



Polar spots revisited with

= el TIGRE =

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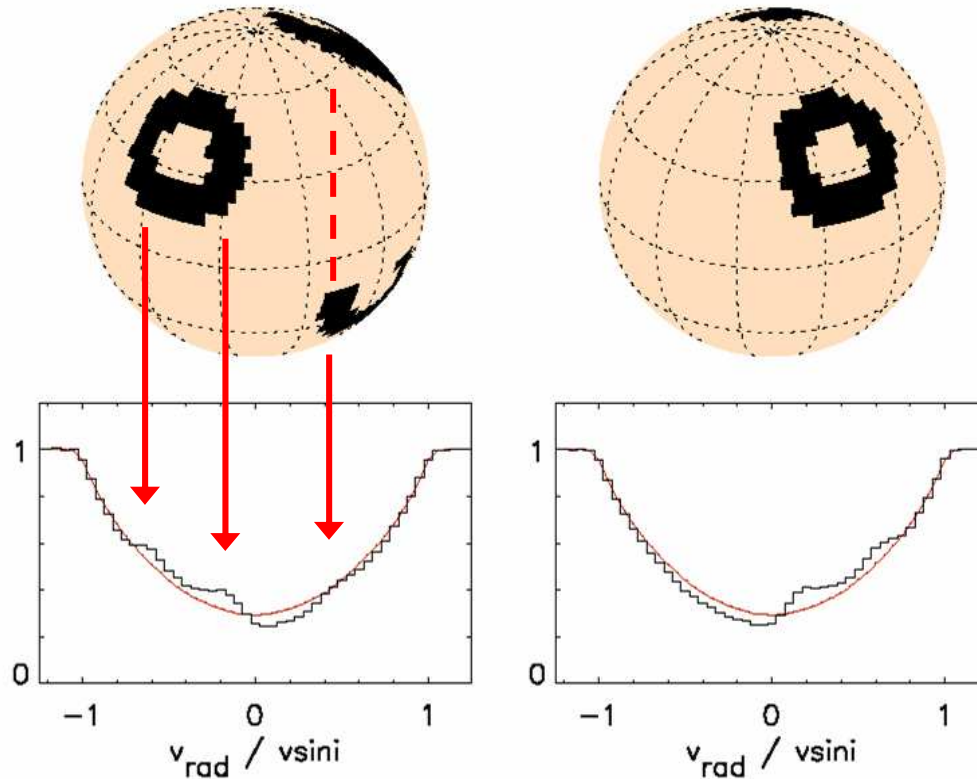
Guanajuato -- December 2015



Outline



- Doppler imaging and polar spots
- Chromospheric polar spots
as seen in photometry and spectroscopy
- Low-noise spectroscopy using HEROS



Surface resolution:

$$\Delta\varphi \approx \frac{180^\circ}{\pi} \cdot \frac{c}{R \cdot v \sin i}$$

$$\Delta\varphi \approx 360^\circ \cdot \frac{t_{\text{exposure}}}{P_{\text{rot}}}$$

For TIGRE:

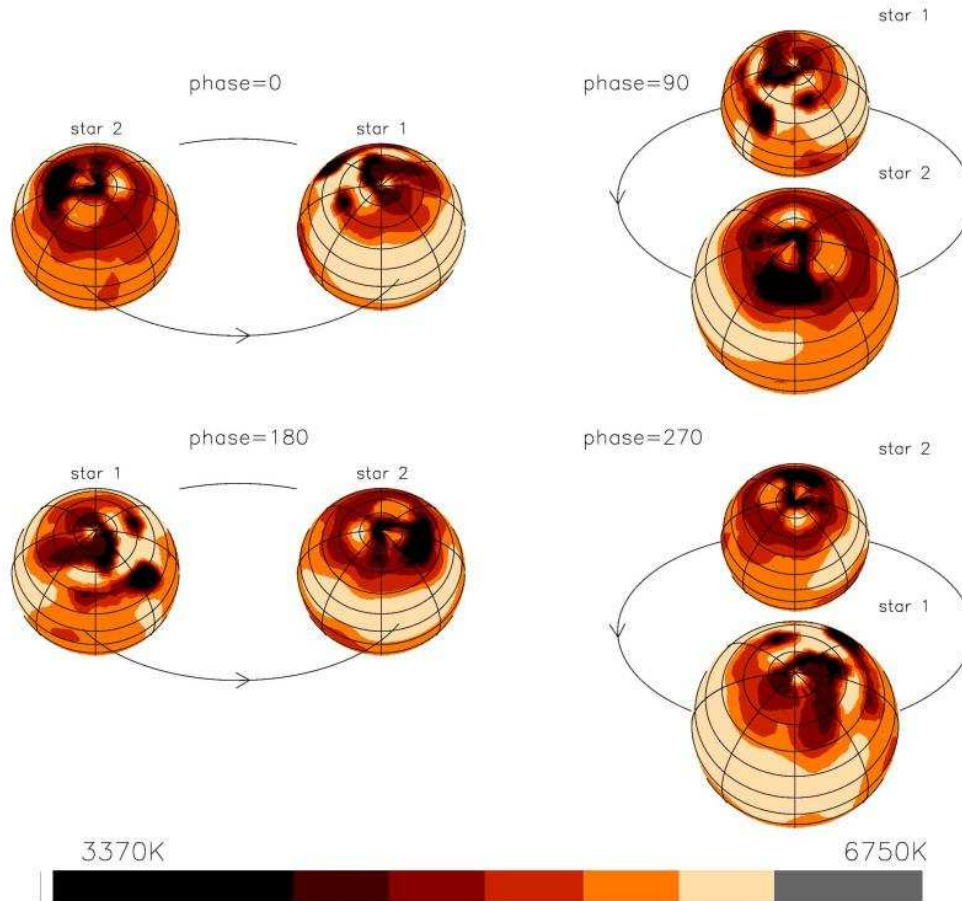
($R = 20\,000$, $t_{\text{exp}} = 1800\text{s}$)

$$\Delta\varphi \approx \frac{86^\circ}{v \sin i [10 \text{ km/s}]}$$

$$\Delta\varphi \approx \frac{7.5^\circ}{P_{\text{rot}} [\text{days}]}$$

Deutsch 1958, Falk & Wehlau 1974, Goncharski et al. 1982
 Vogt & Penrod 1983, Rice, Wehlau & Khoklova 1989
Donati, Semel & Praderie 1989; Piskunov & Kochukhov 1992
 Kürster, Schmitt & Cutispoto 1994; Wolter & Schmitt 2005

