Results from RSS Commissioning tasks

Anja Schröder,
Steve Crawford, Alexei Kniazev

Overview

RSS Science Commissioning

This is a development version of the RSS-VIS commissioning plan. For questions on the plan contact Eric Hooper (ehooper@astro.wisc.edu) and Ken Nordsieck (khn@astro.wisc.edu). Details of some of the instrument configurations still need to be entered and/or tweaked, and some tasks need to be added.

Each task listed below has an identifying string which starts with IMG (imaging without the use of any gratings but may employ a mask), LS (longslit), MOS (multiobject spectroscopy), or FP (Fabry-Perot). Closely related observations in different modes are grouped together. Several end-to-end tests of measurements of astronomically important parameters (e.g., velocity gradients, redshifts) are denoted by the string "_astro_" in the task identifier.

The priority assigned to the "_astro_" tasks is "low," not because they are of scientifically low priority (quite the opposite in fact), but because the initial failure of any single one of them would not necessarily jeopardize the entire corresponding instrument mode and because these are bridge observations between commissioning and routine science operation.

The meaning of the 'traffic lights' are: ● = done; ● = in progress; ● = not done yet.

Task	Priority	Status	People	Data	Analysis	Results	Comment
1 #IMG_bias	very high	●	Matt D., Cris H., Ken N.	●	●	●	
2 #IMG_dark	very high	●	Steve	●	●	●	
3 #IMG_read_noise	very high	●	Steve	●	●	●	
4 #IMG_gain	very high	●	Steve	●	●	●	
5 #IMG_acq_img	very high	●		●	●	●	
6 #IMG_acq_ls	very high	●		●	●	●	
7 #IMG_acq_mos	very high	●		●	●	●	
8 #IMG_acq_fp	very high	●		●	●	●	
9 #IMG_mask_rep_ls	very high	●	Steve, Anja	●	●	●	jump seen in data, could use to repeat with longer sequence
10 #IMG_mask_rep_mos	very high	●	Petri	●	●	●	Repeat test for new holder
11 #IMG_iq	very high	●	Anja, Steve	●	●	●	Repeat to check stability
12 #LS_iq	very high	●					cf. LS_focus
13 #MOS_iq	very high	●					cf. MOS_focus
14 #FP_iq	very high	●	Nicola, Ken	●	●	●	check repeatability
15 #IMG_guide	very high	●	Petri, Alexei	●	●	●	
16 #IMG_distortion	very high	●	Steve	●	●	●	
17 #LS_focus	very high	●	Anja, Steve	●	●	●	
18 #MOS_focus	very high	●		●	●	●	see LS focus covers full FOV
19 #LS_tput	very high	●	Petri, Alexei	●	●	●	
20 #MOS_tput	very high	●	Petri	●	●	●	Further work required at low priority
21 #FP_tput	very high	●	Ted	●	●	●	Repeat to check stability
22 #FP_calib	very high	●	Ted, Encarni	●	●	●	Repeat to check stability

salt wiki -> Commissioning
-> RSS Science Commissioning

very high priority

high priority

medium priority

low priority

Overview

20 #MOS_tput	very high	🟢	Petri	🟢	🟢	🟢	Further work required at low priority
21 #FP_tput	very high	🟢	Ted	🟢	🟢	🟢	Repeat to check stability
22 #FP_calib	very high	🟢	Ted, Encarni	🟢	🟢	🟢	Repeat to check stability
23 #LS_calib	high	🟢	Steve, Anja	🟢	🟢	🟢	
24 #LS_uv	high	🟡	Alexei, Anja	🟢	🟡	🔴	
25 #MOS_uv	high	🟡	Steve, Anja	🟢	🟡	🔴	
26 #IMG_adc	high	🟡	Steve, Anja	🟡	🔴	🔴	
27 #LS_adc	high	🟡	Anja, Steve	🟢	🟢	🔴	
28 #LS_flat_field	high	🟡	Alexei	🟢	🟡	🔴	
29 #MOS_flat_field	high	🟡	Steve, Anja	🟢	🔴	🔴	
30 #FP_flat_field	high	🟡	Ted, Darragh	🟢	🟡	🔴	Preliminary results exist
31 #IMG_flat_field	low	🟢	Ted, Darragh	🟢	🟢	🟢	
32 #LS_wavelength	high	🟢	Alexei, Anja	🟢	🟢	🟢	
33 #MOS_wavelength	high	🟡	Steve, Anja	🟡	🔴	🔴	
34 #FP_wavelength	high	🟡	Ted, Encarni	🟢	🟢	🔴	
35 #LS_resolution	high	🟢	Petri	🟢	🟢	🟢	Analyze higher spectral resolution as well?
36 #MOS_resolution	high	🟡	Steve, Anja	🟢	🟡	🔴	
37 #FP_resolution	high	🟡	Ted	🟢	🟢	🟡	
38 #LS_stray_light	high	🟡	Anja, Steve	🟢	🔴	🔴	
39 #MOS_stray_light	high	🟡	Anja, Steve	🟢	🔴	🔴	
40 #FP_stray_light	high	🔴		🟡	🔴	🔴	
41 #IMG_stray_light	medium	🔴		🟡	🔴	🔴	
42 #IMG_psf	medium	🟡					
43 #LS_psf	medium	🟡		🟢	🔴	🔴	
44 #MOS_psf	medium	🟡	Steve				
45 #FP_psf	medium	🔴	Encarni, Ted	🟢	🔴	🔴	
46 #LS_radial_vel	medium	🟢	Alexei	🟢	🟢	🟢	
47 #MOS_radial_vel	medium	🔴		🟢	🔴	🔴	
48 #FP_radial_vel	medium	🔴	Encarni, Ted	🟡	🔴	🔴	
49 #LS_sky_sub	medium	🟡		🟢			
50 #MOS_sky_sub	medium	🟡		🟢			
51 #FP_sky_sub	medium	🟡	Ted	🟢	🟡	🔴	see also FP_flat_field [1]
52 #IMG_ls_slit	medium	🔴		🟢	🔴	🔴	
53 #IMG_mos_slit	medium	🟡					

🟢 done
🟡 in progress
🔴 not done yet

Overview

IMG_iq

[edit]

Check telescope closed-loop focus and overall image quality. Adjust focus with spectrograph to generate focus plots (psf characteristics vs. focus). Check with image position in f.o.v., temperature, focus encoder repeatability, night to night at same temperature. Measure spatial resolution.

