Precision assembly of back-to-back "2S" modules and Front-to-back Metrology

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Precision Assembly of 2S Modules

Aim at front-to-back alignment accuracy of ≈ 15 µm derived from target resolution of on-module pt measurement.

We know that gantry assembly robots can achieve ≈ 10 µm standard deviation for single sided modules.

Strategy:

- place alignment marks on both sides of the double-sided 'fold-around' hybrid (using hybrid photolithography)

- measure position of marks on hybrid after hybrid assembly and store results in data base

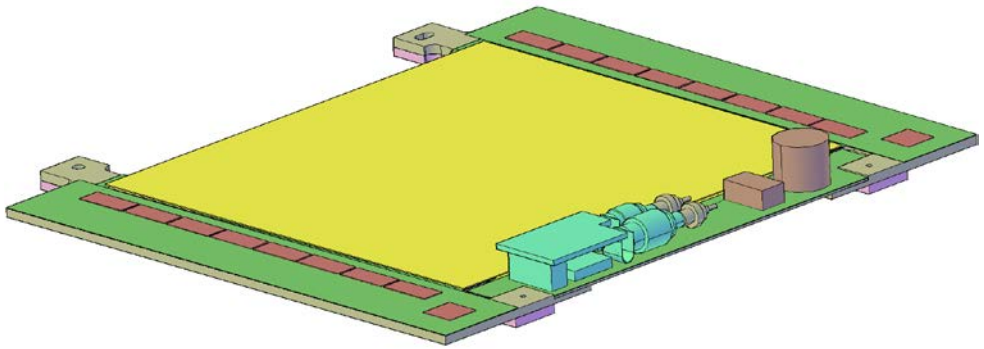
$\rightarrow$ aim: front-to-back alignment of hybrid marks known to ≈ 5 µm

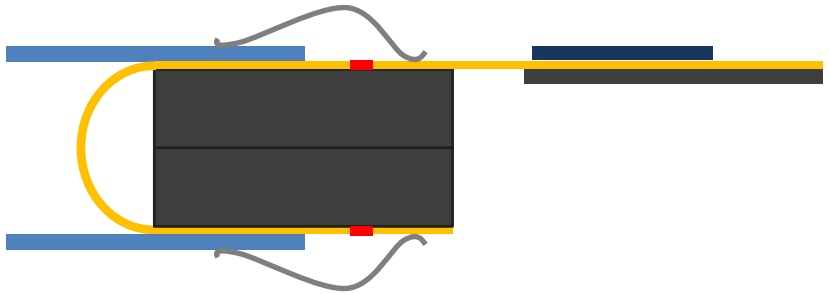
$\rightarrow$ need to develop optical metrology set-up to do this

- glue sensors to hybrids using gantry robots and hybrid mark coordinates from data base

$\rightarrow$ alignment of sensors to hybrid marks on same side ≈ 10 µm

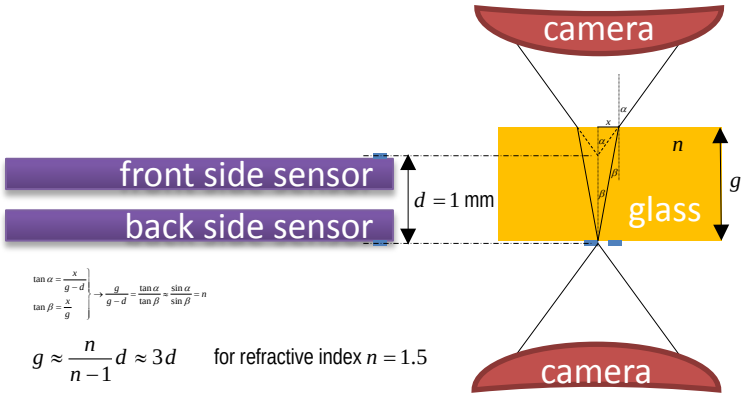
$\rightarrow$ alignment of front sensor to back sensor $\approx \sqrt{(10\ \mu\text{m})^2 + (5\ \mu\text{m})^2 + (10\ \mu\text{m})^2} = 15\ \mu\text{m}$





Front-to-back Metrology

Options:



- transprent fiducials a la ATLAS-SCT 'turn plate'

→ works (ATLAS exprience)

→ requires to flip the hybrid/module/petal during measurement

→ requires to mount the hybrid/module/petal in a frame which holds the fiducial

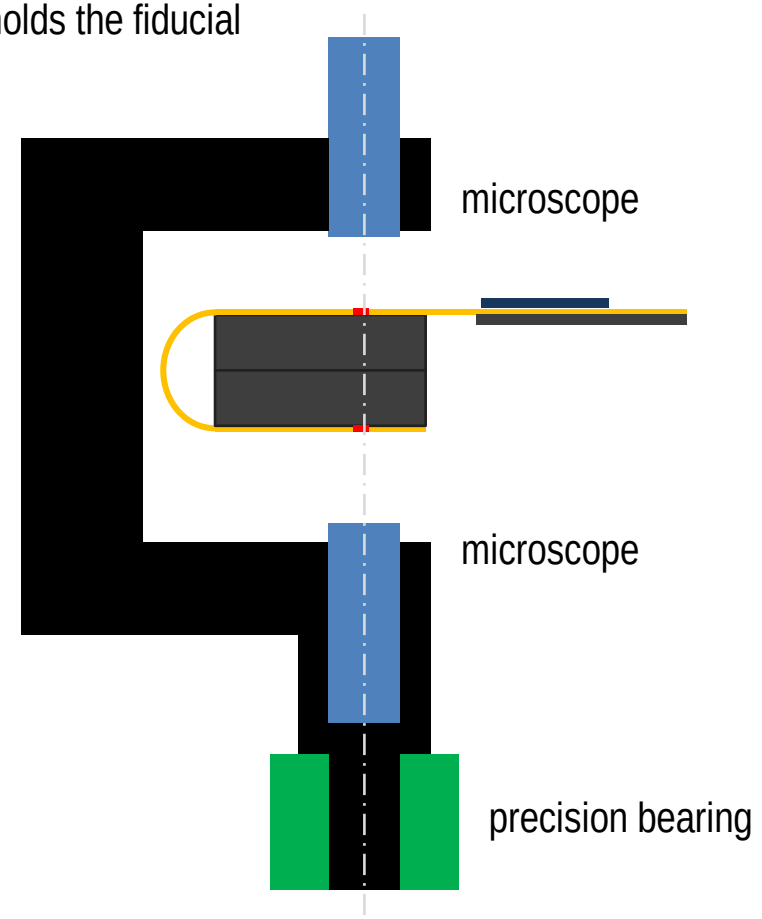
- simultaneous measurement on both sides

