Status of metrology measurements at DESY

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Outline

1. Resume

2. Measurements
   - Upper precision hole
   - Precision longhole
   - Fibre gaps

3. Results
   - Upper precision hole
   - Precision longhole
   - Fibre gaps

4. Summary
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What happened so far?

Results from last meeting

- CERN measurements could be reproduced at DESY
- Precision hole measurement should be improved
- Automation should be implemented to speed up measurement
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Upper precision hole - pre-considerations

Pre-considerations

- Used as center of coordinate system for all 10 plates
  - High precision needed
- Magnification of microscope too large to see whole circle at once
  - Find circle edges in different regions → fit whole circle with RFit
Upper precision hole

Pre-considerations

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  ⇒ High precision needed
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  ⇒ Find circle edges in different regions → fit whole circle with RFit
Measurement steps

1. Let user position microscope on upper edge of hole
2. Let LabView find edge coordinates of circle
   → write coordinates to textfile
3. Move to next region automatically
4. Give user chance to correct microscope position
5. . . . continue with step 2
6. Let RFit use final textfile with all edge coordinates to fit center coordinates and radius
7. Move microscope to fitted center coordinates and set to (0,0)
Upper precision hole

How it actually looks
Precision longhole - pre-considerations

Pre-considerations

- Used to define direction of coordinate system for all 10 plates
  - High precision needed
- Magnification of microscope too large to see whole longhole at once
  - Find straight edges on both sides of hole and calculate the center between edges
Precision longhole - pre-considerations

- Used to define direction of coordinate system for all 10 plates
  ⇒ High precision needed
- Magnification of microscope too large to see whole longhole at once
  ⇒ Find straight edges on both sides of hole and calculate the center between edges
Precision longhole - how it’s done

Measurement steps

1. Move to straight edges automatically
2. Let LabView find edge coordinates on both sides
3. Fit two parallel lines with found coordinates
4. Calculate mid-point between both sides
5. Take (0,0) and calculate angle from vertical
Precision longhole

How it actually looks
Fibre gaps

Fibre gaps - pre-considerations

Pre-considerations

- Different lightsources effect image quality
  ⇒ Try to make measurement+results independent from used lightsource

- Change to higher magnification not possible due to error in lense-mechanics of microscope
  ⇒ Use same magnification (lowest) as for precision hole measurements

- Use ”template picture” of gap for LabView’s pattern matching
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- Use "template picture" of gap for LabView’s pattern matching
Fibre gaps - how it's done

Measurement steps

1. Move automatically to first gap between two fibres
2. Rotate picture 45°
3. Let LabView look for "template gap" in right, middle and left area of picture
4. Take centers of found gaps as result
5. Move to next three gaps automatically
Fibre gaps

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Upper precision hole

Results for upper precision hole

Results:

- ~ 70-200 points found, depending on lightsource
- **But:** Precision-results from different lightsources vary only insignificantly!
- Precision received after 20 measurements in a row: 2-3 \( \mu \text{m} \)
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**Precision longhole**

**Center-Coordinates Distribution**

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<td>RMS y</td>
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Results for Precision longhole

Results:
- Method seems to work fine
- Further precision studies needed
Results for Precision longhole

Results:
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Results for fibre gaps

Preliminary Results:

- LabView finds (almost) all gaps on its own
  ⇒ Only little user intervention needed!
- Finds three gaps in one picture
  ⇒ Reduces picture-download-time bottleneck
- Even with low magnification: Needed precision seems to be achieved
  ⇒ Further precision studies needed
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Q: What has been achieved so far?
   A: Programming for circular hole and long hole done. Fibre gaps programming almost done.

Q: What about the precision?
   A: A precision of $\sim 2-3 \, \mu m$ is possible for the coordinate system.

Q: What about the overall automation?
   A: User intervention (measurement-time) already reduced drastically.

Q: What's up next?
   A: Finish programming of fibre gaps + put everything together.