

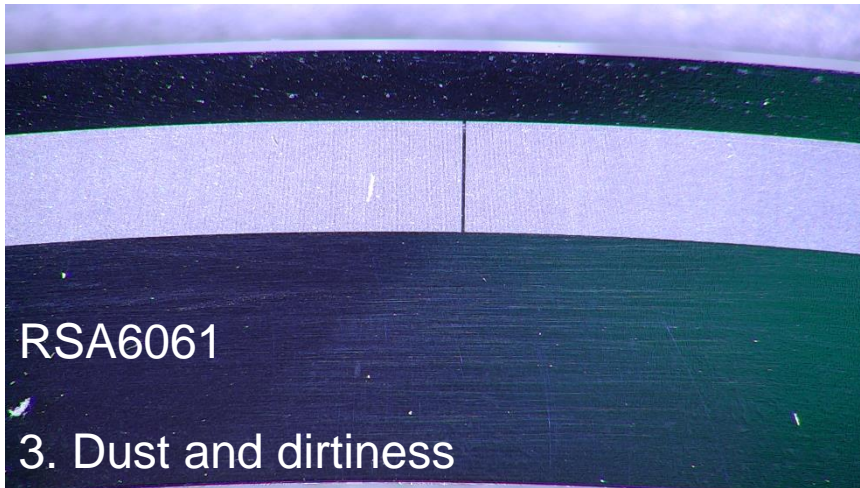
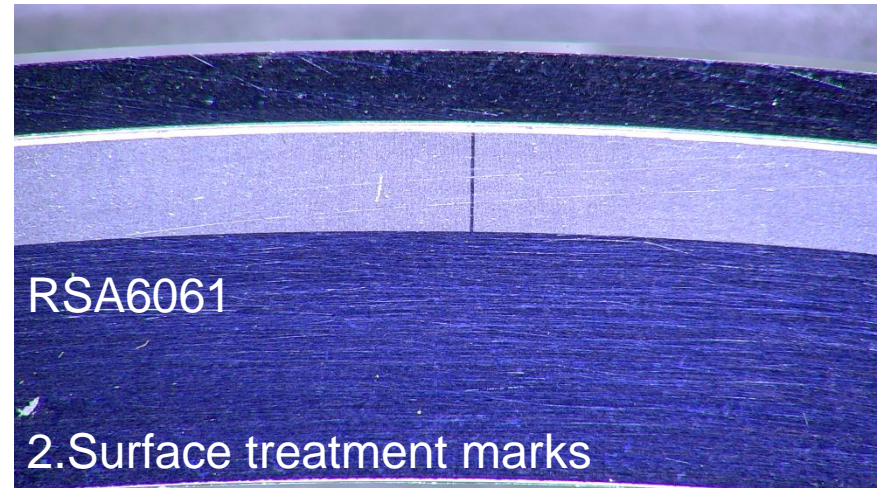
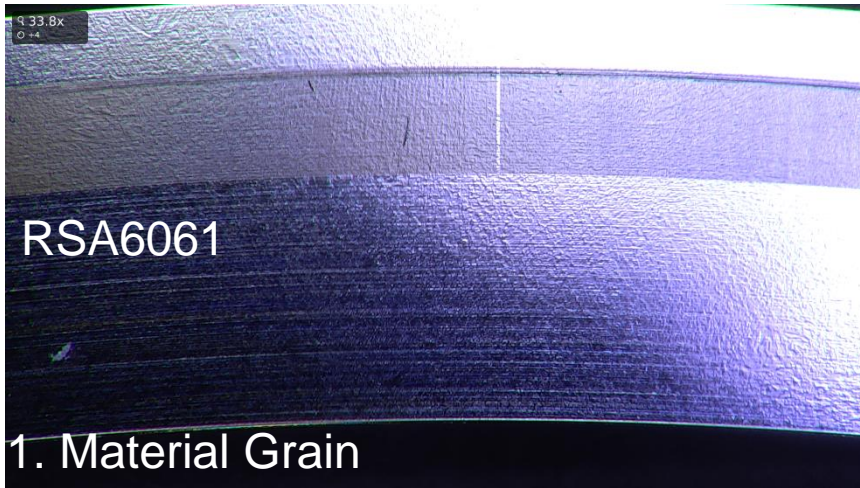
# Calibration with Metallic Disk PSB\_PXBWSRA005\_CR000001 (Results with Shaft exchanged)

J.L. Sirvent  
BE-BI-PM

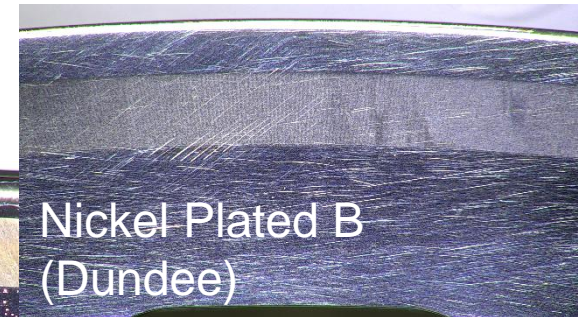
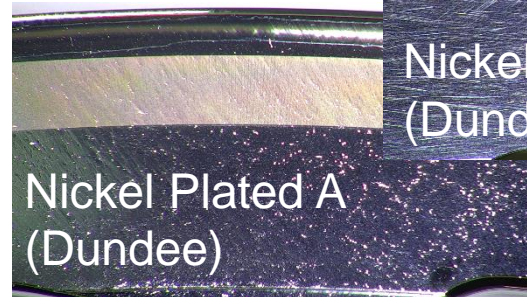
WS Acquisition Electronics  
23/02/2018

# 0. Some pictures of the disk

## 0.1 RSA6061 Full Size Disk After Engraving



Previous samples



# 0. Calibrations performed

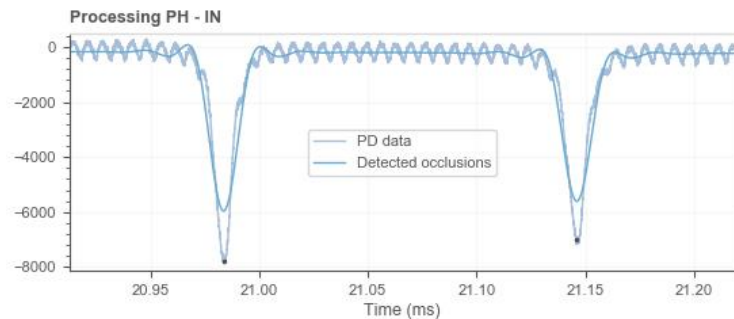
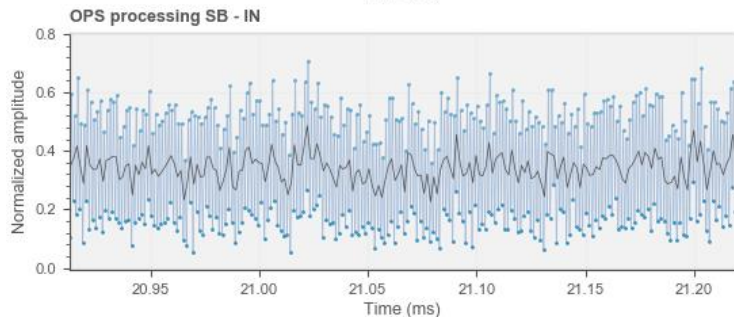
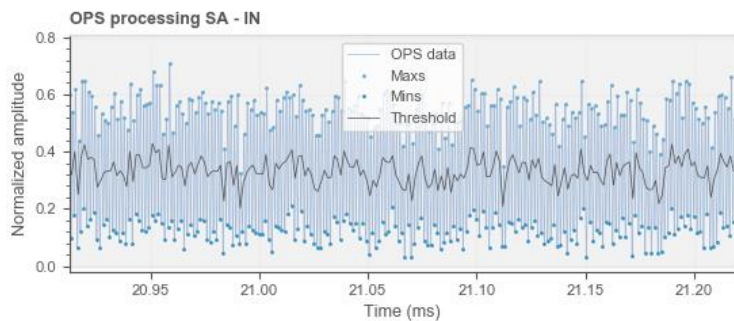
## 0.1 Operation with PSB\_PXBWSRA005\_CR000001

- **Scanner operation summary with Metallic Disk:**
  - Speed 133rad/s (150rad/s max)
  - Dev. Kit control electronics
  - 1 Single point calibration [~200 scans]
    - SN65\_\_2018\_02\_09\_\_11\_17
  - 5 Full calibrations [~1450 scans]
    - SN65\_\_2018\_02\_09\_\_11\_41
    - SN65\_\_2018\_02\_14\_\_10\_05
    - SN65\_\_2018\_02\_15\_\_11\_41
    - Mechanical problem detected (Shaft replaced)
    - SN65\_\_2018\_02\_23\_\_11\_17
    - SN65\_\_2018\_02\_23\_\_12\_07
  - Total # of scans ~ 1650
  - Control App. Crash after ~80-120 scans
    - Calibrations stopped & re-started

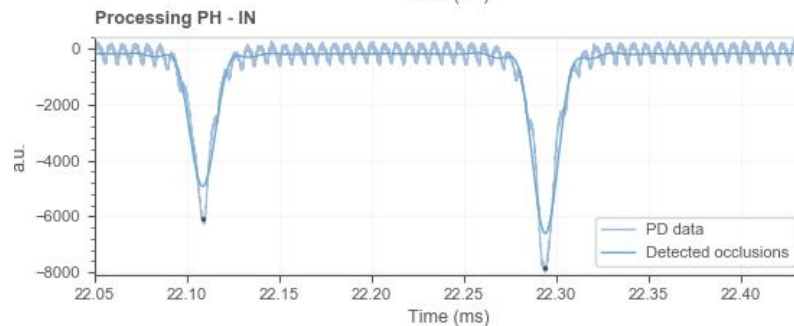
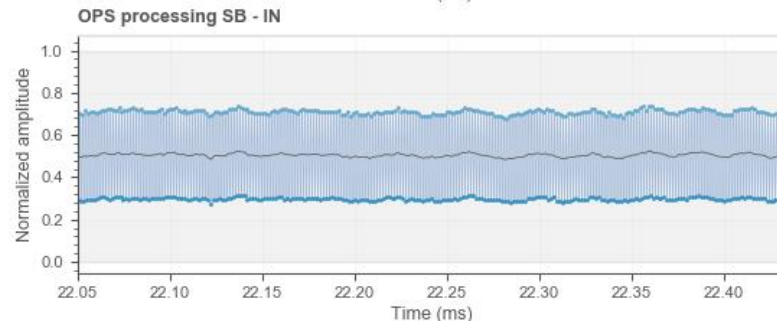
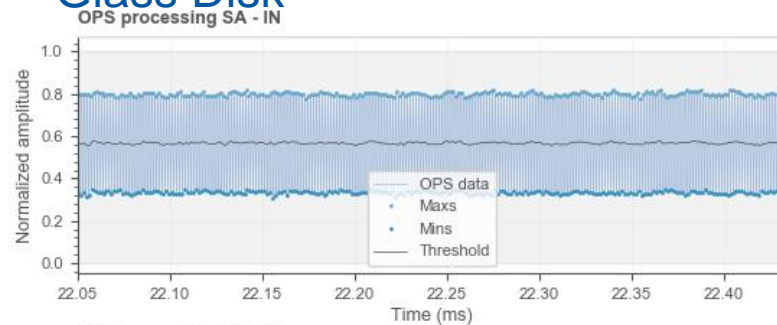
# 1. Raw signals for analysis

