Specificities of the RVS observations, processing and performances

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on behalf of CU6

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Publication of the Gaia final catalogue

What to do with the RVS data?

- Datamine the catalogue: Vr, v sin i, Teff, logg, [Fe/H], [X/Fe]
  - Observational strategy
  - Sources of noise, precisions and accuracies

- Re-analyse the spectra
  - What will be available in the catalogue?
  - Specificities of the instrument

Datamine the catalogue

Radial velocities

End of mission specifications (40 transits / no contaminant)

	V	Vr km/s
B1V	7	1
B1V	12	15
G2V	13	1
G2V	16.5	15
K1 III MP	13.5	1
K1 III MP	**17**	**15**

Signal to noise ratio G2V star

V	S/N / transit	S/N / mission
6	150	1060
10	20	160
12	8	60
14	2	20
16		4

→ K1III V=17.5 15 km/s

Scanning law and number of epochs of observation (transits)

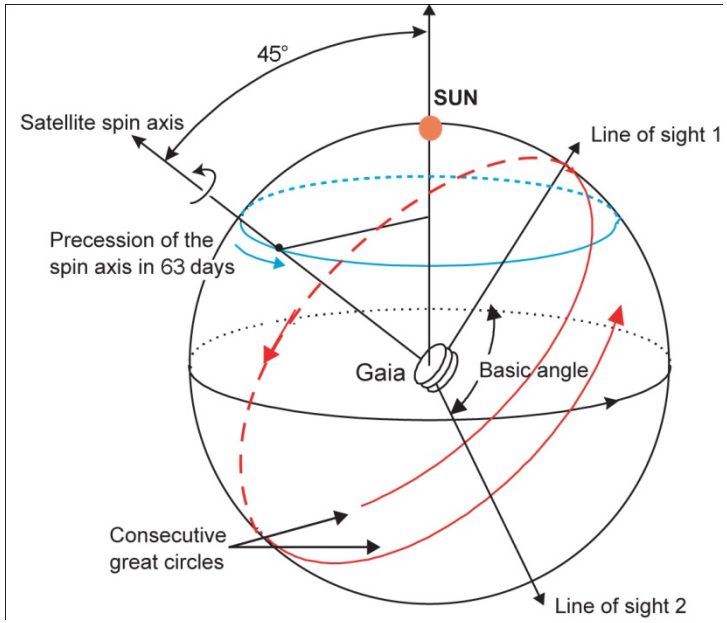


Image courtesy of ESA

K1III star: 15 km/s
(assuming 20% dead-time)

