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Problems and solutions for accurate laser control at Helios and RILIS

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Outline

- Wavemeter peculiarities at Helios, KU Leuven
- Etalon control in Ti:Sa lasers at RILIS
- Conclusion

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Wavemeter peculiarities at Helios KU Leuven

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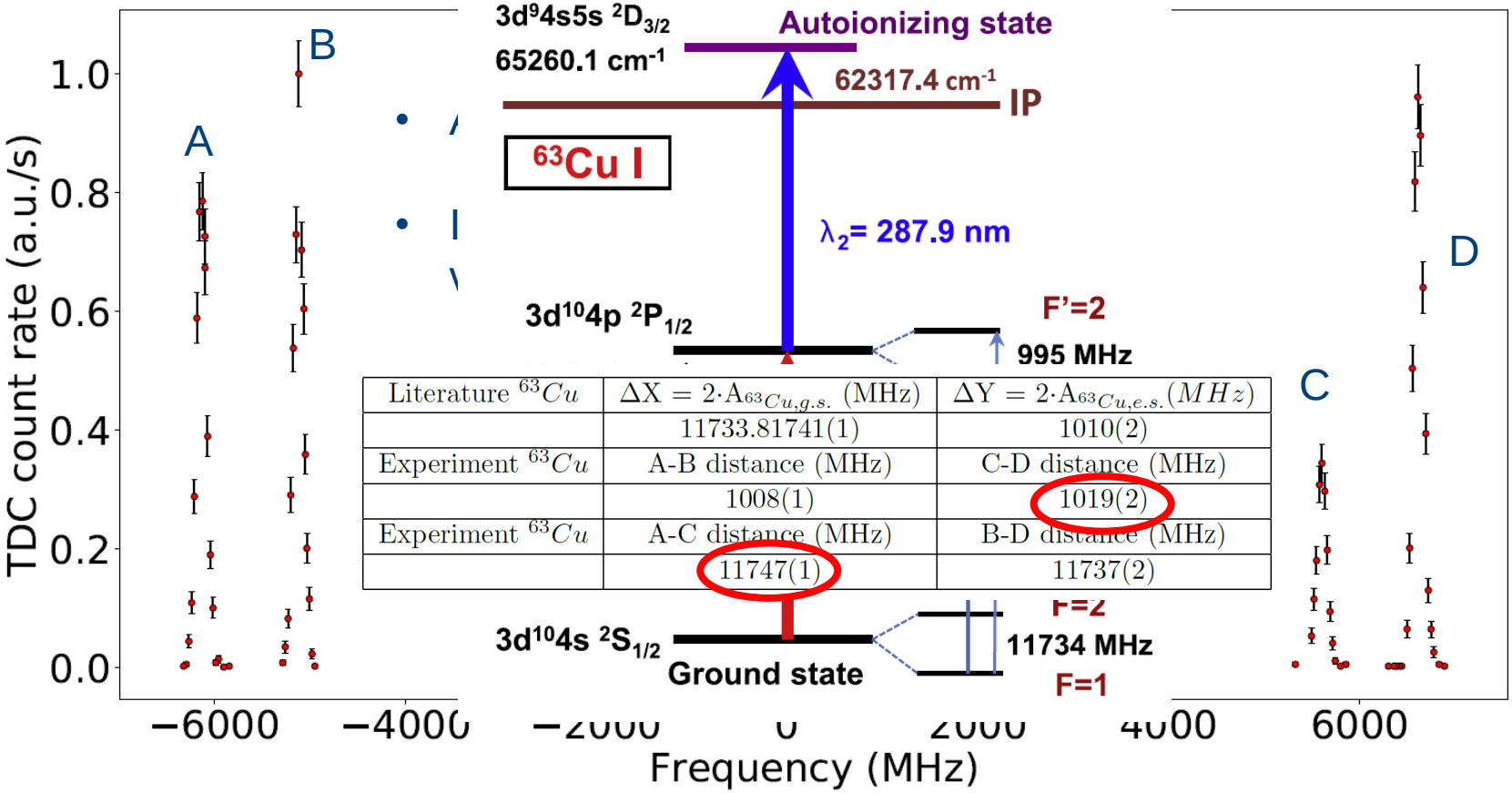
Observation of the problem