## 1.1 Metal Disk optical signal + Photodiode

### Metal Disk



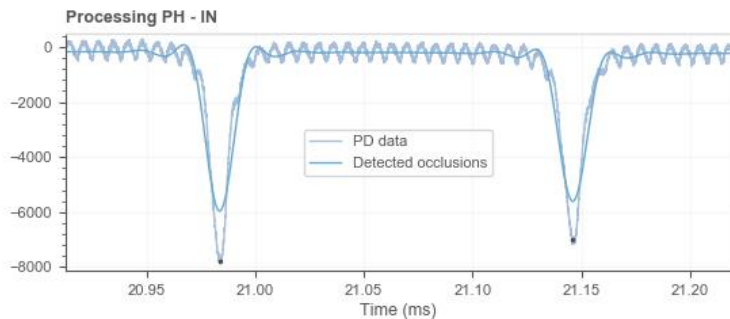
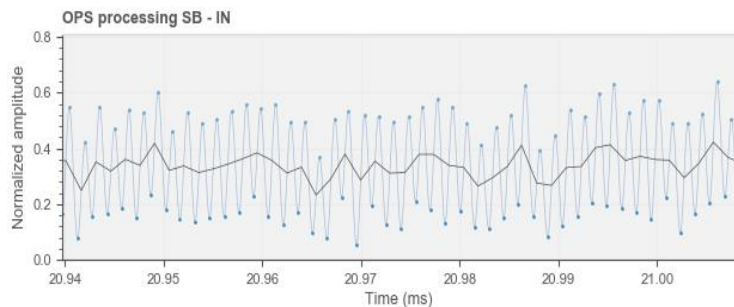
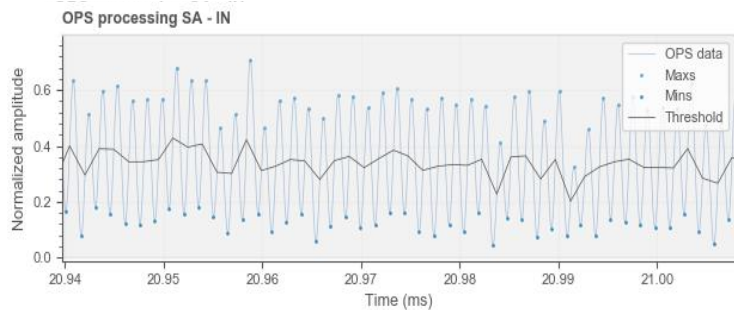
### Glass Disk



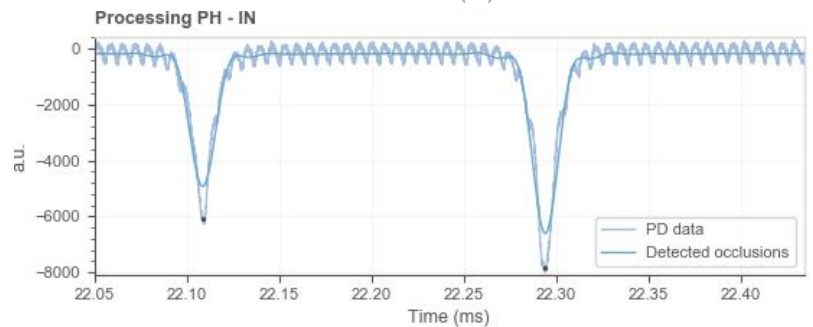
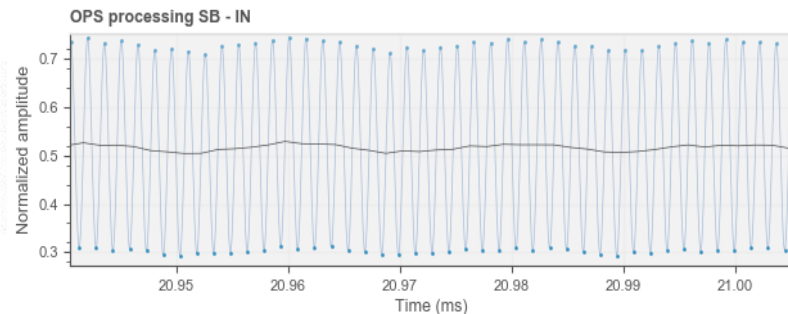
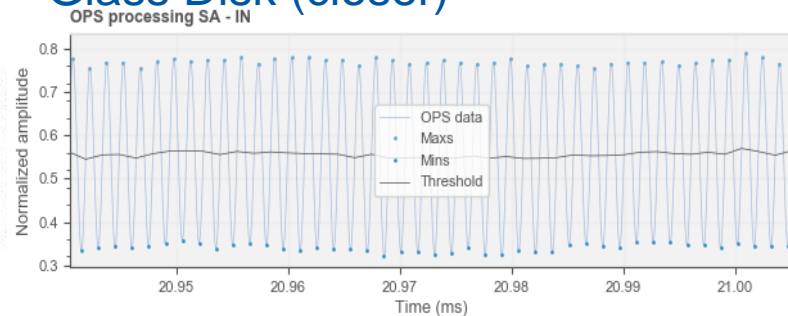
# 1. Raw signals for analysis

## 1.1 Metal Disk optical signal + Photodiode

### Metal Disk (closer)



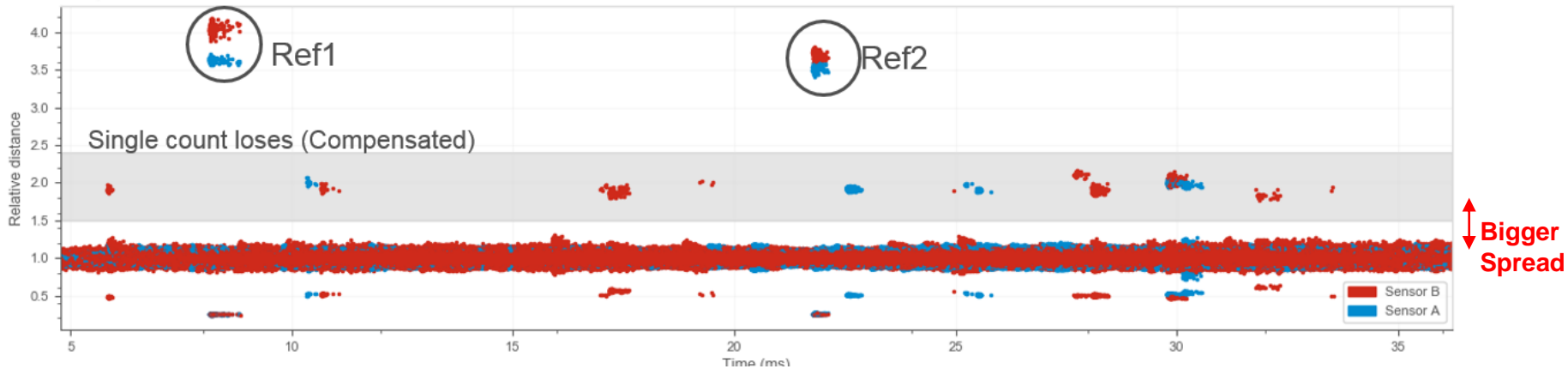
### Glass Disk (closer)



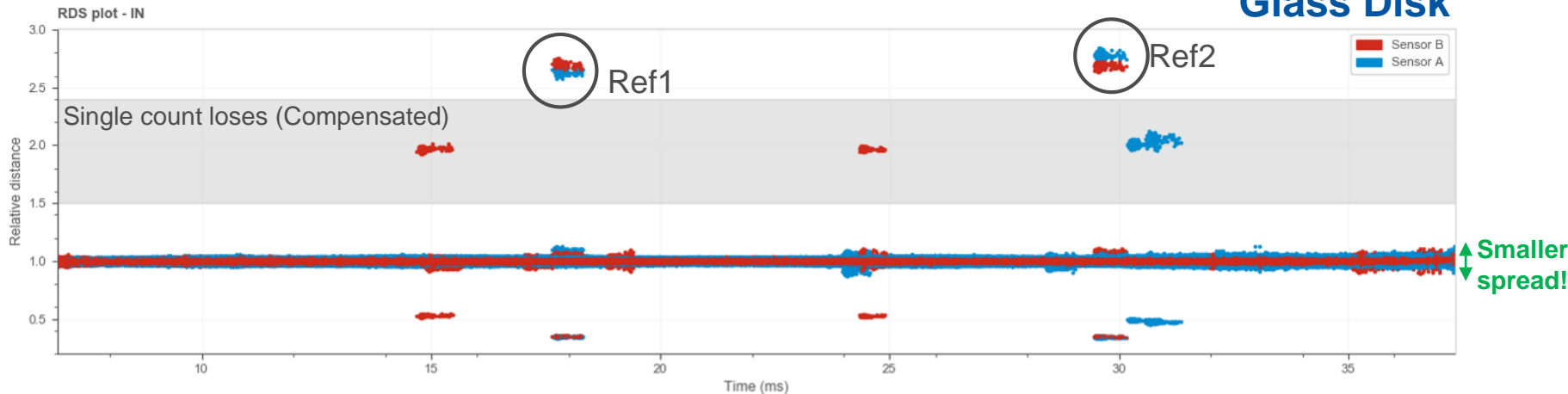
# 2. Position measurement sanity check

## 2.1 Finding references and loss counts

### Metallic Disk



### Glass Disk



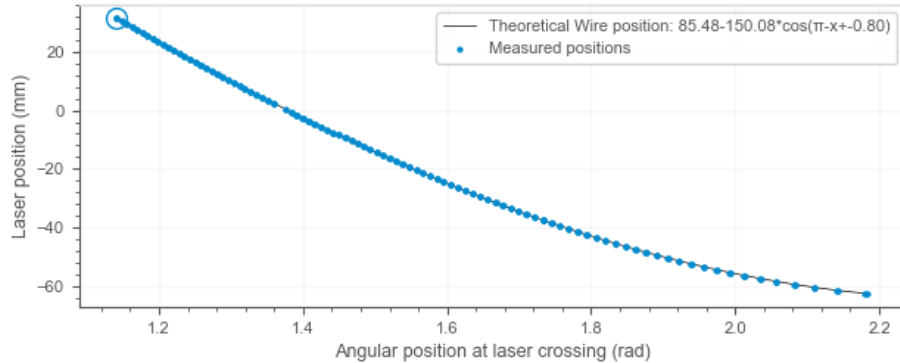
Post processed position from **glass disk** features **lower position uncertainty** (Better slit detection uniformity)

# 3. Scanner performance (Metal VS Glass)

## 3.1 Results on calibration bench

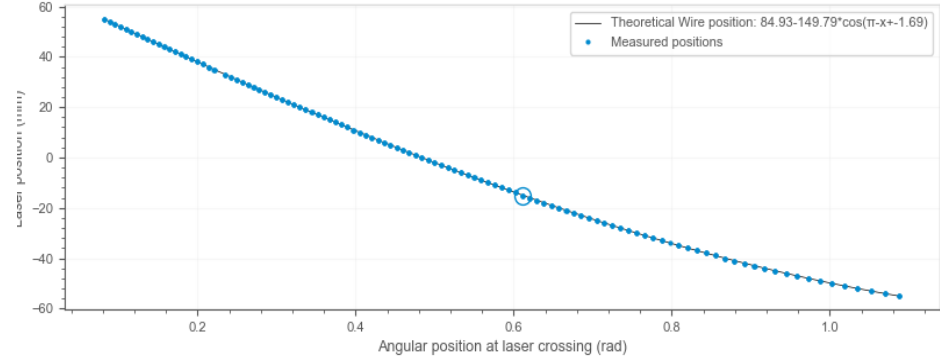
### Metallic Disk (IN)

