Compensation of TPA-TCT signal fluctuations using the 2nd harmonic

39th RD50 workshop

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Outline

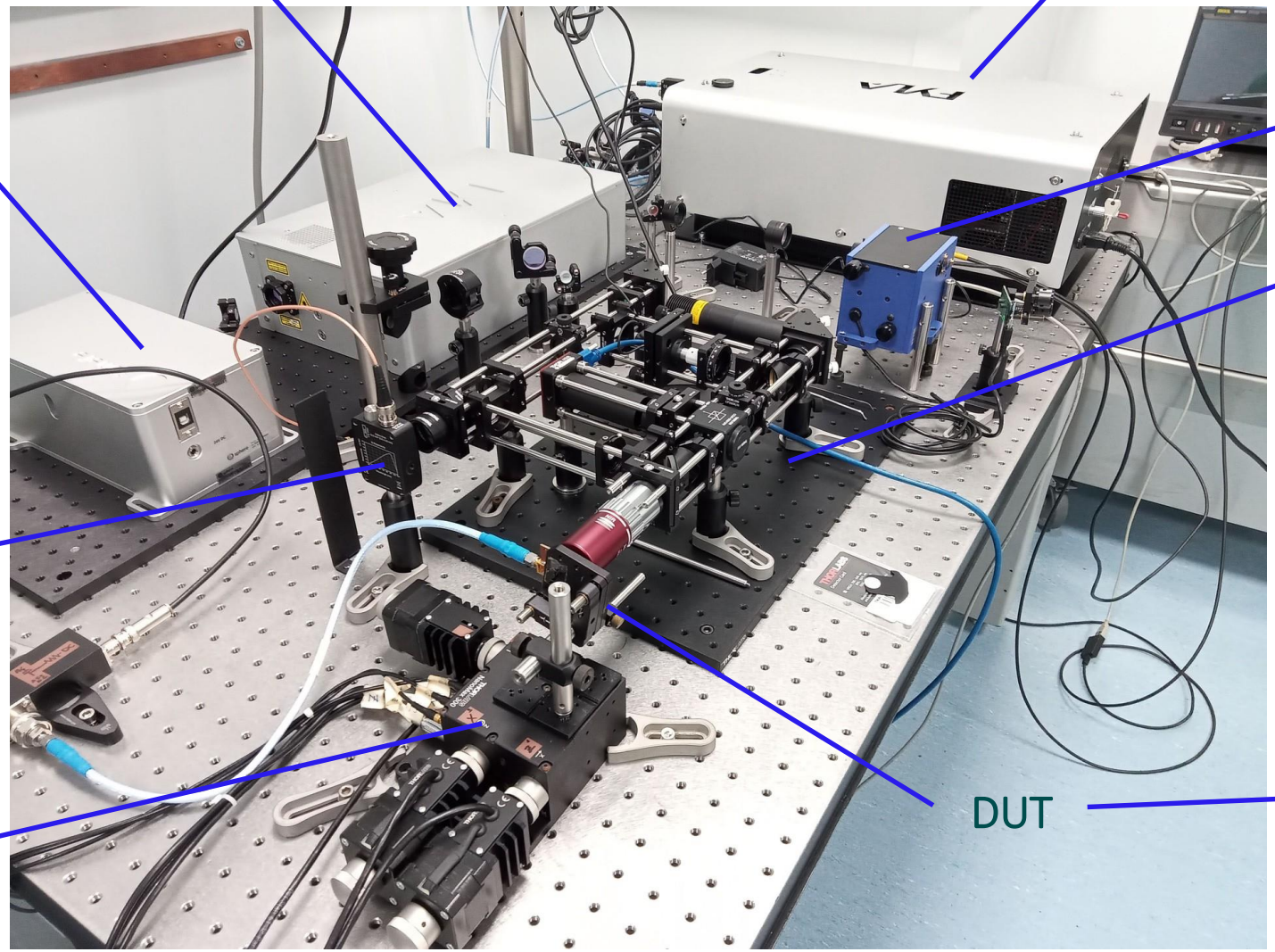
- Description of the fiber laser setup at IFCA
  - Integrated optical bench
- TPA-TCT signal stability studies.
- Compensation of TPA signal fluctuations using the 2nd harmonic.
- Initial commissioning measurements: z-scan
- Summary and Outlook

Setup description and measurement conditions

Beam conditioning (pulse picker, attenuation)

Fiber laser

Pulse stretcher



Autocorrelator

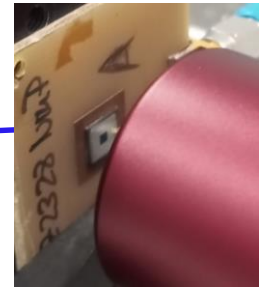
Integrated optical bench

- λ=1550nm
- Repetition rate 100Hz (up to 8MHz)
- energy per pulse up to 10nJ
- full detail in FYLA´s talk in this session.