Doppler Imaging: State-of-the-art temperature mapping



σ^2 CrB

(Rice & Strassmeier 2003, A&A 399)

T_{eff}

3200 K
M4V

V 374 Peg
(Morin et al. 2008)

6150 K
F8V/G0V

AE Phe A/B
(Maceroni et al. 1994)

$v \sin i$

9 km/s

BP Tau

(Donati et al. 2008)

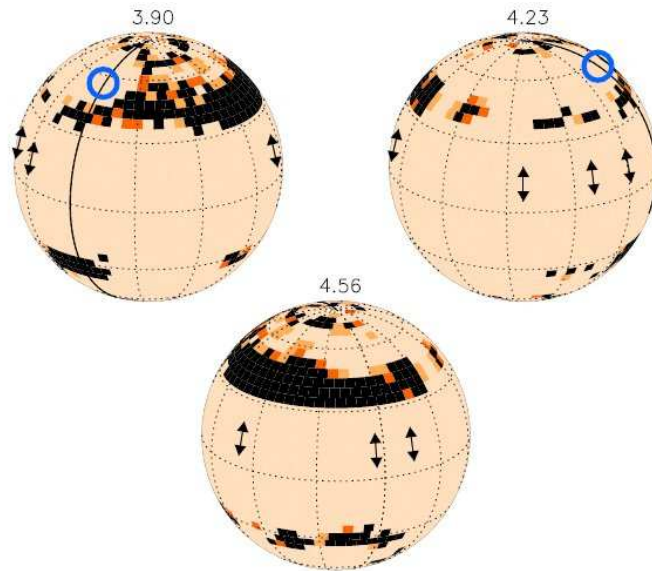
238 km/s

VXR45A

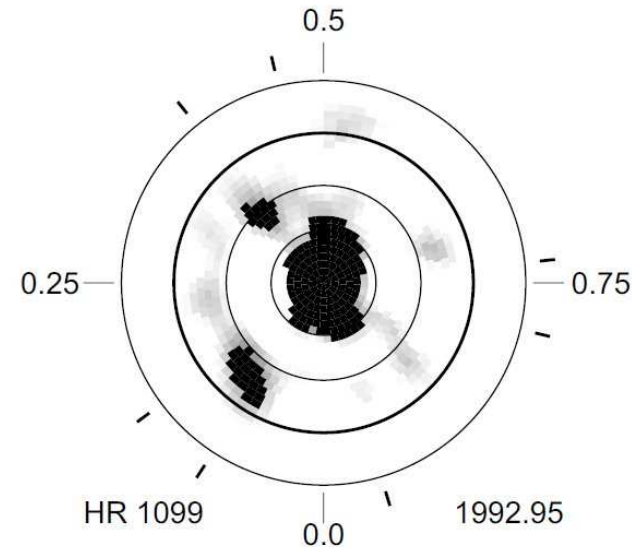
(Marsden et al. 2004)

(Strassmeier 2009, A&ARv 17)

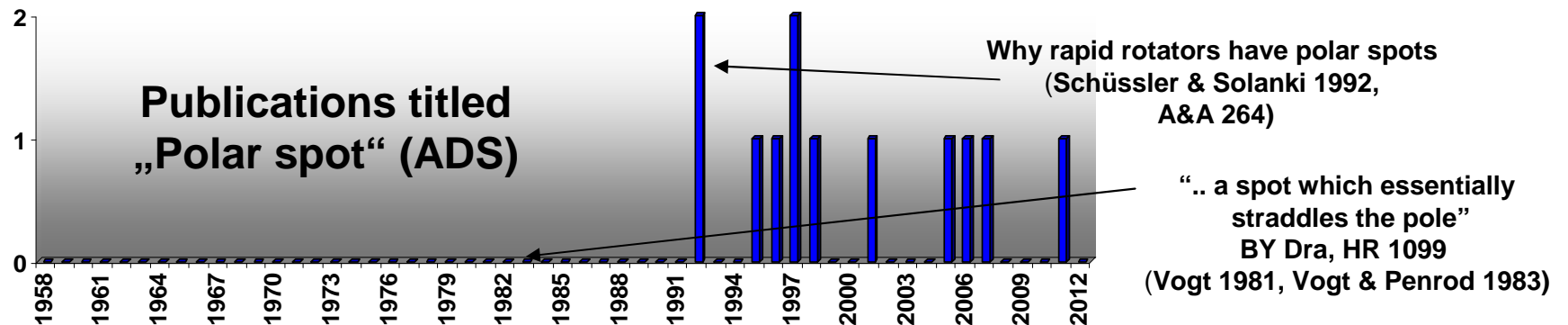
Doppler Imaging – Polar spots



BO Mic (Wolter et al. 2008, A&A 520)

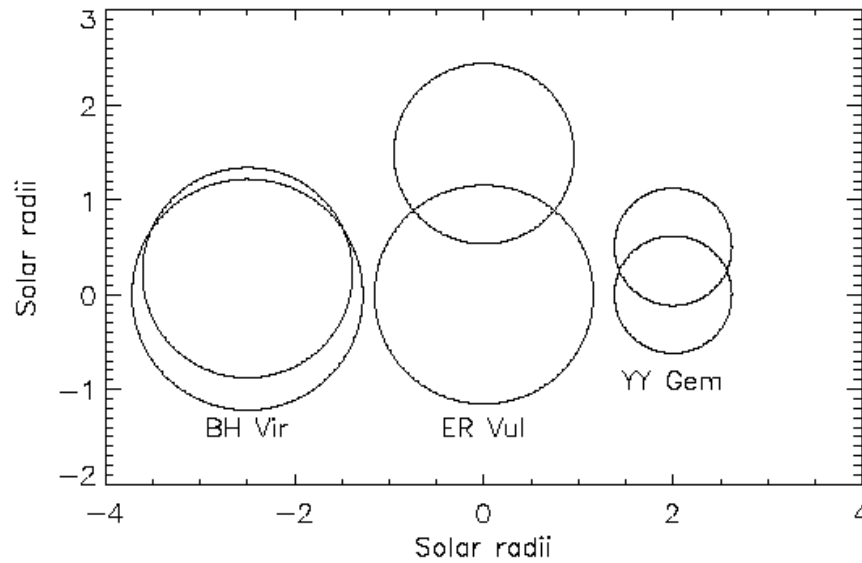


HR 1099 1981-92
(Vogt, Hatzes et al. 1999, ApJS 121)