Theoretical wire positions vs. measured positions

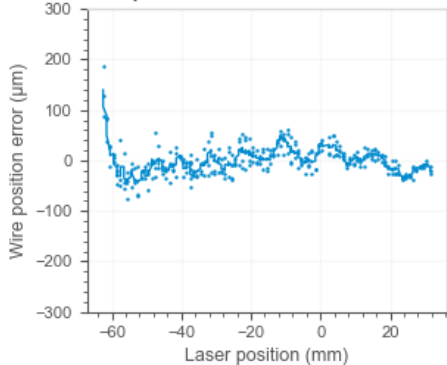


### Glass Disk (IN)

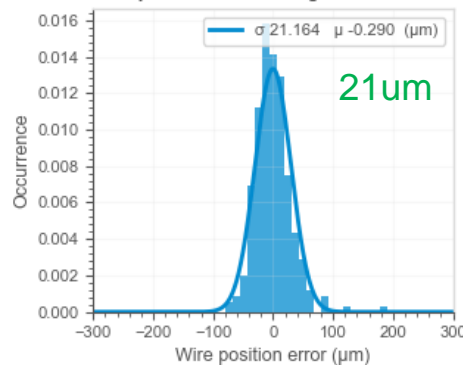
Theoretical wire positions vs. measured positions



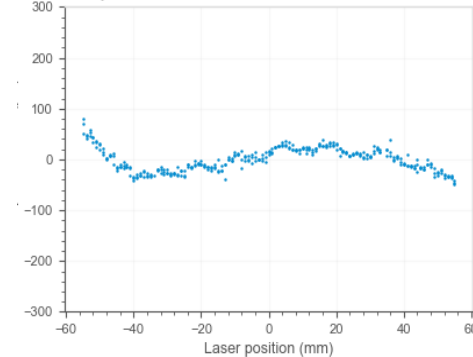
Wire position error



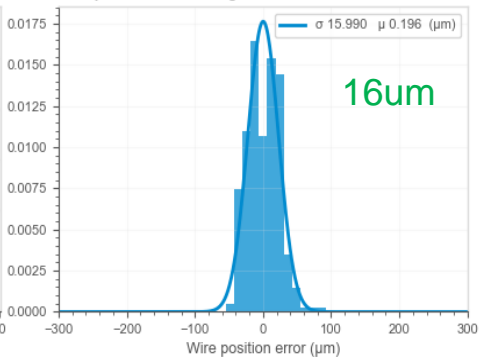
Wire position error histogram



Wire position error



Wire position error histogram

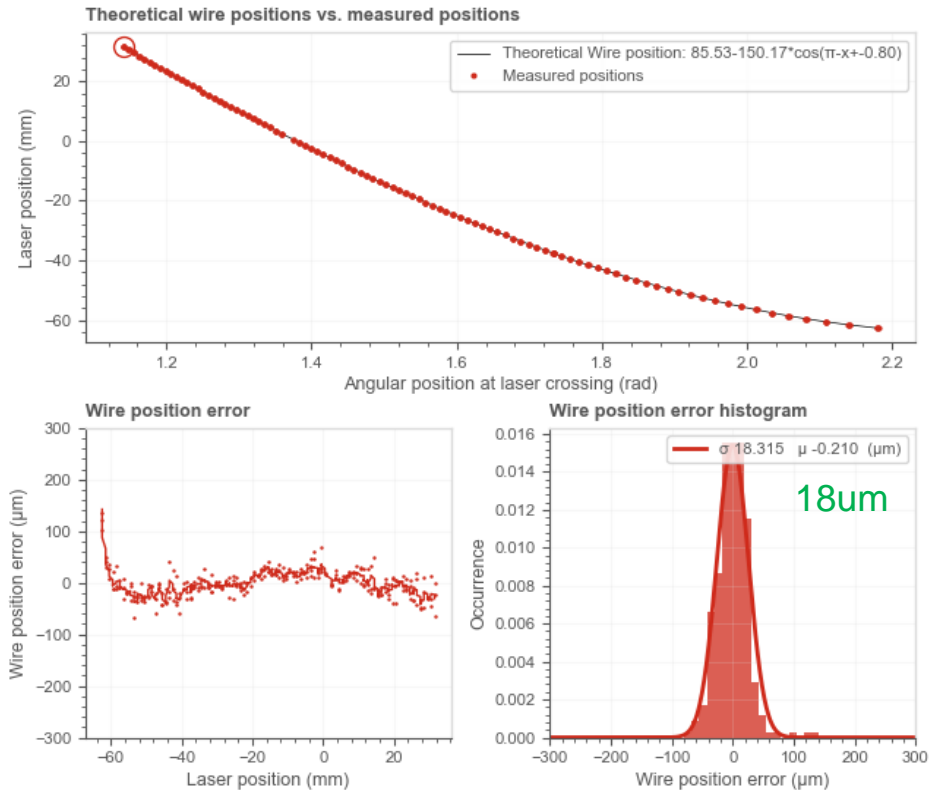


Same Scanner & control electronics

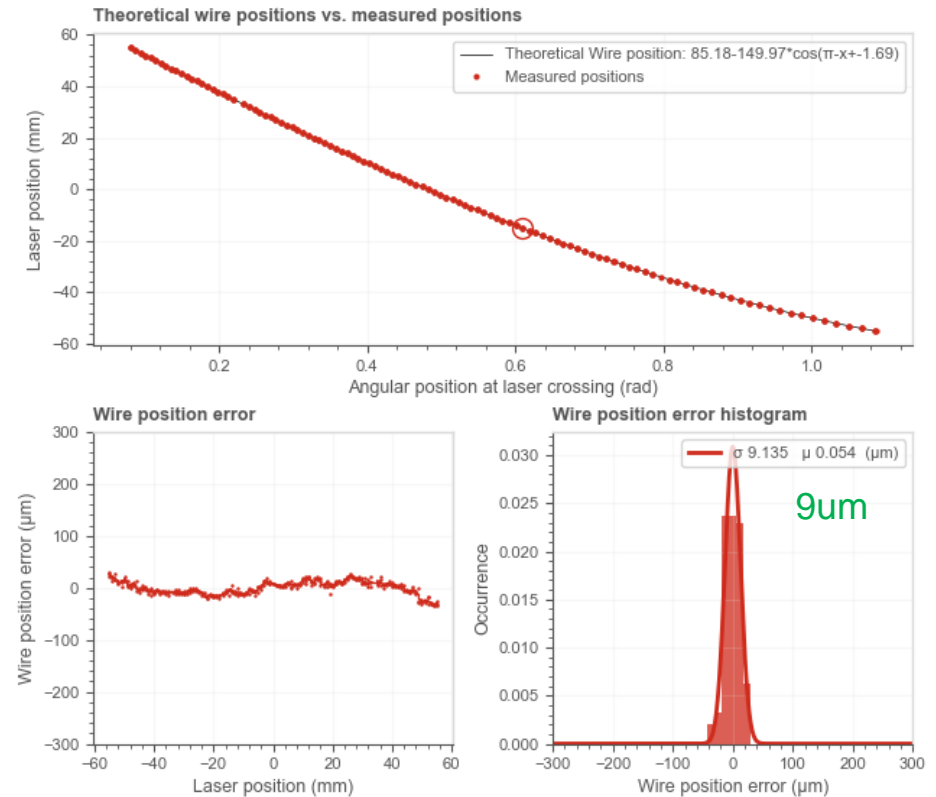
# 3. Scanner performance (Metal VS Glass)

## 3.1 Results on calibration bench

### Metallic Disk (OUT)



### Glass Disk (OUT)



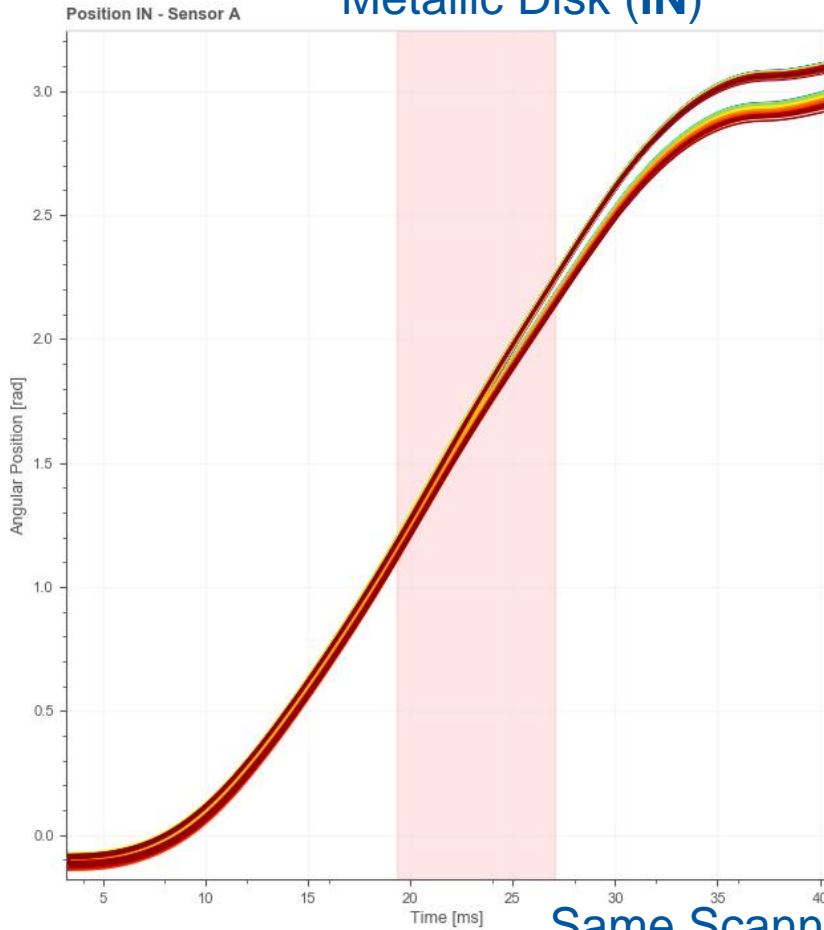
Same Scanner & control electronics



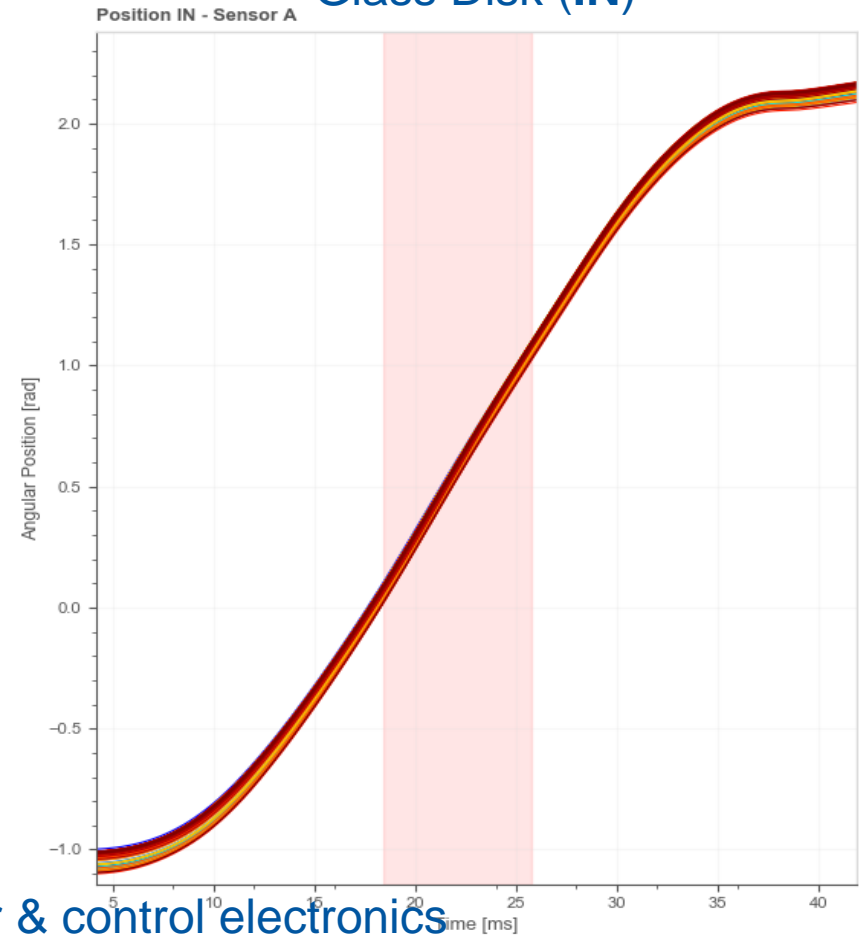
# 3. Scanner performance (Metal VS Glass)