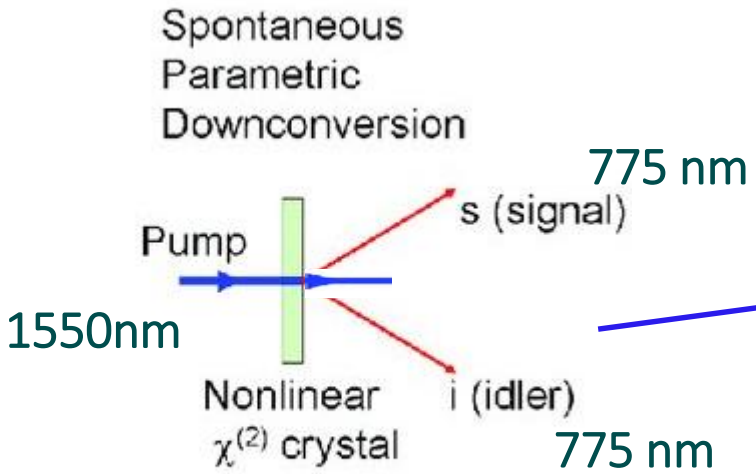
2ω monitoring diode

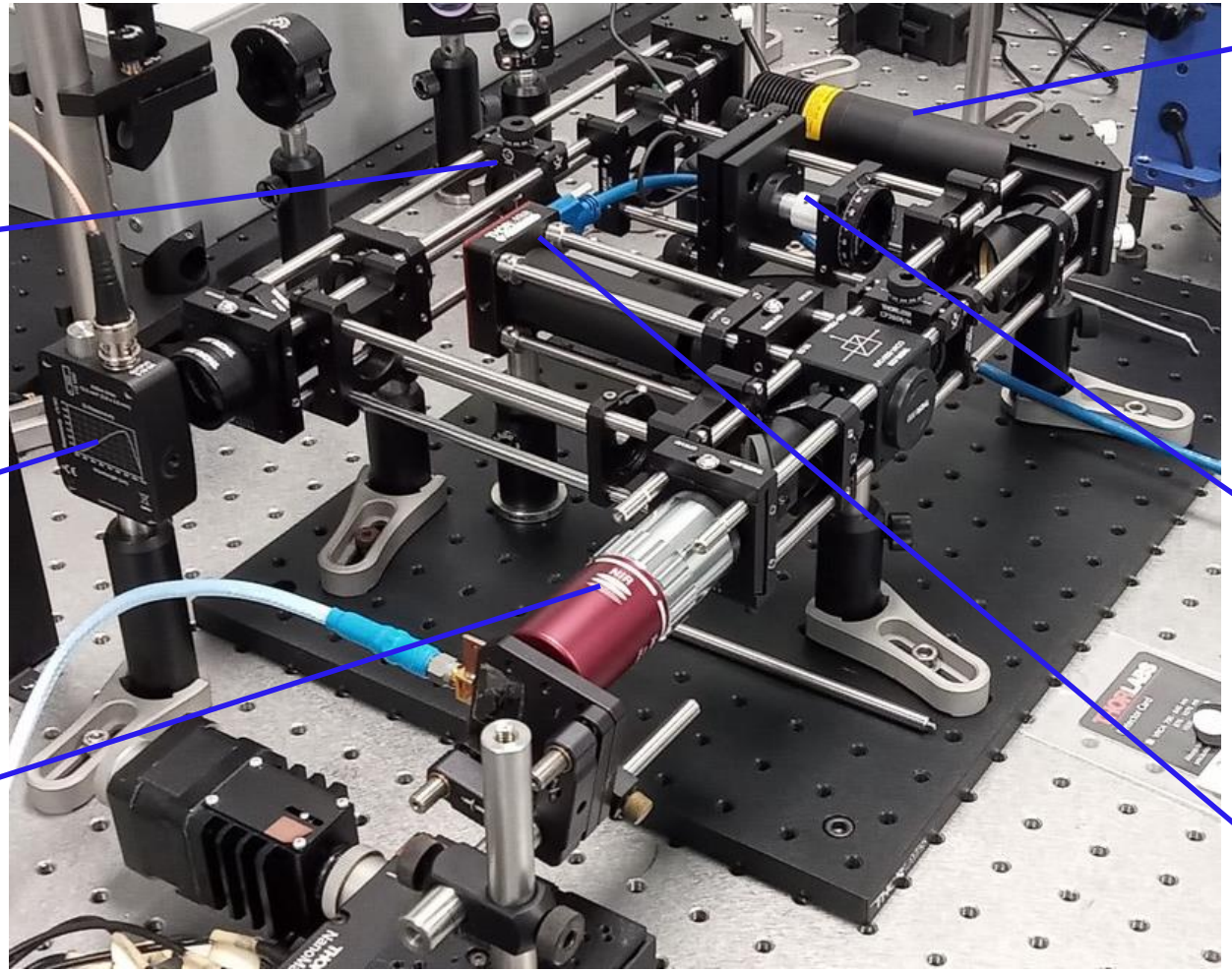
Motorized Stages

DUT



Setup description and measurement conditions (2)