- Priority: Very high
- Object: Many points covering full field of view.
- Config: No gratings. No slit or mask. All filters, order blocking and narrow-band. 4 extreme tracker positions + 1 central position @ 2 rotations (90 degrees apart) in one or two filters. 1 tracker position at remaining two 90 degree angles.
- Notes:
- People: Anja, Steve
- Propid:
- Data:
  - 19 APR 2011 (P20110419)
    - Images P8 - P20. Filter PI06290. Focus run using 12.5 micron pinhole.
- Status: Results see Image quality analysis (Anja 16sep13)
- Further work: Repeat test (i.e., two years after the first test) to check for stability (Anja 18sep13)

LS_iq

[edit]

Verify optimum focus in spatial direction of dispersed light is the same as optimum focus in straight imaging mode. Spatial resolution as fcn. of wavelength. No need to check all params, as in IMG_iq.

- Priority: Very high
- Object: Points in a line. When picking the target optimize the length of the line and a low scatter of the centroids of the poin

ts about the line.

- Config: Long slit (wide?). All gratings, blue & red ends:
  - SR300: 3596-9000 Angstroms (R ~ 600).

Tasks

- Image quality analysis
- LS/MOS focus analysis
- LS wavelength stability
- Image mask insertion stability
- LS calibration
- RSS radial velocity accuracy (Kniazev)
- RSS stability (Kniazev)

Image quality analysis

- Variation of a point source across the image as a function of focus setting
- Data: P20110419, exposures P0008 - P0020
- Focus: 100 – 1300 in steps of 100
- Specifics: 1x1 binning, faint, fast
- Filter: PI06290
- Mask: P000000N03