## 3.2 Position profiles

Metallic Disk (IN)



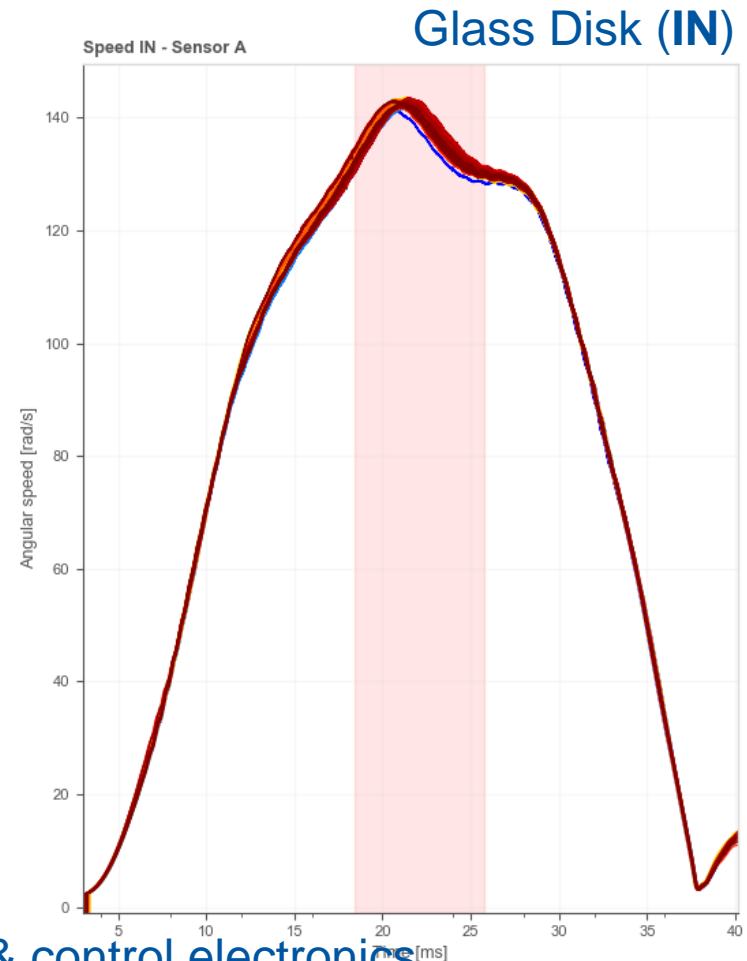
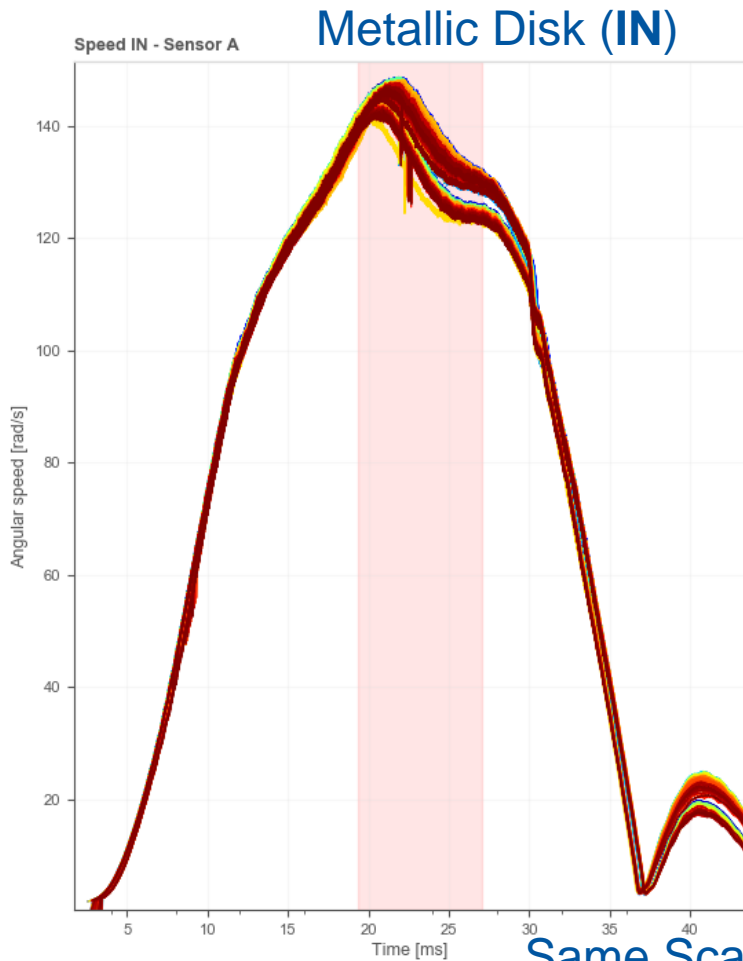
Glass Disk (IN)



Same Scanner & control electronics

# 3. Scanner performance (Metal VS Glass)

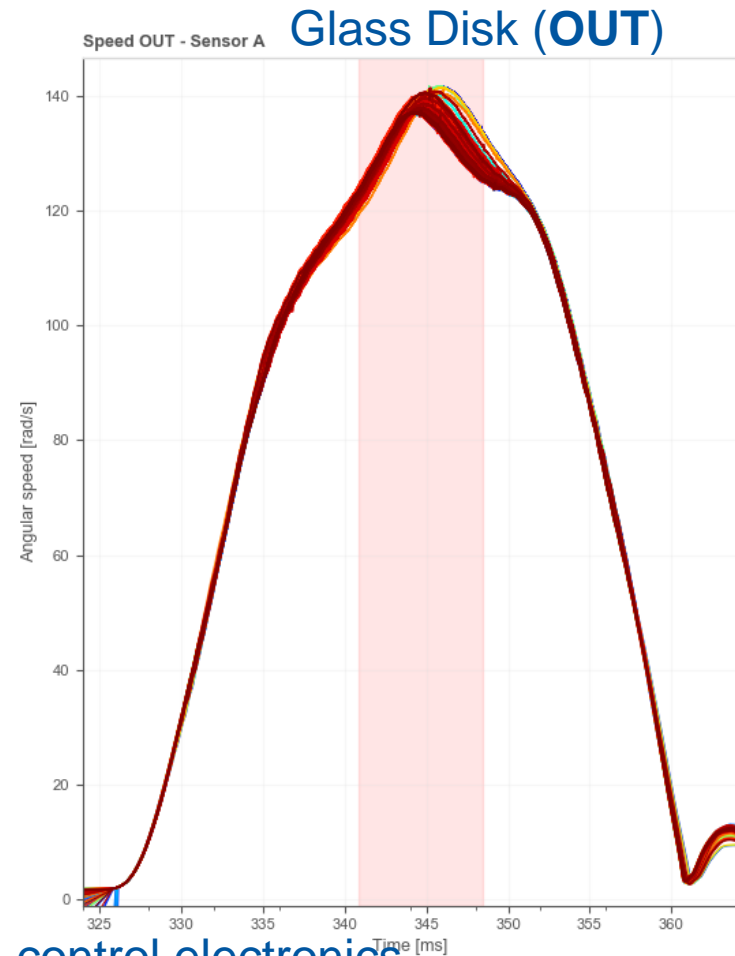
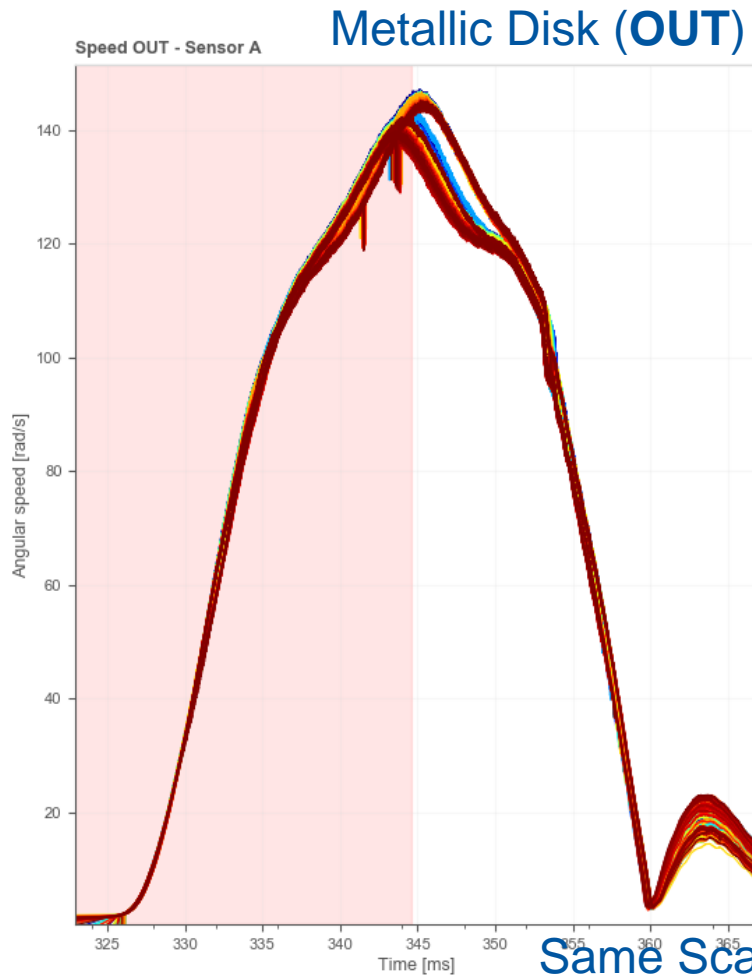
## 3.3 Speed profiles (~15% Less inertia = Higher speed)



Same Scanner & control electronics

# 3. Scanner performance (Metal VS Glass)

## 3.3 Speed profiles (~15% Less inertia = Higher speed)

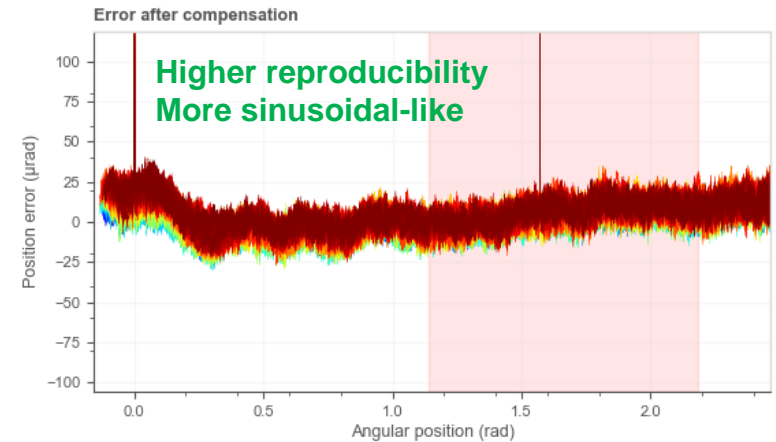
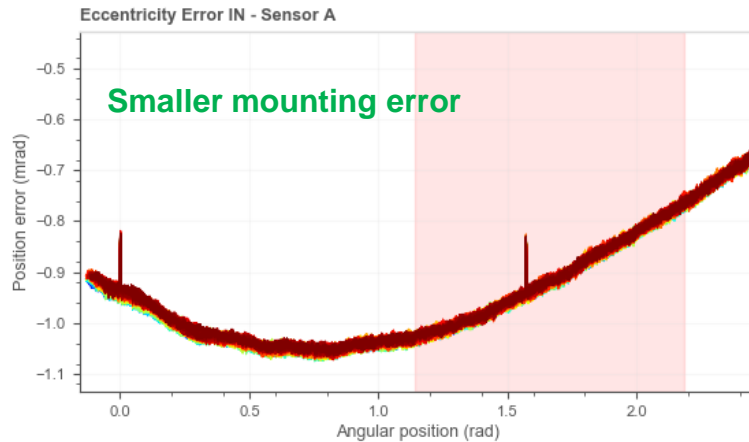