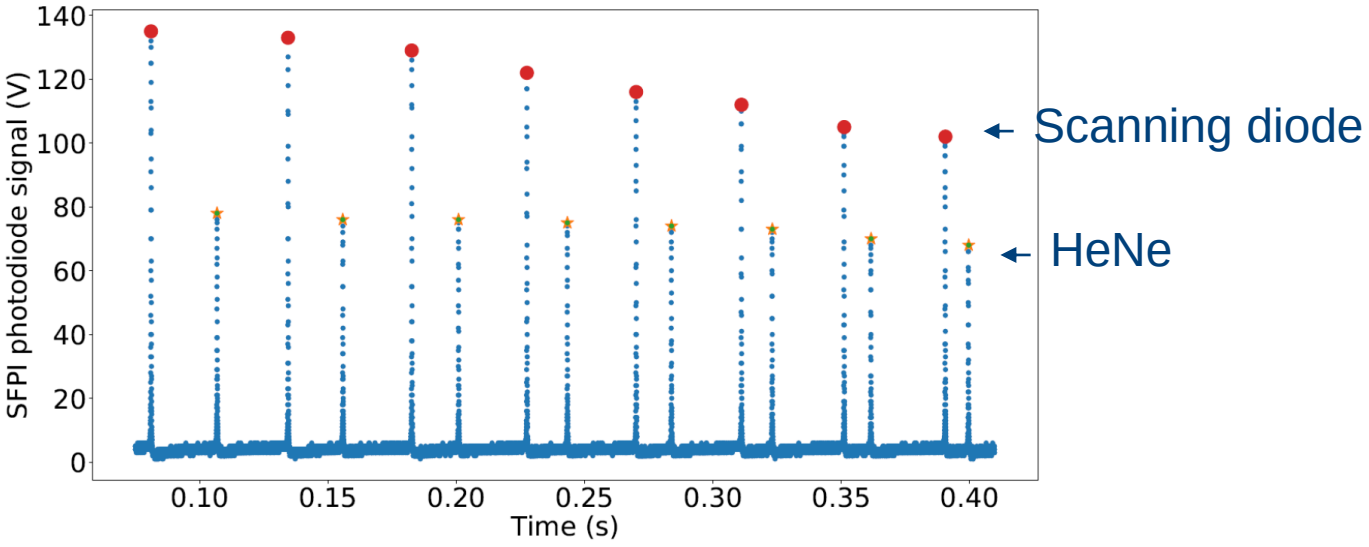


Literature ^{63}Cu	$\Delta X = 2 \cdot A_{^{63}Cu,g.s.}$ (MHz)	$\Delta Y = 2 \cdot A_{^{63}Cu,e.s.}(MHz)$
	11733.81741(1)	1010(2)
Experiment ^{63}Cu	A-B distance (MHz)	C-D distance (MHz)
	1008(1)	1019(2)
Experiment ^{63}Cu	A-C distance (MHz)	B-D distance (MHz)
	11747(1)	11737(2)

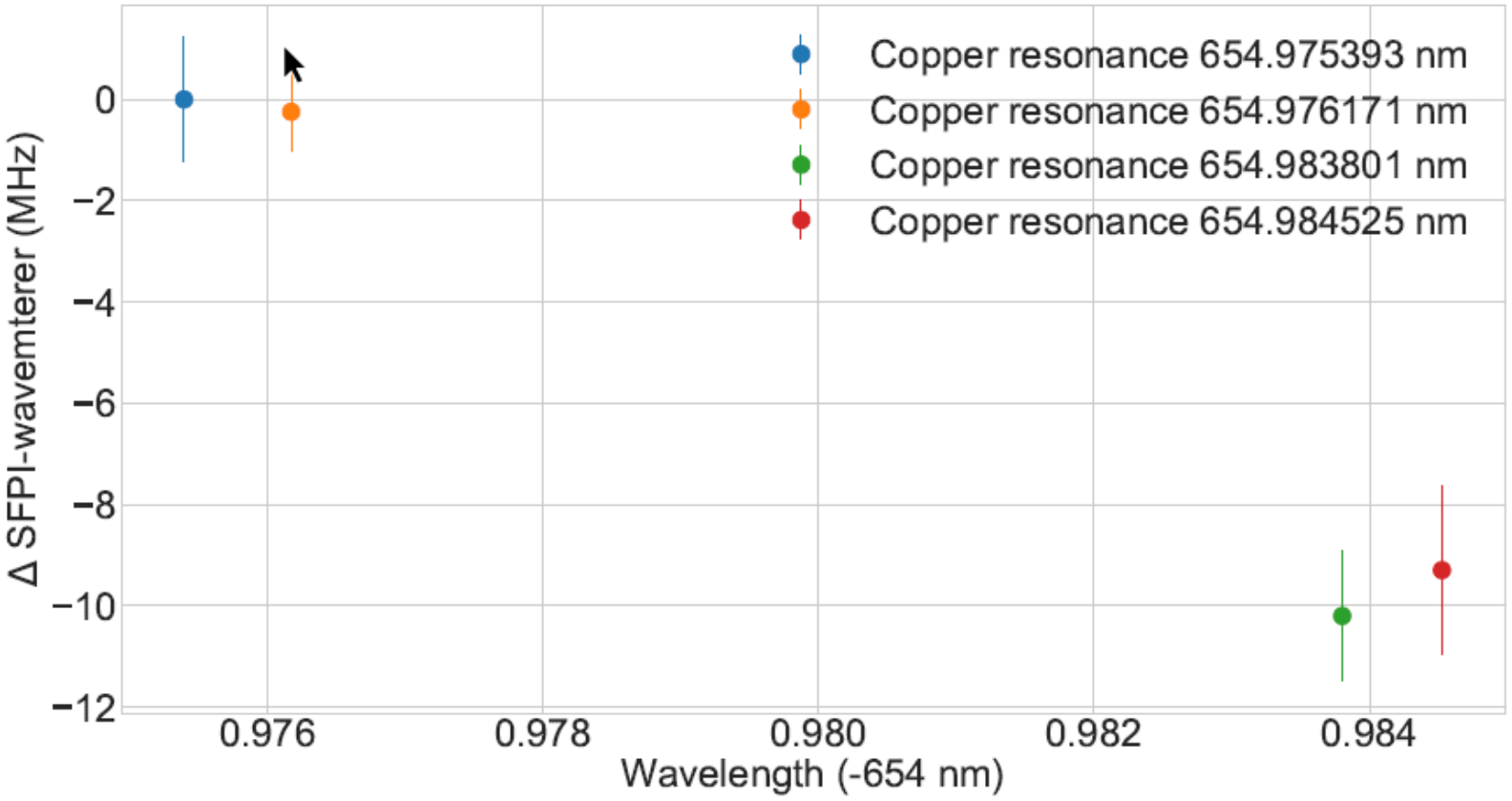
Wavelength meter vs. SFPI

- Scan wavelength range as for Cu spectroscopy
  - Calibration of WS-7 with HeNe or K-locked diode
  - Wavelength stabilization vs HeNe or K-locked diode