Image quality analysis

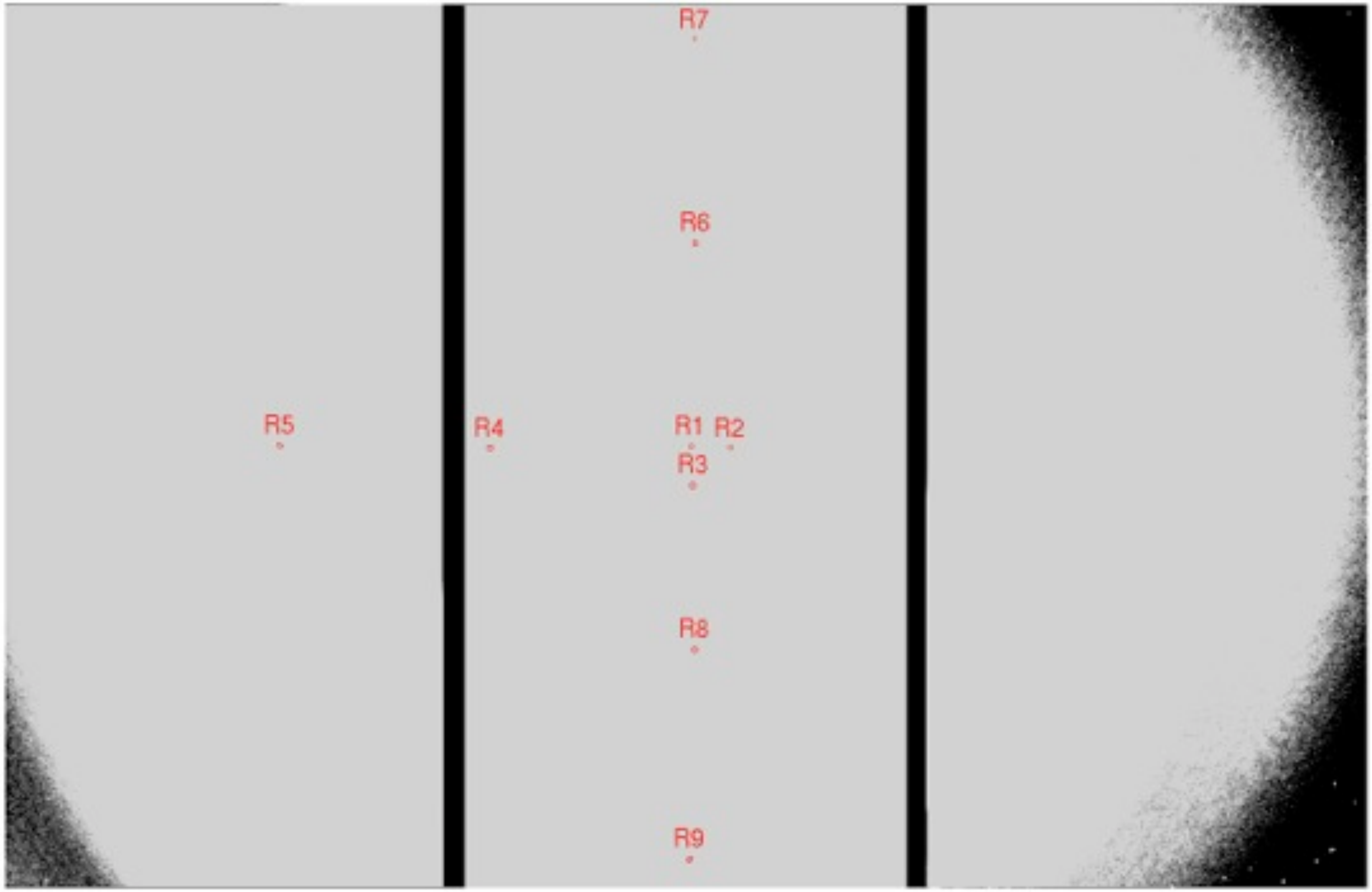


Image quality analysis

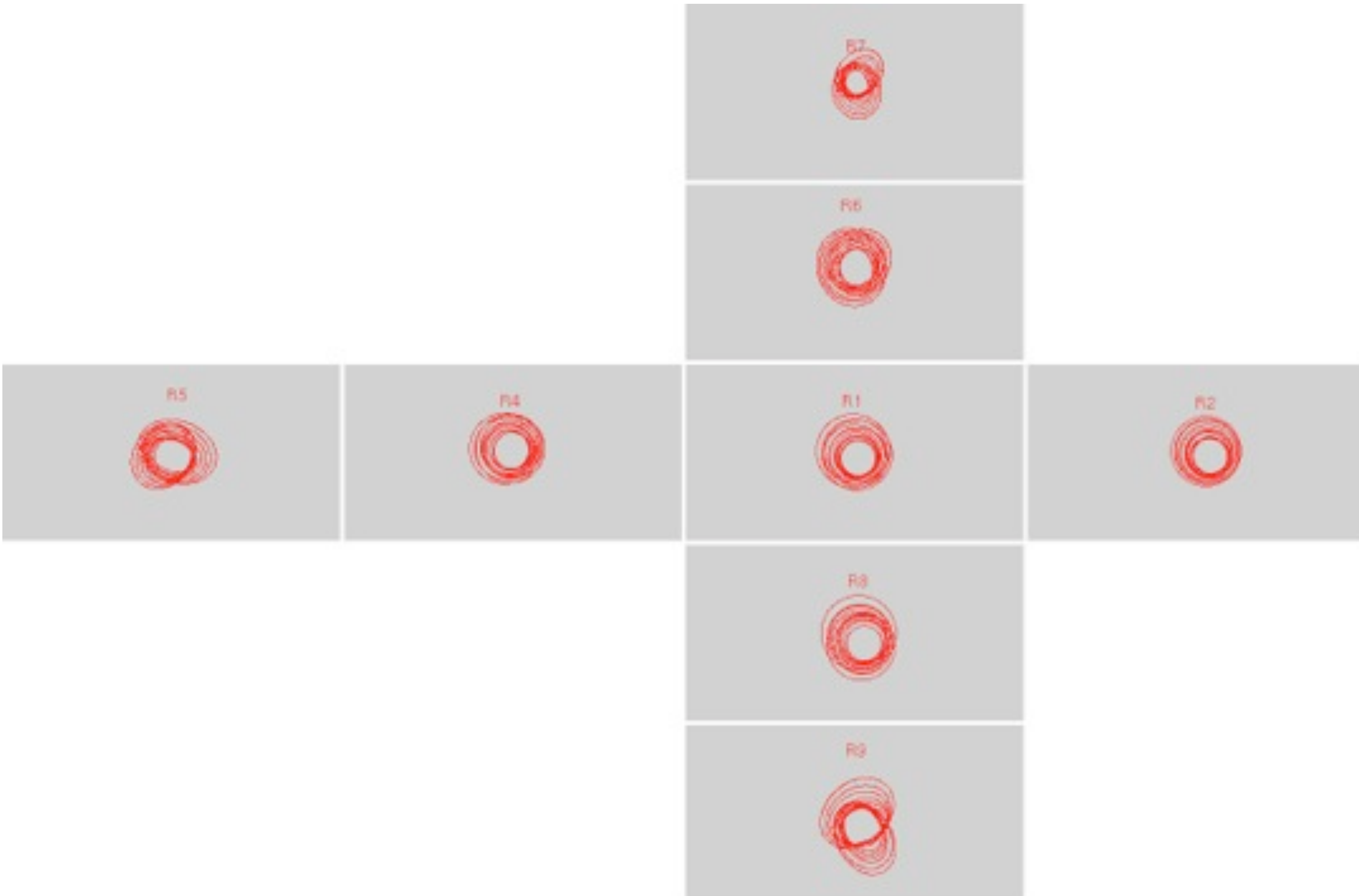
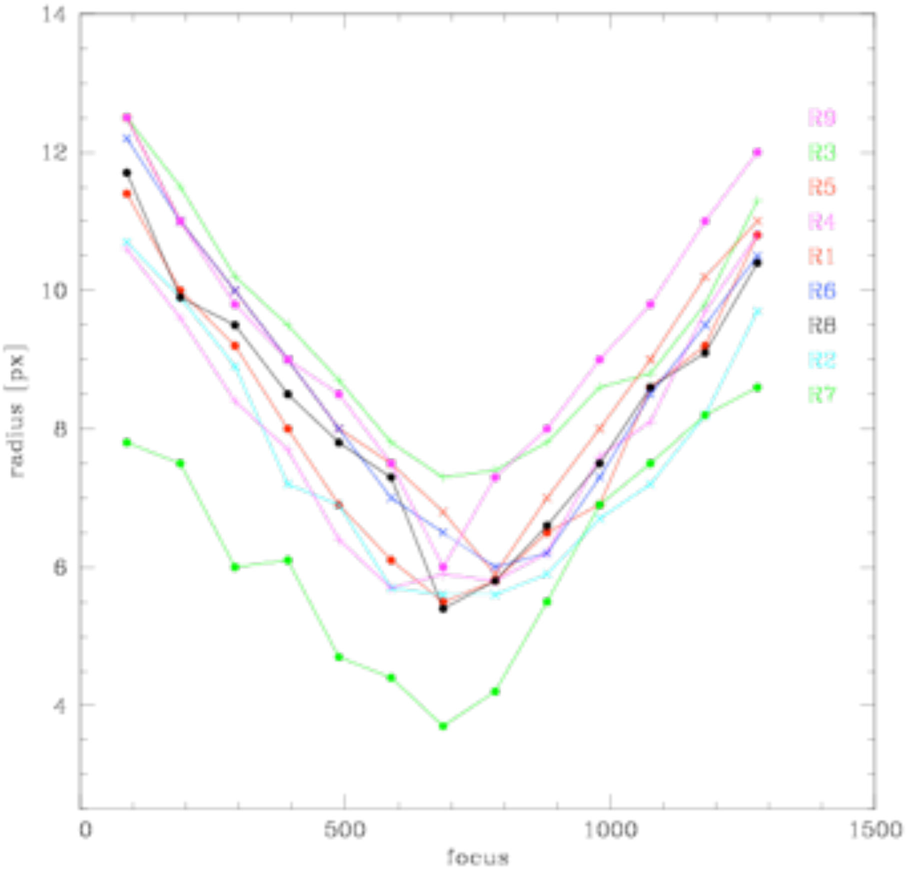


Image quality analysis



Regions:

7

6

5 4 1/3 2

8

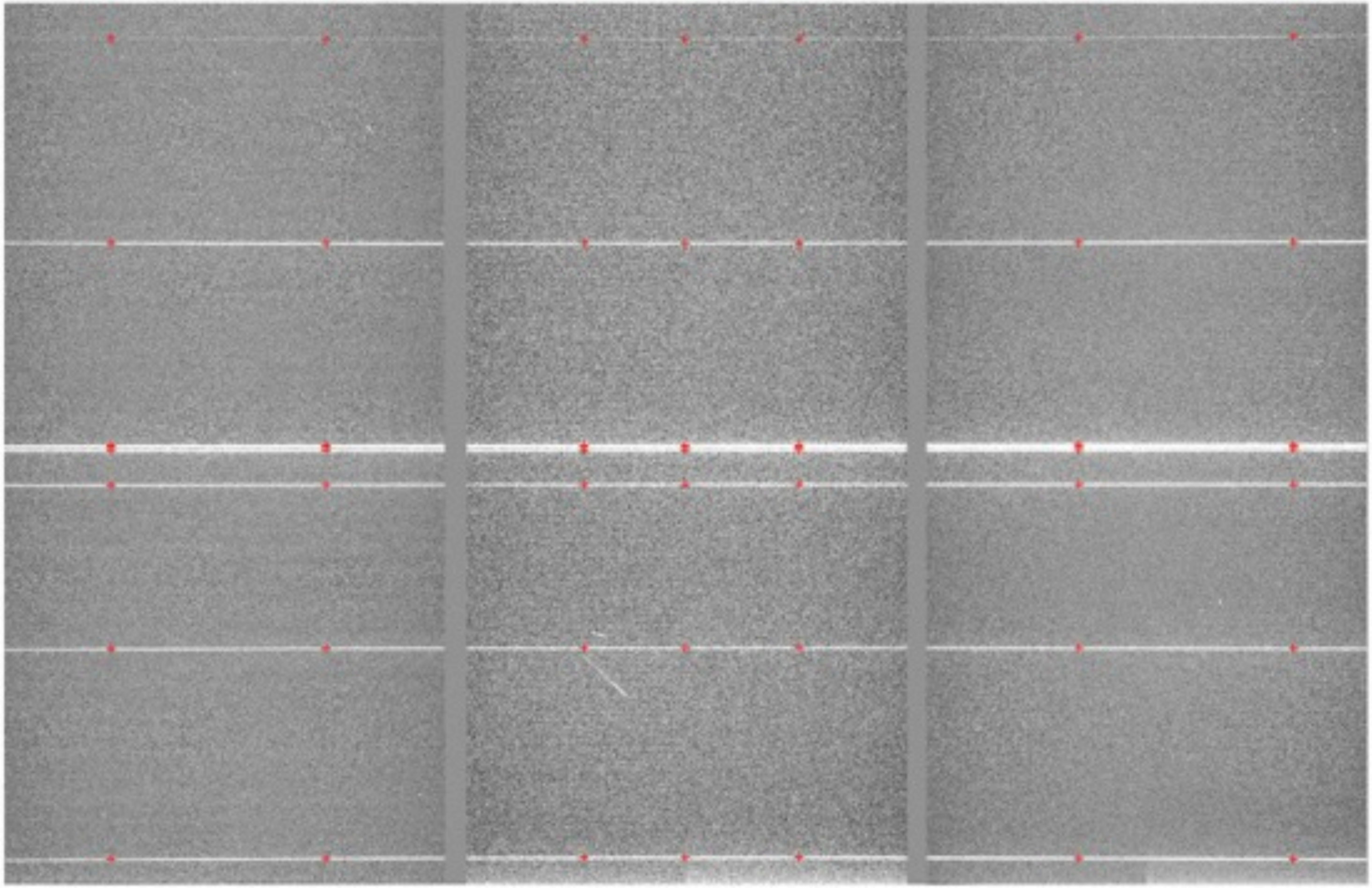
9

Variation across image: ~2px

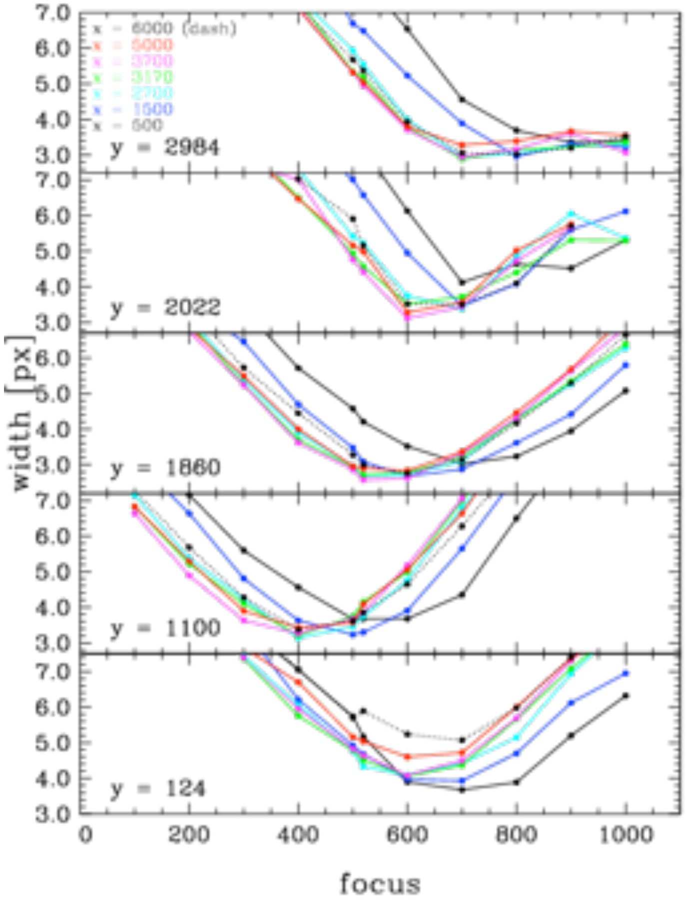
LS/MOS focus

- Variation of the FWHM of a spectrum as a function of focus setting
- Data: P20130926, exposures P0034 - P0044
- Focus: 100 – 1000 in steps of 100 and 'best' focus of 519
- Mask: P00000N03
- Specifics: 1x1, faint, slow
- Filter: PC00000

LS/MOS focus



LS/MOS focus



(y = 3934)

Y = 2984

(y=2035/42)

