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GREGOR: Optics Redesign - Image Quality

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Signatures & Approval

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Change Log				
Vers.	Date	Author	Description of Changes	Sect./Para.
1	2020-03-21	L. Kleint	New Document	

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1 Scope

This document shows the first light results of the optics redesign of GREGOR.

2 First Results

From Mar 8-21, 2020 KIS installed the new setup of the GREGOR optics lab. The optics were first aligned via laser originating in GRIS F4. The off-axis parabolic mirrors are used at their nominal angle of 2x4 degrees, which was verified by measurements.

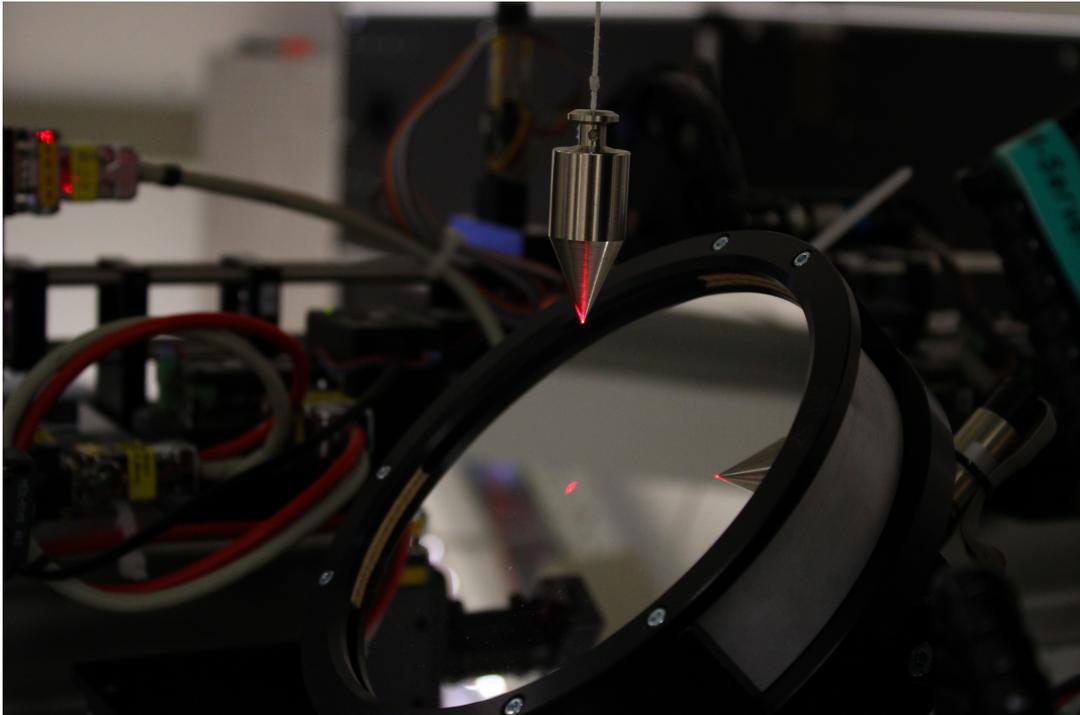


Figure 1: laser alignment of M11. The laser is reflected into the vertical optical axis, which is verified with a plummet.

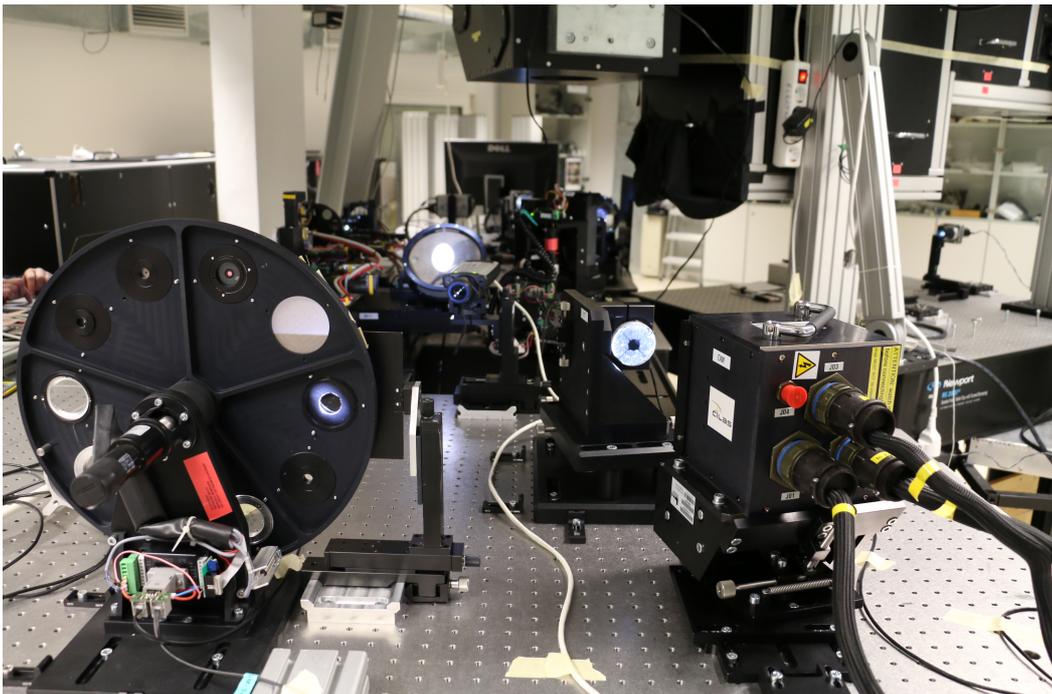


Figure 2: Layout of the optics lab

Then we installed, aligned, and calibrated the wavefront sensor. On Mar 21 we were able to lock on the target and the image was perfectly sharp over the whole field of view. In fact, even without AO, the image was sharp, just jittering a little more. This proves that the optics are very good.

