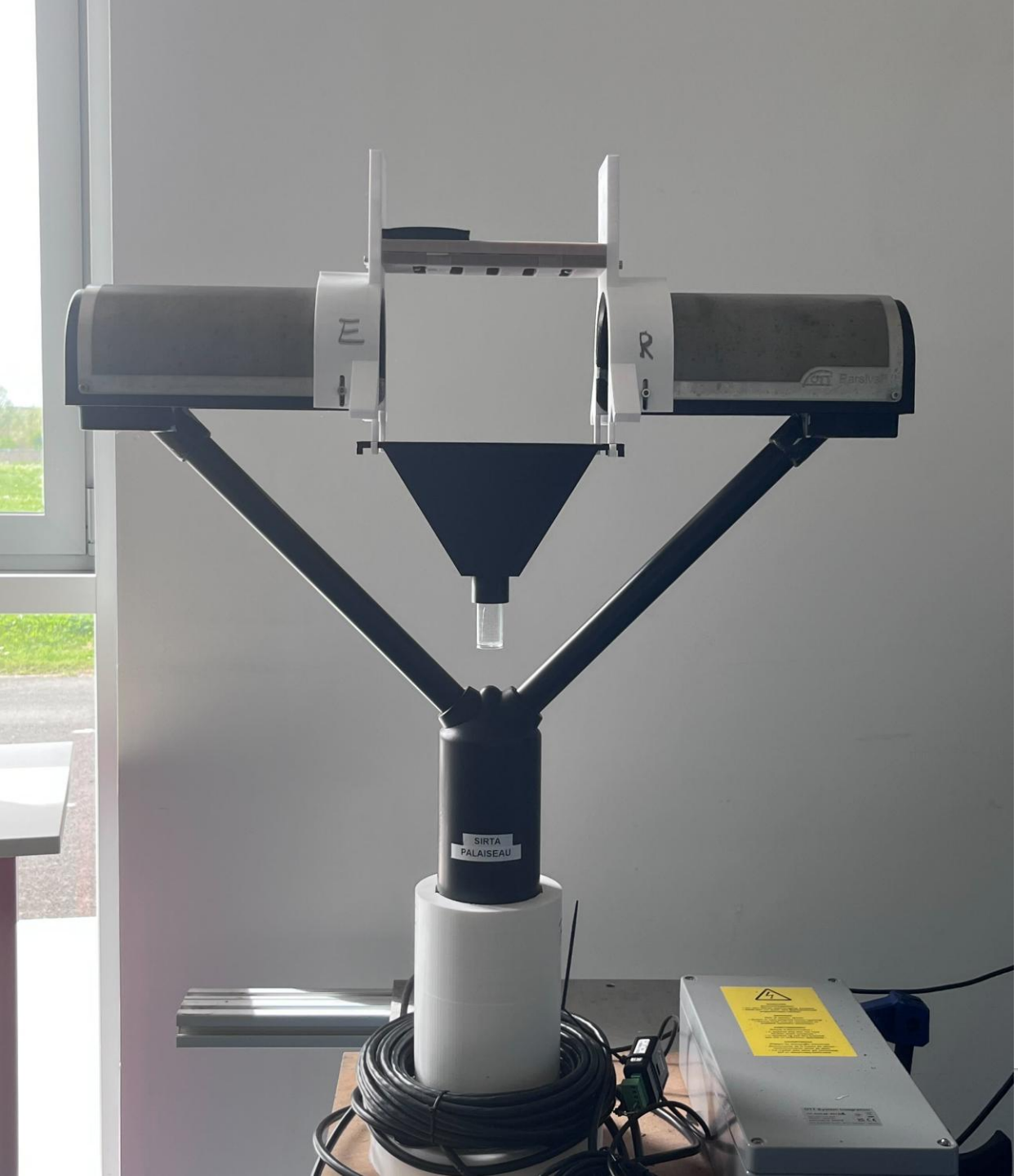


ACTRIS
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# Disdrometer operational services

## Disdrometer evaluation campaigns at Palaiseau and Munich

***JC. Dupont***, *JF. Ribaud (IPSL) ;* ***S. Kneifel*** *(LMU)*

***CCRES/CLU Spring Workshop, online, 1st and 2d of June 2026***

# Outlines

1. **Objectives**
2. **Lab experiment at CCRES-FR Facility in Palaiseau**
   - ✓ Experimental set-up and initial check
   - ✓ Size distribution & laser spatial stability evaluation
   - ✓ Conclusions and perspectives
3. **Field experiment at LMU**
   - ✓ Parsivel intercomparison
   - ✓ Characterization of the laser band
   - ✓ Next steps

# Objectives

i. Develop one method to **evaluate measurement provided by disdrometer** of ACTRIS NF, **OTT Parsivel2 and THIES LPM**

ii. Evaluate **the quality of the hydrometeor size distribution and of the laser beam stability**

iii. Finally, we will use these **disdrometers to monitor the calibration constant of Doppler cloud radars** (disdrometer processed reflectivity will then be compared to collocated measurements of reflectivity from a Doppler cloud radar near the surface).

# Lab experiment @ Palaiseau : disdrometers involved

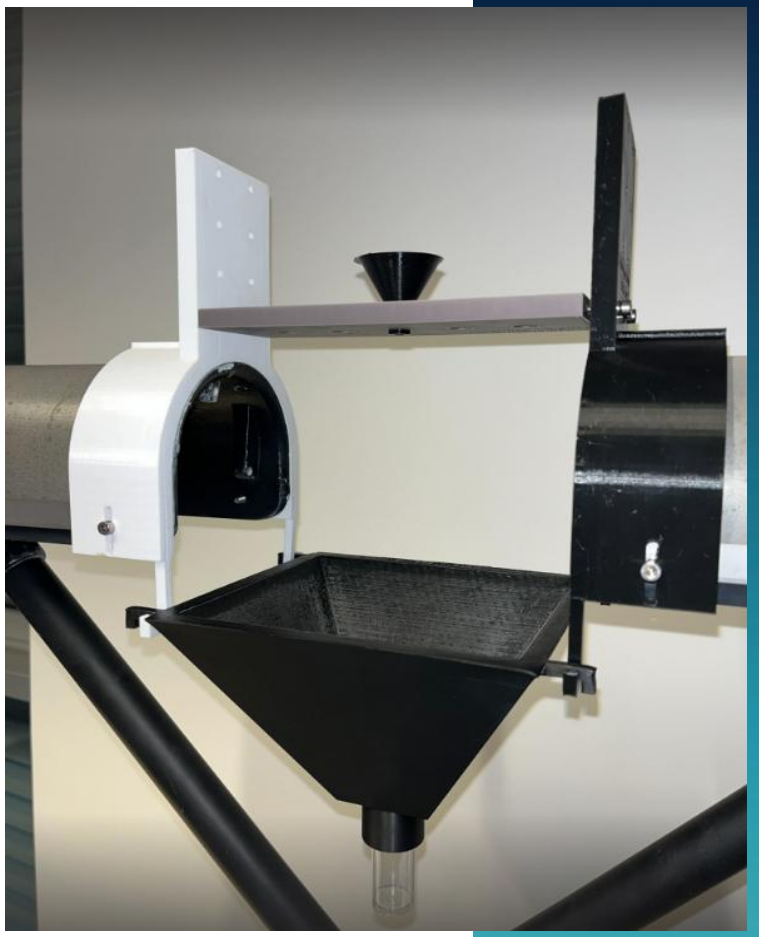
- ✓ **Two weeks of Lab Exp at CCRES-FR Facility in Palaiseau** : March 23rd – April 3rd 2026.
- ✓ **11 disdrometers / 10 National Facilities :** 8 OTT Parsivel2 and 3 THIES LPM

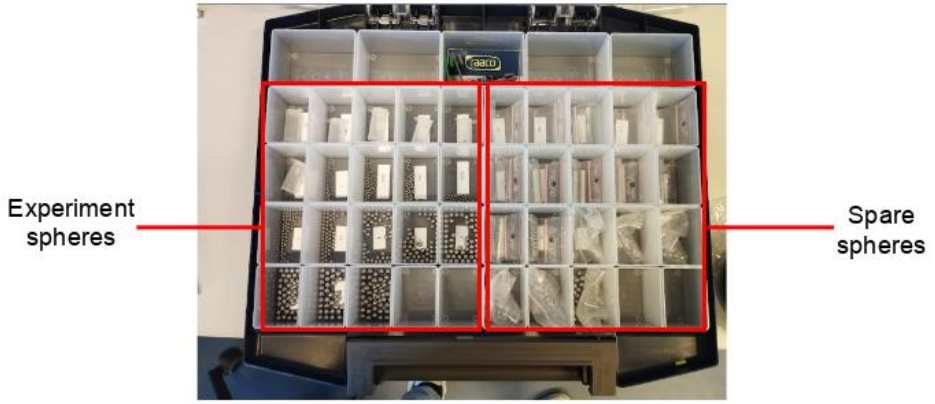
| # | NF | Contact | | Model | PID |
|---|---|---|---|---|---|
| | | Nom | Mail | | |
| 1 | Lindenberg | Ulrich Görsdorf | ulrich.goersdorf@dwd.de | OTT Parsivel 2 | https://hdl.handle.net/21.12132/3.1b0966f63b2d41f2 |
| 2 | Granada | Maria J. Granados-Muñoz | mjgranados@ugr.es | OTT Parsivel 2 | https://hdl.handle.net/21.12132/3.8f31e16545d14ff3 |
| 3 | Aquila | Andrea Balotti | andrea.balotti@graduate.univq.it | Thies LPM | https://hdl.handle.net/21.12132/3.7cd404bd07d74e93 |
| 4 | Payerne | Renaud Matthey | renaud.matthey@unibe.ch | OTT Parsivel 2 | https://hdl.handle.net/21.12132/3.bb12977029a94d8f |
| 5 | Bucharest | Anca Nemuc | anca@inoe.ro | OTT Parsivel 2 | https://hdl.handle.net/21.12132/1.85a2aa7ce0c64b3a |
| 6 | Lampedusa | Giandomenico Pace | giandomenico.pace@enea.it | Thies LPM | https://hdl.handle.net/21.12132/3.4e7765c0c8bd4d1d |
| 7 | Warsaw | Lucja Janicka | Lucja.Janicka@fuw.edu.pl | OTT Parsivel 2 | https://hdl.handle.net/21.12132/3.0b70b7b738cb4593 |
| 8 | Cluj | Nicolae Ajtai | nicolae.ajtai@ubbcluj.ro | OTT Parsivel 2 | https://hdl.handle.net/21.12132/3.5a6e24d0ff9042b1 |
| 9 | Leipzig | Patric Seifert | seifert@tropos.de | OTT Parsivel 2 | https://hdl.handle.net/21.12132/3.0bc7d48784f14637 |
| 10 | Palaiseau | Jean-Charles Dupont | jean-charles.dupont@ipsl.fr | OTT Parsivel 2 (nominal) | https://hdl.handle.net/21.12132/3.7e13f3f243854ae8 |
| 11 | Palaiseau | Jean-Charles Dupont | jean-charles.dupont@ipsl.fr | Thies LPM | https://hdl.handle.net/21.12132/3.11d3217867474e22 |