→ main question: how to align the microscopes on both sides?

→ we are currently investigating the option to use an axis of rotation for this purpose

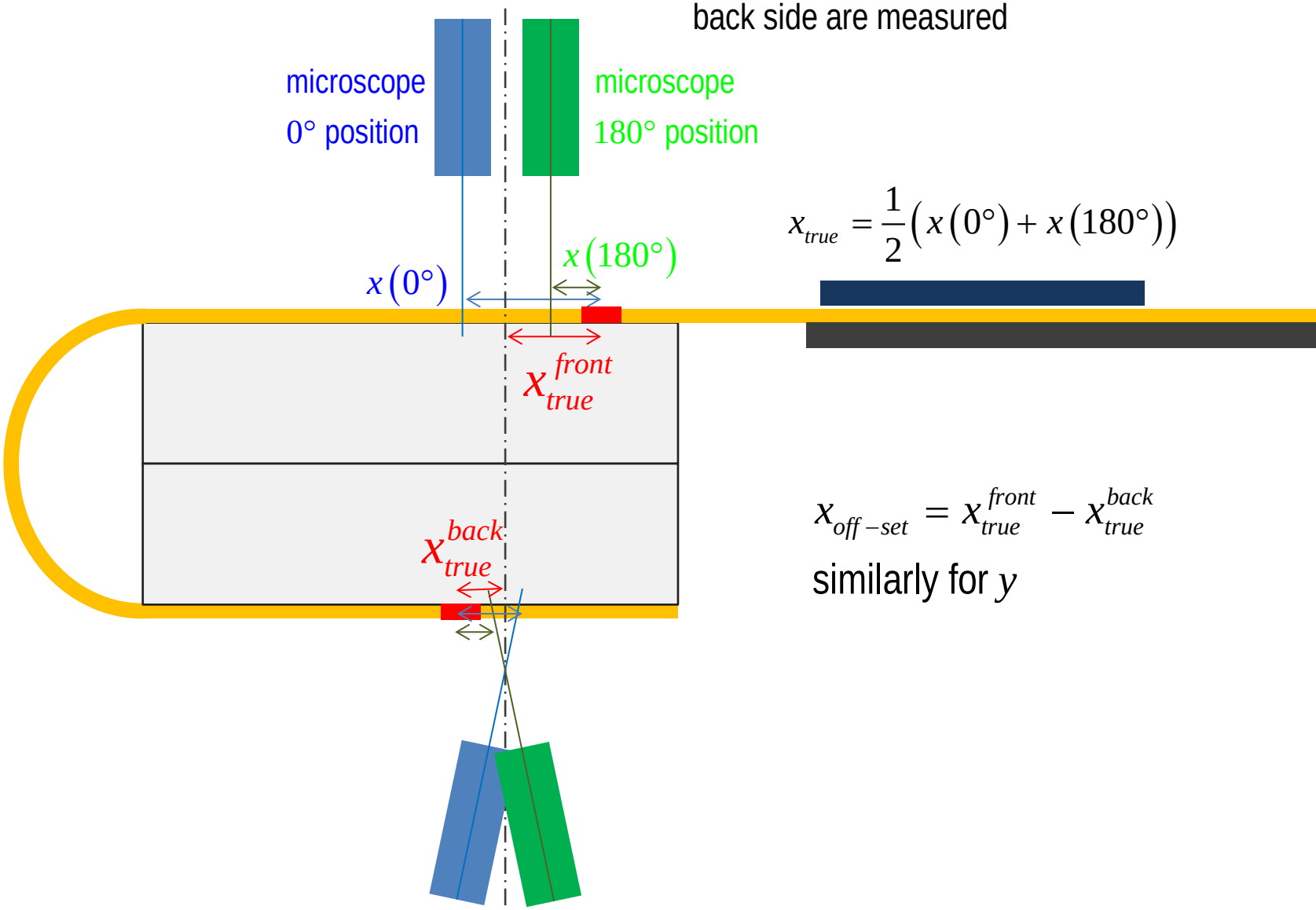
one version is shown to the right

alternative: house microscopes in separate but precisely aligned bearings



Front-to-back Metrology

axis of rotation is used as the reference axis to which the mark positions on front and back side are measured



$$x_{true} = \frac{1}{2}\left(x(0°) + x(180°)\right)$$

$$x_{off-set} = x_{true}^{front} - x_{true}^{back}$$

similarly for y

Next Steps

- prepare technical drawings of 2S module with 'fold-around' hybrid

- build a dummy hybrid/module

→ exercise hybrid carrier machining

→ exercise hybrid assembly

→ exercise module assembly

- work out details of optical front-to-back metrology

- eventually build a test version of the 'rotating double microscope'