Same Scanner & control electronics

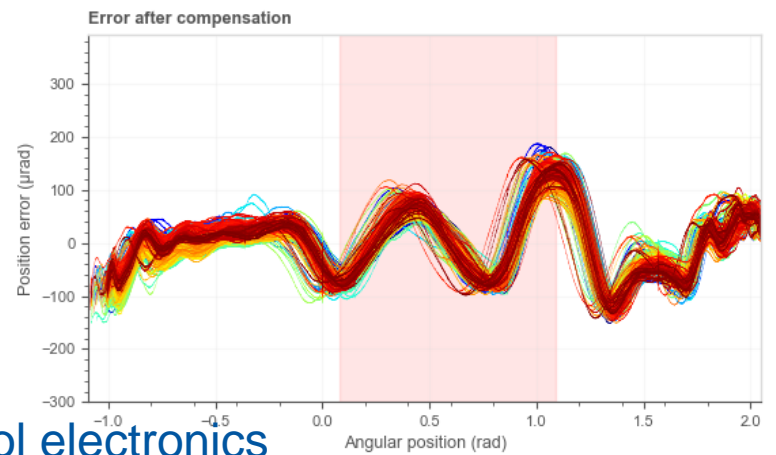
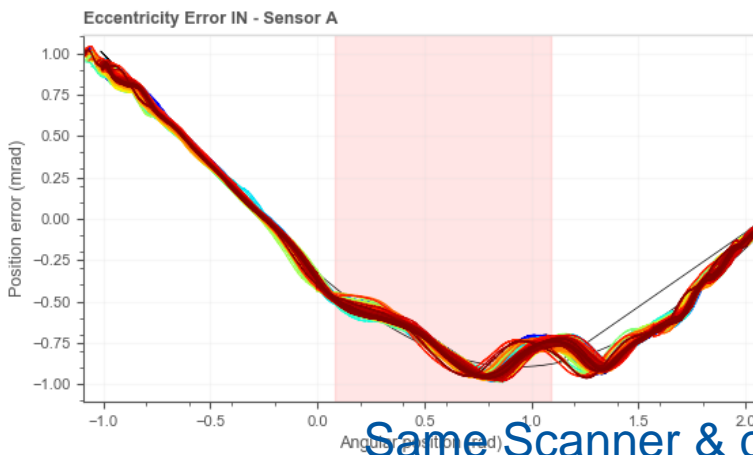
# 3. Scanner performance (Metal VS Glass)

## 3.4 Eccentricity compensation (highly reproducible, no drift)

### Metallic Disk (IN)



### Glass Disk (IN)



Same Scanner & control electronics

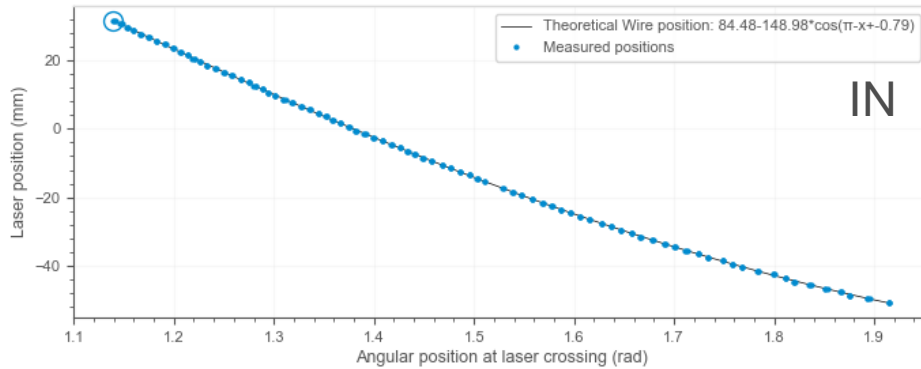


# 2. Full Calibration results

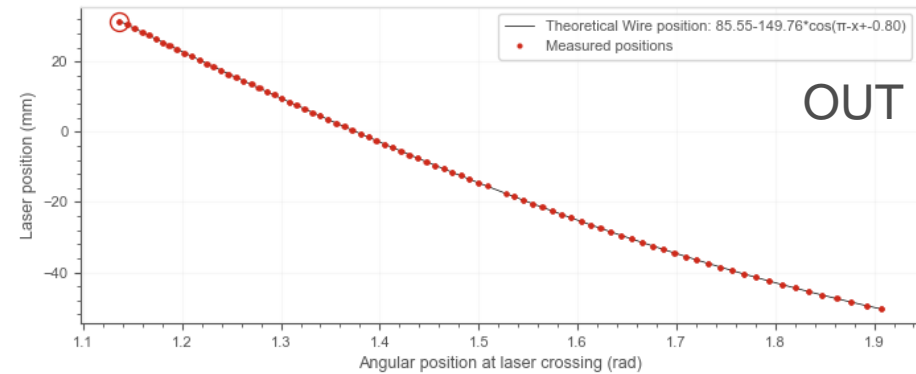
## 2.1 Calibration curves and position incertitude

Two calibrations with same configuration (different days) → Consistent results!

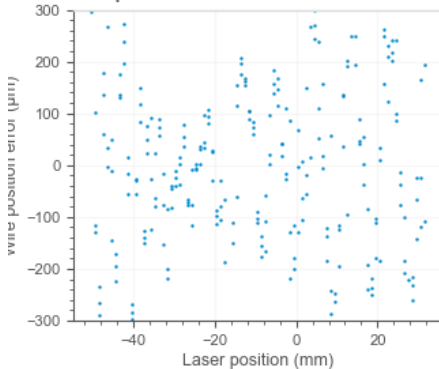
Theoretical wire positions vs. measured positions



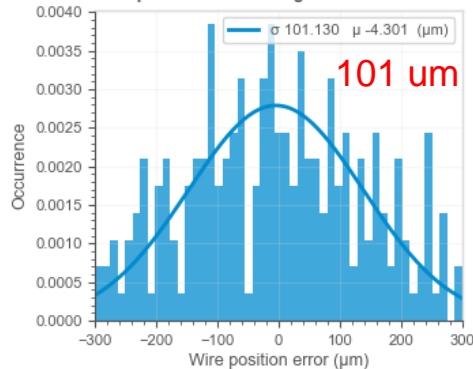
Theoretical wire positions vs. measured positions



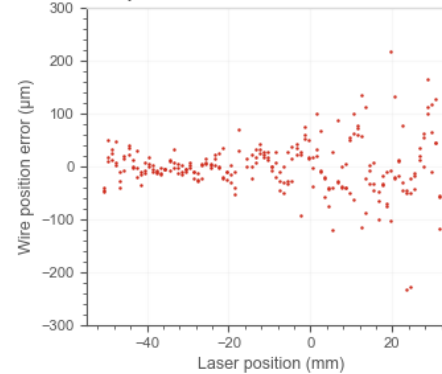
Wire position error



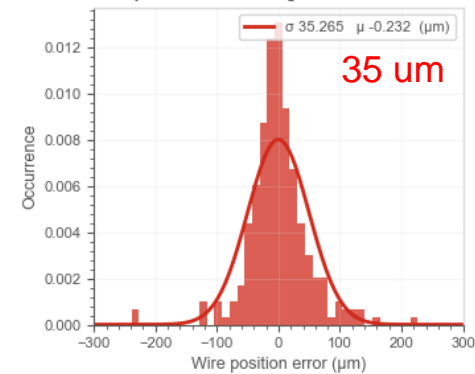
Wire position error histogram



Wire position error

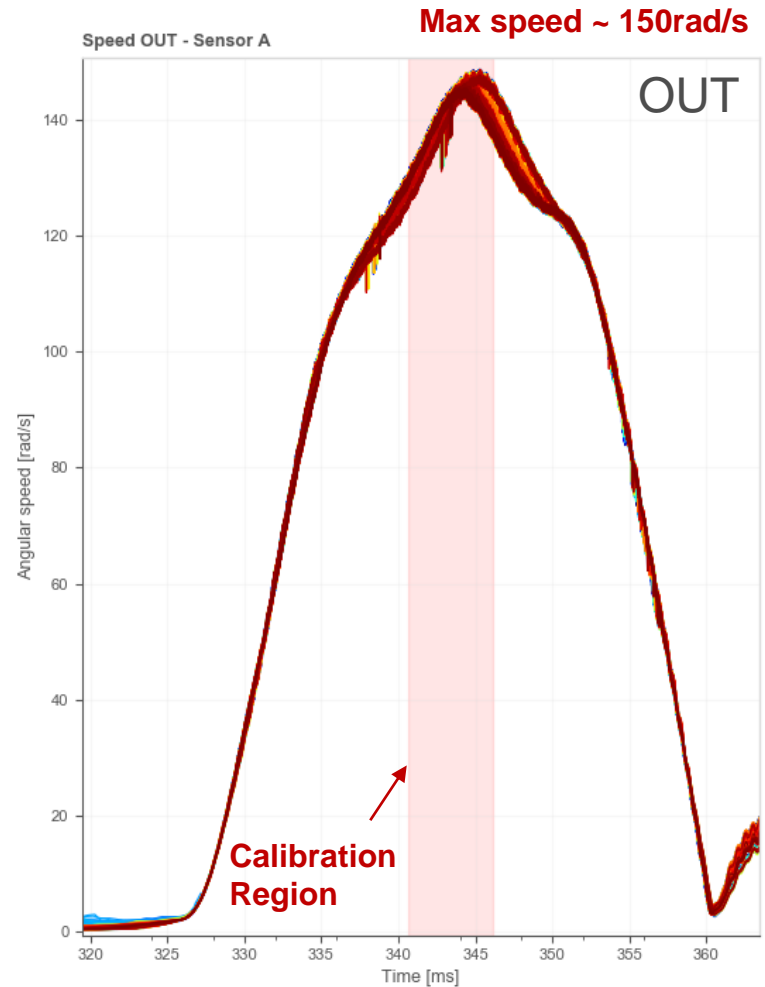
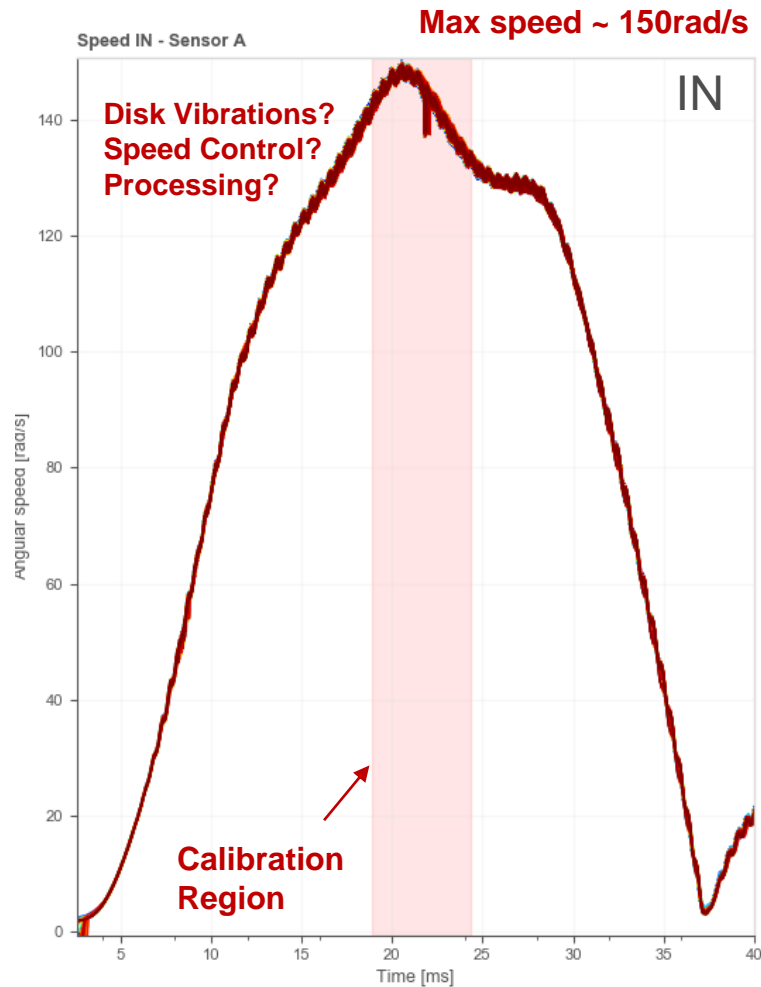