Y = 2022

Y = 1860

Y = 1100

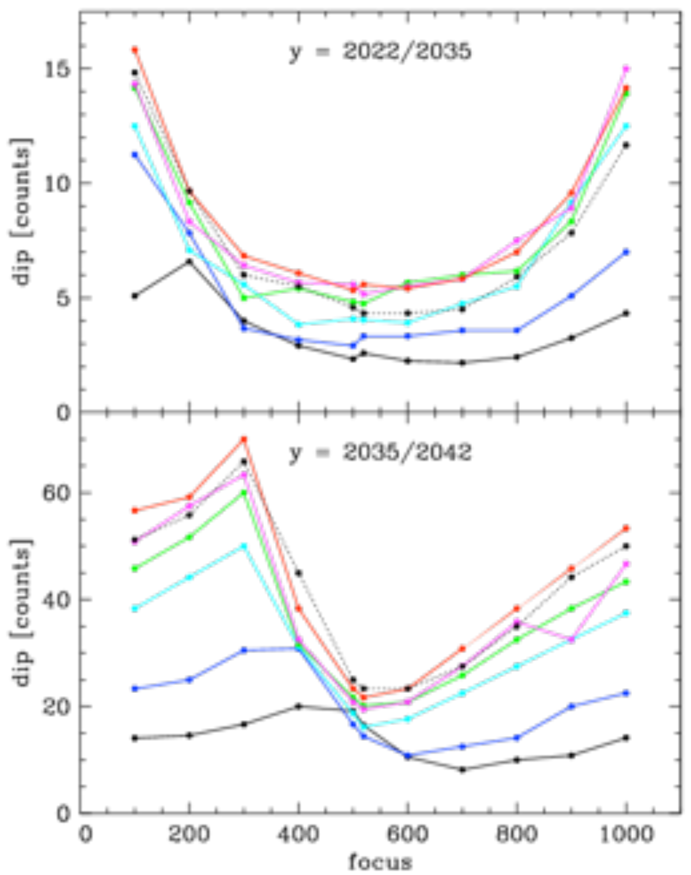
Y = 124

LS/MOS focus

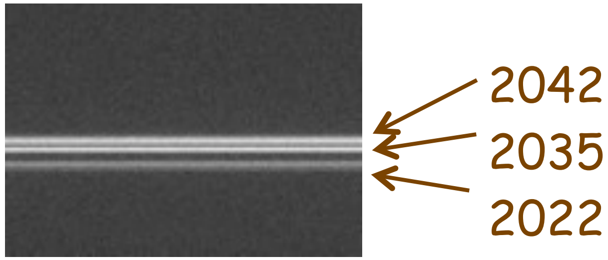
Δ (focus setting) across image:

y \ x	500	1500	2700	3170	3700	5000	6000
2984	400	300	200	200	200	200	300
2022	200	200	200	100	100	100	200
1860	200	100	19	19	19	100	100
1100	100	0	-100	-100	-100	-100	-100
124	100	100	100	100	100	100	200

LS/MOS focus



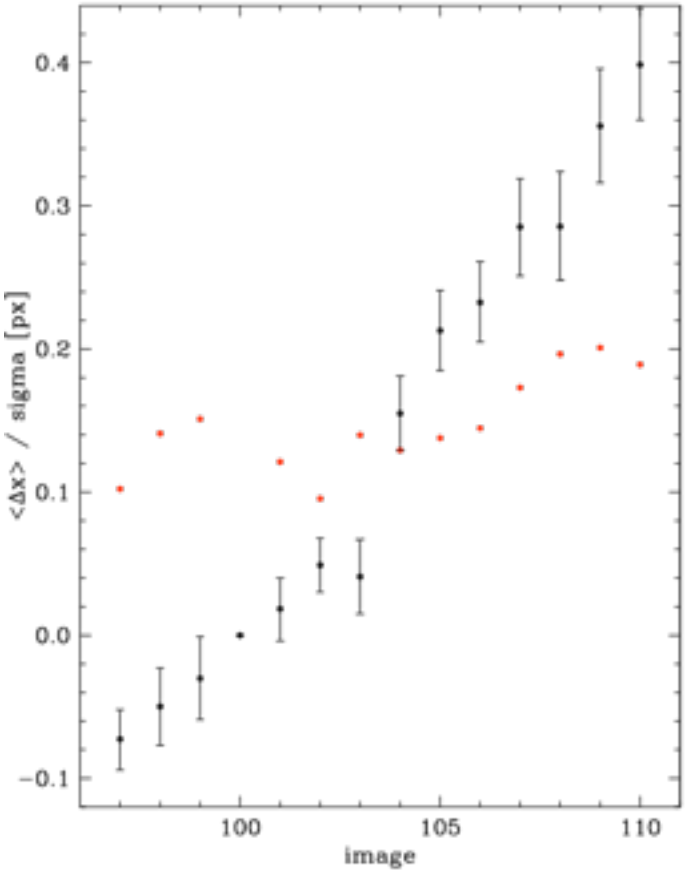
Resolution:



LS wavelength stability

- Stability of wavelength calibration while tracking
- Data: P20130502, exposures P0097 - P0110
- CuAr lamp, PG3000, PL0150N001
- Method: measure residuals from fit
- Specifics: 2x2 binning, faint, slow
- Filter: PC00000

LS wavelength stability

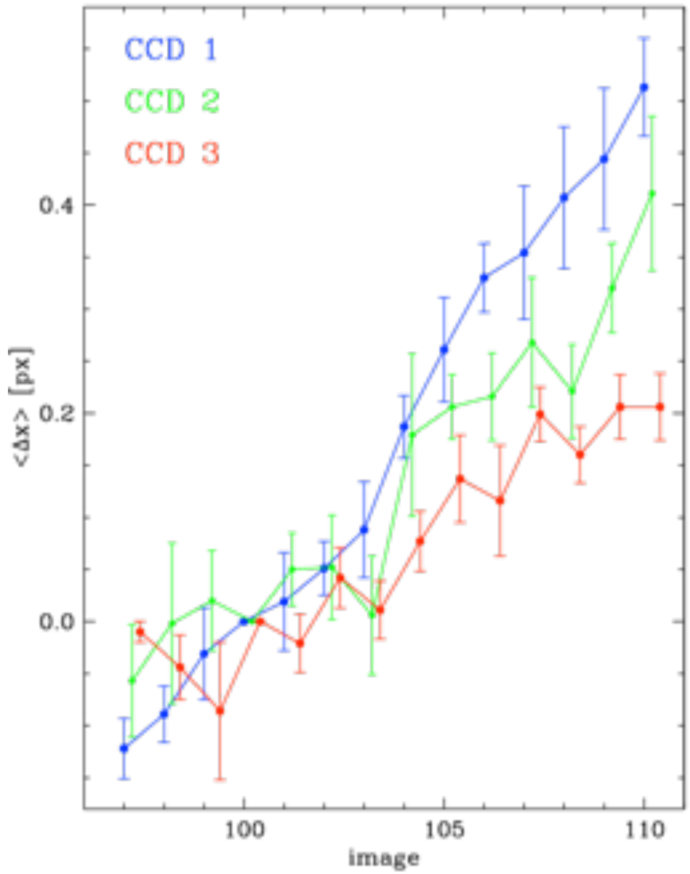


variation in x:

0.012 px/min   0.0026 Å/min
0.696 px/hr   0.1561 Å/hr

- mean residuals of 25 - 31 lines
- stdev in the residuals of the lines

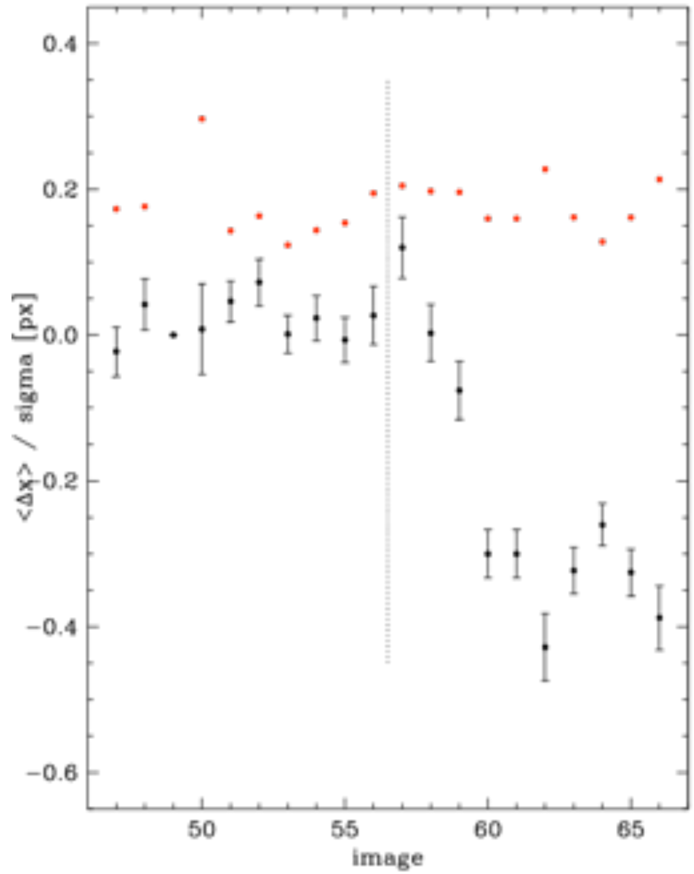
LS wavelength stability



Mask insertion stability

- Stability of wavelength calibration while the slitmask was removed and re-inserted before an exposure
- Data: P20130914, exposures P0047 - P0066
- First 10 exposures are without any movement
- CuAr lamp, PG3000, PL0060N001
- Method: measure residuals from fit
- Specifics: 2x2 binning, faint, slow
- Filter: PC00000

Mask insertion stability



no insertion (n = 10):

1σ = 0.029 px
= 0.0066 Å

with insertions (n = 7):

1σ = 0.057 px
= 0.0129 Å

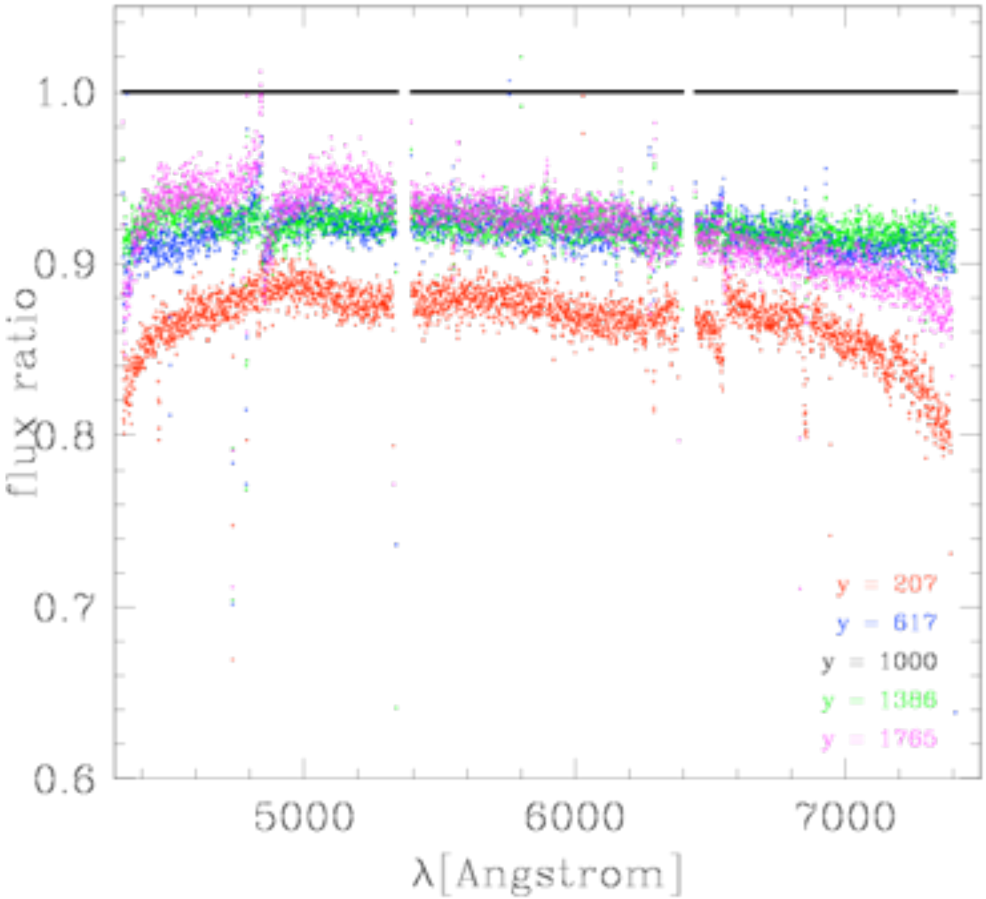
- mean residuals of 22 – 27 lines
- stdev in the residuals of the lines

LS calibration

- Change of spectral shape across the FOV
- Data: P20130826, exposures P0002 - P0006
- Standard star LTT7987, PG0900, PL0400N001
- Specifics: 2x2 binning, faint, slow
- Filter: PC03850

LS calibration

Normalised spectra:



Change of shape:

- overall: <10%
- inner 90% in x: < 5%
- inner 2/3 in y: <3%

y = 1765

y = 1386

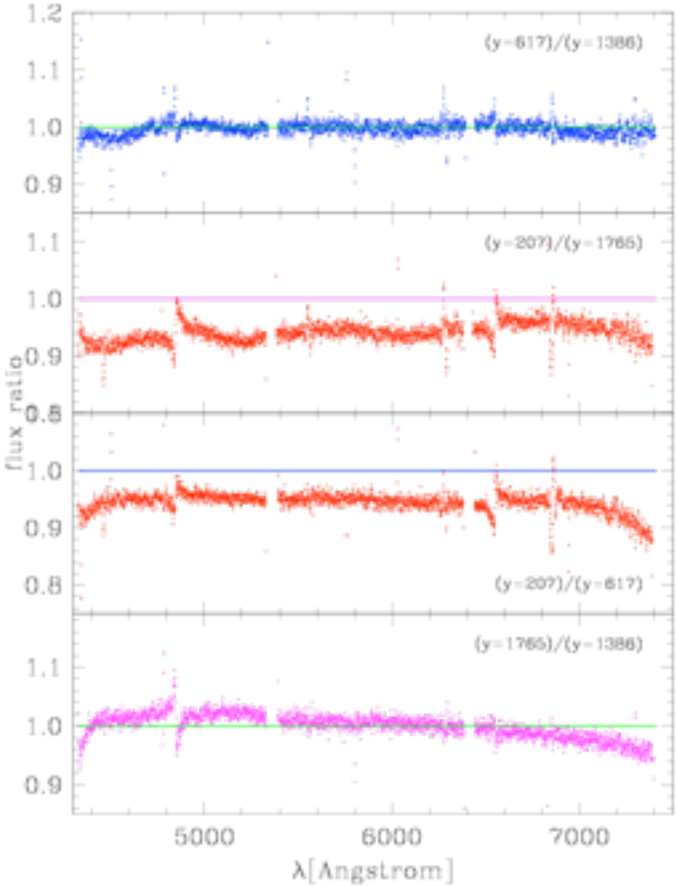
y = 1000

y = 617

y = 207

LS calibration

Normalised spectra:



617 / 1386 : 2 central positions

207 / 1765 : 2 edge positions

207 / 617 : 2 lower positions

1765 / 1386 : 2 upper positions

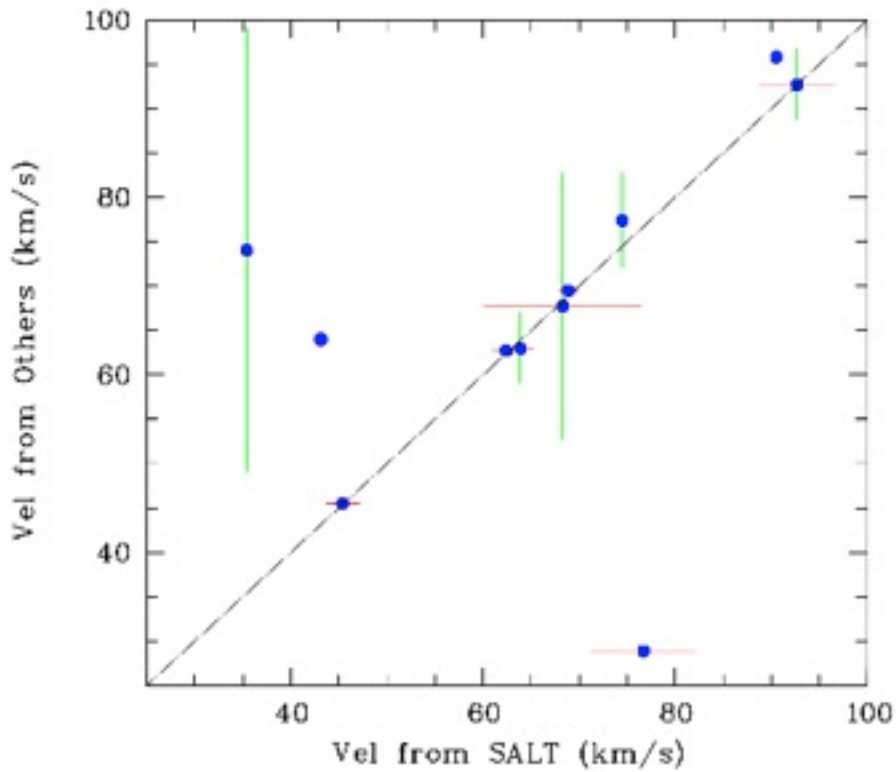
RSS: Radial Velocity Accuracy using Emission Lines (A. Kniazev)

- Observational data were taken with RSS during 2006-2012
- We used spectral data taken with VPH gratings GR900 and GR1800
- Data from 20 different spectral blocks were reduced
- Data were analyzed for:
  - The dust-lane polar-ring galaxy AM1934-563
  - The dwarf irregular galaxy IC4662
  - Four lenticular galaxies
  - 11 Planetary Nebulae
- Measured velocities were compared with previously published results

Conclusions:

- All analysed data show that with RSS data user can routinely reach an accuracy of ~10 km/s with grating GR900 and ~5 km/s with grating GR1800.

RSS: Radial Velocity Accuracy using Emission Lines (A. Kniazev)



The comparison between SALT and other measurements. Each point is shown with 1σ error. Errors for SALT data are shown with red colour and errors from Schneider et al. (1983) and Durand, Acker & Zijstra (1998) are shown with green colour. Black lines shows the equality relation.