	Nb. transit	V
➢ 5% minimum	< 23	17.2
➢ Average	40	17.5
➢ 5% maximum	> 62	17.75

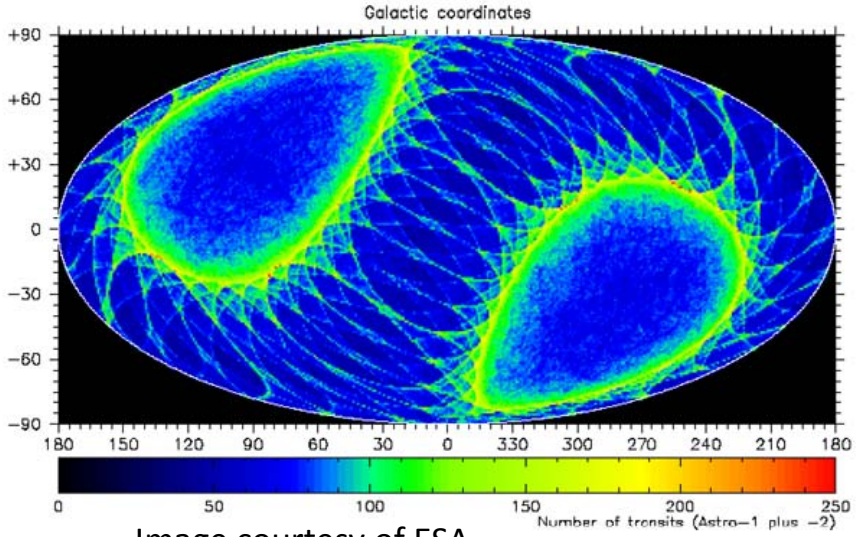
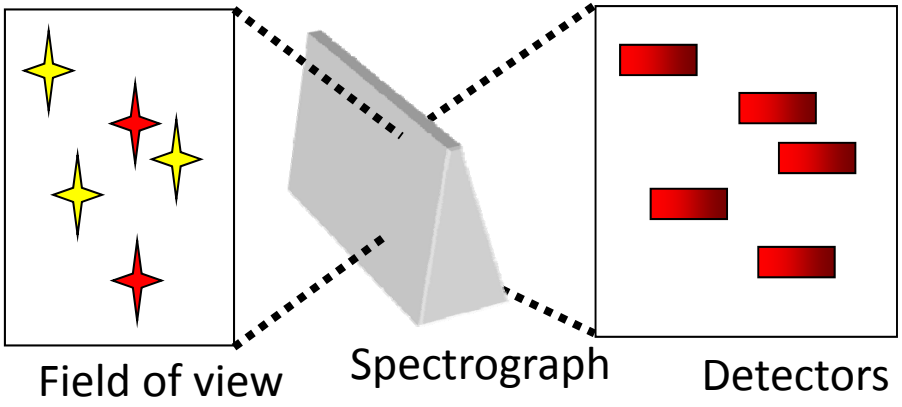
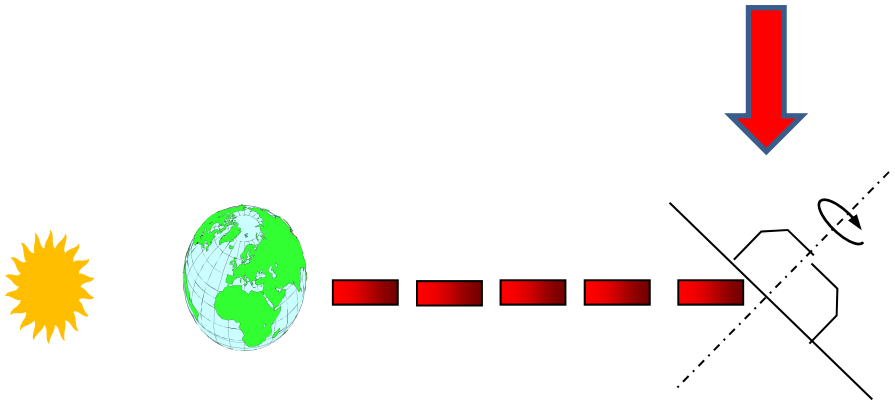


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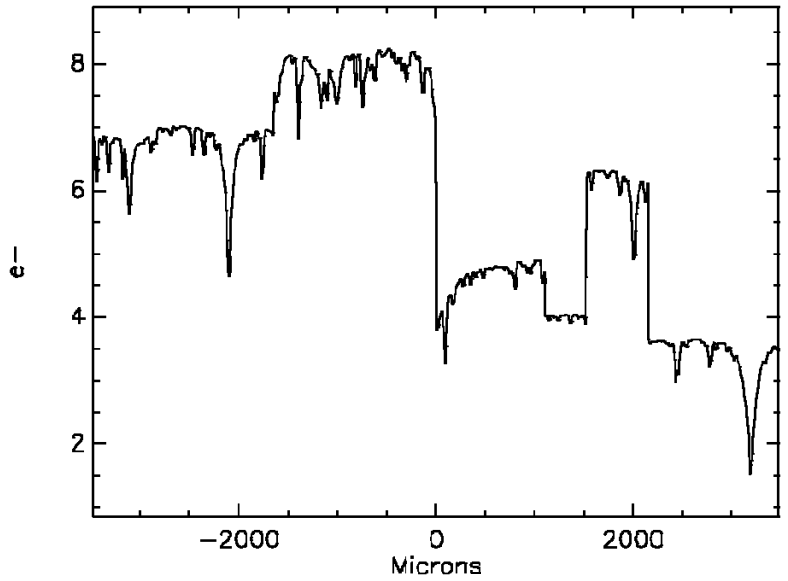
- Moderate impact on Vr
- Stronger impact on variability studies

