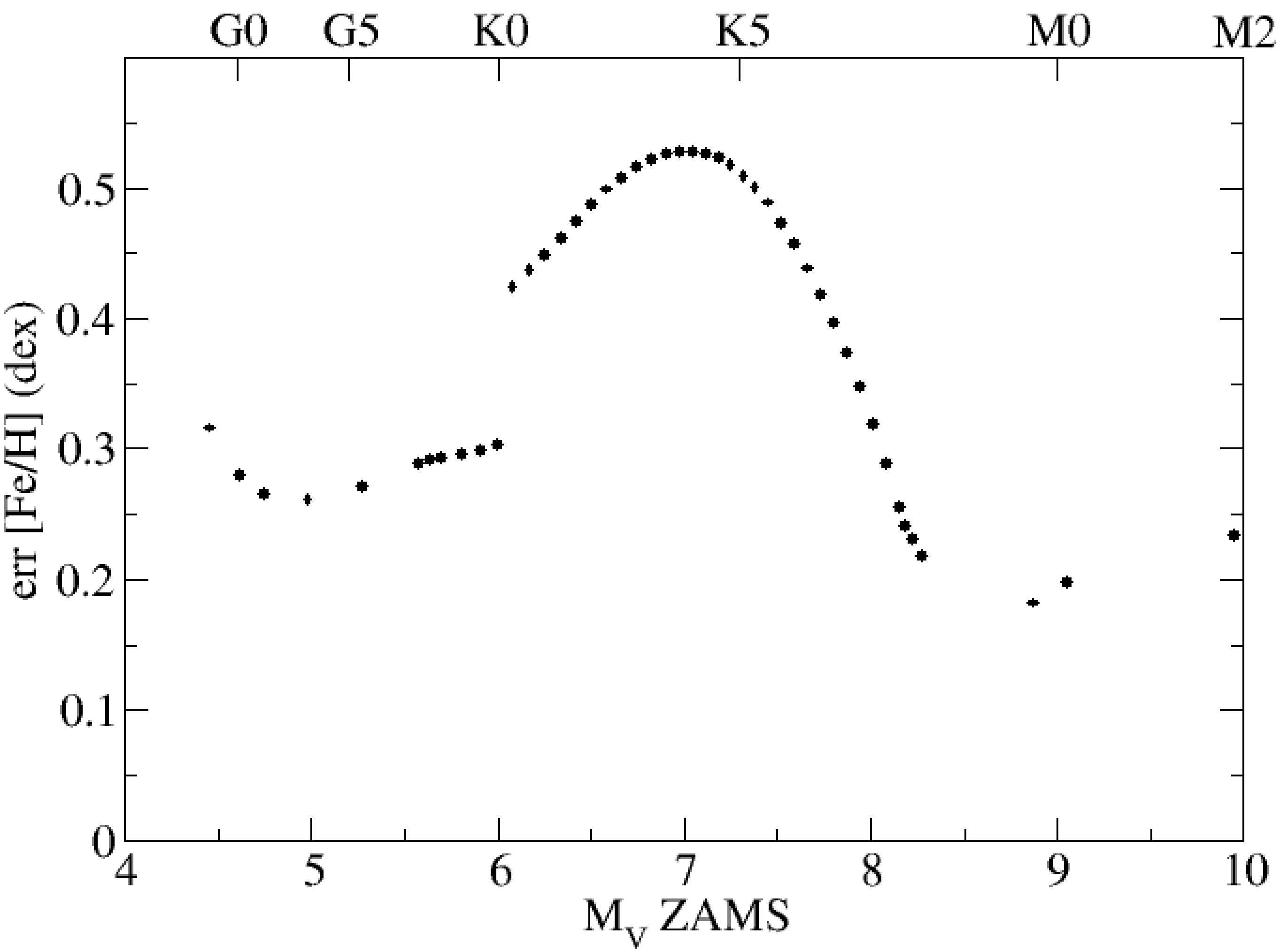
σ_{inst}=10mmag

σ_{std}=11.7mmag

σ_{red}=18.8mmag

Sample data from Olsen, A&AS 57, 443

Metallicity (b-y,m1,c1)