# Experimental set-up and methodology

- Use **well known steel spheres** (18 sizes between 0.4 and 6mm, accuracy of 20µm) to compare output data provided by the disdrometer and the theoretical size

- Develop one **experimental set-up** to have a system for passing thousands of steel spheres (system printed with a 3D printer, thanks to LMU !)

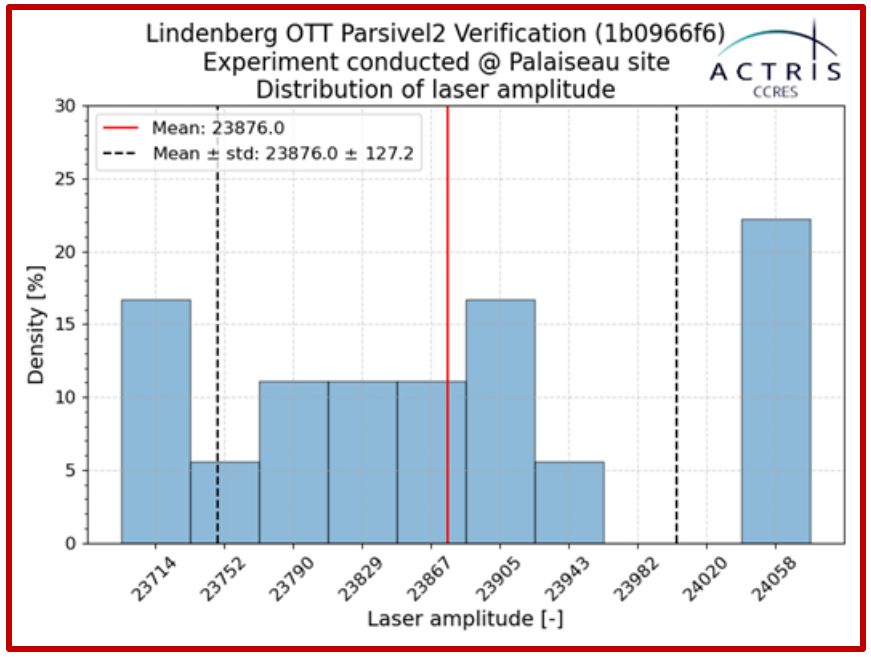


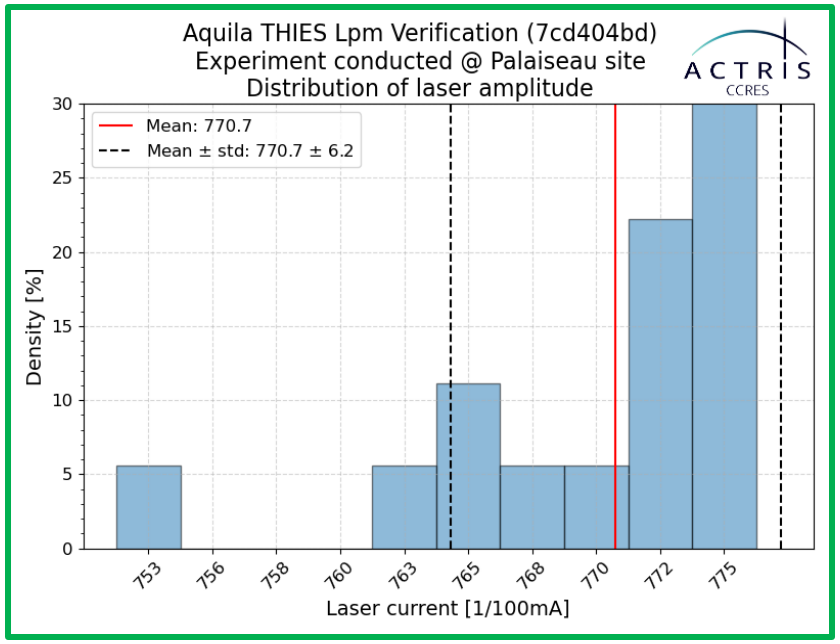


# Initial check of each disdrometer

**Laser signal amplitude for OTT Parsivel2, or laser current, control and optical voltage for THIES LPM.**

- Immediately after unpacking the disdrometers, the signal amplitude is measured.
- The laser value for each disdrometer (OTT Parsivel2 on the left and THIES LPM on the right) is measured and recorded during each experiment.



# Initial check of each disdrometer

## Shape and size of the laser signal

- For the OTT Parsivel2 disdrometer, we have the option of taking a picture of the laser signal by placing a sheet of graph paper in the optical path.

  Manufacturer's specifications: 30mm x 8mm.

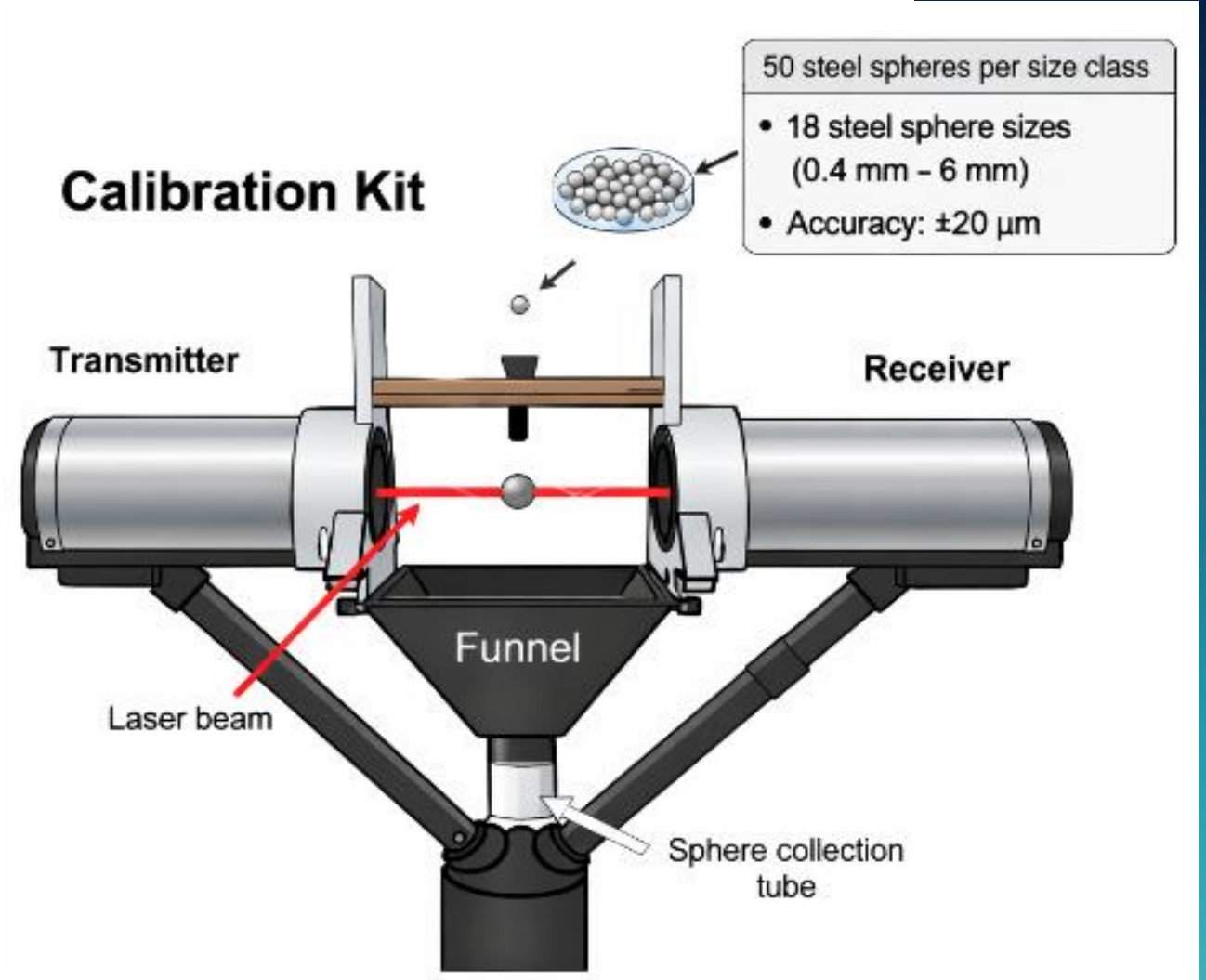
# Evaluation of the size distribution

## Lab experiment setup

| # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| steel sphere diameter (mm) | 0.4 | 0.6 | 0.8 | 1 | 1.2 | 1.5 | 2 | 2.381 | 2.5 |
| Metal | AISI 316L | Si3N4 | AISI 420 | AISI 440 | AISI 440 | AISI 440 | AISI 420 | AISI 304L | AISI 304L |
| Grade or Classe | G 100 | G 10 | G10 | G10 | Cl. III | Cl. III | G 200 | G40 | G 40 |
| Number | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

| # | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|
| steel sphere diameter (mm) | 2.778 | 3 | 3.5 | 4 | 4.5 | 5 | 5.3 | 5.556 | 6 |
| Metal | AISI 420 | AISI 316L | AISI 304 | AISI 420 | AISI 316 | AISI 304 | AISI 420 C | AISI 440 | 100Cr6 |
| Grade or Classe | Cl. III | G40 | G40 | G40 | G100 | G40 | G200 | Cl. III | G5 |
| Number | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