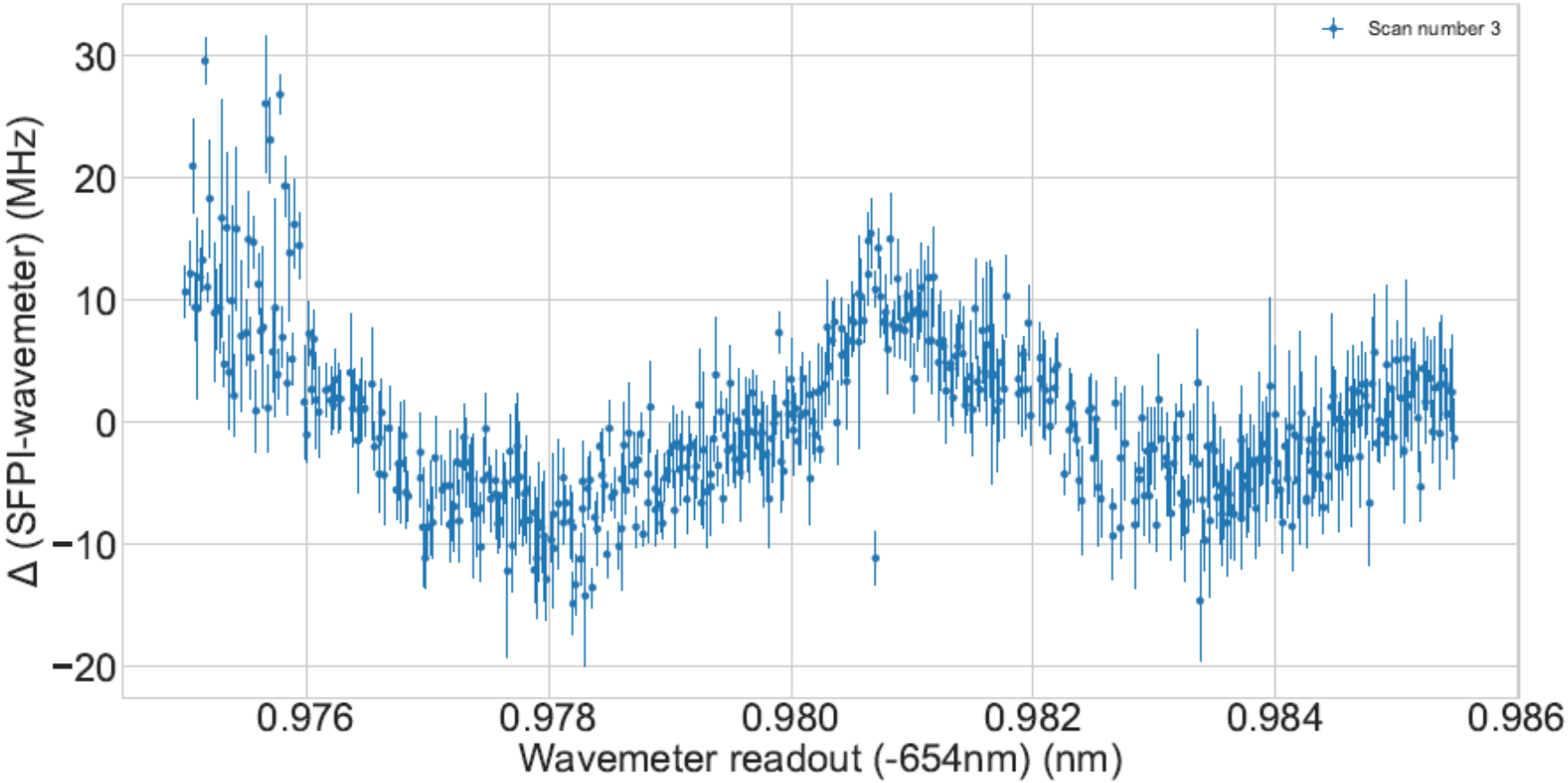
- Wavelength jump in wavelength meter vs SFPI