Wire position error histogram



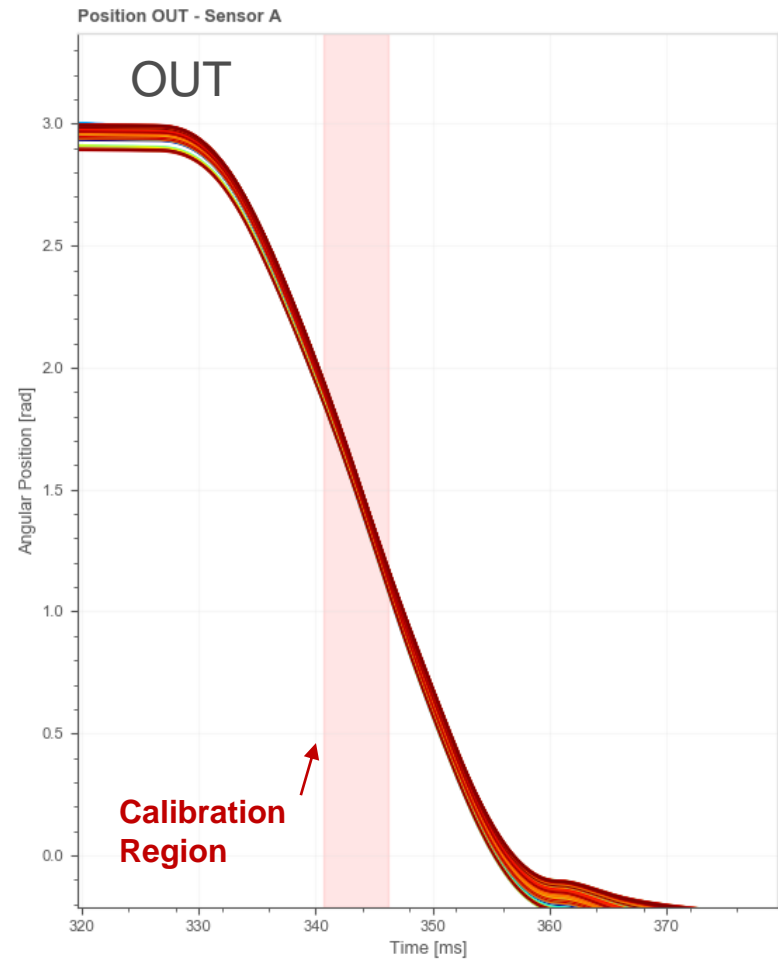
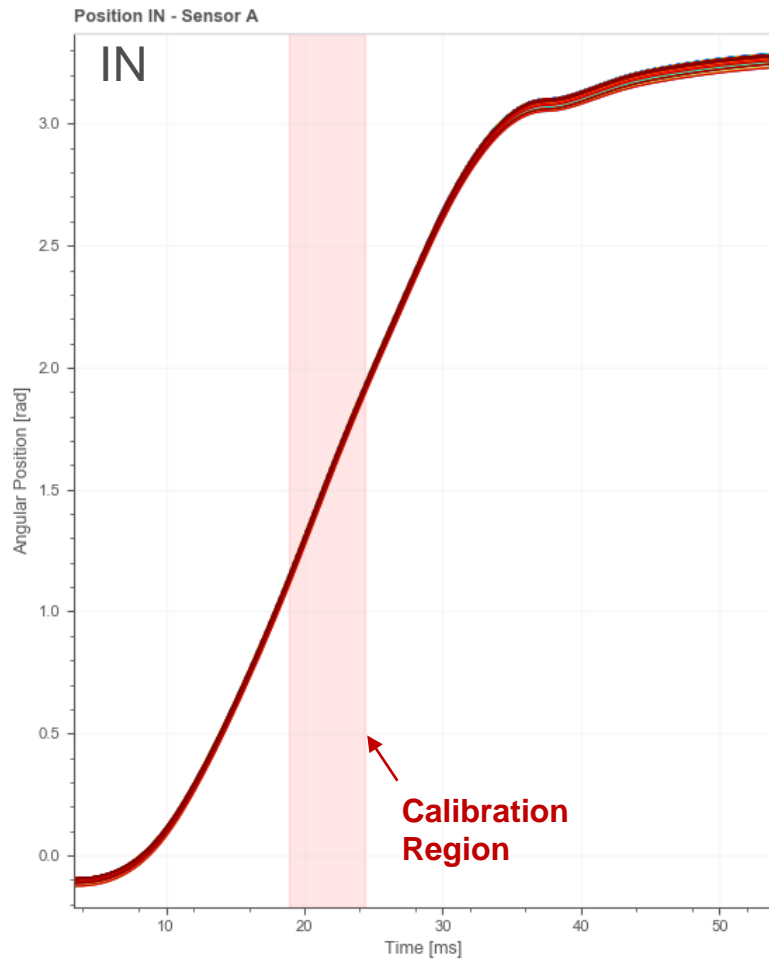
# 2. Full Calibration results

## 2.3 Scan Speed VS Time (260 curves)



# 2. Full Calibration results

## 2.2 Fork angular position VS Time (260 curves)

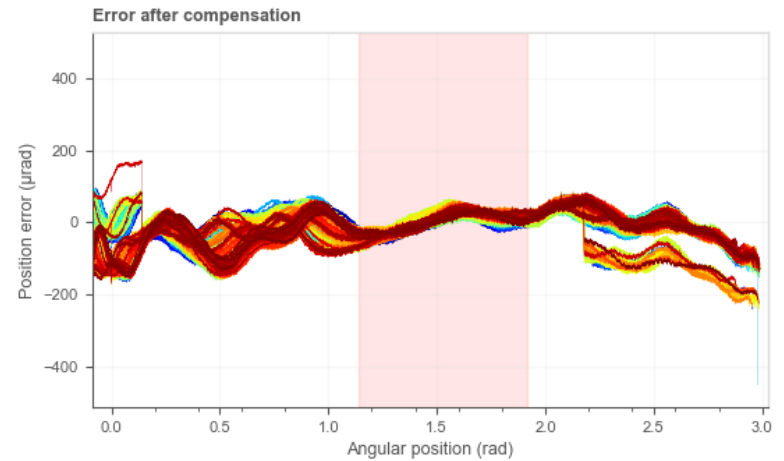
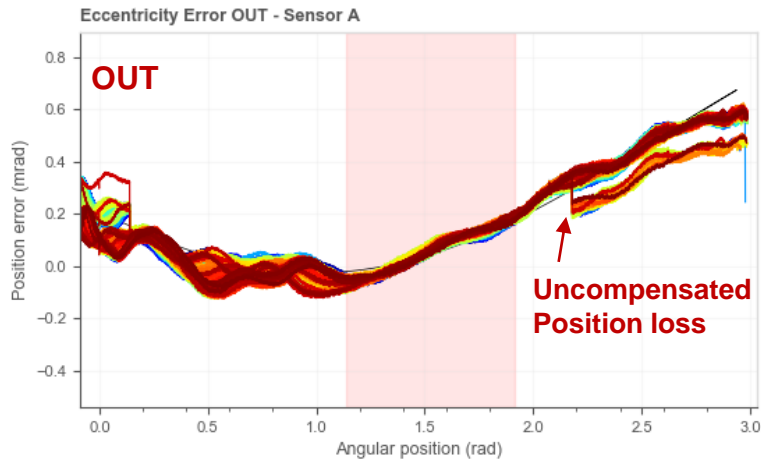
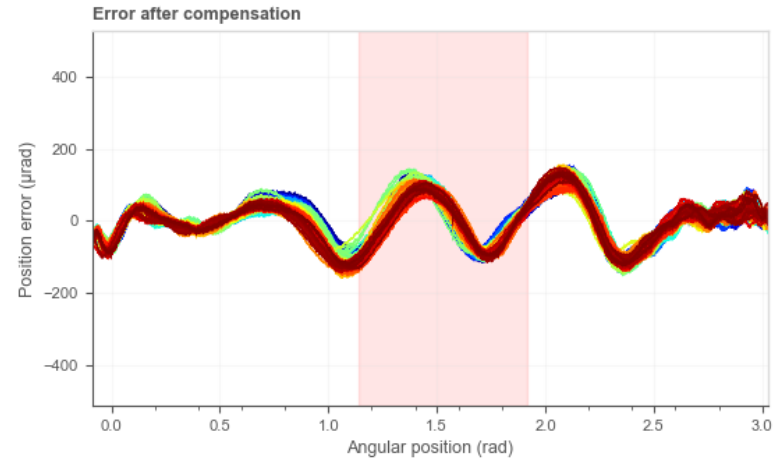
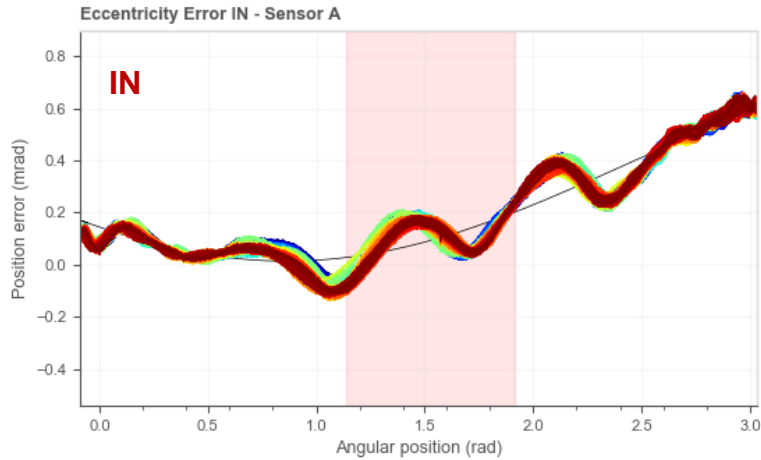