White light
Lamp for
imaging

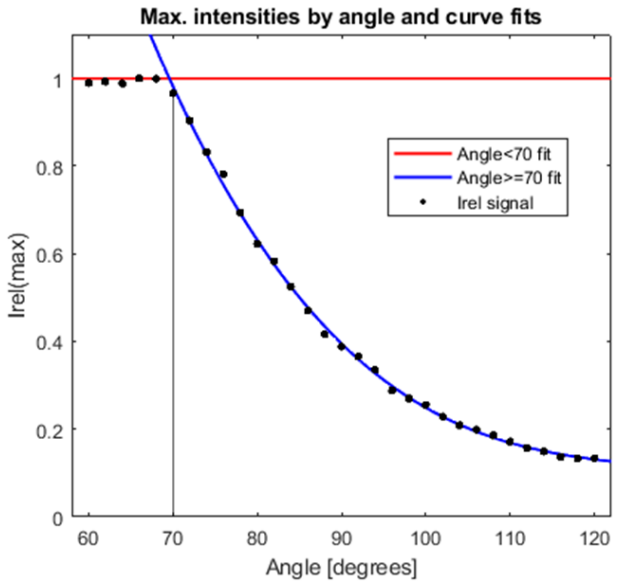
Diode Read
laser
for beam
alignment

CMOS
Focus
Imaging
camera

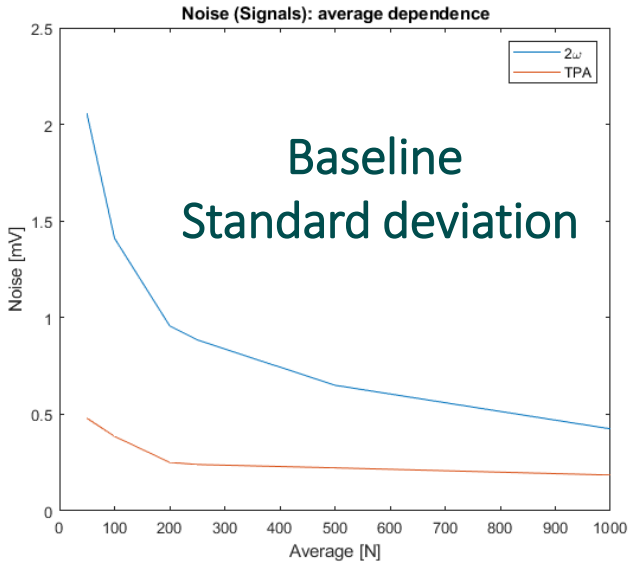
Conventional Si
Photodiode for
2ω monitoring

Microscope
Objective

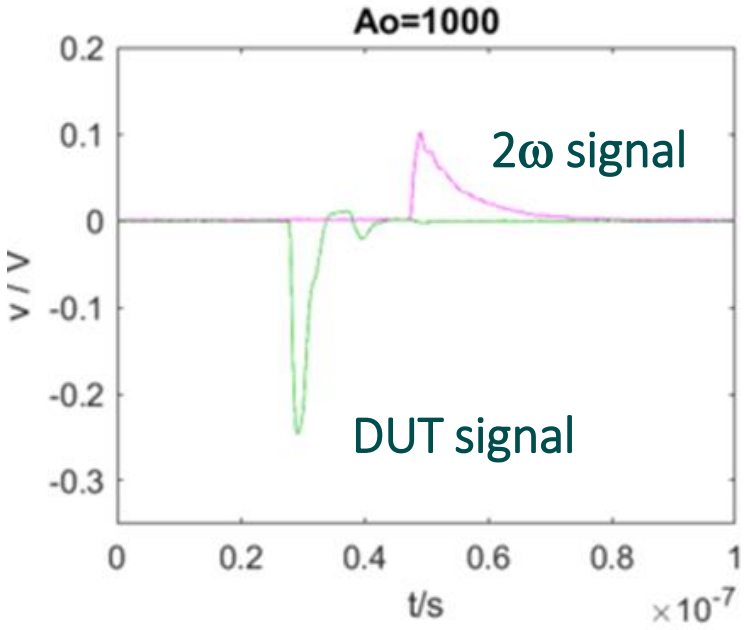
Setup description and measurement conditions (3)