Integral field spectrograph and complex background





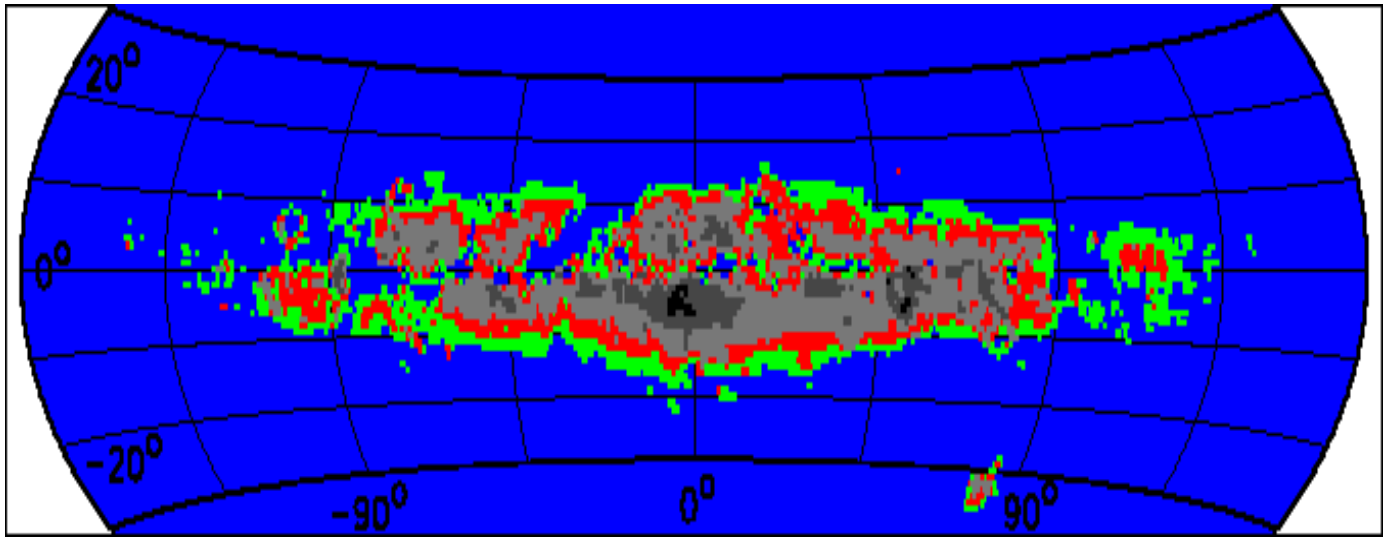
The background is made of the sum of the neighbouring / overlapping sources



Radial velocities in the Galactic plane

“Limiting” magnitude: 15 km/s

Nb star / sq. deg. (G < 20)	ΔV
10 000	0.0
100 000	-0.1
500 000	-0.4
1 000 000	-0.65
3 000 000	-1.1