Wavelength meter vs. SFPI



Wavelength meter vs. SFPI



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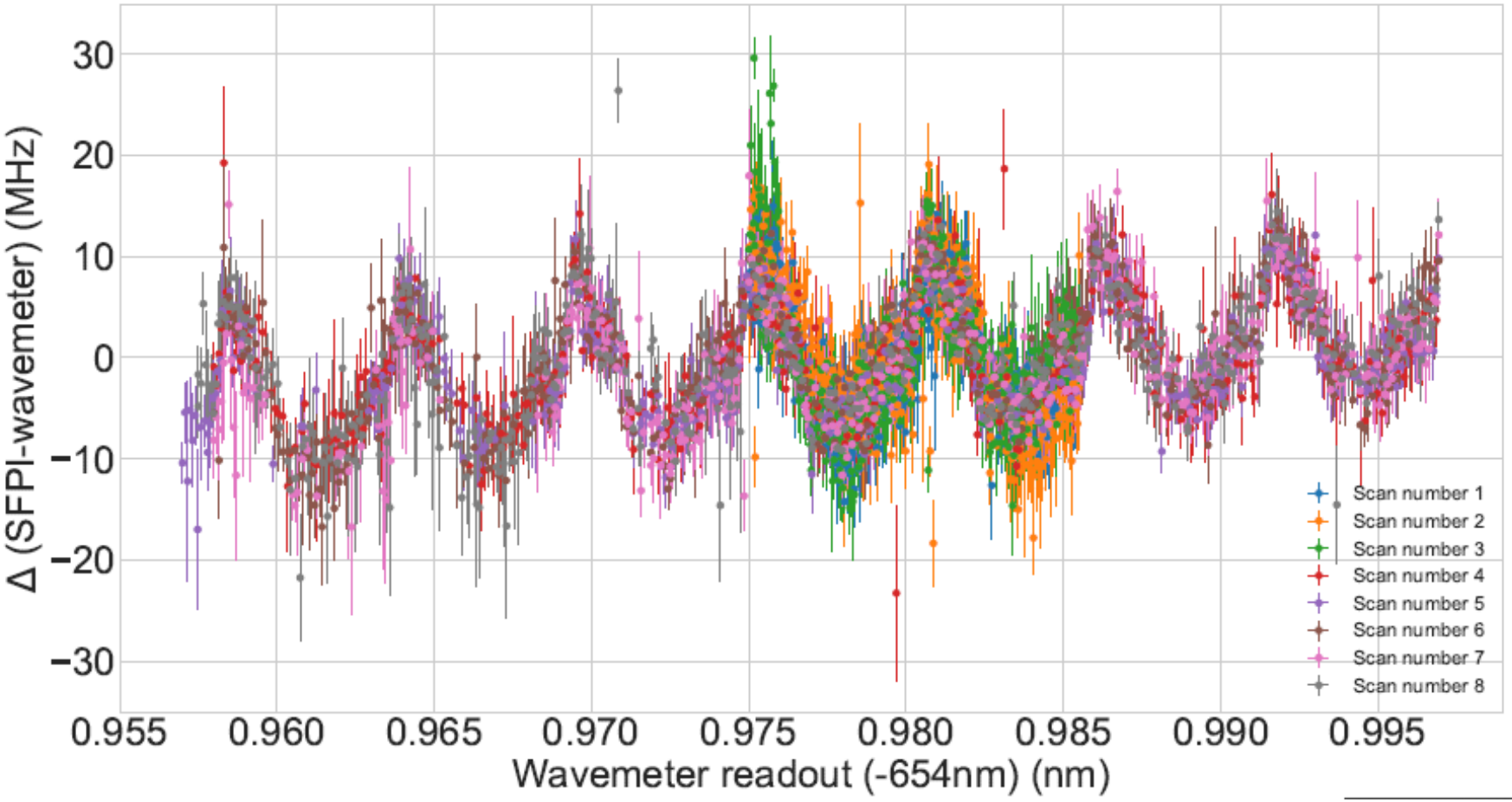
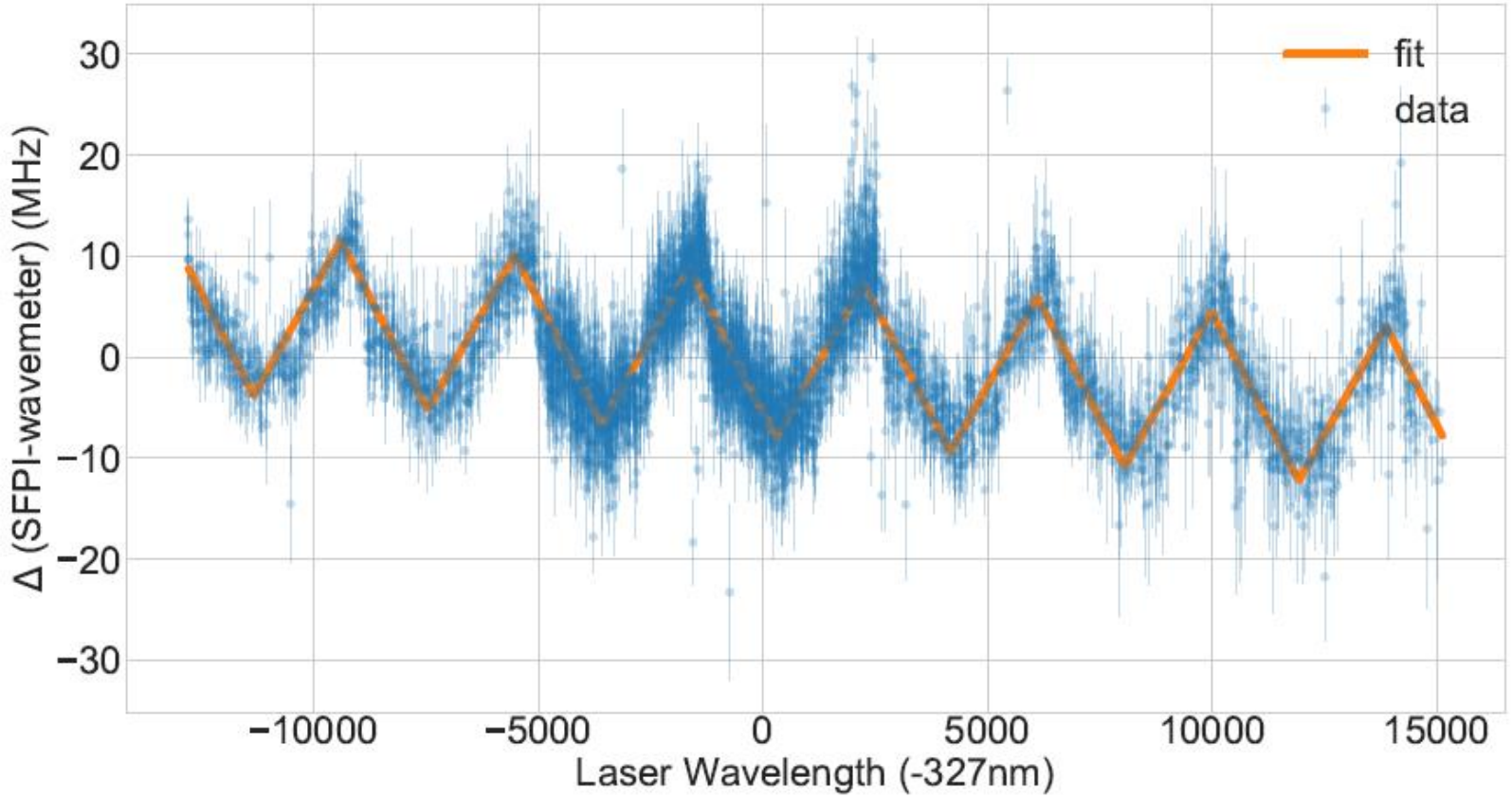
Wavelength meter vs. SFPI