*Characteristics of the steel sphere used in this experiment*

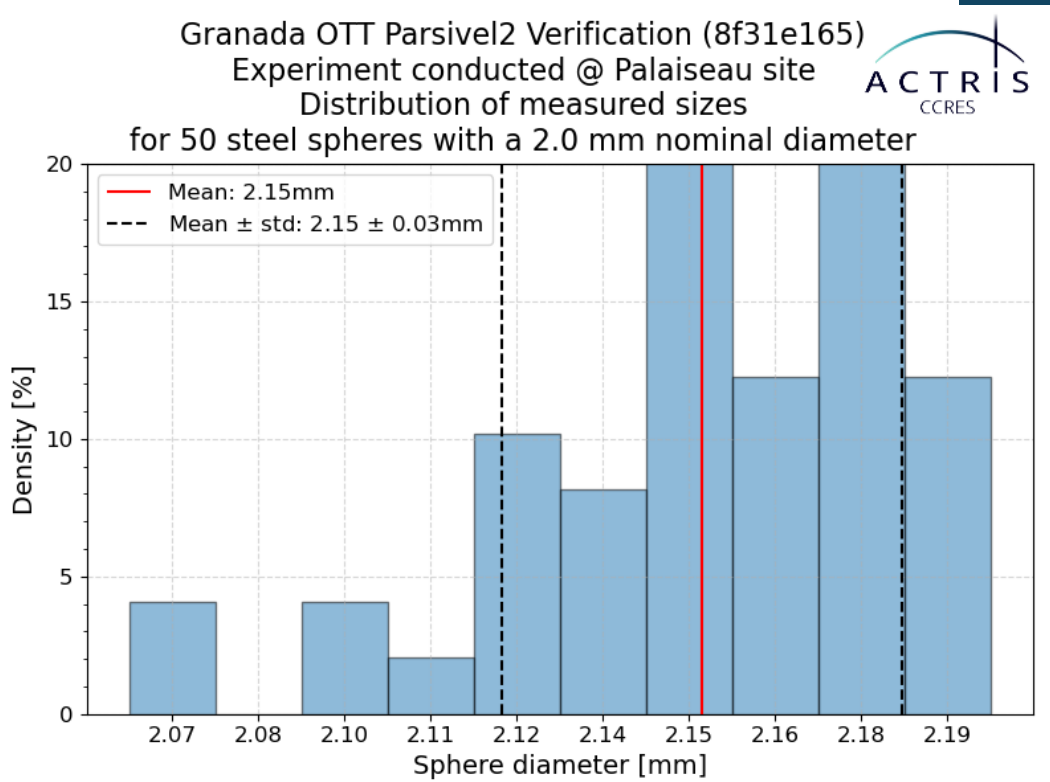


# Evaluation of the size distribution

## One example of output file provided by our Python code

```
# date: 2026-03-23T12:58:04Z
# manufacturer: ott
# instrument-type: parsivel
# instrument-pid: https://hdl.handle.net/21.12132/3.8f31e16545d14ff3
# instrument-site: granada
# operator: saya.ung
# code-version: 1.0.0
# calibration-site: palaiseau
# calibration-kit-version: palaiseau.2025.10
# calibration-type: standard
# laser-amplitude: 24686.0
# mean-value-laser-current:  nan
# control-voltage: nan
# optical-control output: nan
# sphere-type: metal
# sphere-size (um): 2000
# sphere-number: 50
# sphere-drop-height: min
# sphere-drop-position-longitudinal: center
# sphere-drop-position-axis: 0.0
# size, speed
2.096,1.142
1.990,1.053
```

**=> The goal is to have an organized database, DOI soon available**



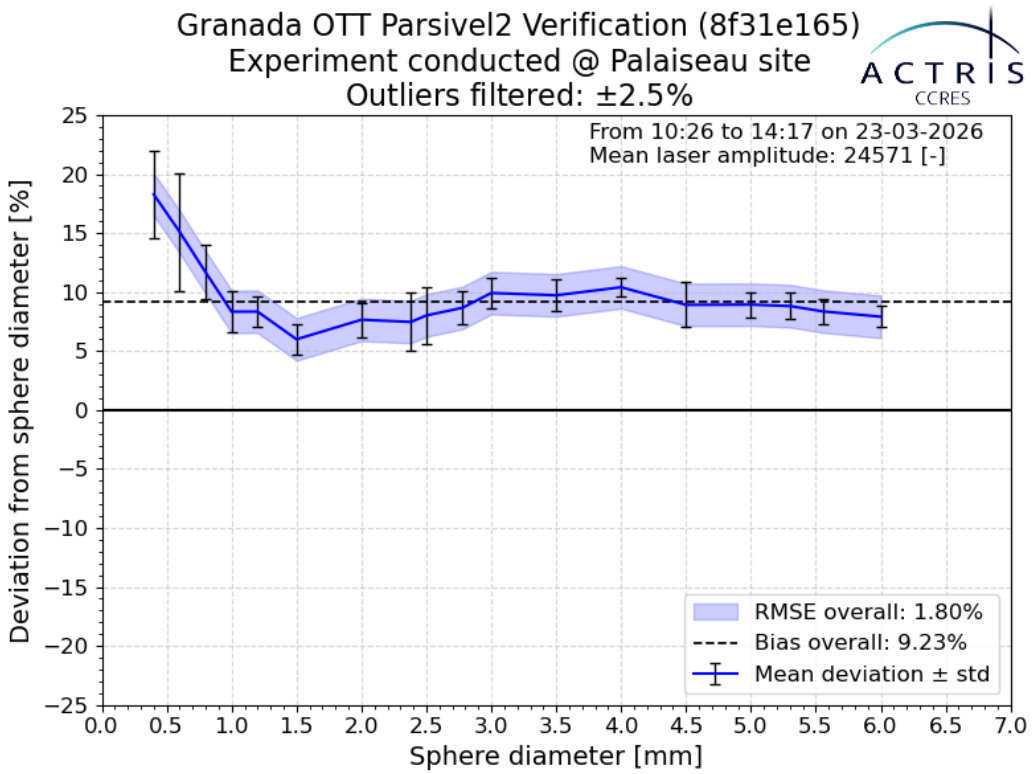

*Size distribution for 50 steel spheres of 2mm*

**Name of the output file** :

*parsivel_0a_PstandardLgranadal8f31e165-s2000n50_20260323_125804.txt*

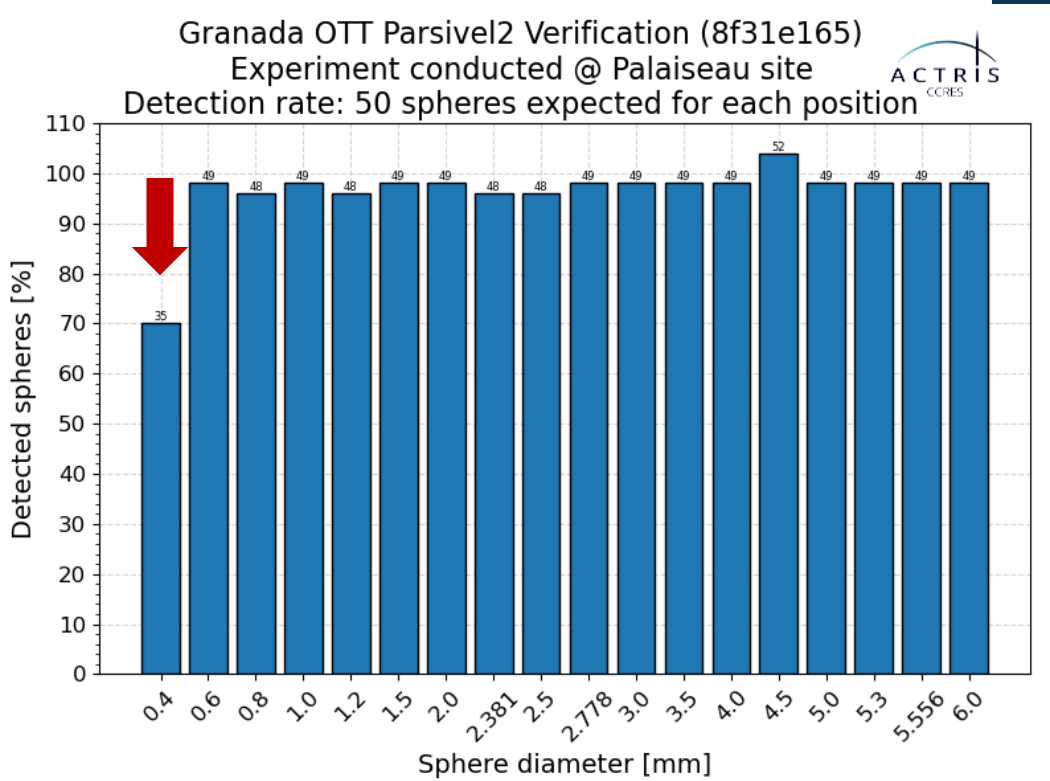
# Evaluation of the size distribution

## Preliminary results for Granada OTT Parsivel2 disdrometer




*Relative difference between measured and theoretical sizes for steel spheres between 0.4 and 6mm (50 steel spheres for each size)*