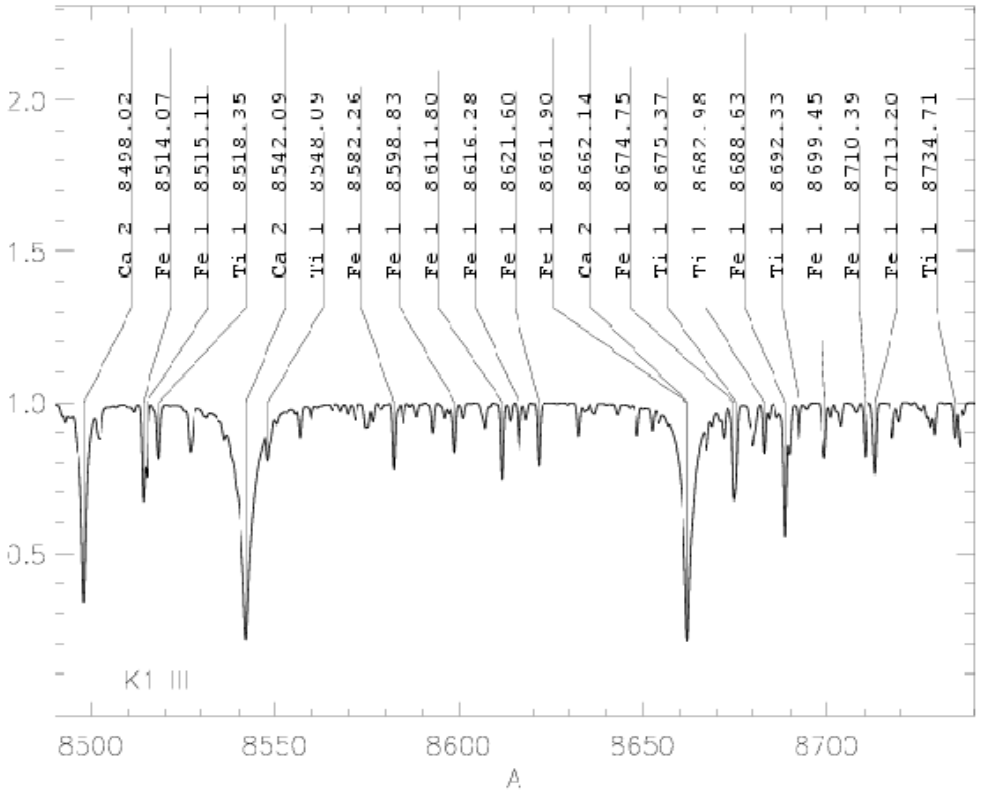
Atmospheric parameters: astrometry, spectro-photometry and RVS

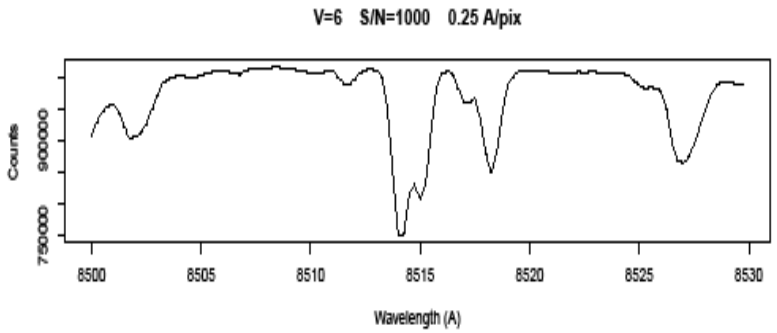
- RVS spectra will contribute to the determination of the atmospheric parameters down to **V~13-14**.

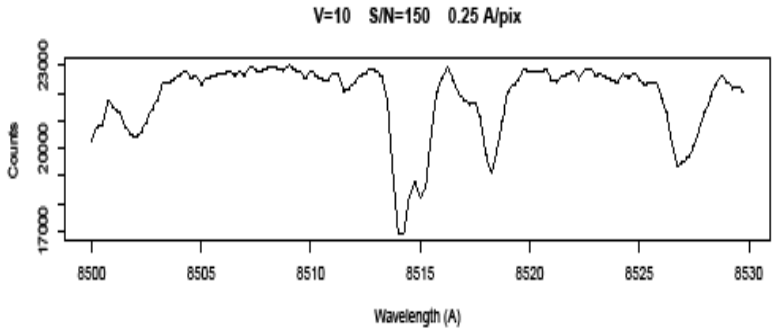
- Gaia via astro + BP/RP will provide atmospheric parameters down to V=18-20
  http://www.rssd.esa.int/index.php?project=GAIA&page=Science_Performance
- Target performances
  - V=18 σ[Fe/H] = 0.1 dex
  - V=20 σ[Fe/H] = 0.3 dex