Fine tuning of pulse energy possible



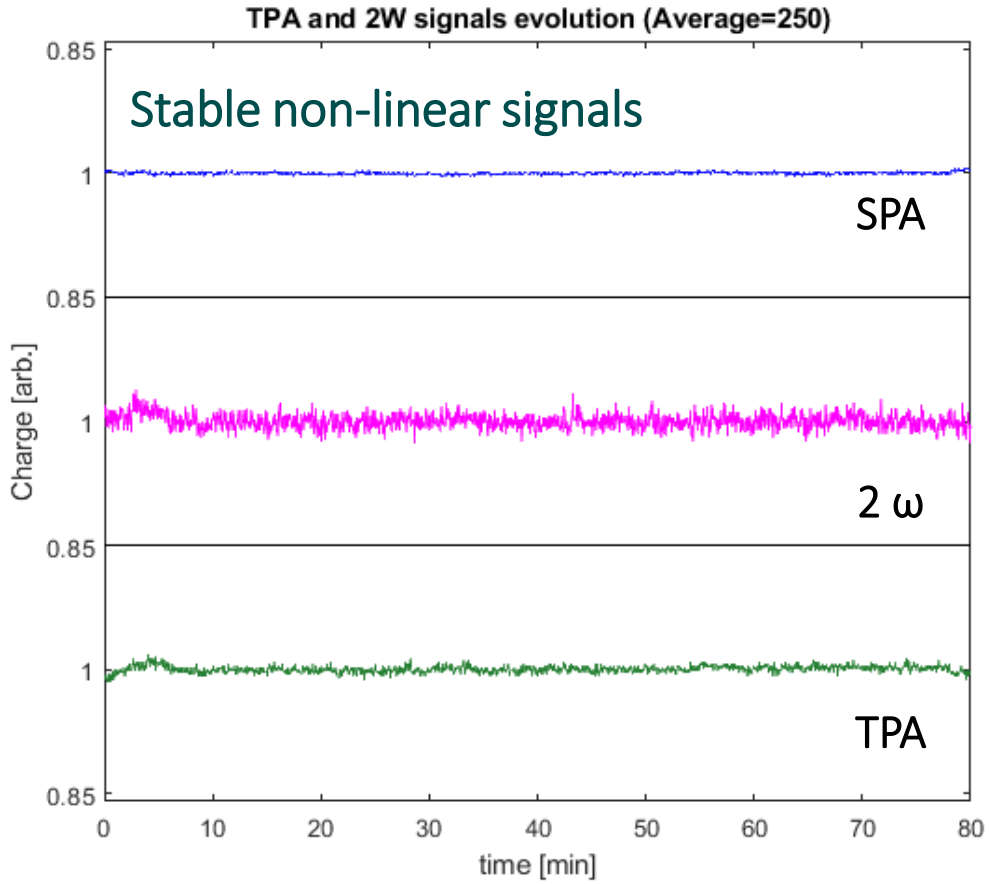
Pick-up EM noise
Suppressed by averaging