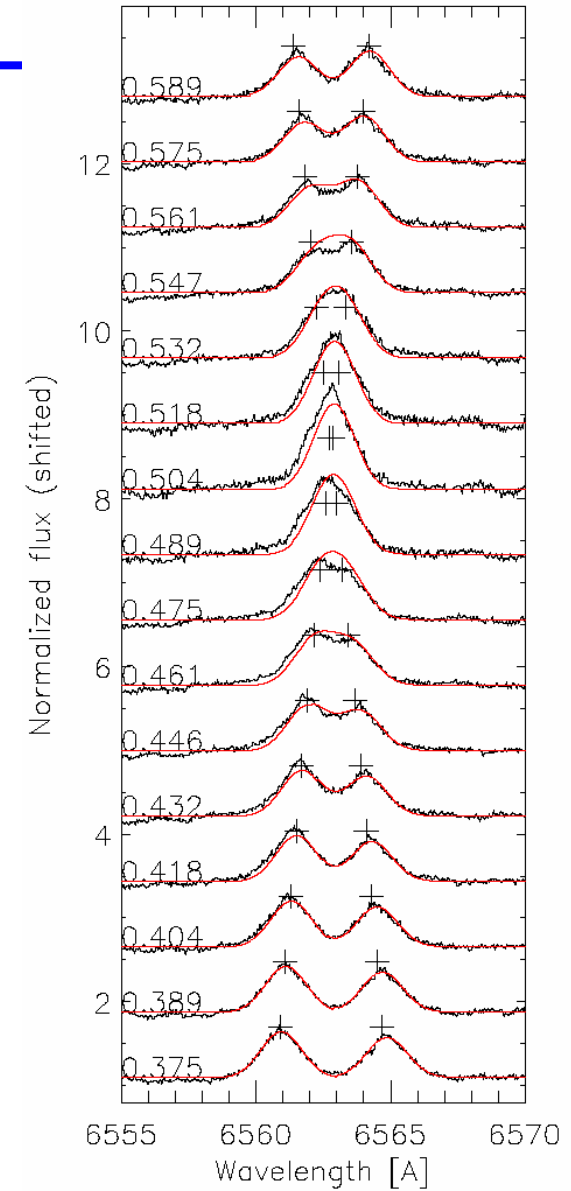


Chromospheric polar spots: eclipse mapping



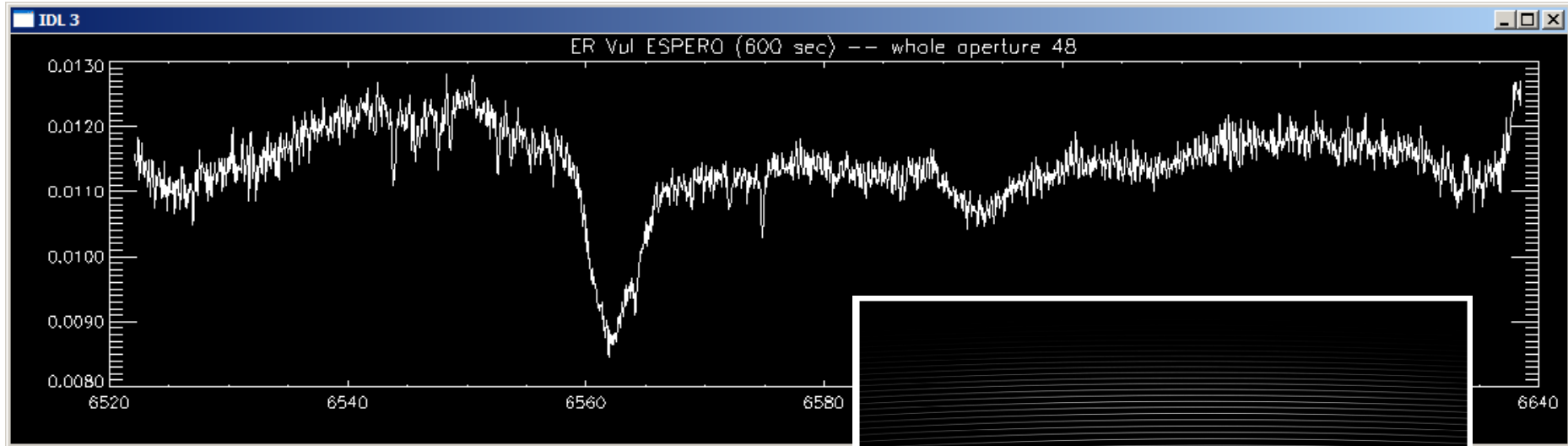
CAHA CAFE observations (2014, 2015)

XMM-Newton ? (2016 ?)