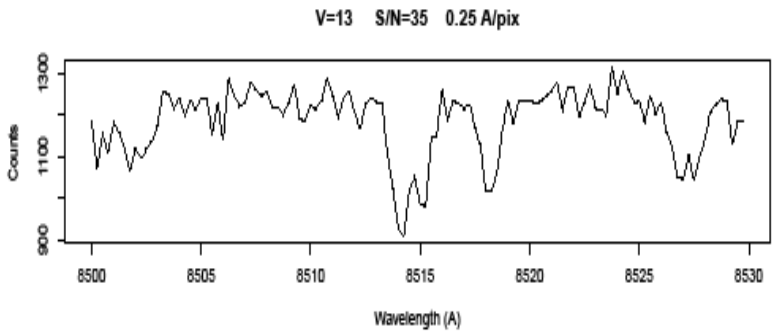
- Bailer-Jones, 2010, MNRAS, 403, 96 (Using Bp/Rp)
  - V=15 σ[Fe/H] = 0.1 to 0.2 dex (TGM case Av=0)
  - V=18.5 σ[Fe/H] = 0.4 to 0.6 dex (TGM case Av=0)

Individual abundances









- Individual abundances down to **V~12-13**, e.g.
  - Mg I 8718, 8736
  - Ti I 8518, 8680
  - Si I 8556, 8648, 8742
  - N I 8667, 8629, 8683