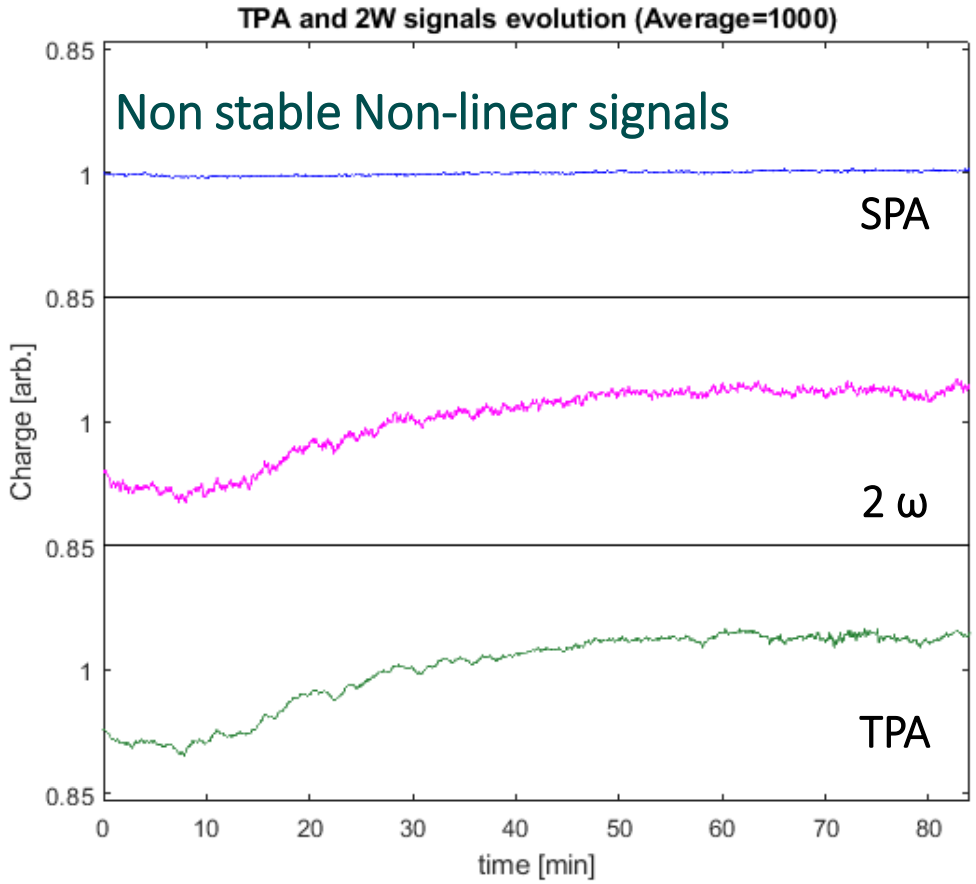


Good SNR in transient current

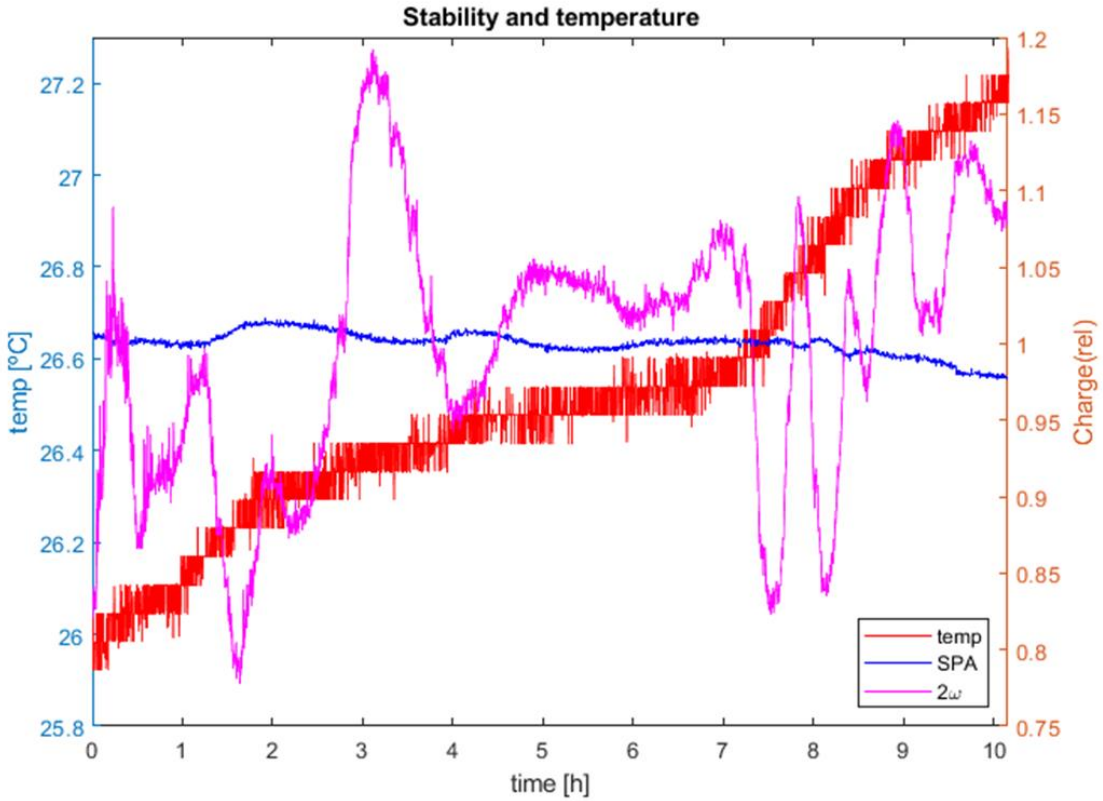
SPA, TPA and 2w signal stability

– Laser power (excellent stability) does no guaranty non-linear signal stability

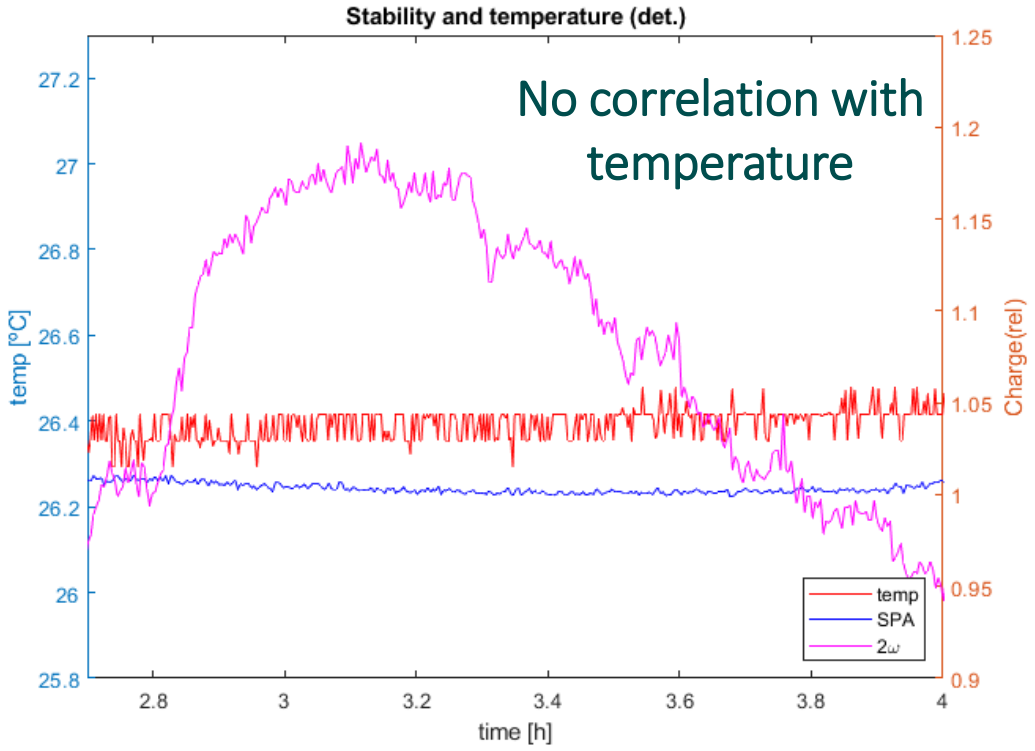




Non linear Signal Long term Stability