# 2. Full Calibration results

## 2.3 Disk Eccentricity (260 curves)

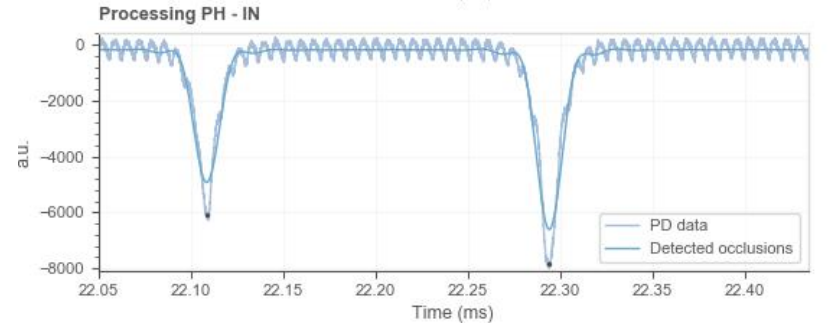
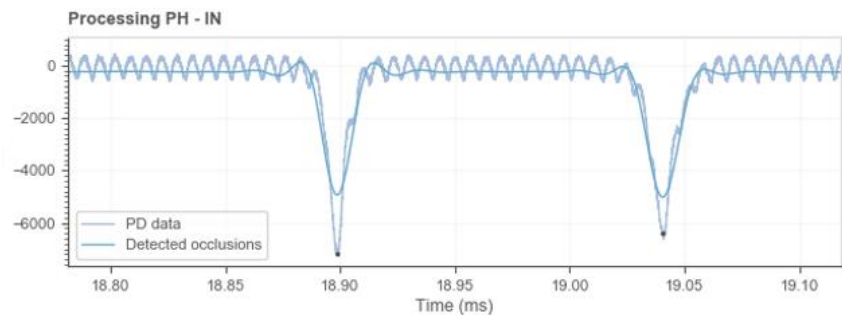
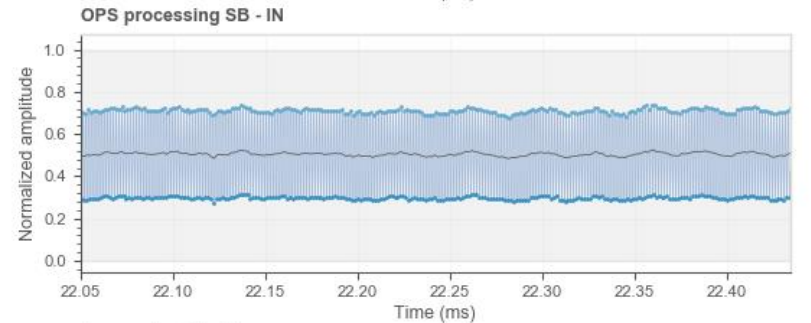
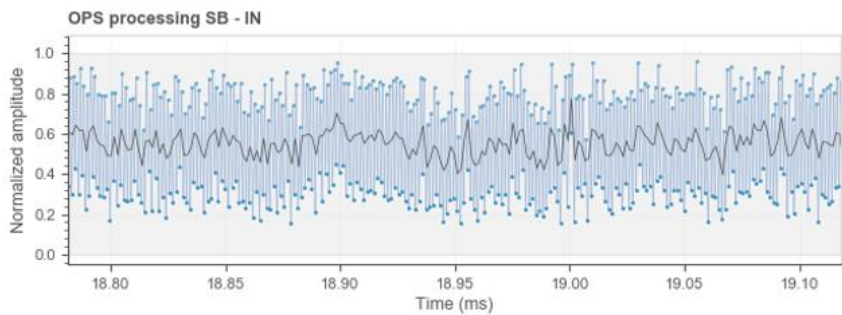
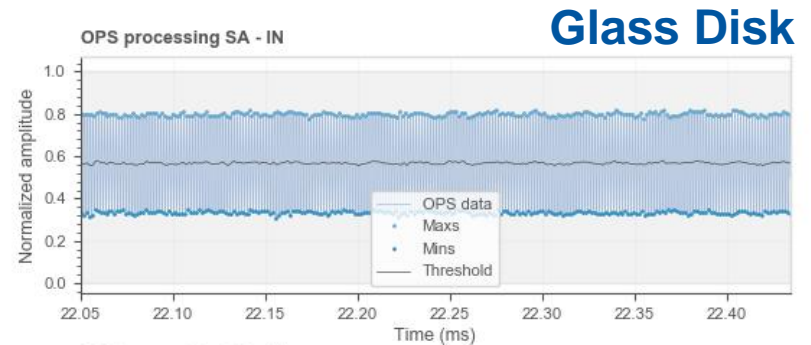
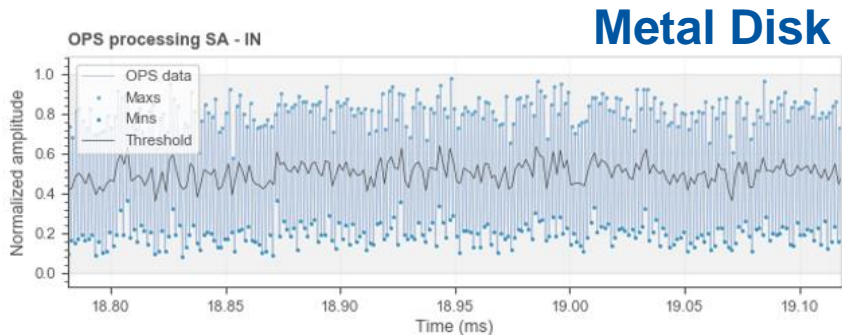
- Eccentricity curves must be equal for IN & OUT
- Behaviours dependent on speed / acceleration?
- Highly reproducible, no disk drift!



Disk Off-Centre by ~75µm

# 3. Comparison with Glass Disk

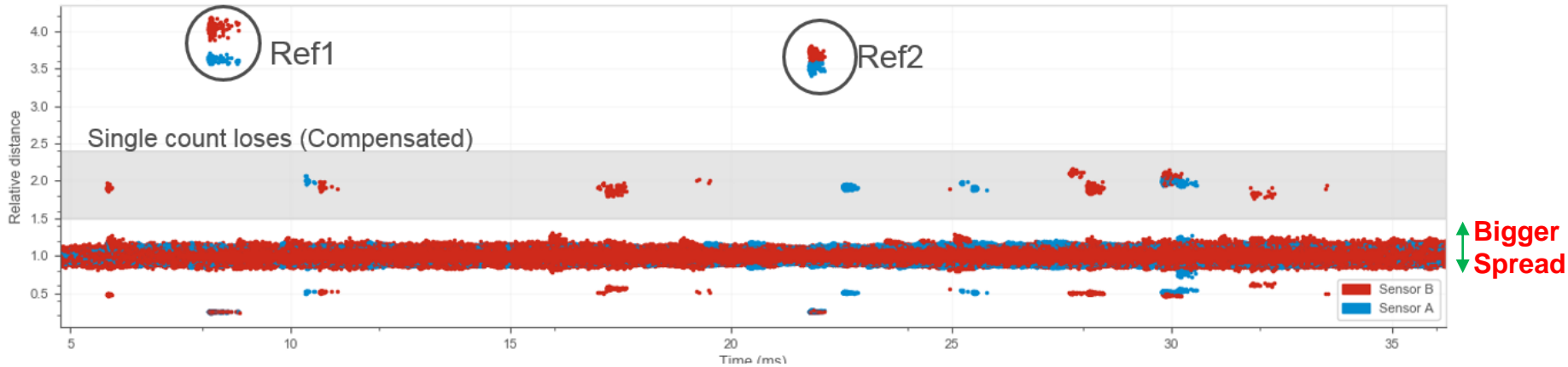
## 3.1 Disk optical signal + Photodiode



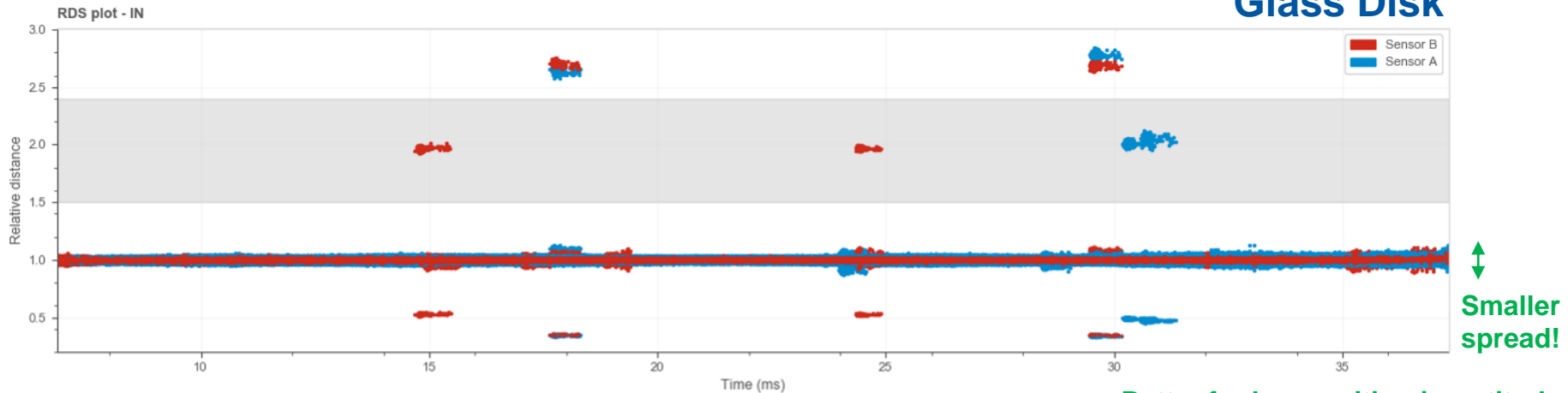
# 3. Comparison with Glass Disk

## 3.1 Sanity Check

Metal Disk



Glass Disk



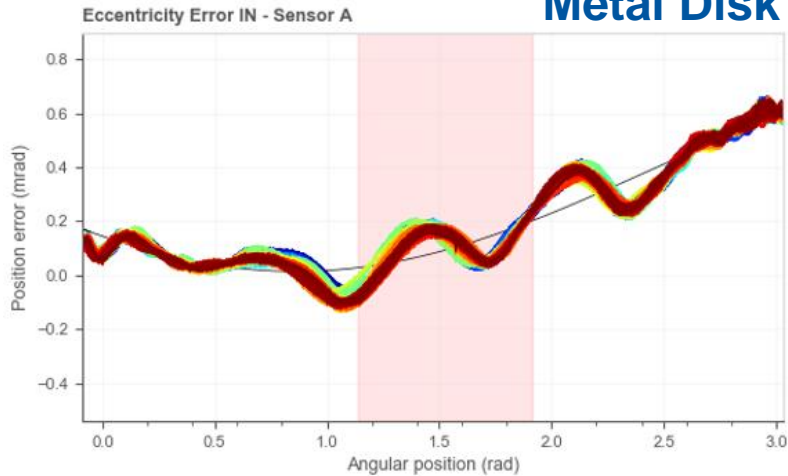
Better for low position uncertainty

From same scanner and control system → CC05\_\_2017\_09\_15\_\_15\_57

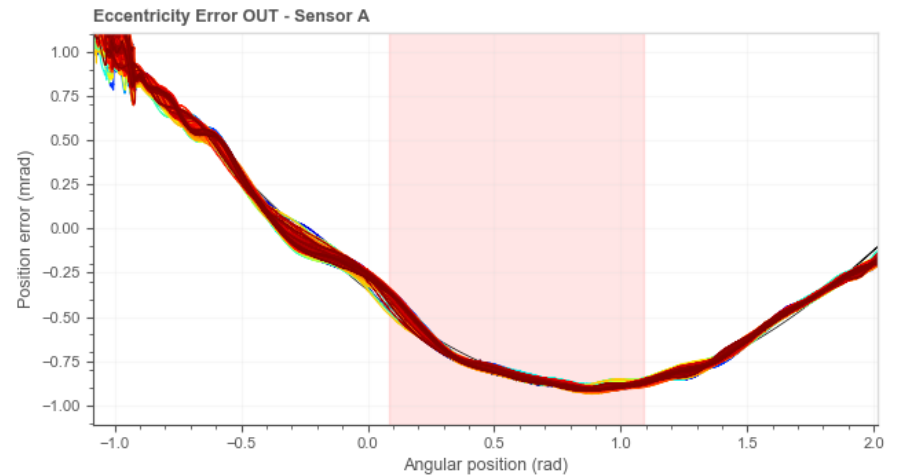
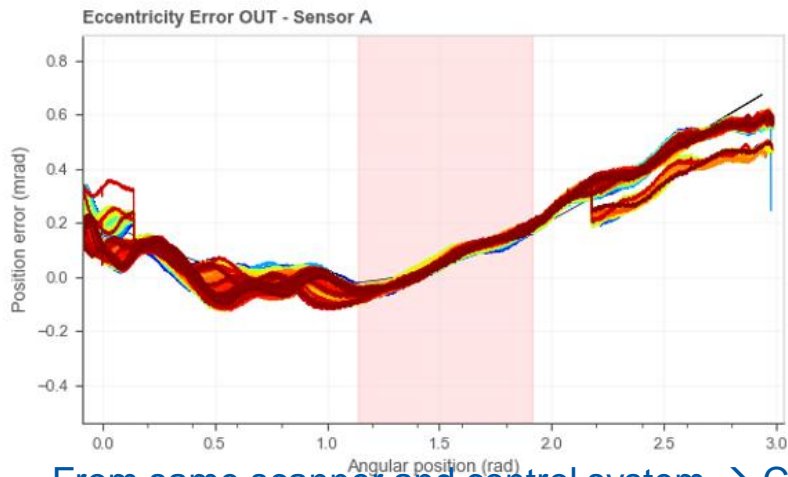
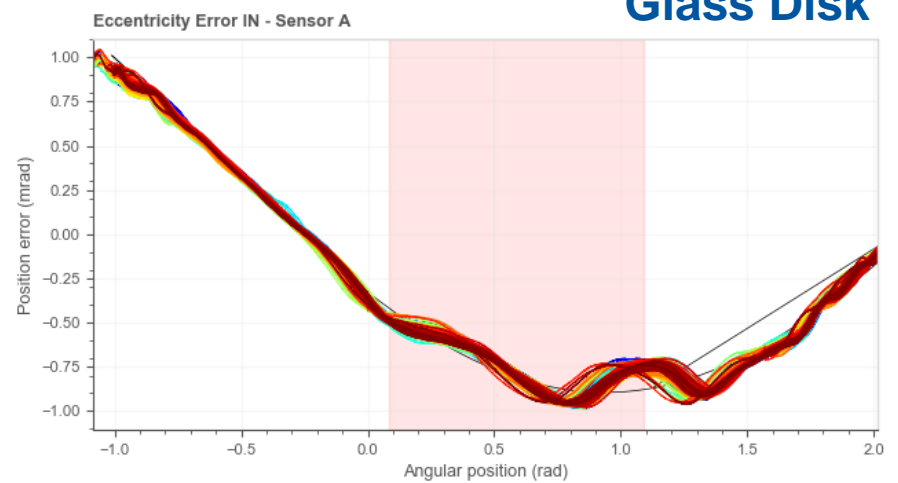
# 3. Comparison with Glass Disk