Wavelength meter vs. SFPI



Literature ^{63}Cu	$A^{Lit}_{^{63}Cu,g.s.}$ (MHz)	$A^{Lit}_{^{63}Cu,e.s.}$ (MHz)
	5866.90871(2)	505 (1)
Experiment ^{63}Cu	$A^{Exp}_{^{63}Cu,g.s.}$ (MHz)	$A^{Exp}_{^{63}Cu,e.s.}$ (MHz)
	5869(1)[1]	504(1)[1]

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WS-7 conclusion

- Characterization of wavelength response of WS-7

- Highfinesse: Attributed to non linearities in the imaging of the interferograms. Software is not efficient enough in this wavelength range.

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Etalon control in Ti:Sa lasers at RILIS

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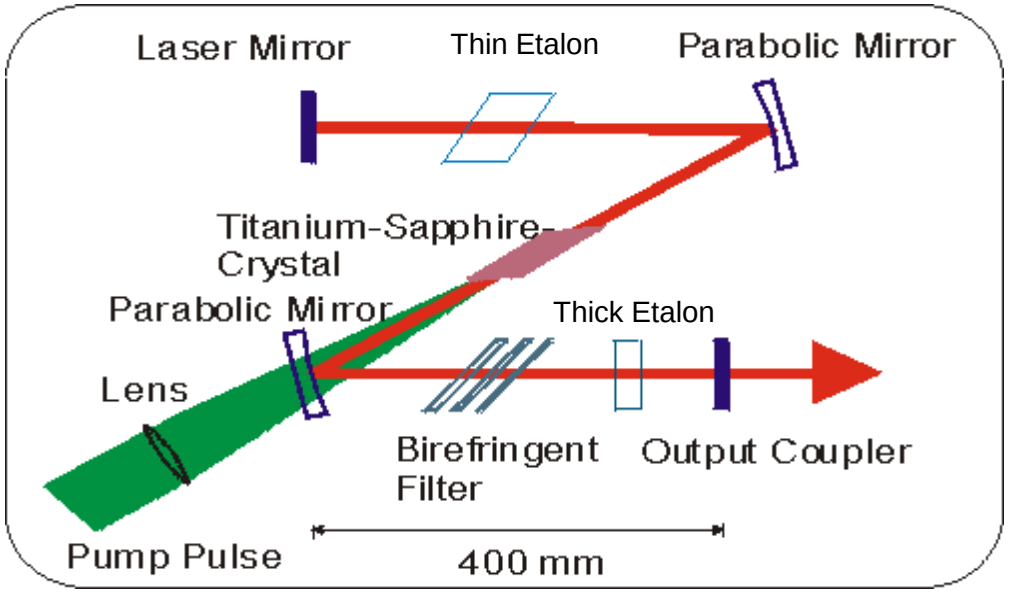
‘Industrial Laser Facility’

- Remote laser system
  - ➔As less human interaction as possible
  - ➔Automatic laser stabilization
  - ➔Automatic frequency selection



- Library of etalon positions for specific elements
  - Requires accurate positioning of etalon
    - ➔ **No hysteresis of etalon mounts**
    - ➔ **Absolute positioning**

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Smar-Act STT-12.7 mounts

- Hysteresis?
- Reproducibility?
- Absolute positioning?
- Stability?