ER Vul – as seen through ESPERO

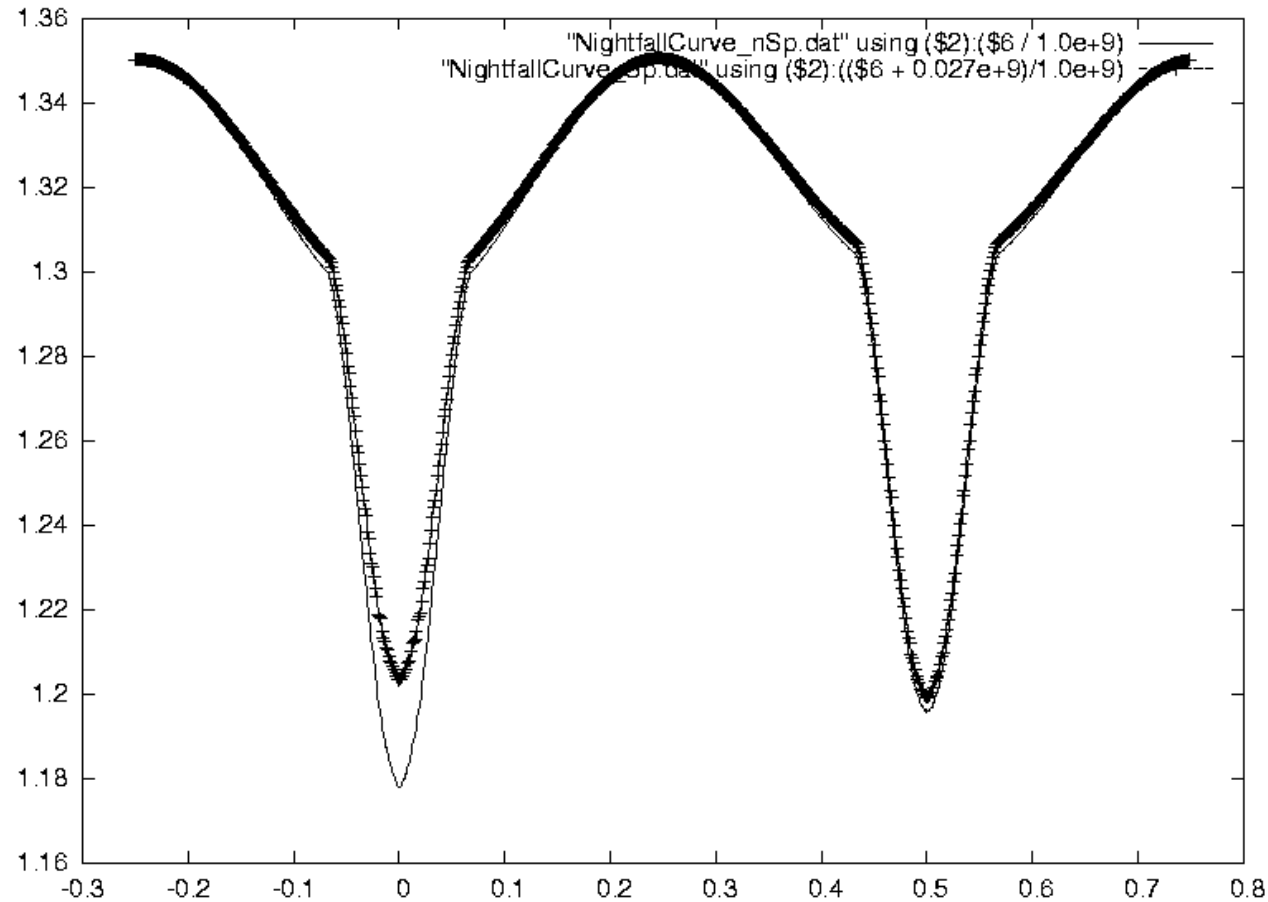


ESPERO (Rozhen, Oct. 2015)

A. Borisova



Longterm evolution of polar spots – using photometry !



Rozhen BVR photometry (N. Petrov)
Nightfall modeling (R. Wichmann)