Interstellar reddening

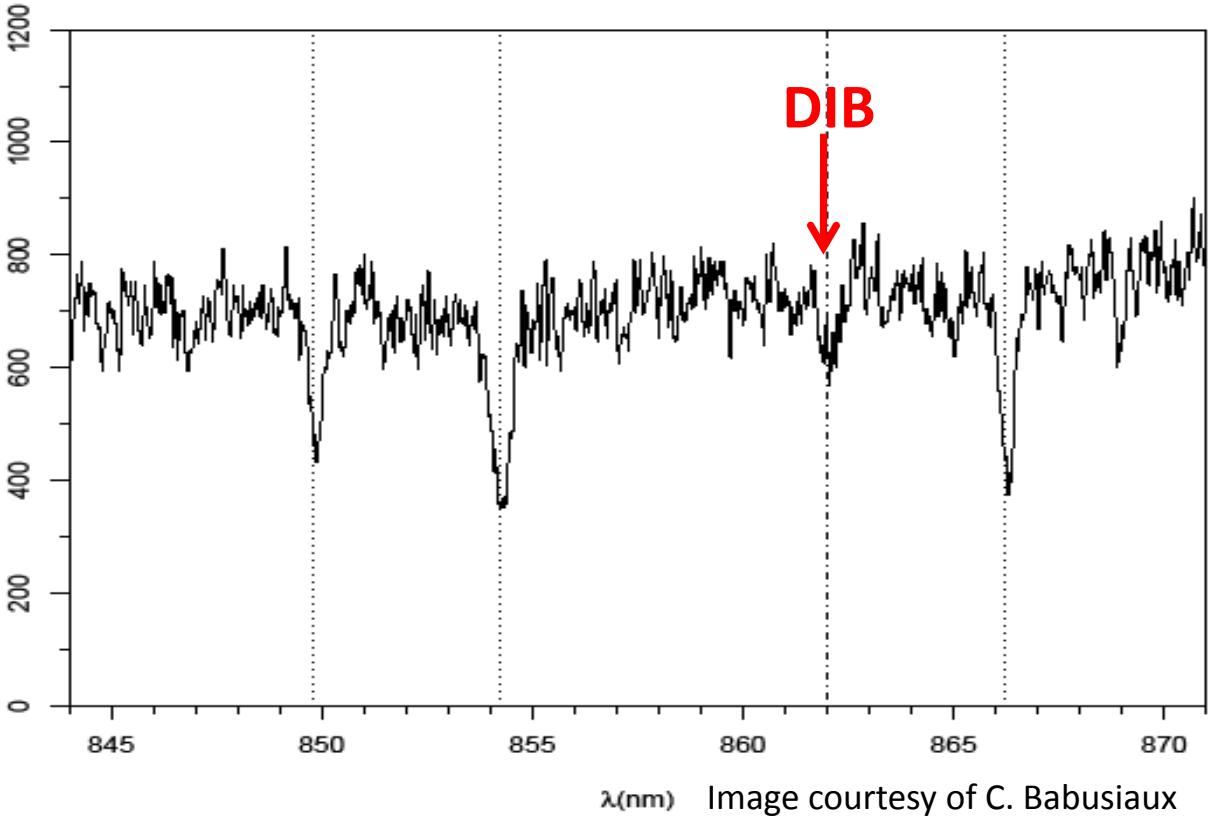


Image courtesy of C. Babusiaux

RVS observations will contributes to reddening estimation down to **V~13-14**

BP/RP will provide

Information relying on fainter (more remote) targets

Diffuse Interstellar Band(DIB): 8620 A

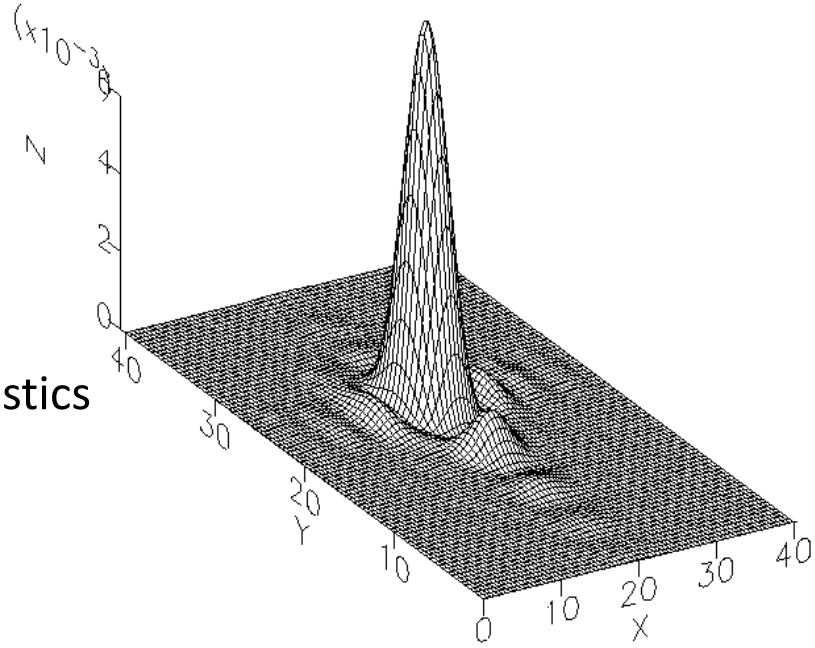
Correlates with E(B-V): **E(B-V) = 2.72 × EW (Ang)**

Munari, Tomasella, Fiorucci et al., 2008, A&A, 488, 969

Re-analyse the spectra

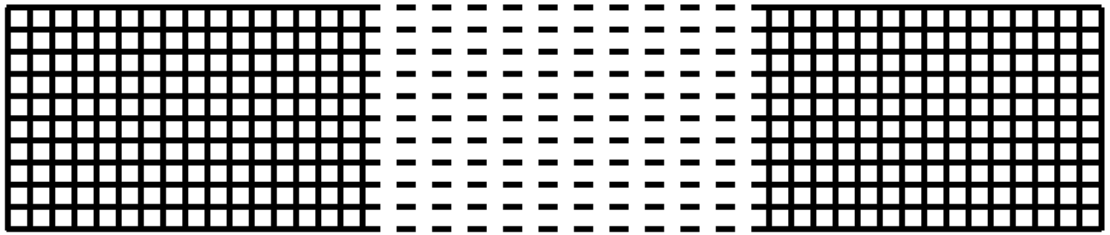
Available materials

- Stellar parameters
  - Teff, log g, [Fe/H], [X/Fe], Vr, v sin i, variability, multiplicity, etc...
- Calibrated spectra
  - clean, combined, re-sampled (over-sampled)
- Raw spectra (per CCD)
- Background
  - or tools to derive the background
- Calibrations (per CCD, per FoV)
  - PSFs
  - Instrument efficiency and CCD characteristics
  - Dispersion law
  - Etc...