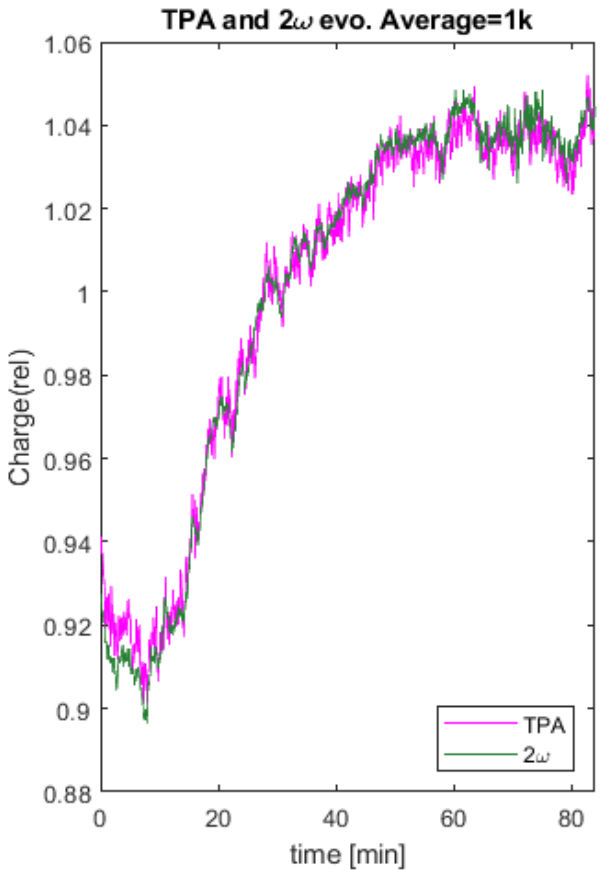


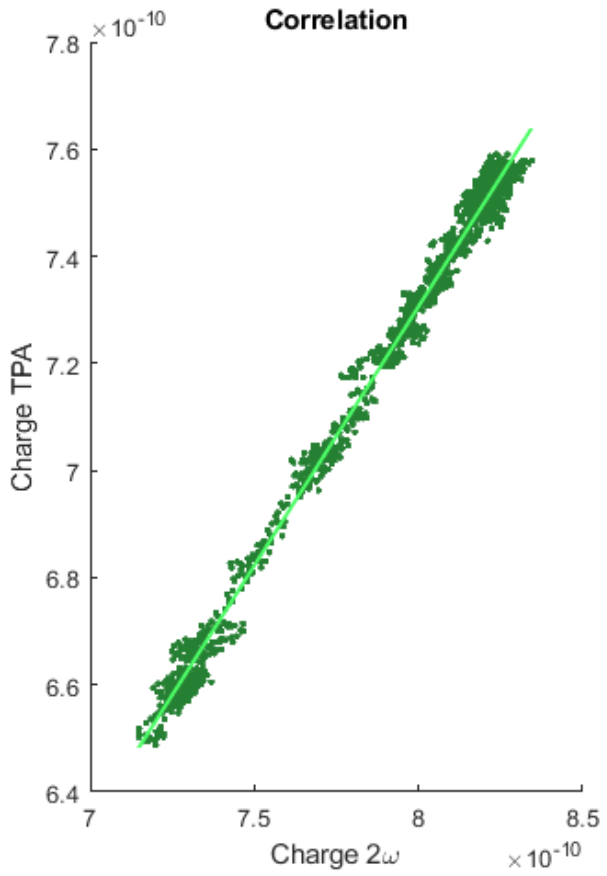
After more than 10 hours of laser warming up

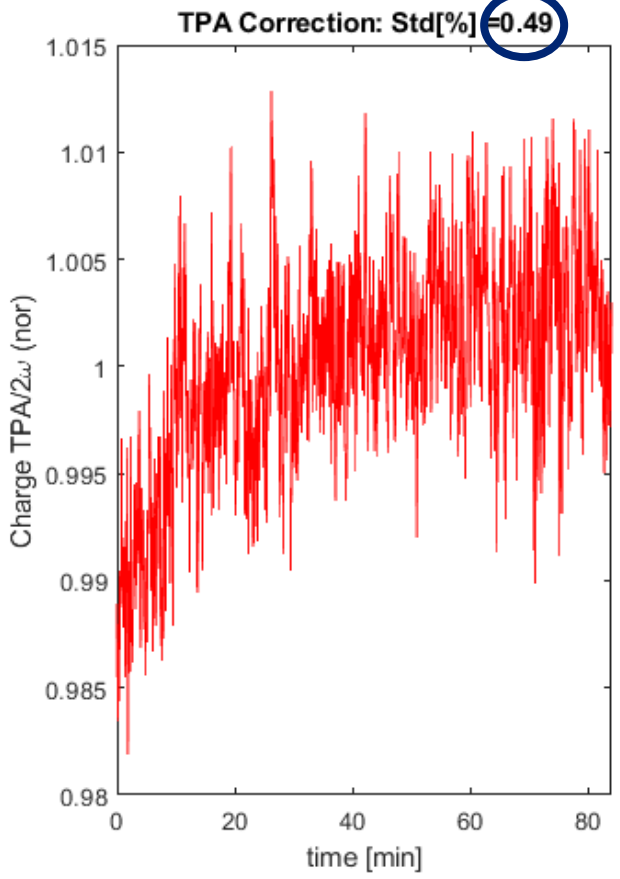


Generation of 2nd harmonic and TPA vs 2ω correlation

Non-linear signals present and excellent correlation, 2ω signal can be used to correct for TPA signal drifts