## 3.2 Eccentricity

### Metal Disk



### Glass Disk



From same scanner and control system → CC05\_2017\_09\_15\_15\_57

# 3. Comparison with Glass Disk

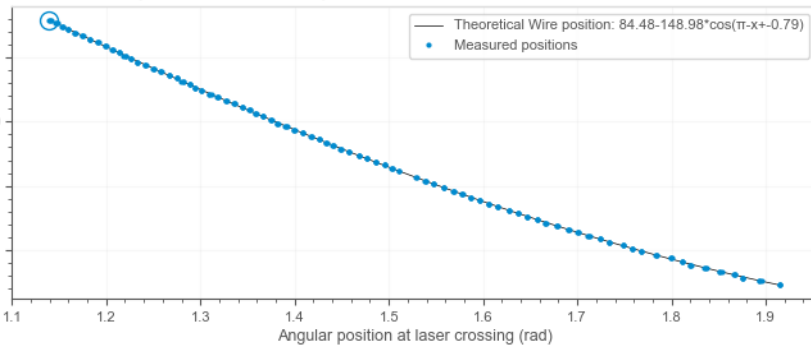
## 3.3 Full Calibration

From same scanner and control system → CC05\_2017\_09\_15\_15\_57

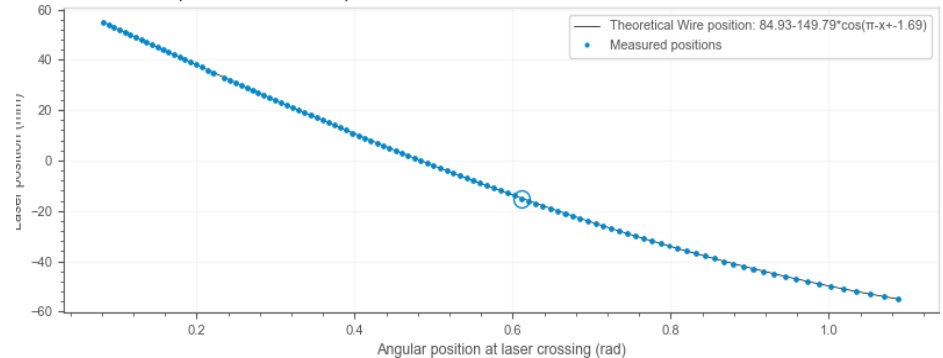
### Metal Disk

### Glass Disk

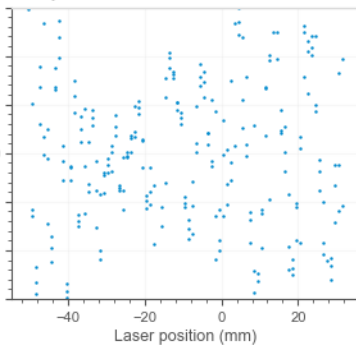
Theoretical wire positions vs. measured positions



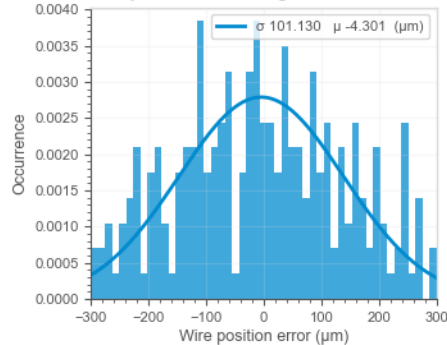
Theoretical wire positions vs. measured positions



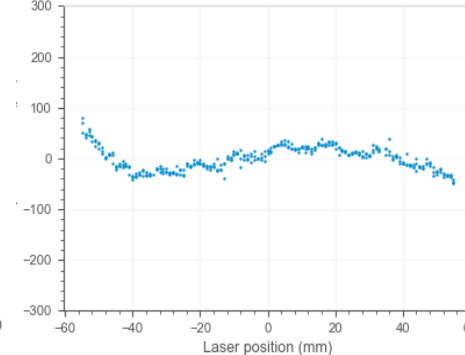
Wire position error



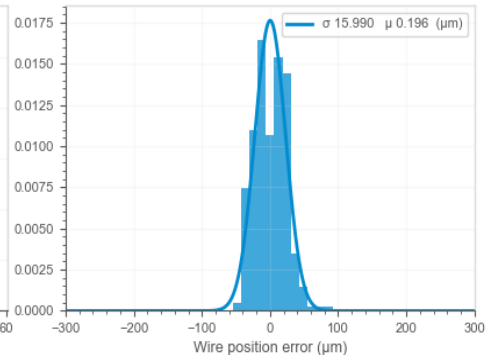
Wire position error histogram



Wire position error



Wire position error histogram



101 um

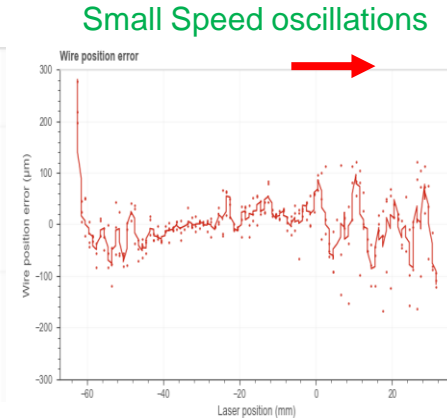
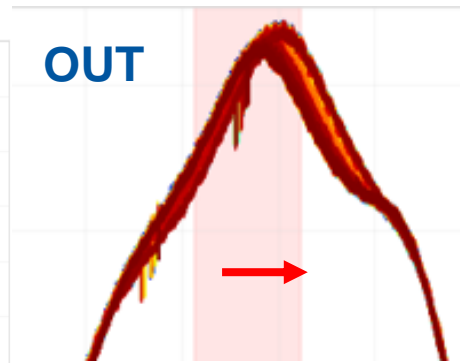
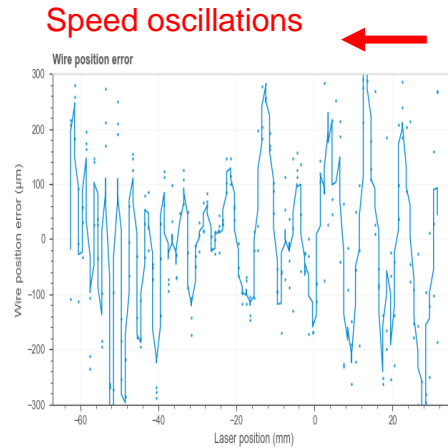
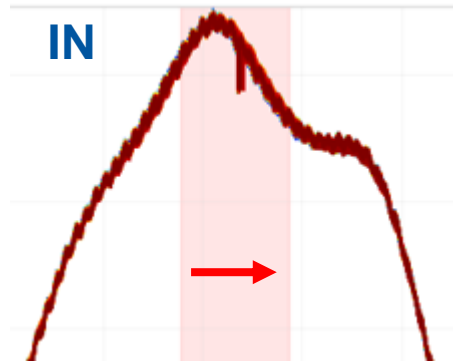
16 um

# 4. Uncertainty Source

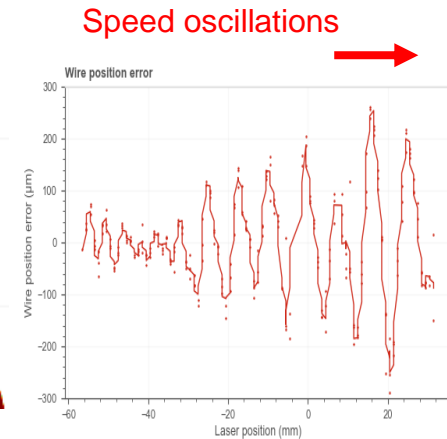
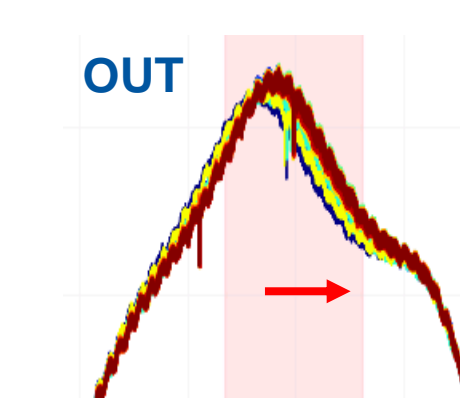
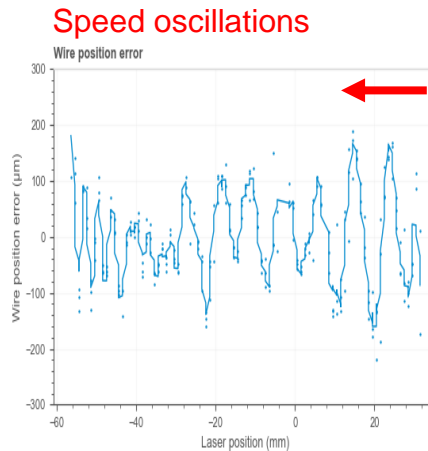
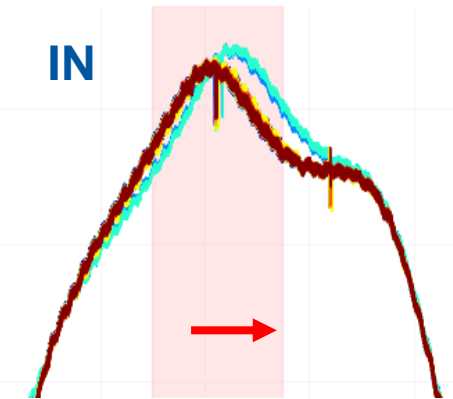
## 4.3 Metallic disk or wire vibrations....?

Mechanical play on shaft-motor observed

Starting Angle 0.6 rad



Starting Angle 0.8 rad



Same number of oscillations on Speed and Residuals in the calibration region!! → Disk elastic deformations? ~1.94 kHz

# 6. Calibration Application

## 6.1 Debugging and usability upgrade