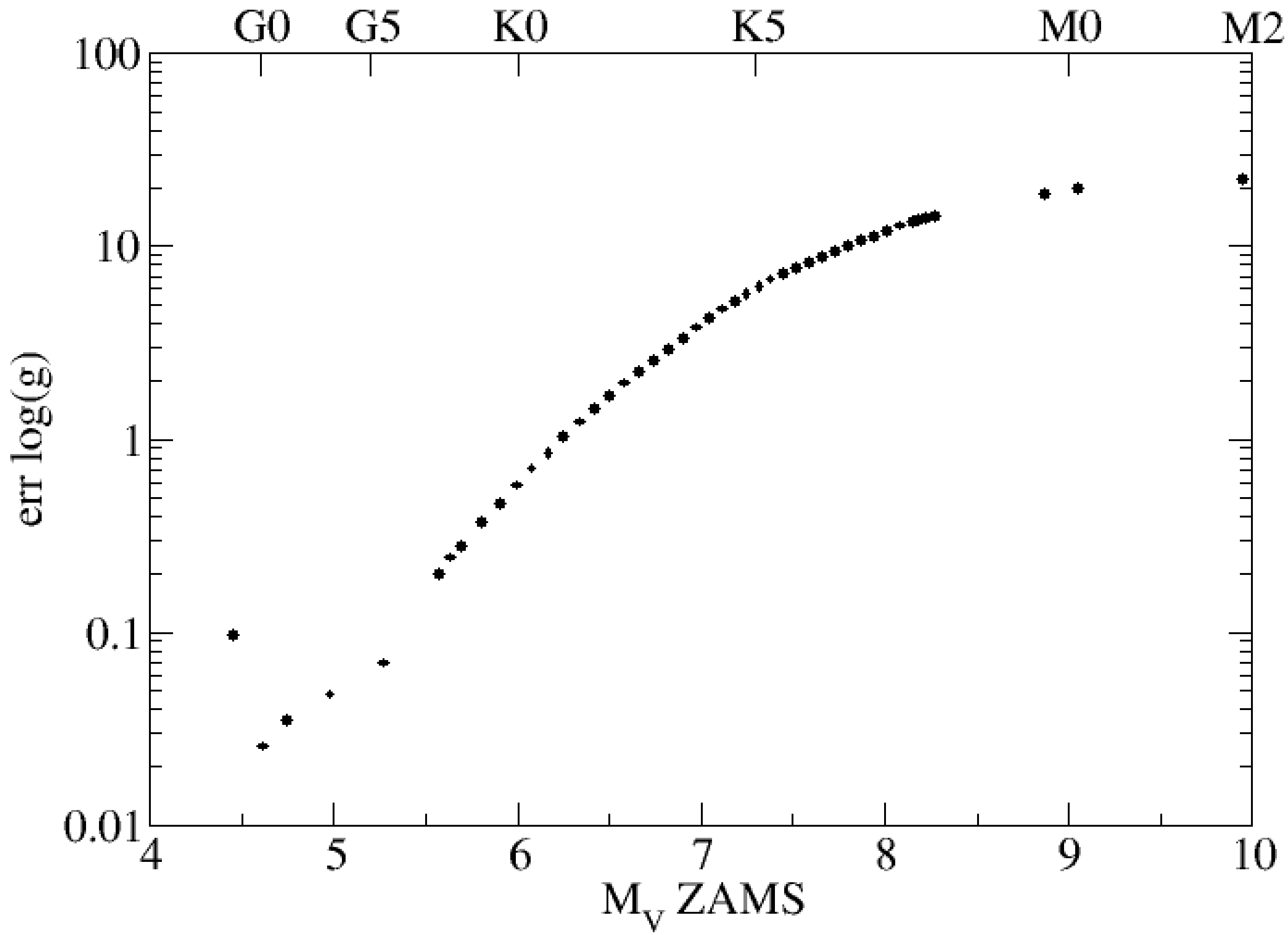


m1:

$\sigma_{\alpha,\varepsilon}$=0,
σ_{inst}=17.1mmag
σ_{std}=19.6mmag
σ_{red}=5.6mmag

Sample data from Olsen, A&AS 57, 443

log(g)



c1:

$\sigma_{\alpha,\varepsilon}$=0,

σ_{inst}=21.7mmag

σ_{std}=39.2mmag

σ_{red}=3.8mmag

Sample data from Olsen, A&AS 57, 443

Conclusions

- Extremely ambitious task.
- Success depends on good filter transformation.
- Are there enough standards (in the field)?
- log(g) at best to distinguish dwarfs and giants.
- Sacrifice filters/fields?
- Team up with other telescopes (Super-WASP, bad pixel sampling, VST only ugriz, but Hα)