**=> Overall bias around +9%** (overestimation of the size measured by the OTT Parsivel2 disdrometer)

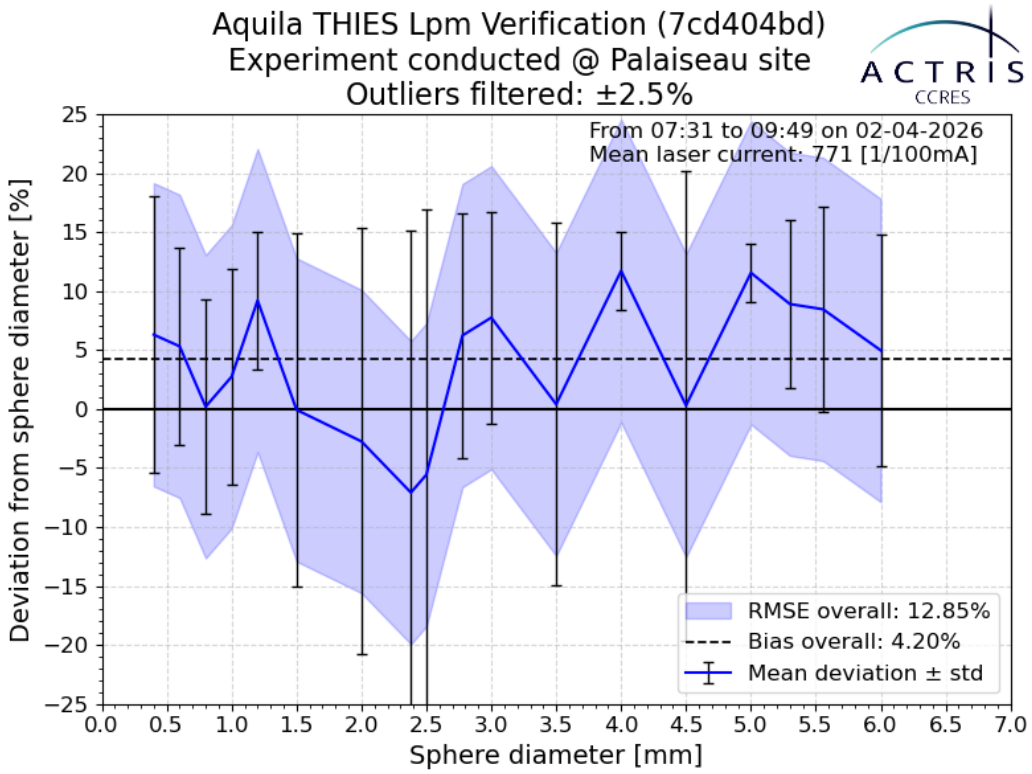



*Sampling for each steel sphere size between 0.4 and 6mm (50 steel spheres for each size)*

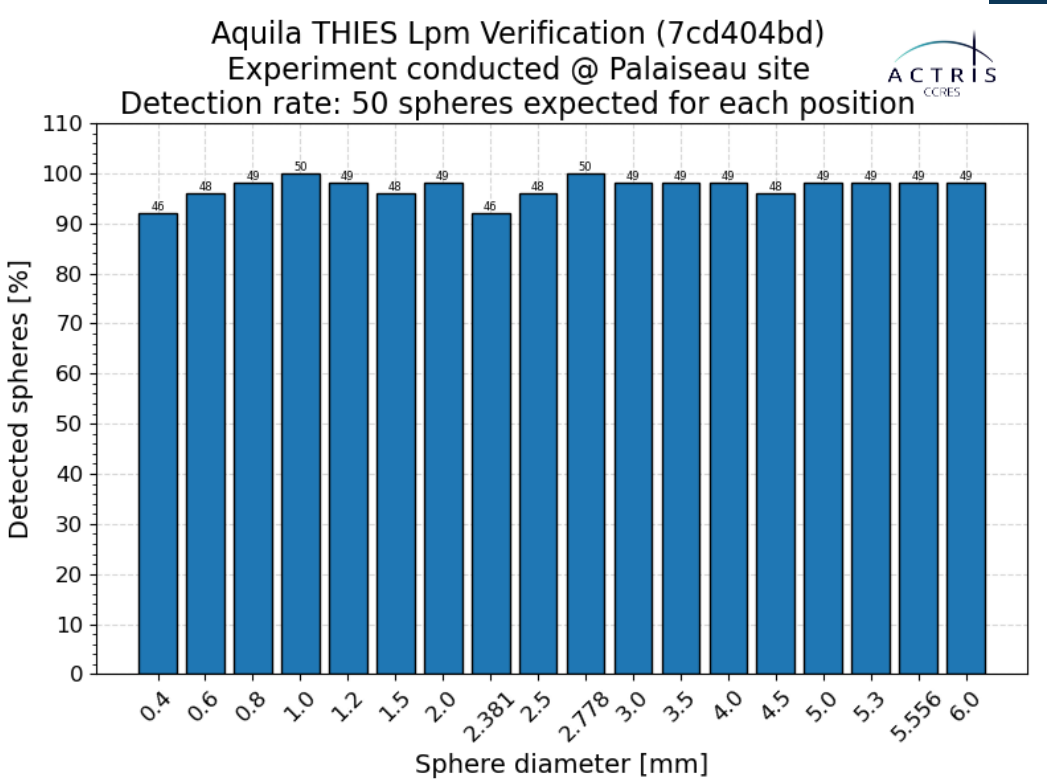
**=> Very good sampling except for 0.4mm**

# Evaluation of the size distribution

## Preliminary results for Aquila THIES LPM disdrometer




*Relative difference between measured and theoretical sizes for steel spheres between 0.4 and 6mm (50 steel spheres for each size)*



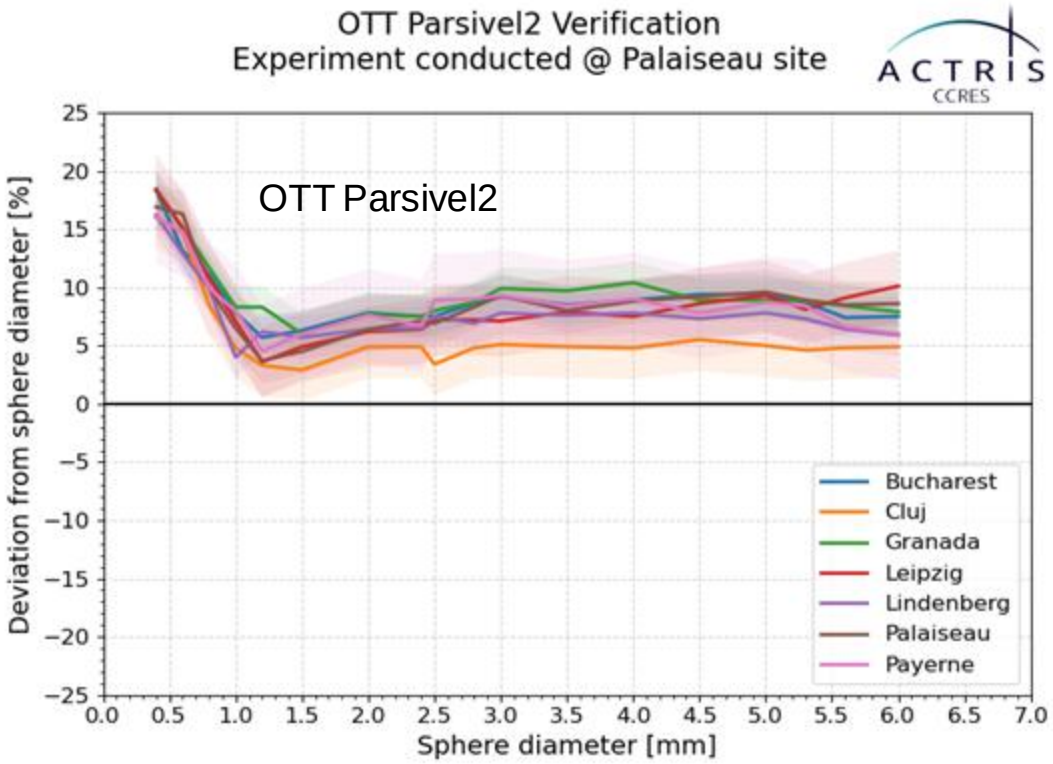

*Sampling for each steel sphere size between 0.4 and 6mm (50 steel spheres for each size)*