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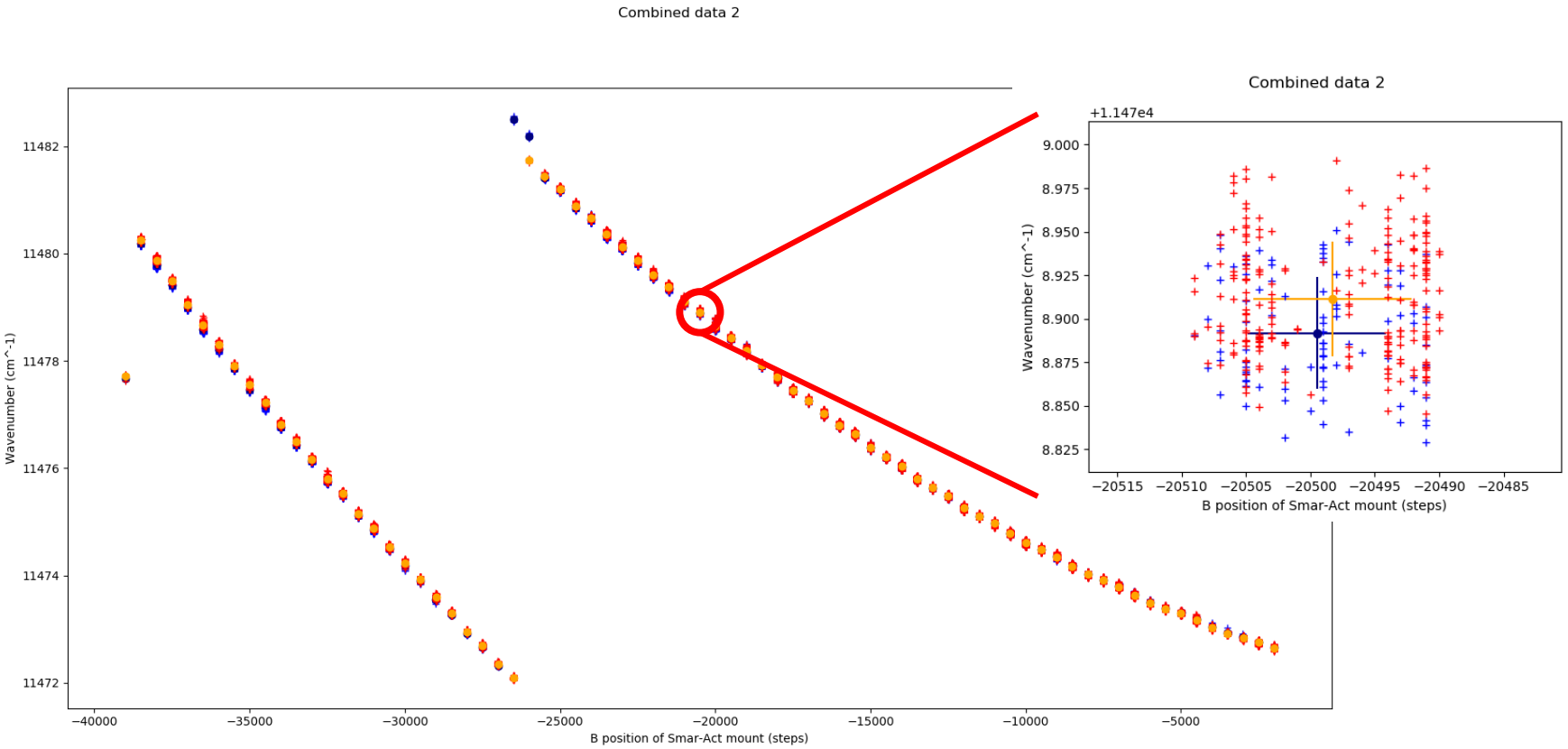
Smar-Act: Hysteresis?

Thin etalon position scanning (x-axis):
No time dependence for wavenumber ➔ No hysteresis