Low-noise spectroscopy with TIGRE/HEROS



- The telescope PSF

- Echelle order shifting

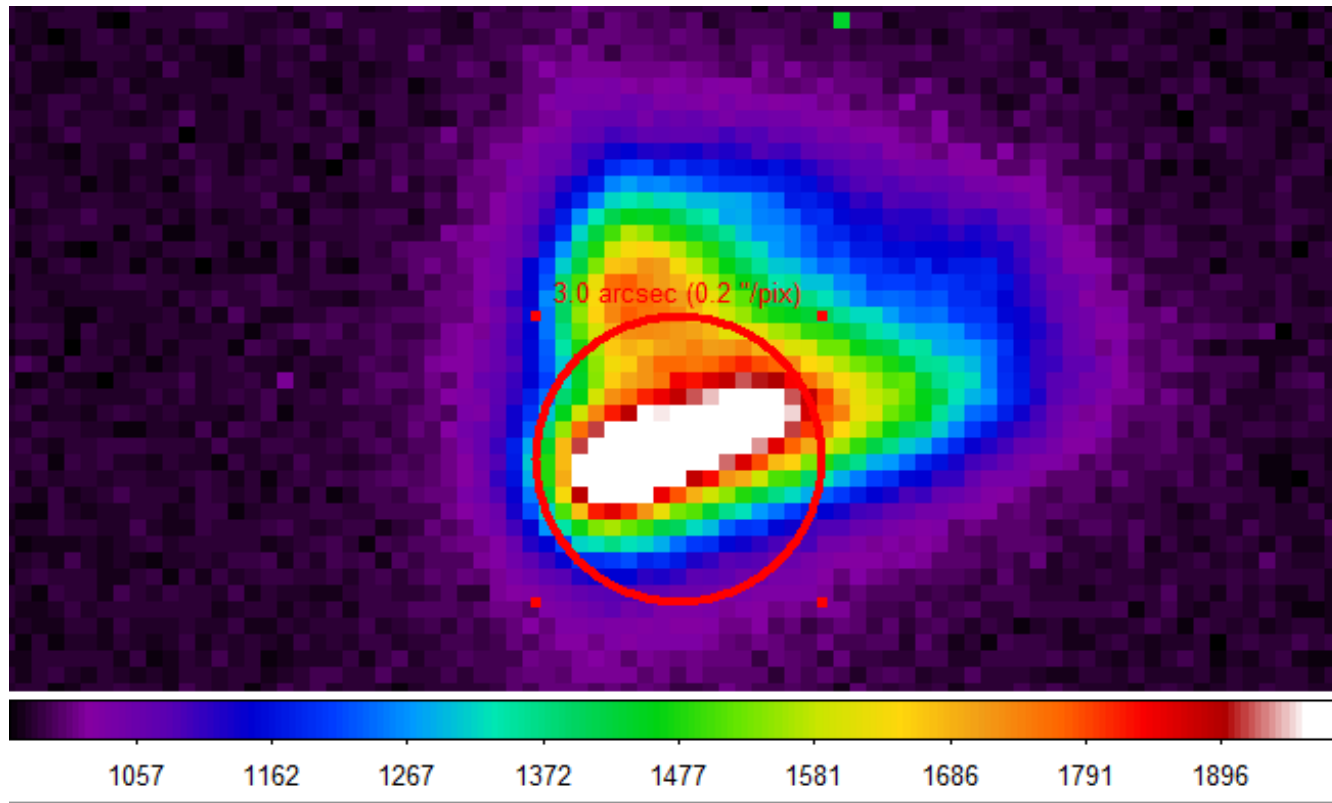


- Pipeline issues



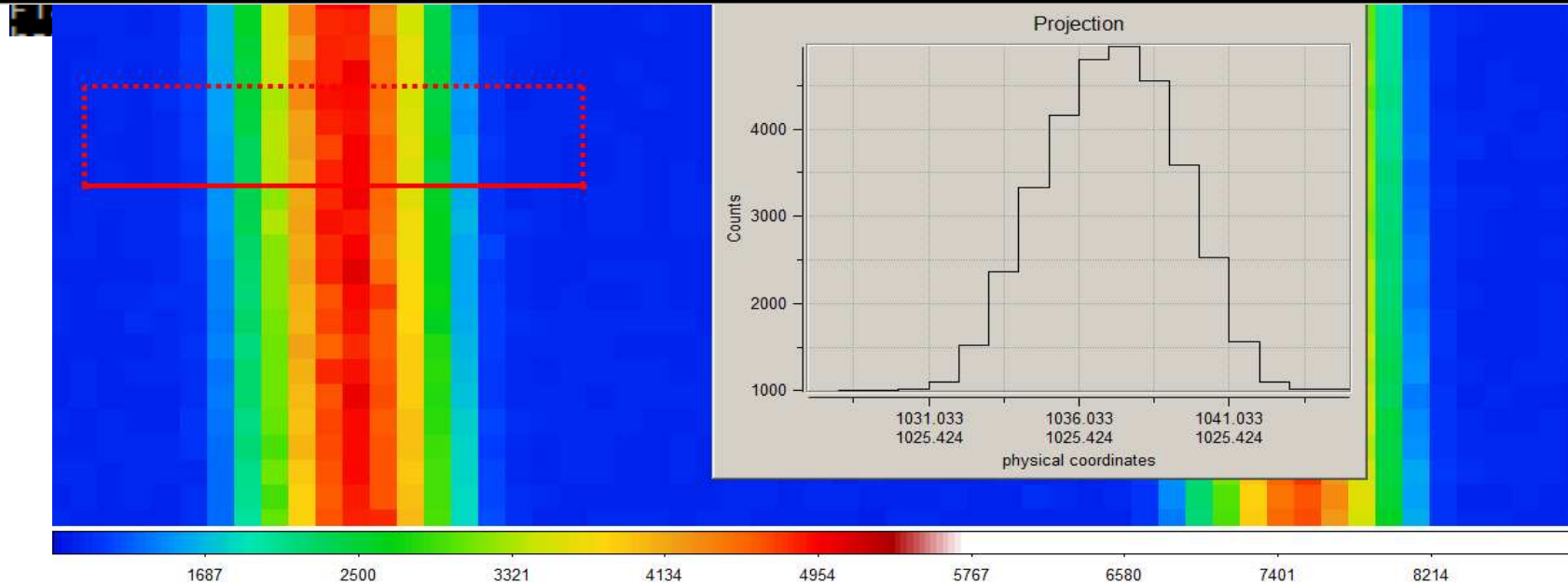
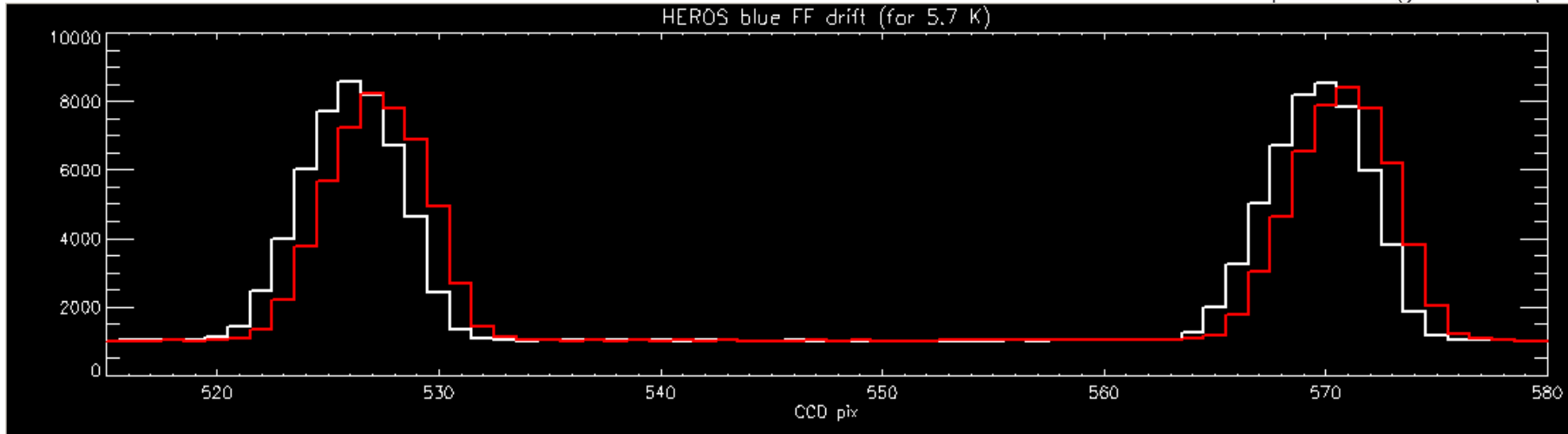