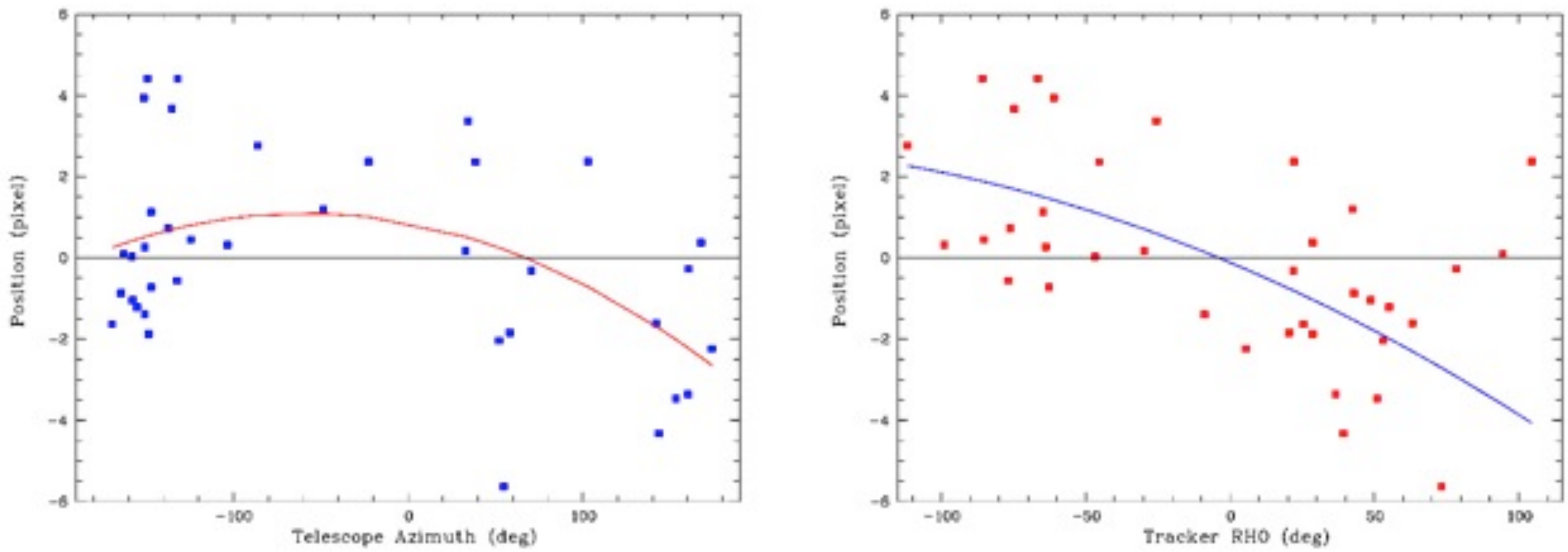
RSS stability and flexure models (A. Kniazev)

- Analyzed observational data were taken with RSS commissioning programs
- We used spectral data taken with VPH gratings GR900
- Data from 82 different spectral frames were used

Conclusions:

- RSS flexure is obviously a function of two parameters: azimuth and rho angle
- RSS repeatability after correction for the flexure has a standard deviation of 1.63 pixels (2x2 binning)

RSS stability and flexure models
Stability



The distributions for measured positions studied lines depending on azimuth angle (left panel) and rho angle (right panel).
Result of the second order polynomial fit is also shown for both panels.

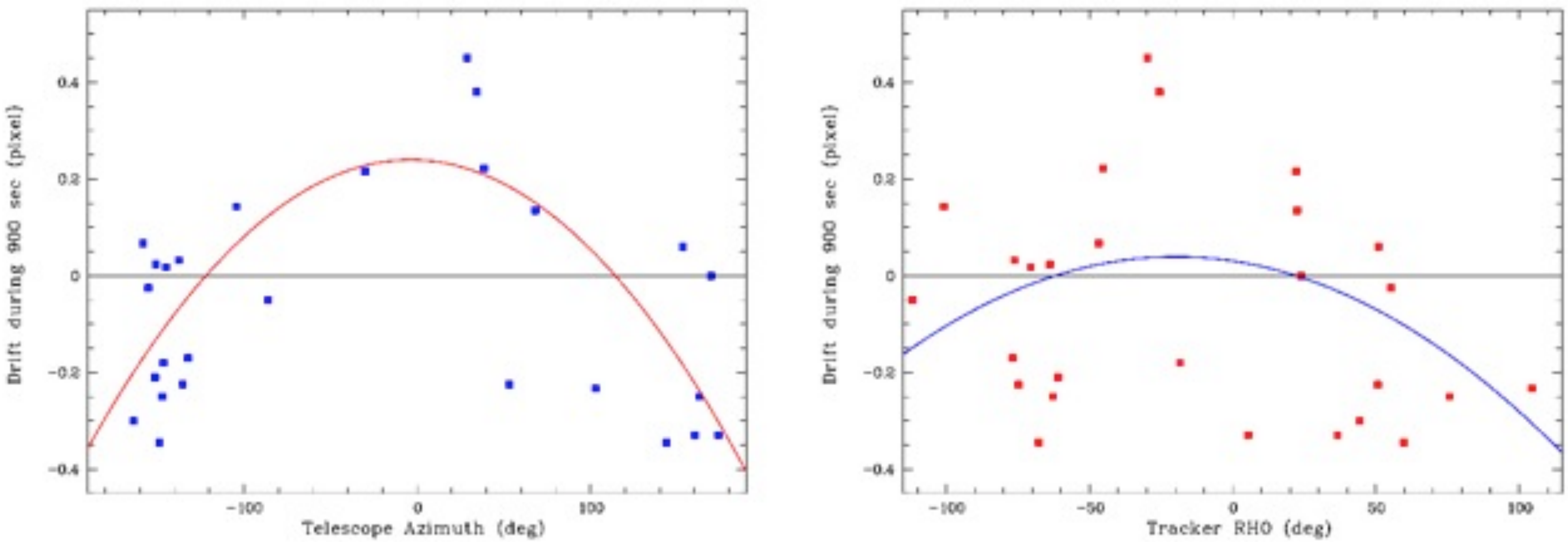
RSS stability and flexure models (A. Kniazev)

- Analyzed observational data were taken with RSS commissioning programs
- We used spectral data taken with VPH gratings GR900
- Data from 82 different spectral frames were used

Conclusions:

- RSS flexure is obviously a function of two parameters: azimuth and rho angle
- RSS repeatability after correction for the flexure has a standard deviation of 1.63 pixels (2x2 binning)
- The RSS flexure drift is obviously a function of two parameters: azimuth and rho angle, but also has a random part with a dispersion of ~0.17 pixels (2x2 binning).

RSS stability and flexure models
Flexure drift



The distributions for measured drift values depending on azimuth angle (left panel) and rho angle (right panel).
Result of the second order polynomial fit is also shown for both panels.

Summary

- Image quality analysis: variation in radius across image = 2 px
- LS/MOS focus analysis:

  variation in fwhm across whole image: 4.5 px

  variation in fwhm for most image: 2 px
- LS wavelength stability: drift with time: 0.1561 Å/hr
- Image mask insertion stability: increased uncertainty by factor 2

  may have caused offset ~0.08 Å
- LS calibration: change in shape of spectrum < 10%

  change in shape for 2/3 in y: < 3%
- RSS radial velocity accuracy: accuracy for PG0900: 10 km/s

  accuracy for PG1800: 5 km/s
- RSS stability: accuracy after flexure corr: 1.6 px

  accuracy in drift correction: 0.17 px