**=> Overall bias around +4%** (overestimation of the size measured by the OTT Parsivel2 disdrometer)

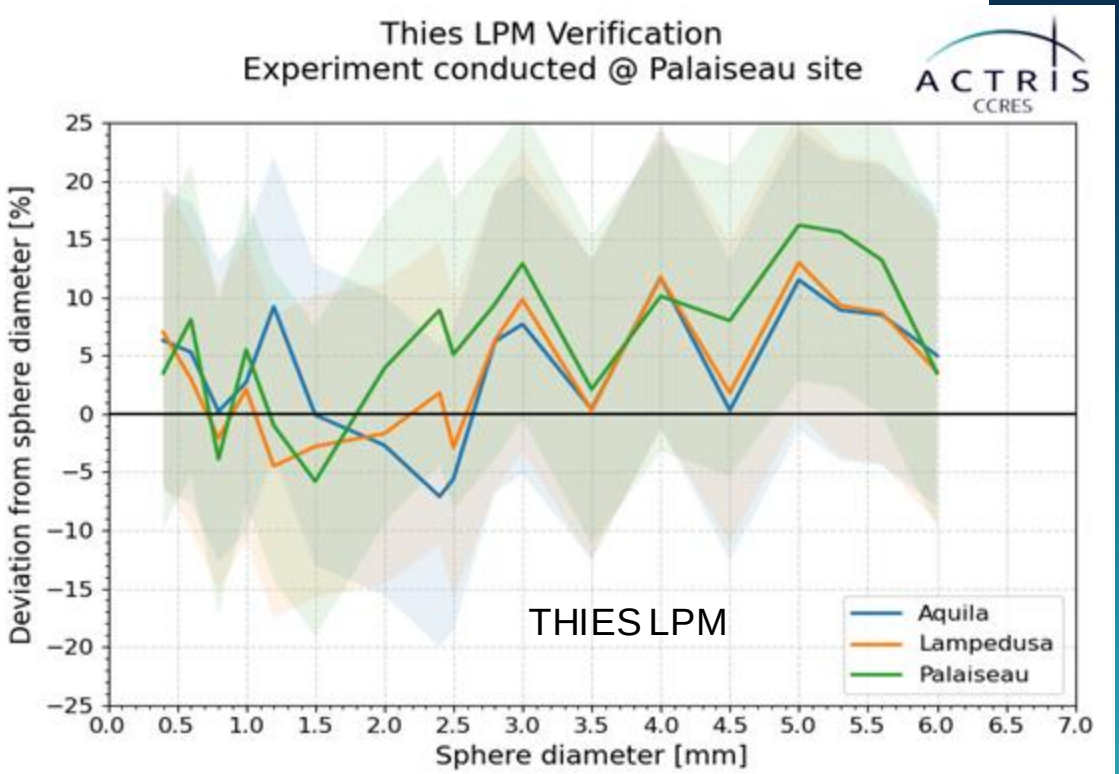
**=> Very good sampling**

# Evaluation of the size distribution

## Statistical results for the 10 disdrometers




*Relative difference between measured and theoretical sizes for steel spheres between 0.4 and 6mm (50 steel spheres for each size) : 7 OTT Parsivel2*




*Relative difference between measured and theoretical sizes for steel spheres between 0.4 and 6mm (50 steel spheres for each size) : 3 THIES LPM*

**=> Very good consistency between all the disdrometers**

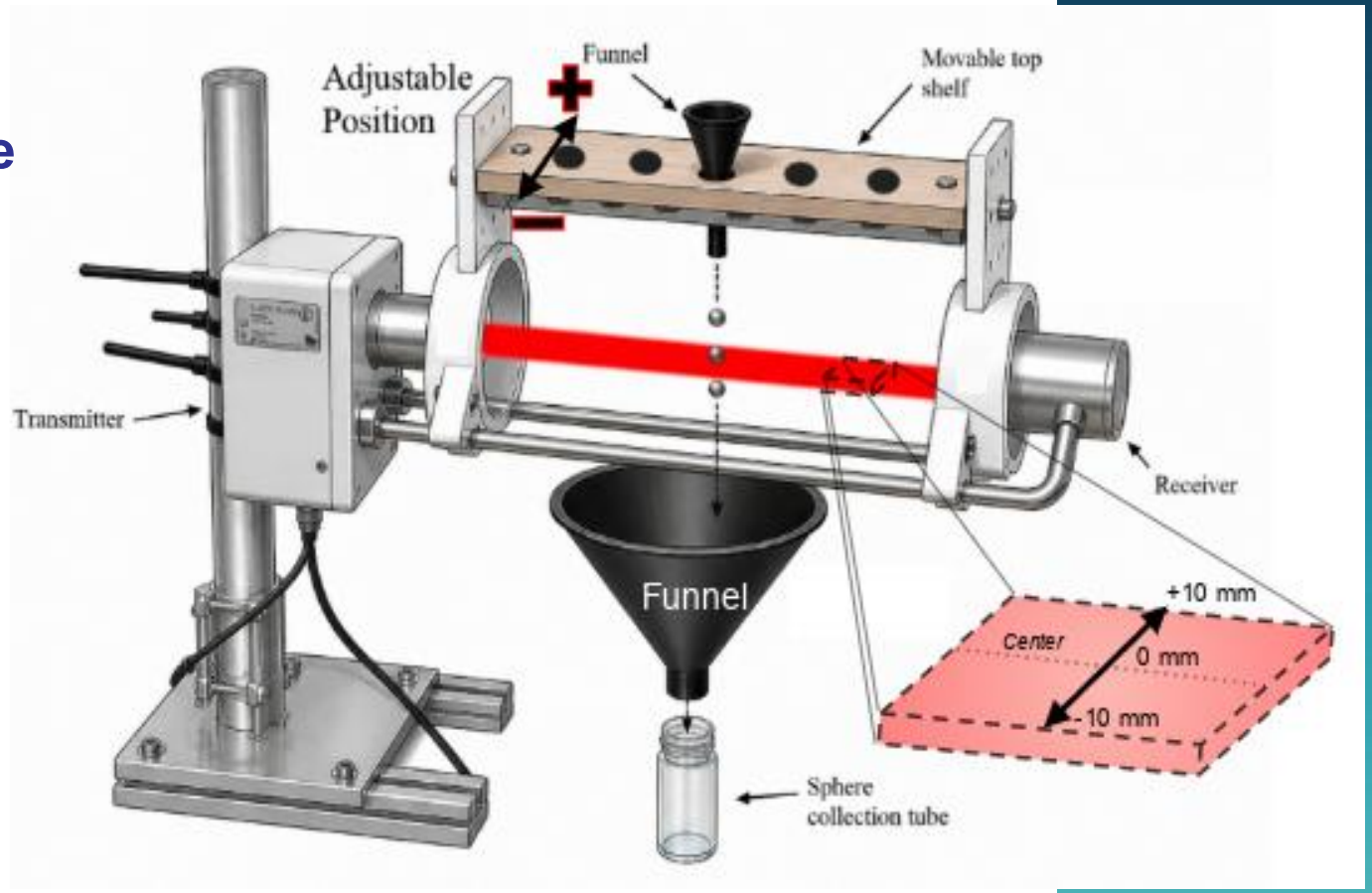
# Laser spatial stability evaluation

## Lab experiment setup

- **Only one steel sphere size = 2mm**
- 50 steel spheres for each position

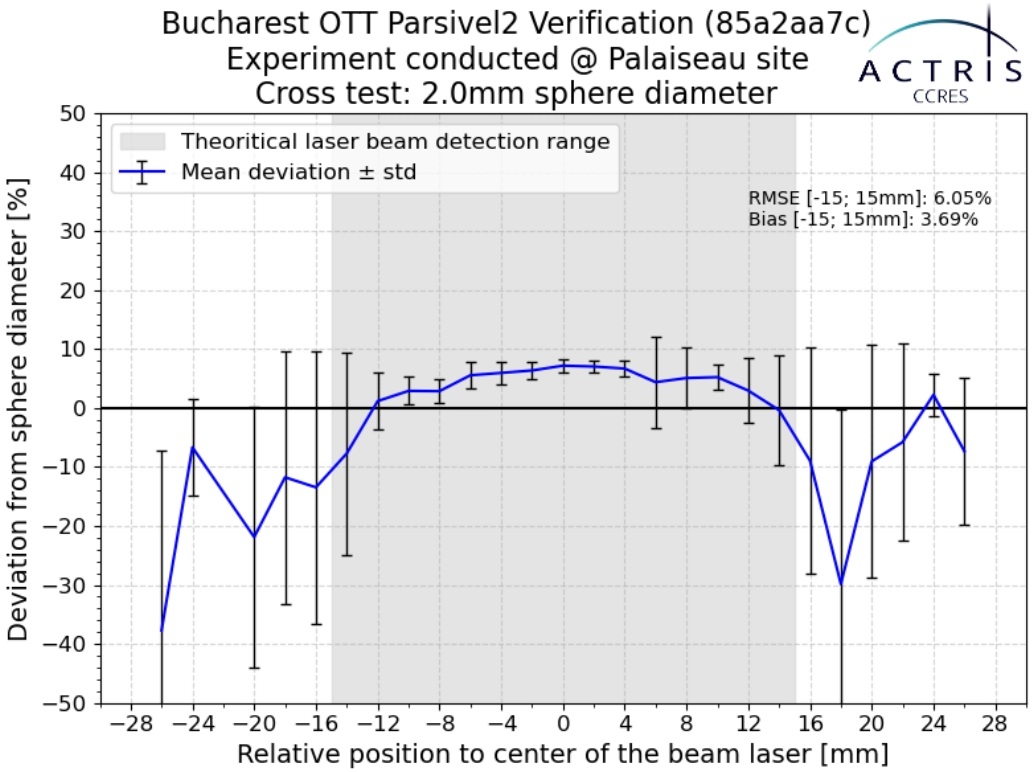
⇒ **We move away from the center of the laser beam** and we note the relative position to the center of the laser beam (50 steel spheres for each position)

  - Between +26mm and -26mm for the OTT Parsivel2
  - Between +20mm and -20mm for the THIES LPM