The tiger is hurt: our **current PSF**



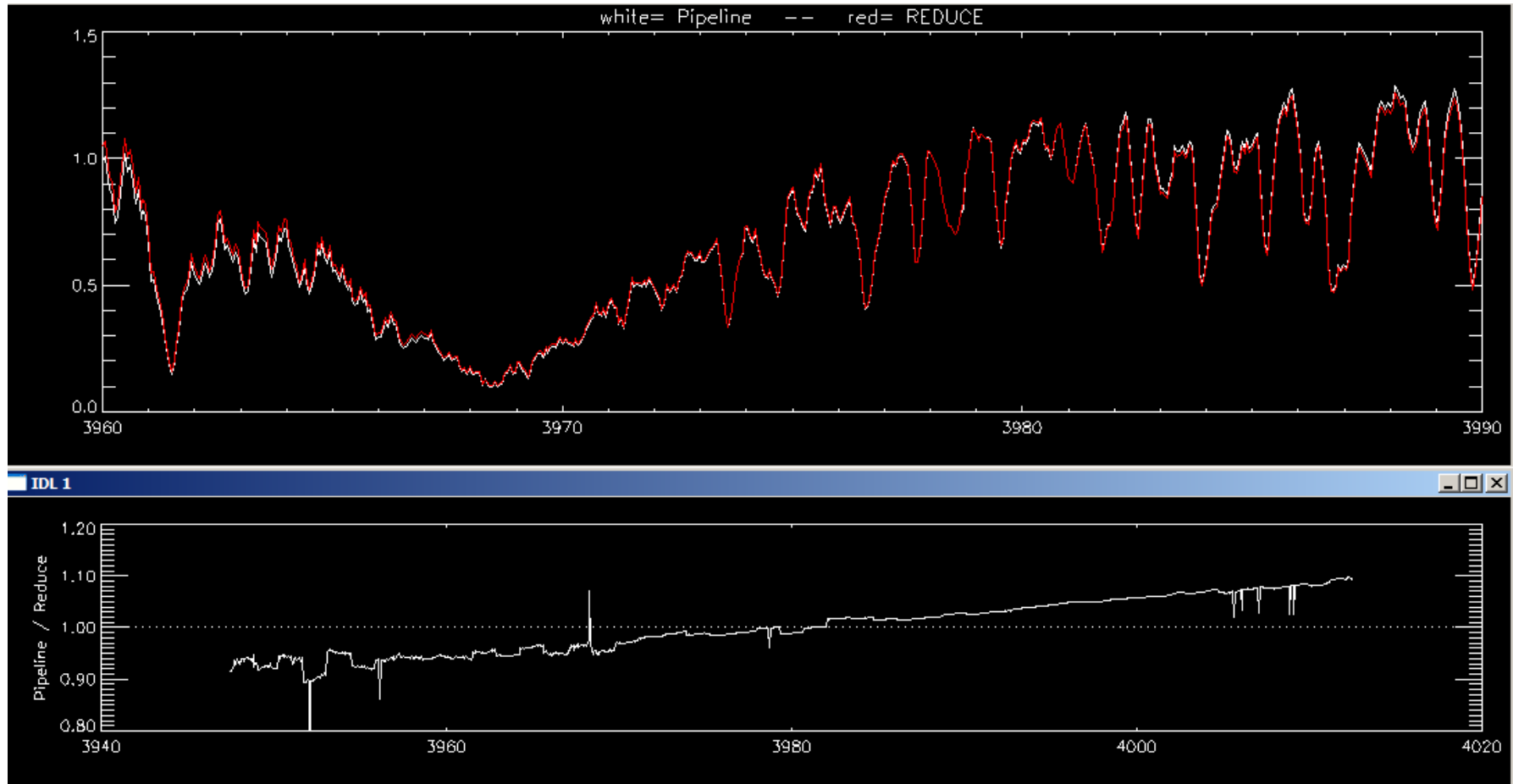


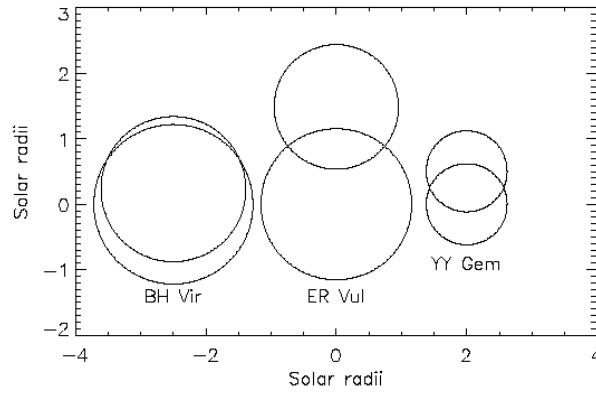
Temperature drifting causes order shifting



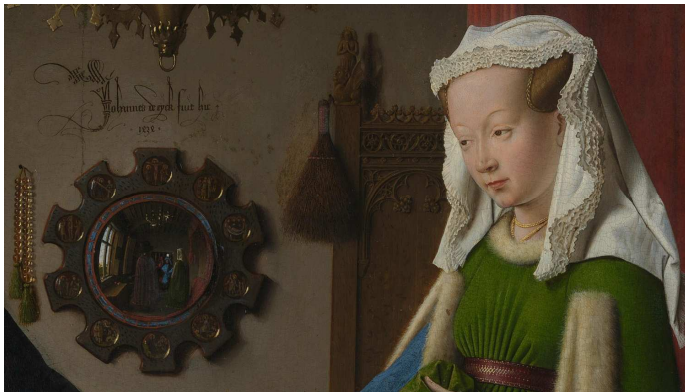
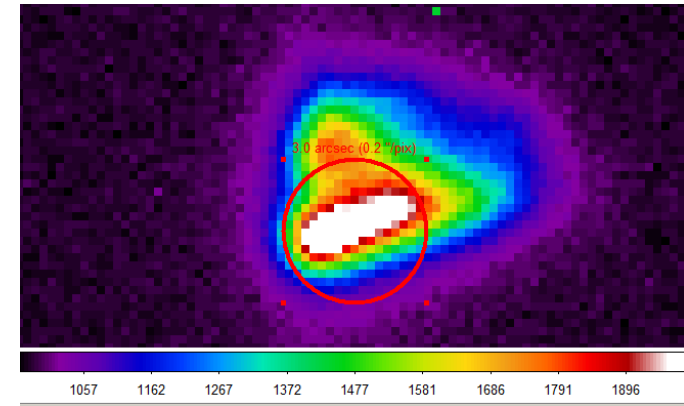
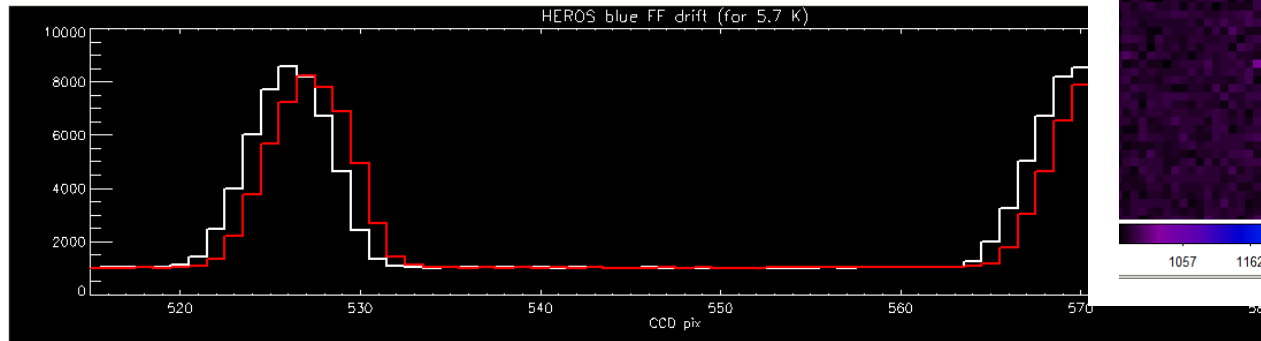