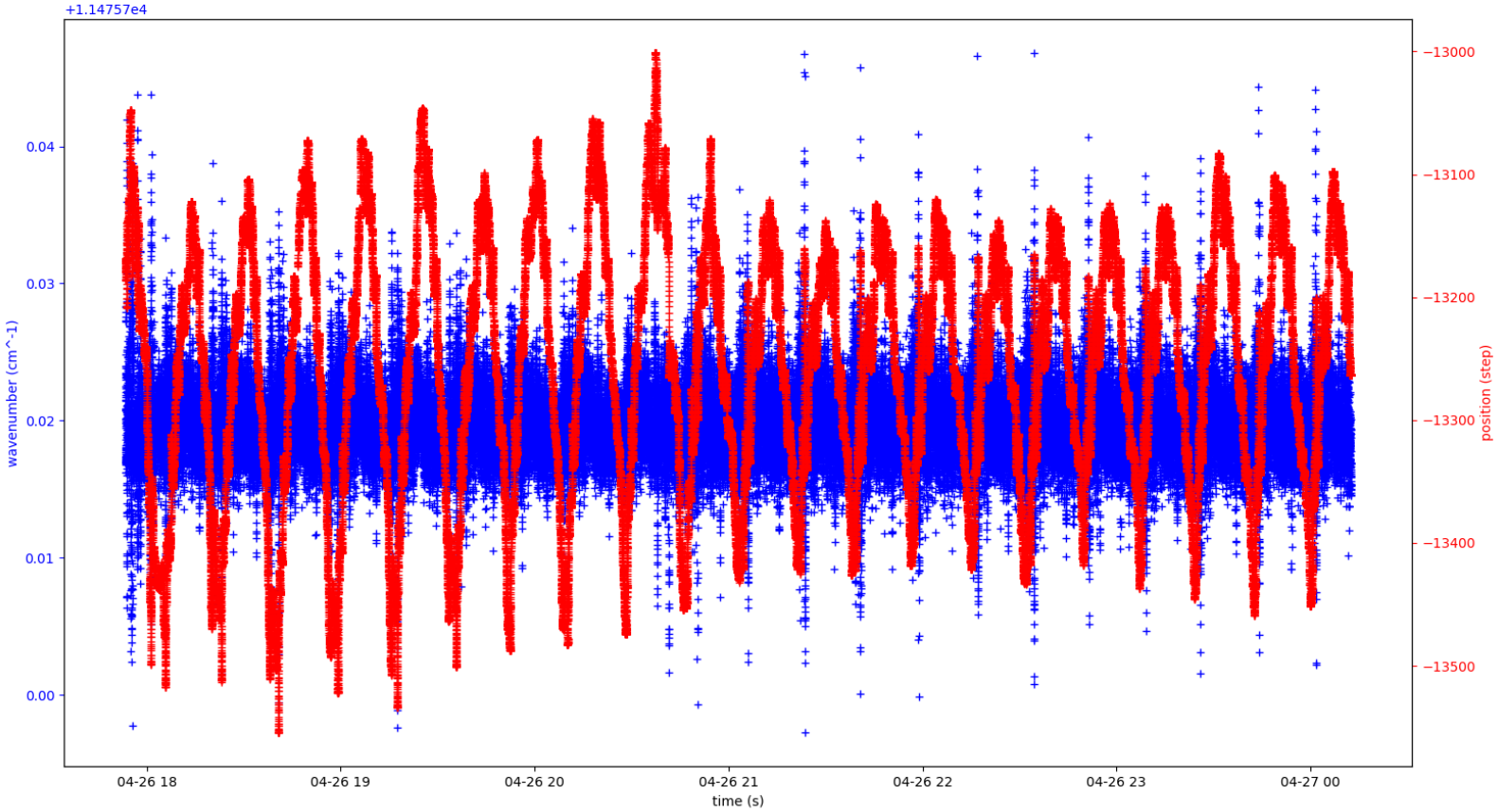


Smar-Act: Stability?

Stability for set wavelength:

Variation on wavenumber = ±0,015 cm^{-1}

- But periodicity in mount position…

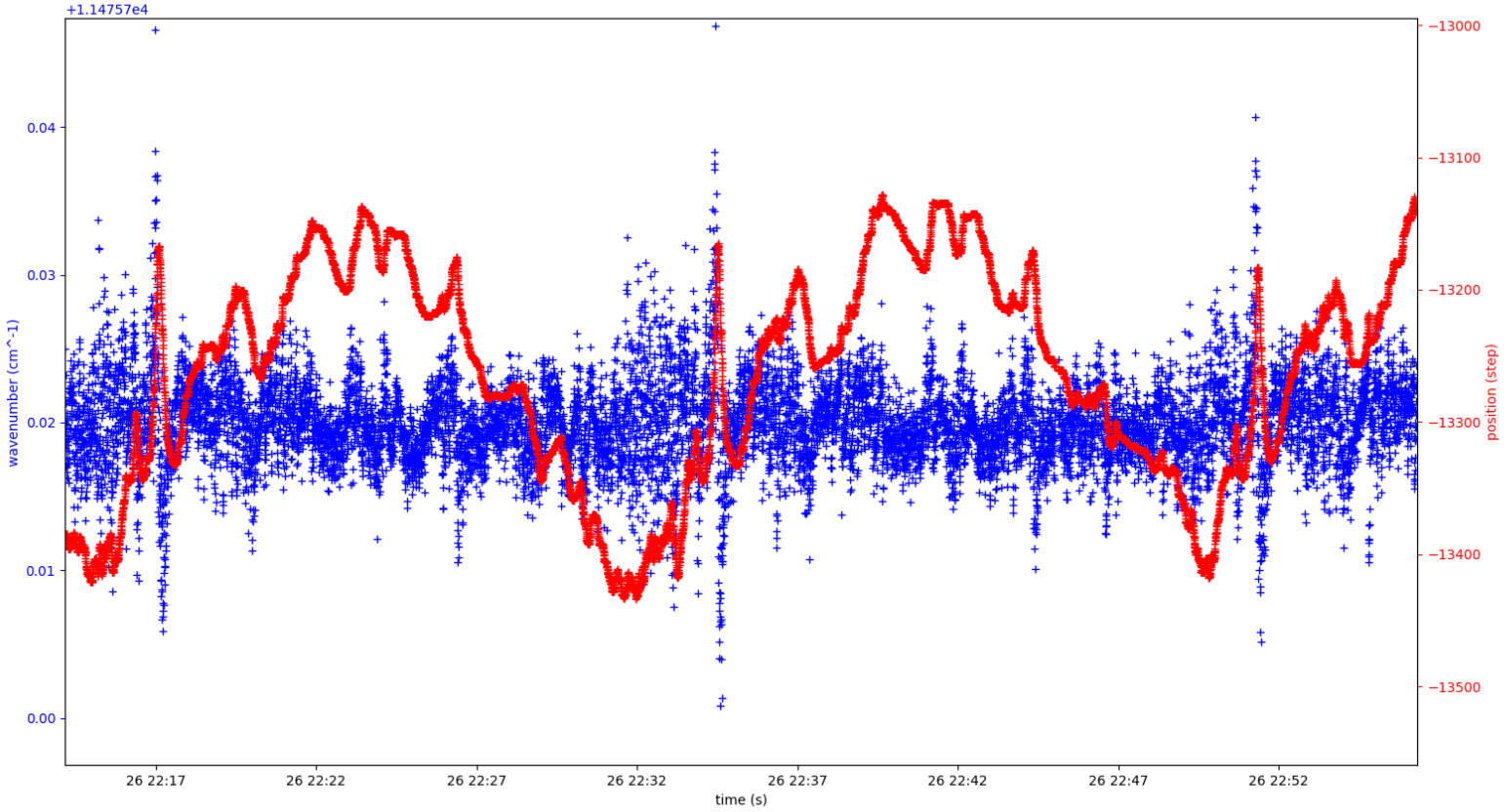


Smar-Act: Stability?