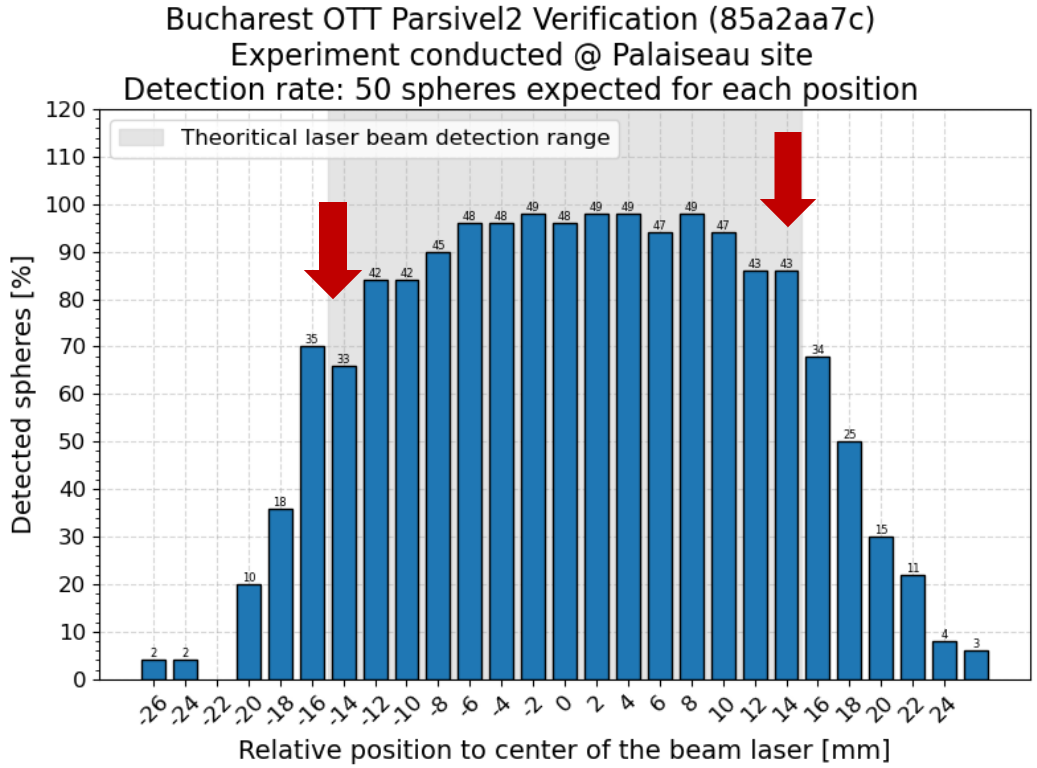
# Laser spatial stability evaluation

## Preliminary results for Bucharest Parsivel2 disdrometer




*Relative difference between measured and the 2mm-theoretical size for the relative position to the center of the laser beam (50 steel spheres for each position)*

**=> Very good stability inside the theoretical laser beam detection range**

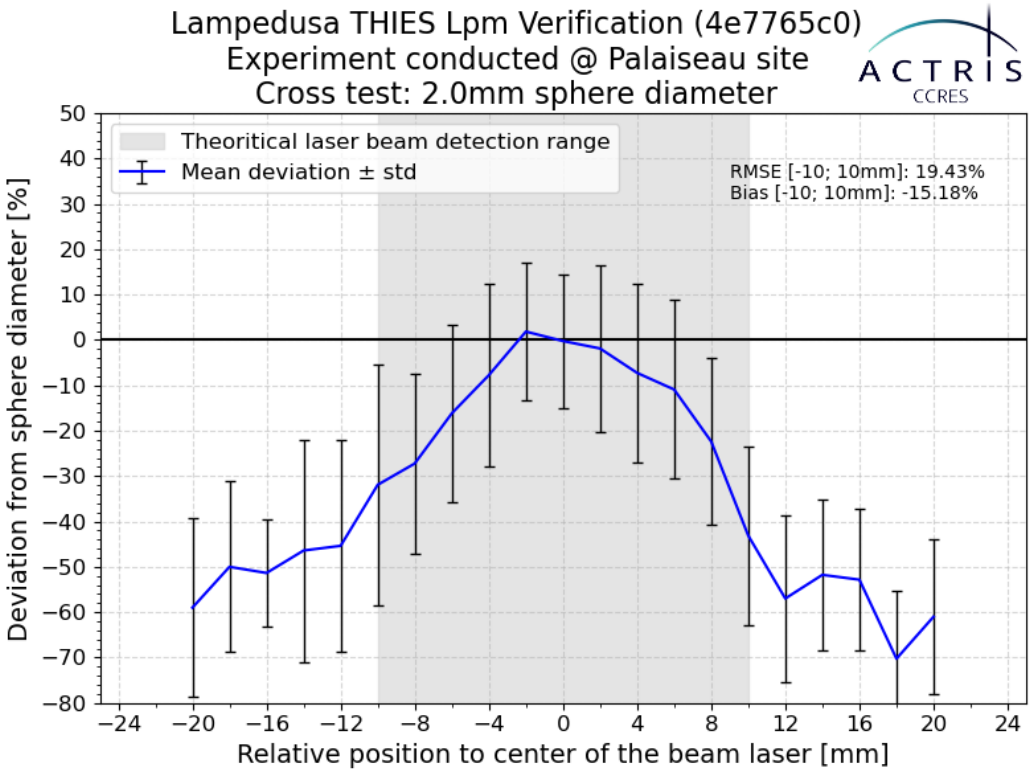



*Sampling for the relative position to the center of the laser beam (50 steel spheres for each position)*

**=> Significantly decrease of the sampling at the edge of the detection range**

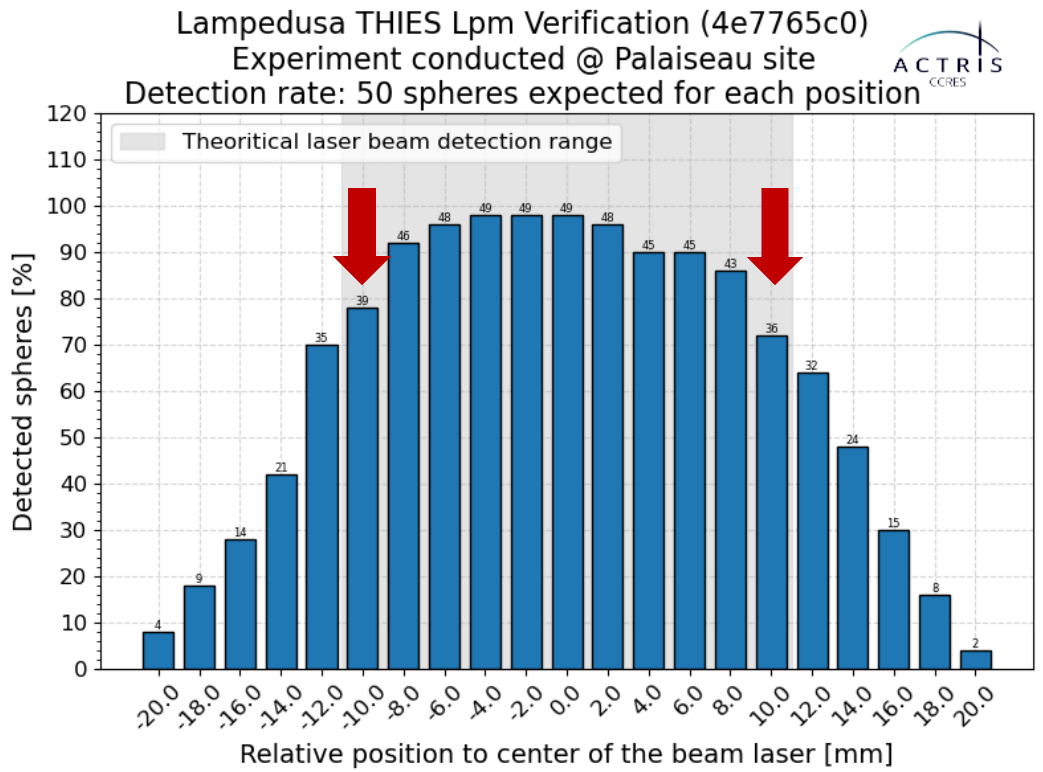
# Laser spatial stability evaluation

## Preliminary results for Lampedusa THIES LPM disdrometer




*Relative difference between measured and the 2mm-theoretical size for the relative position to the center of the laser beam (50 steel spheres each position)*

**=> NO stability inside the theoretical laser beam detection range**

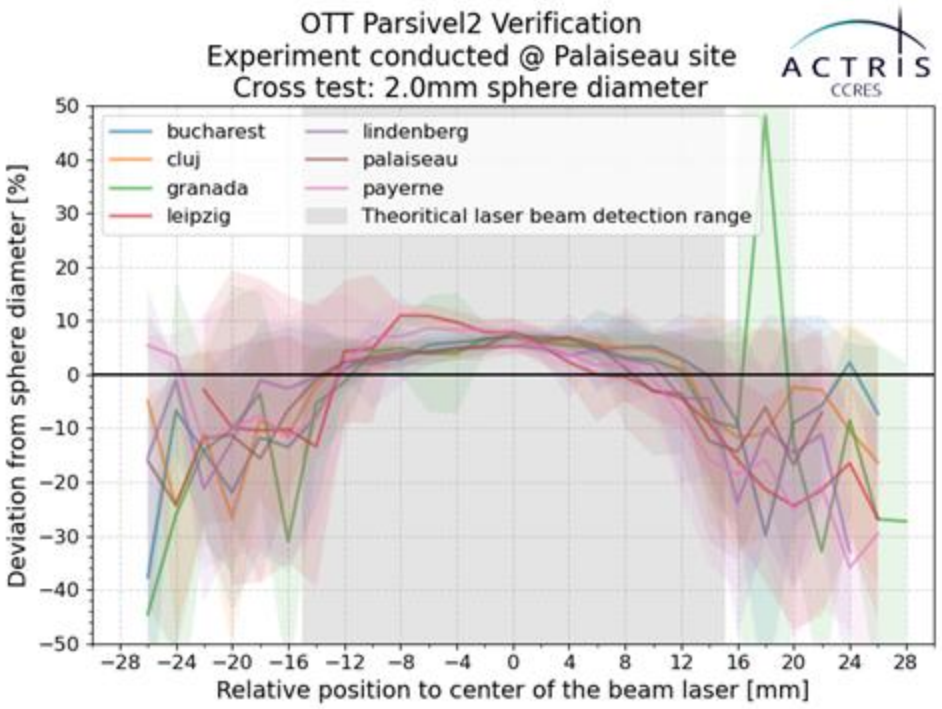



*Sampling for the relative position to the center of the laser beam (50 steel spheres each position)*