Comparing the **HEROS pipeline** and **REDUCE** (feat. our Moon)

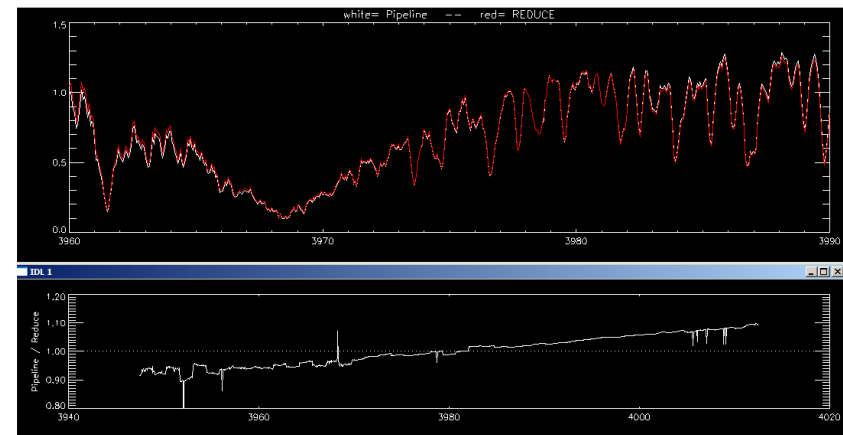




Summary



(Jan van Eyck 1434)