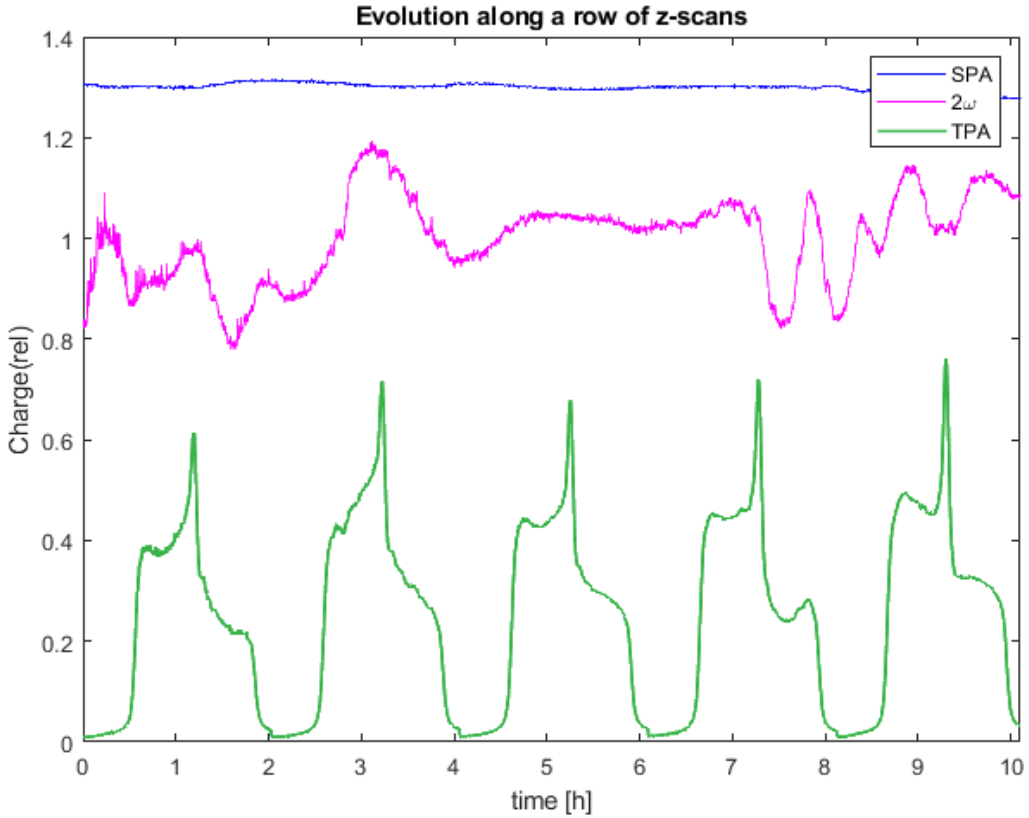




Corrected TPA stability Below 1%

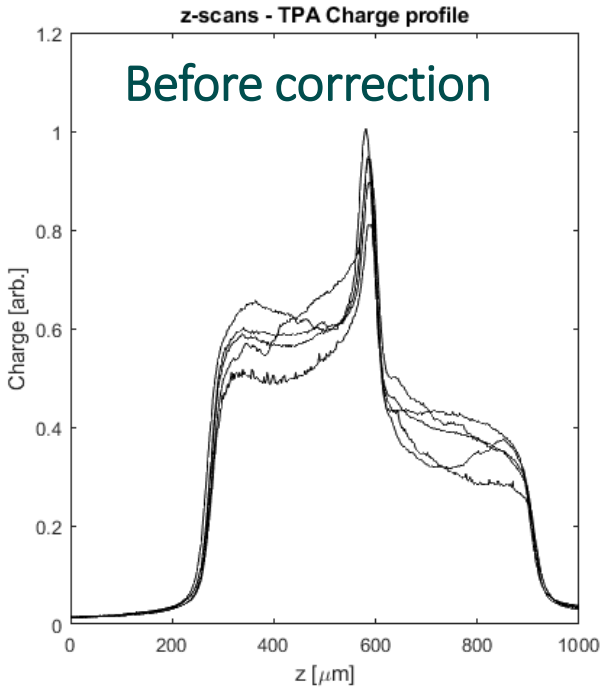
2w compensation in a z-scan

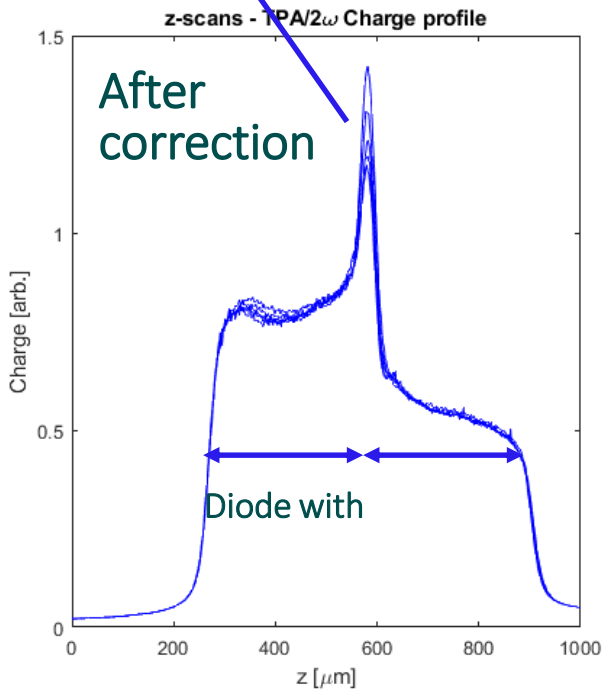
Does it work also for a canonical z-scan experiment?