Stability for set wavelength:

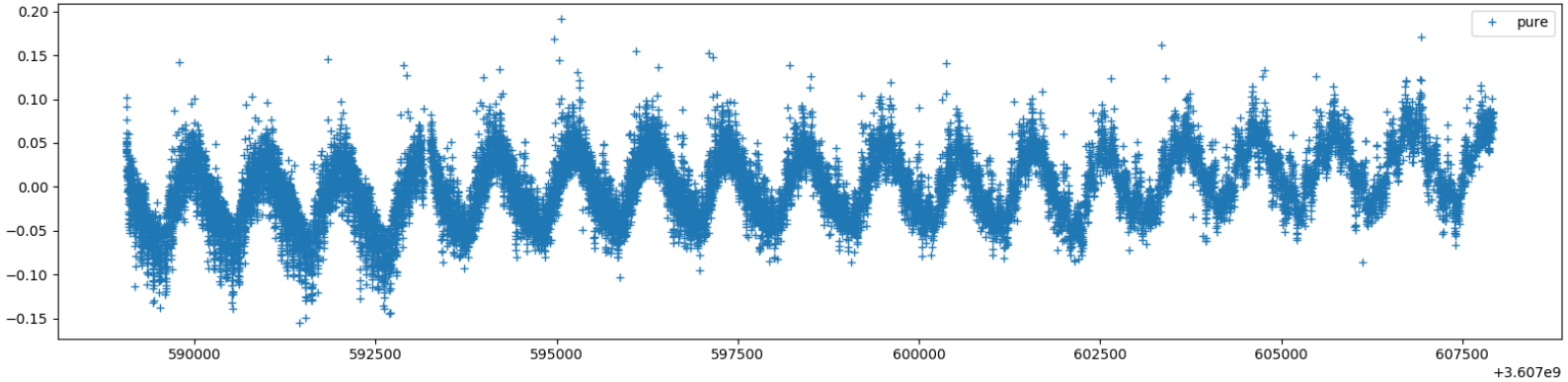
Period of 1050 seconds… ➔ unknown source

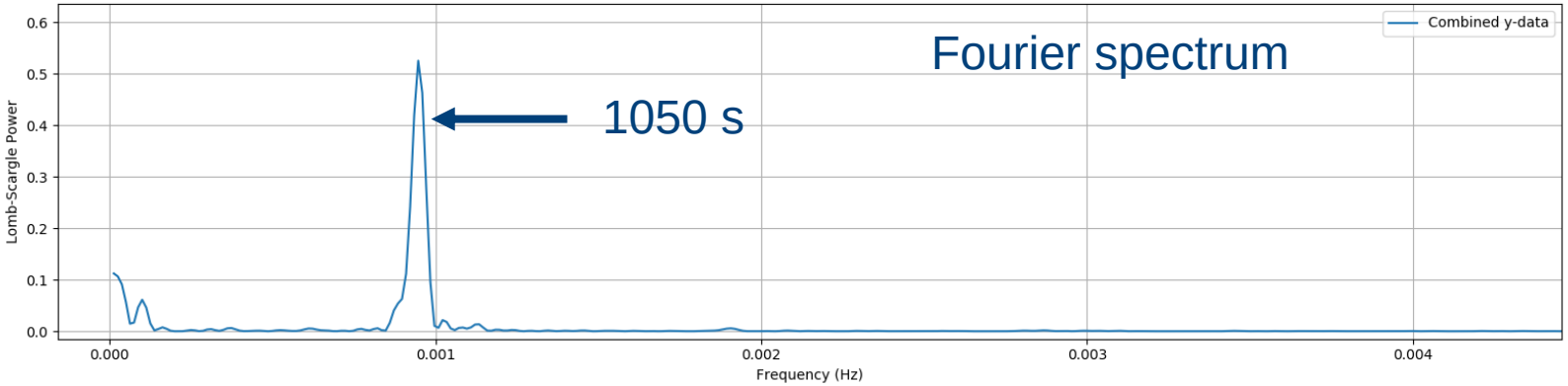
Can control wavenumber within limits



Smar-Act: Stability? 2.0

Reanalysis of position scan (y-position):
Error with average at that position vs time
Same periodicity = 1050 seconds (0,00093 Hz)



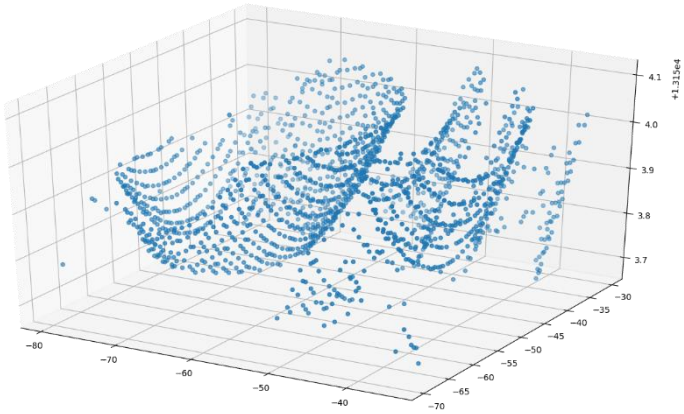


Smar-Act STT-12.7 mount

- **Thin etalon Ti:Sa Laser:**
  - No hysteresis/good reproducibility
  - Good absolute positioning
  - Scatter on wavenumber ±0,015 cm^{-1}

    (to be reduced with better control of environment)
  - **Good prospects for automatic laser tuning**

    but small wavenumber range



Conclusion

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Conclusion

- Wavelength meter performance is crucial for high resolution laser spectroscopy.
- Non-linearities can give in wrong results
- Closed-loop etalon mounts can contribute to easier laser operation
- Further characterization and wider range of motion necessary

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