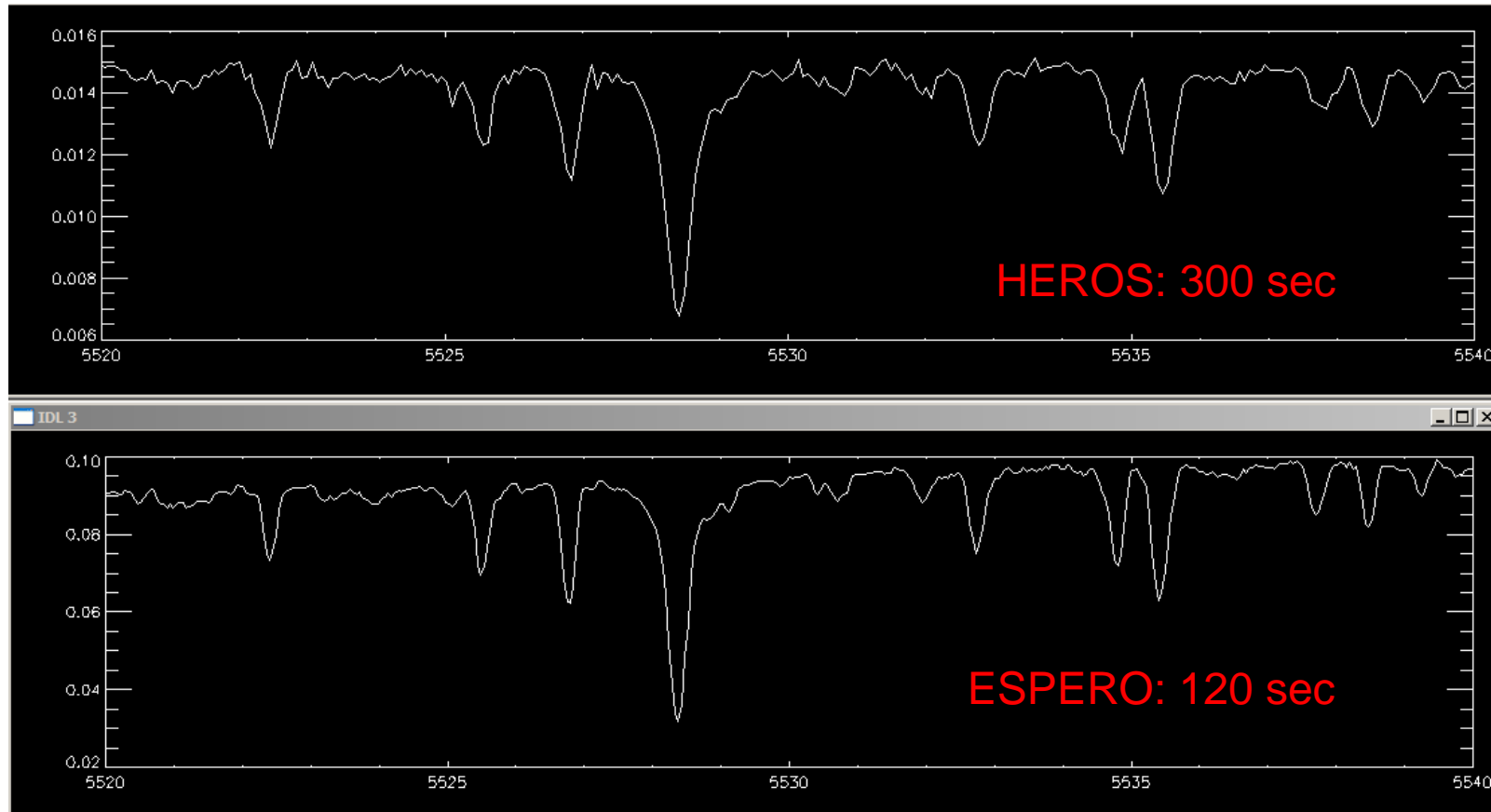




Appendix



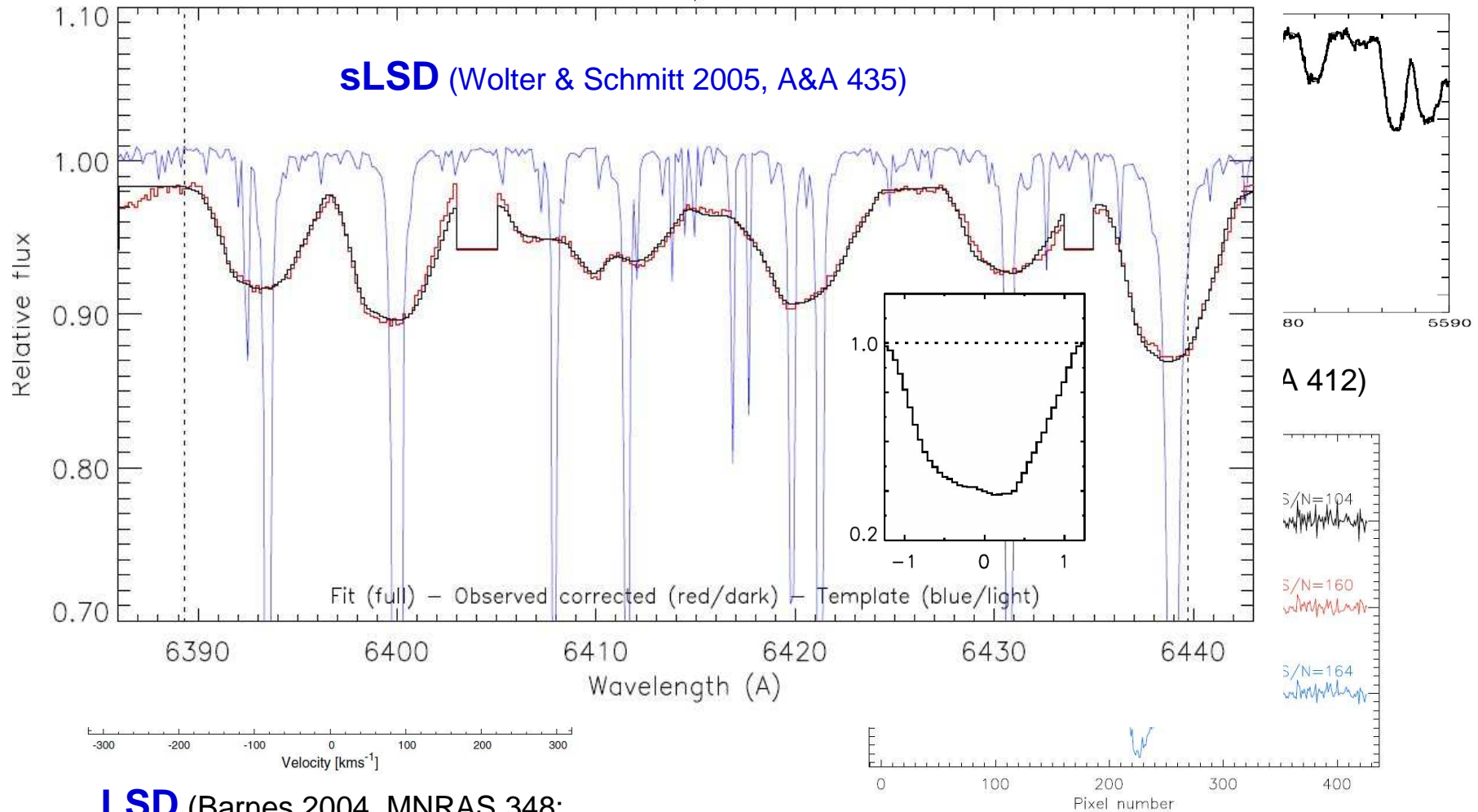
Comparing HEROS and ESPERO (feat. out Moon)





Line profile deconvolution – LSD, pLSD, sLSD, iLSD, ...

„Least-squares-deconvolution“

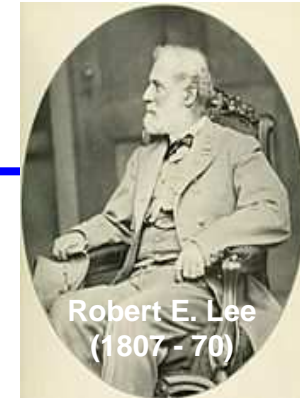
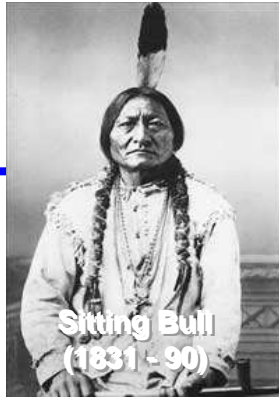


LSD (Barnes 2004, MNRAS 348;
Donati et. al 1997, MNRAS 291;
Rucinski et al . 1992, AJ 104)

iLSD (Khochukhov et al. 2010, A&A 524)



Empty



= HRT =

vs.

STELLA



HRT vs. STELLA – The spectrographs

HRT - HEROS	STELLA - SES
3500 - 5600 A	3880 – 7200 A
5800 – 8800 A	(- 8820 A)
R = 20000 (15 km/s)	R = 55000 (5.5 km/s)
21°N 2300m	28°N 2400m
V = 9 mag 1800 sec → S/N 100	

Weber, Granzer, Strassmeier & Woche 2008
SPIE 7019