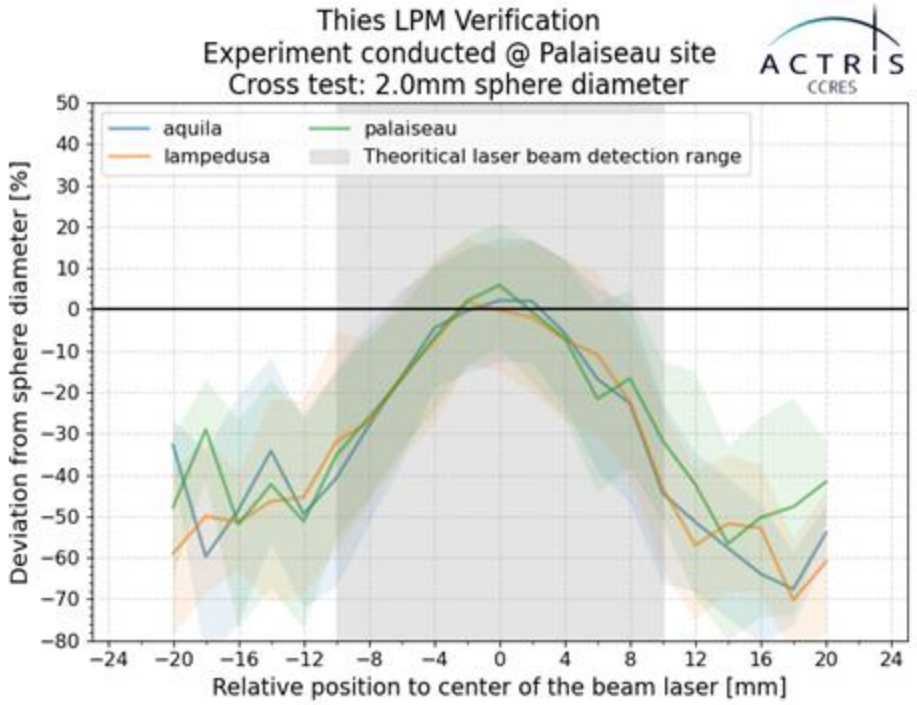
**=> Significantly decrease of the sampling at the edge of the detection range**

# Laser spatial stability evaluation

## Statistical results for the 10 disdrometers



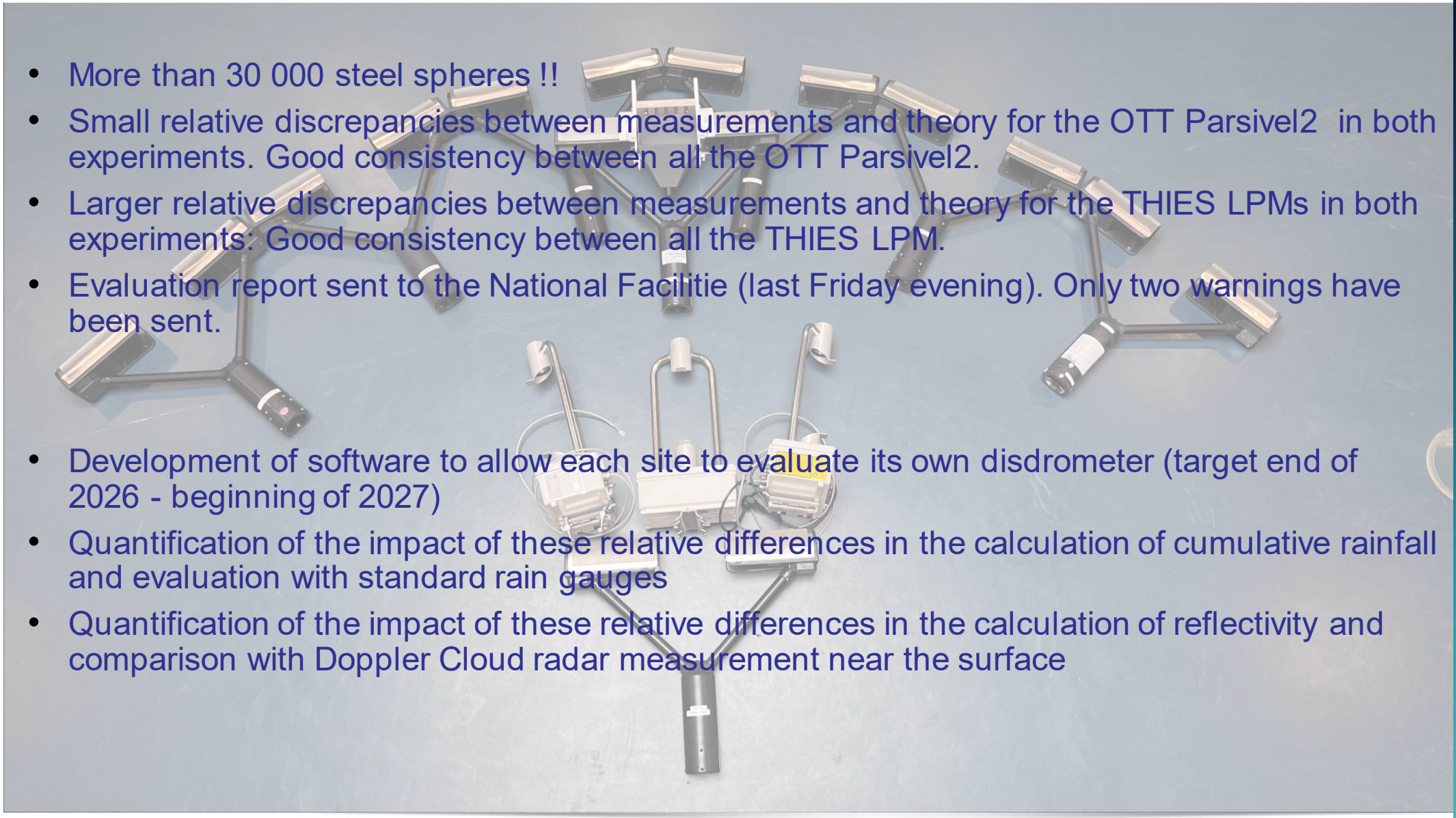

*Relative difference between measured and the 2mm-theoretical size for the relative position to the center of the laser beam (50 steel spheres for each position), 7 OTT Parsivel2*




*Relative difference between measured and the 2mm-theoretical size for the relative position to the center of the laser beam (50 steel spheres for each position), 3 THIES LPM*

**=> Very good consistency between all the disdrometers**

# Conclusions and perspectives for Palaiseau lab experiment

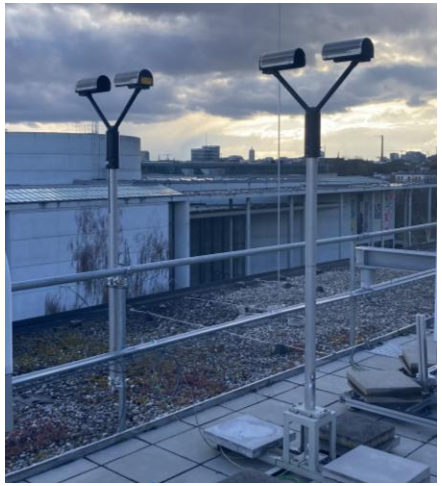


- More than 30 000 steel spheres !!
- Small relative discrepancies between measurements and theory for the OTT Parsivel2 in both experiments. Good consistency between all the OTT Parsivel2.
- Larger relative discrepancies between measurements and theory for the THIES LPMs in both experiments: Good consistency between all the THIES LPM.
- Evaluation report sent to the National Facilitie (last Friday evening). Only two warnings have been sent.

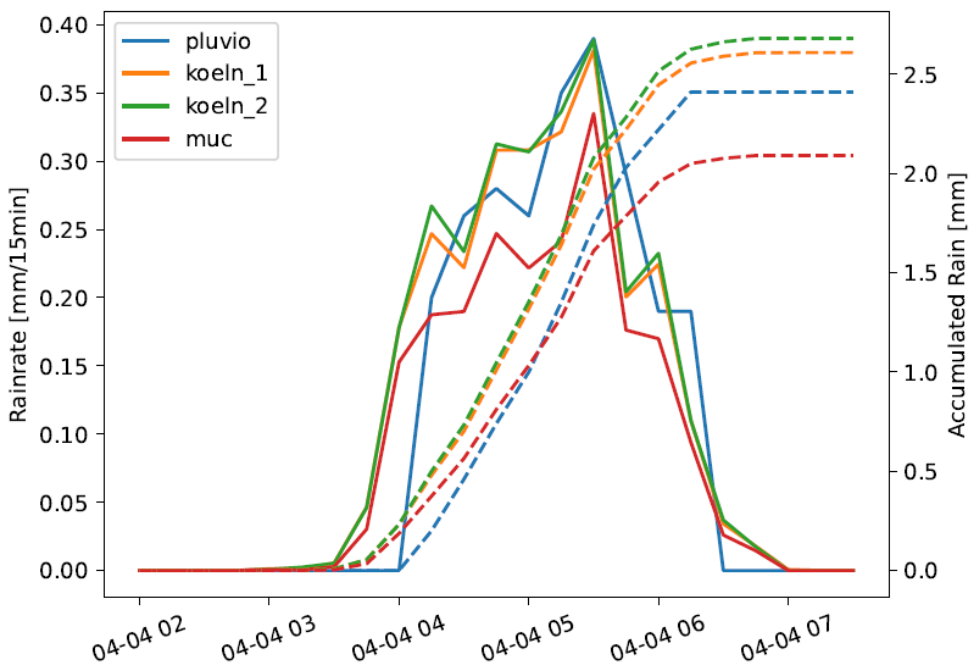
- Development of software to allow each site to evaluate its own disdrometer (target end of 2026 - beginning of 2027)
- Quantification of the impact of these relative differences in the calculation of cumulative rainfall and evaluation with standard rain gauges
- Quantification of the impact of these relative differences in the calculation of reflectivity and comparison with Doppler Cloud radar measurement near the surface