Originality: 3 samplings

- **3 Sampling schemes**
  - ✓ $5 \leq G_RVS \leq 7$
  - ✓ Calibration faint stars
  - ✓ 1260 × 10 samples (1 × 1)
  - ✓ 0.26 A/sample



  - ✓ $7 \leq G_RVS \leq 10$
  - ✓ 1260 × 1 samples (1 × 10)
  - ✓ 0.26 A/sample



  - ✓ $10 \leq G_RVS \leq 17$
  - ✓ 420 × 1 samples (3 × 10)
  - ✓ 0.78 A/sample



  - ✓ Number of available windows allows to observe a maximum of 36 000 stars per square degree (i.e. 36 000 brightest stars per square degree)
  - ✓ Baade's window **Vlim ~ 13-14**

Another originality: window conflicts



- Part of a spectrum could be missing.
- Spectra could extend over 2 windows
  - CU6 processing: de-blends the spectra.
- Mixed sampling mode: HR “wins” over LR.
  - Due to telemetry constraints the faint spectra are “software” binned
  - Increased RoN

More originality: Radiation damage

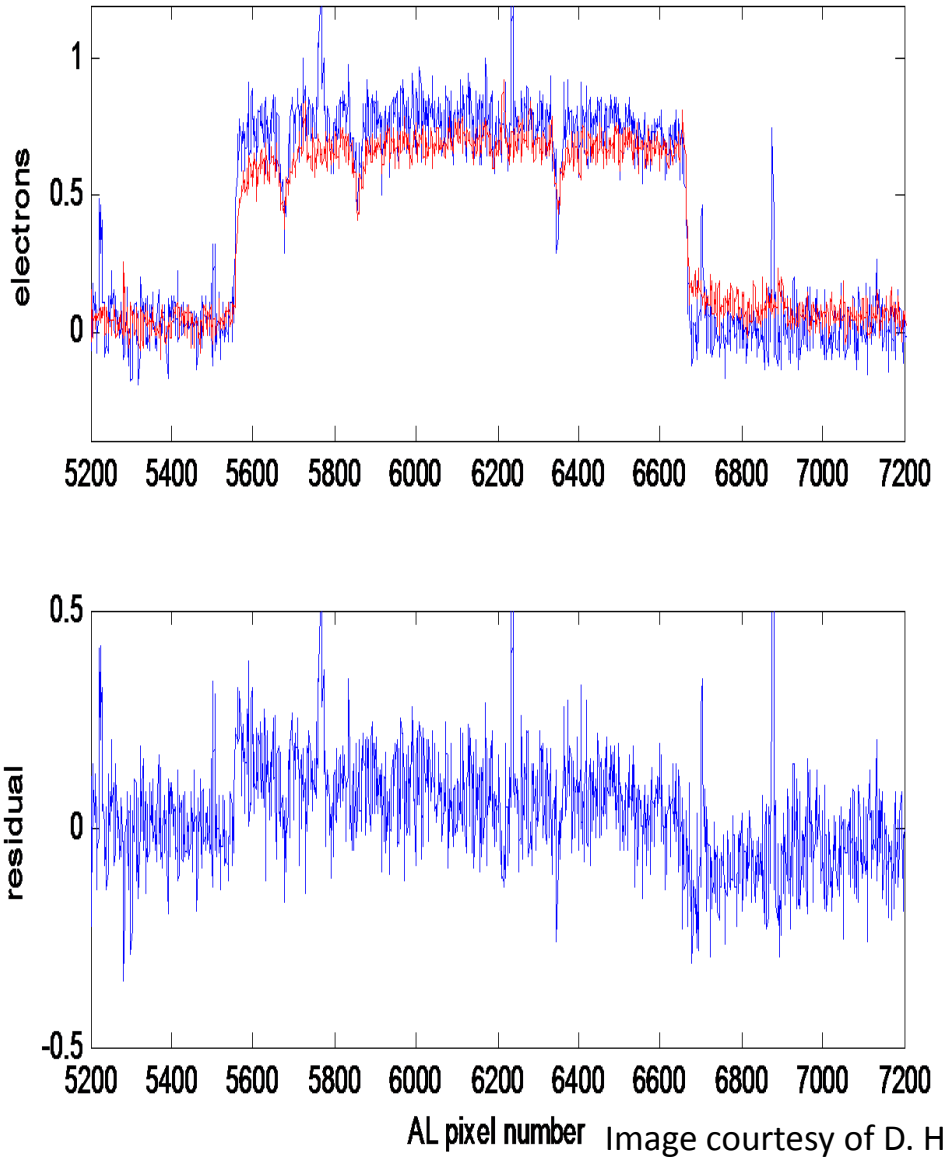


Image courtesy of D. Hall

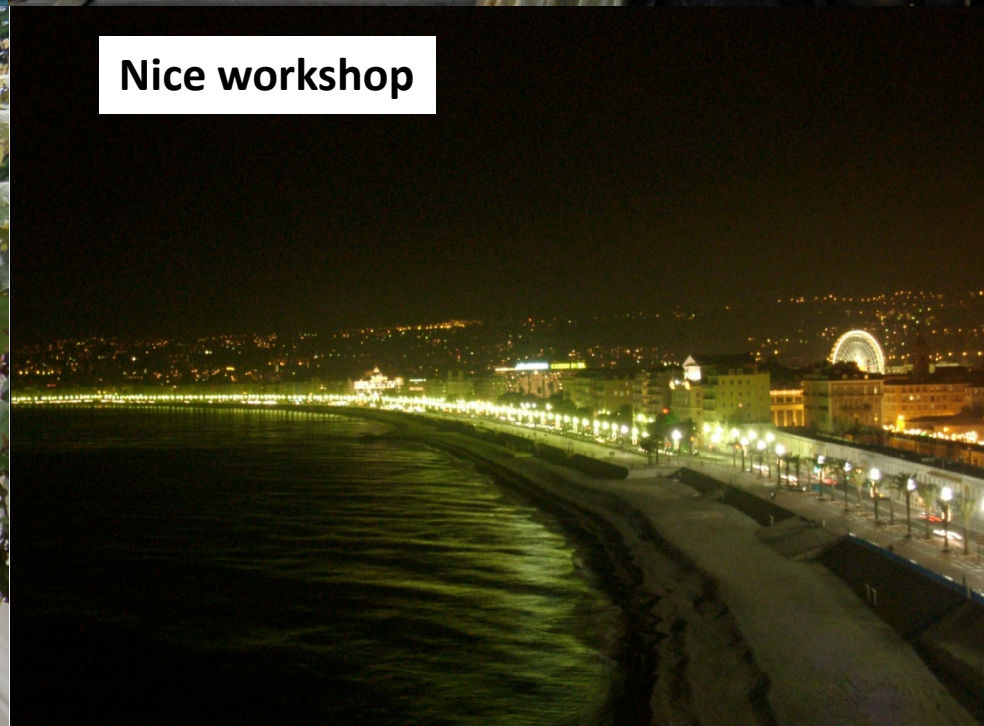
- Cosmics → traps in the CCDs
- Charge trapping / de-trapping
  - Overall charge loss
  - Line profiles distorted
  - Lines partially filled
- Spectroscopic processing
  - Raw spectra not corrected for this effect
  - Effect modelled and applied to the templates
  - Tools available via the "catalogue"

Why waiting for 2015 to see RVS data?
Join CU6 ☺


Ljubljana workshop


Asiago workshop


MSSL workshop


Nice workshop