Five consecutive high-resolution z-scans over a 10h period

Effect of backside Reflection when focus Placed on it

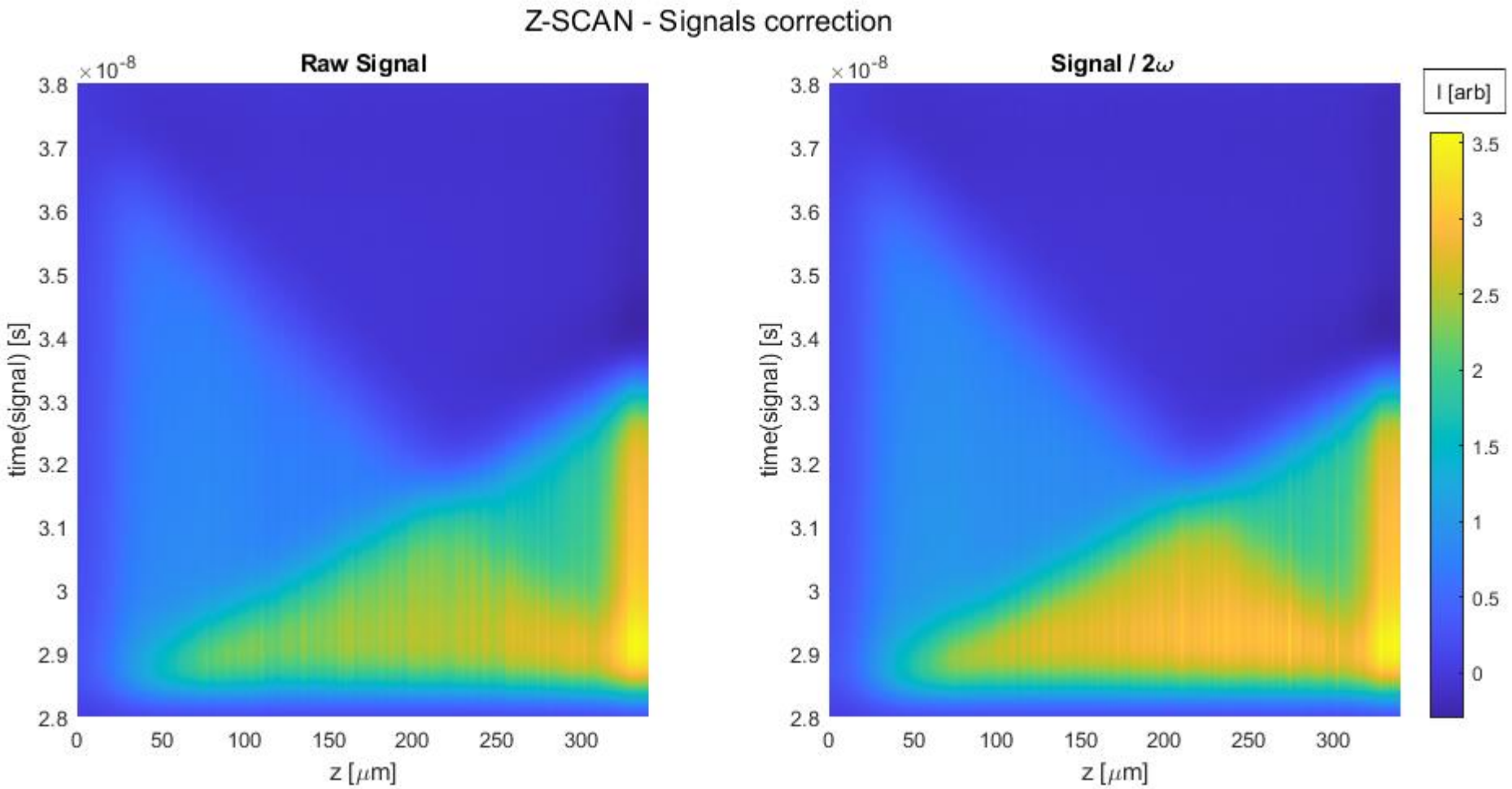




DUT about 300um FZ n-in-p diode with back-side fully metalized (100% reflectivity)

2w compensation in a z-scan

Canonical current – Z plot after correction recovers sharpness



Summary and Outlook

- The fiber laser based TCT-TPA system commissioning at IFCA in progress.
- Fully functional compact standalone optical bench successfully tested.
- Still missing important parts: faraday/black cage, cooling for irradiated samples.
- Non-stability of non-linear signals observed (5-20%).
- Correction of the TPA signal by the 2w signal recovers a TPA signal uniformity better at the 1% level with a negligible use of laser power for the 2w monitoring branch.
- Further studies on the origin of this non-stability are in progress, main suspicion is the non-stability of the laser spectrum inducing time profile changes in the pulses.