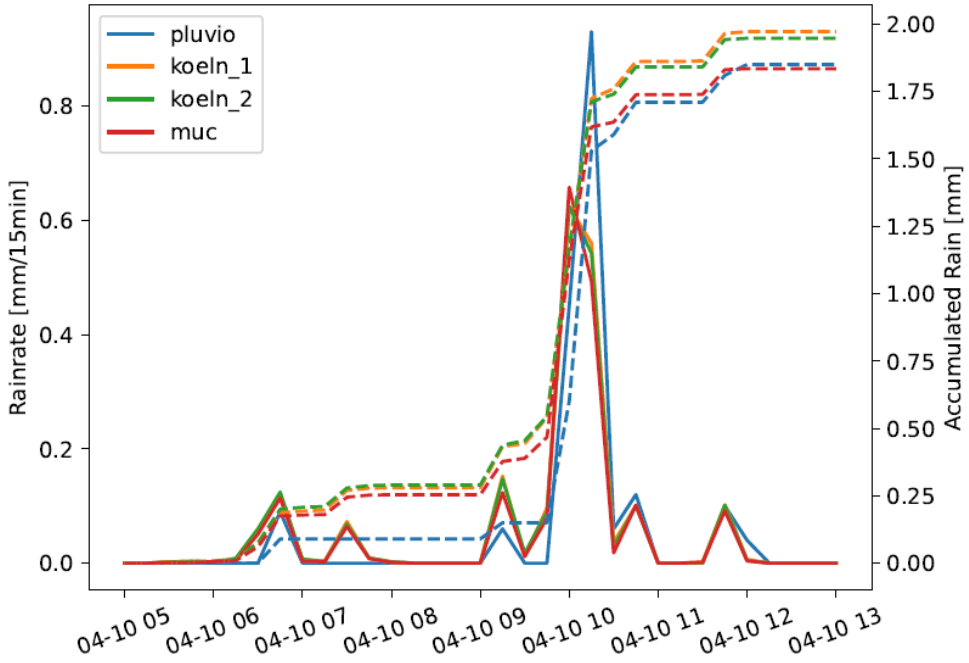
# Parsivel intercomparison at LMU

- Two Parsivel from Univ. Cologne
  - both are Parsivel-2 but 10 years difference in age
- Comparison against LMU Parisvel-2 and Pluvio precipitation gauge
- Also sphere calibration and laser band characterization
- Due to long winter (snow and rain/snow), dry spring and some technical issues, only 6 rain cases
- Goals:
  - See differences in rain observations
  - Collect (raw) data of same rain events which can be used to **test potential correction method**



# Parsivel intercomparison – rain rate and accummulation

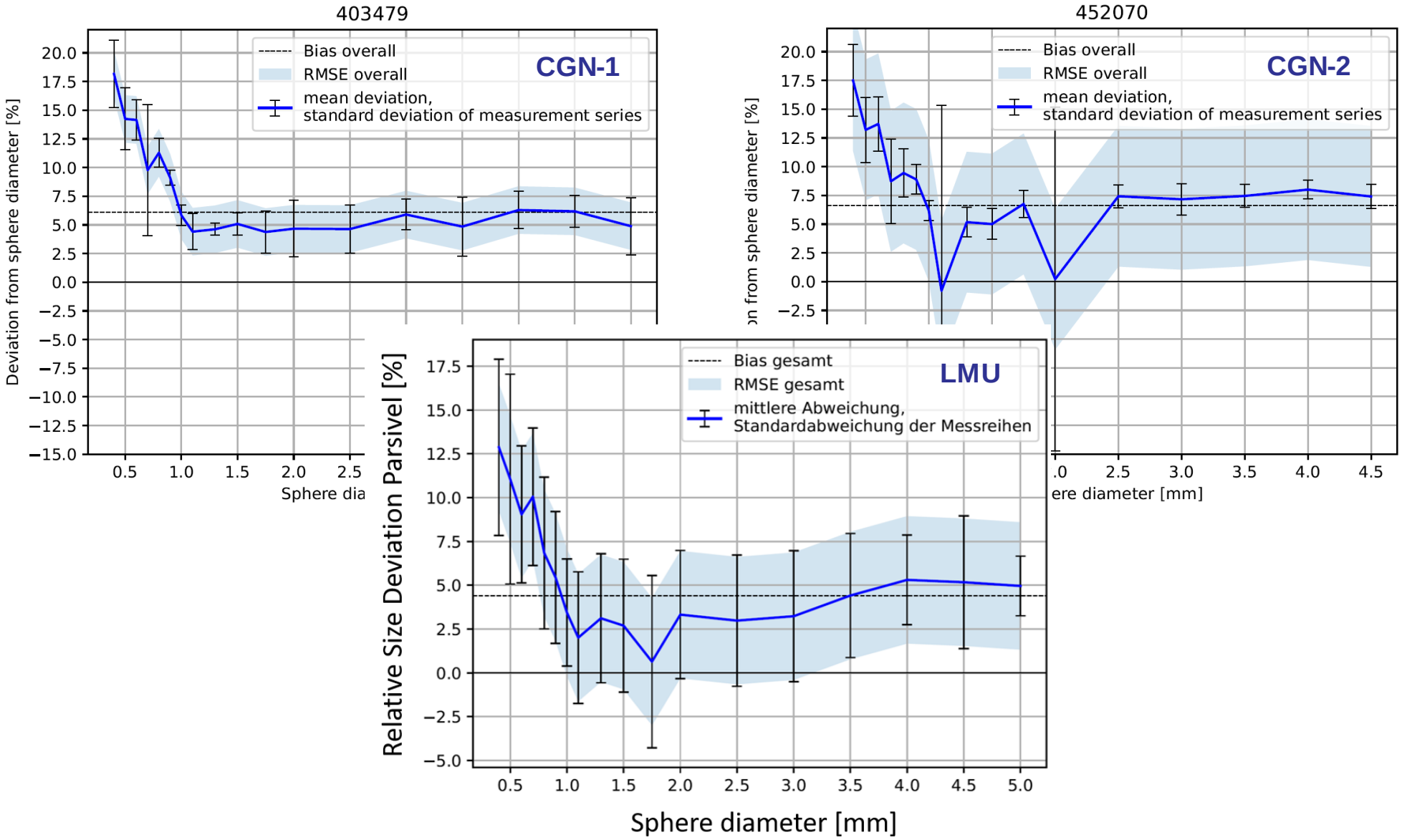



LMU Parsivel underestimates rain much more than the 2 Cologne Parsivels which have 10 years age difference!

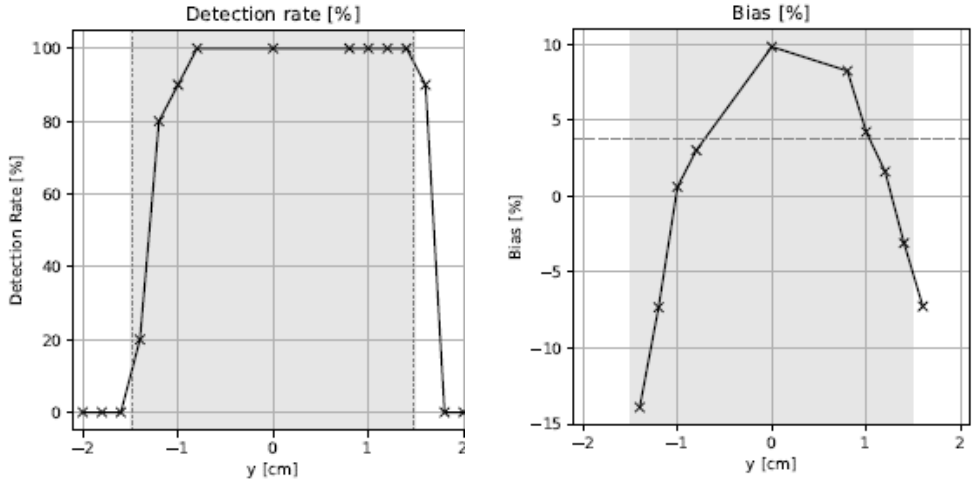
But does it mean Cologne rain estimate is better? Pluvio is closer to LMU Parsivel. Maybe effect of slightly different location?

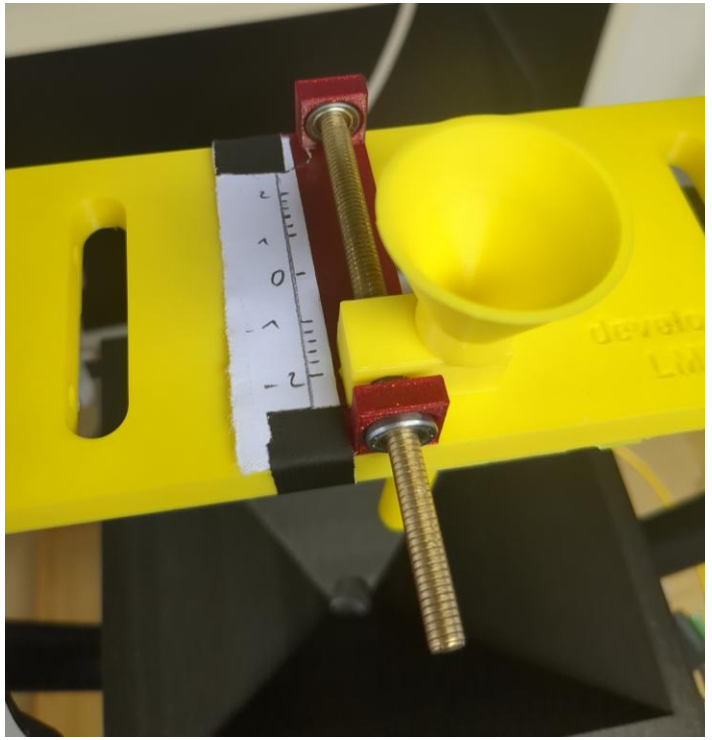
# Parsivel intercomparison – sphere calibration



# Characterization of the laser band and next steps

- Using a threat / spindle to accurately locate the funnel across the laser beam
- Characterization of the laser band for different diameters very important
- The total sphere volume (sphere calibration) needs to be normalized by the laser band area



**Next:** Build a „Parsivel simulator“ where the effect of diameter bias and laser band can be tested (RR, Z) and corrections be derived. Evaluate it on 3-Parsivel dataset!

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# Thank you !