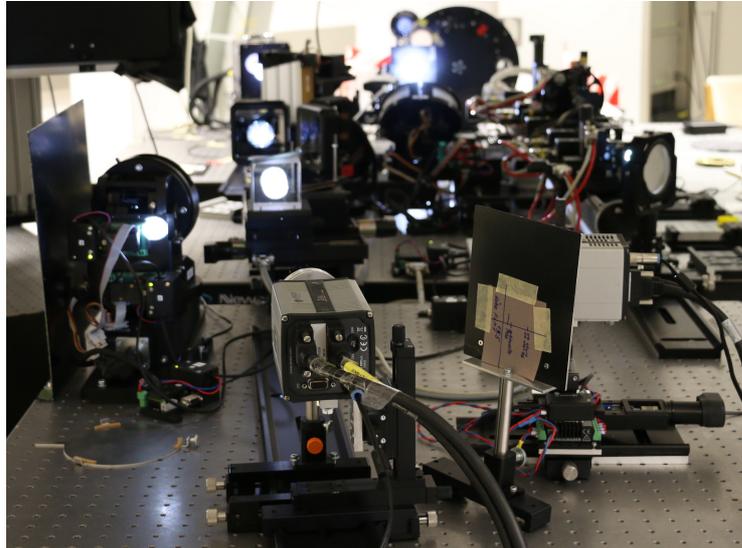


Figure 3: setup used to record the target. BBI camera in LEAP F4

The next figure shows the target as recorded on Mar 21 around 13:20 in the LEAP F4. The wavelength was 393.55 ± 1.1 nm and the exposure time 3 ms. No AO offsets were applied or necessary. The correct group (5th group, 5th element) is resolved in all subimages. No astigmatism or coma is visible.

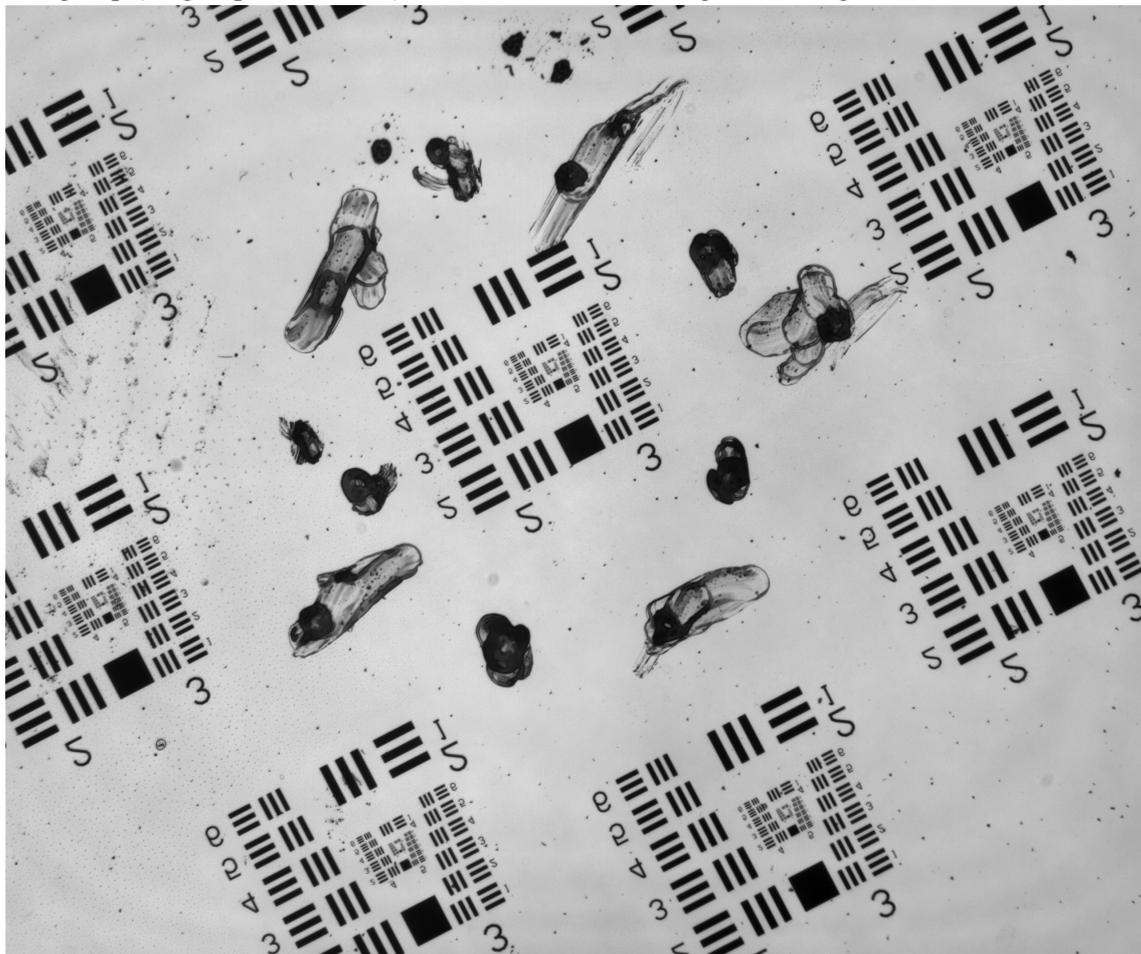
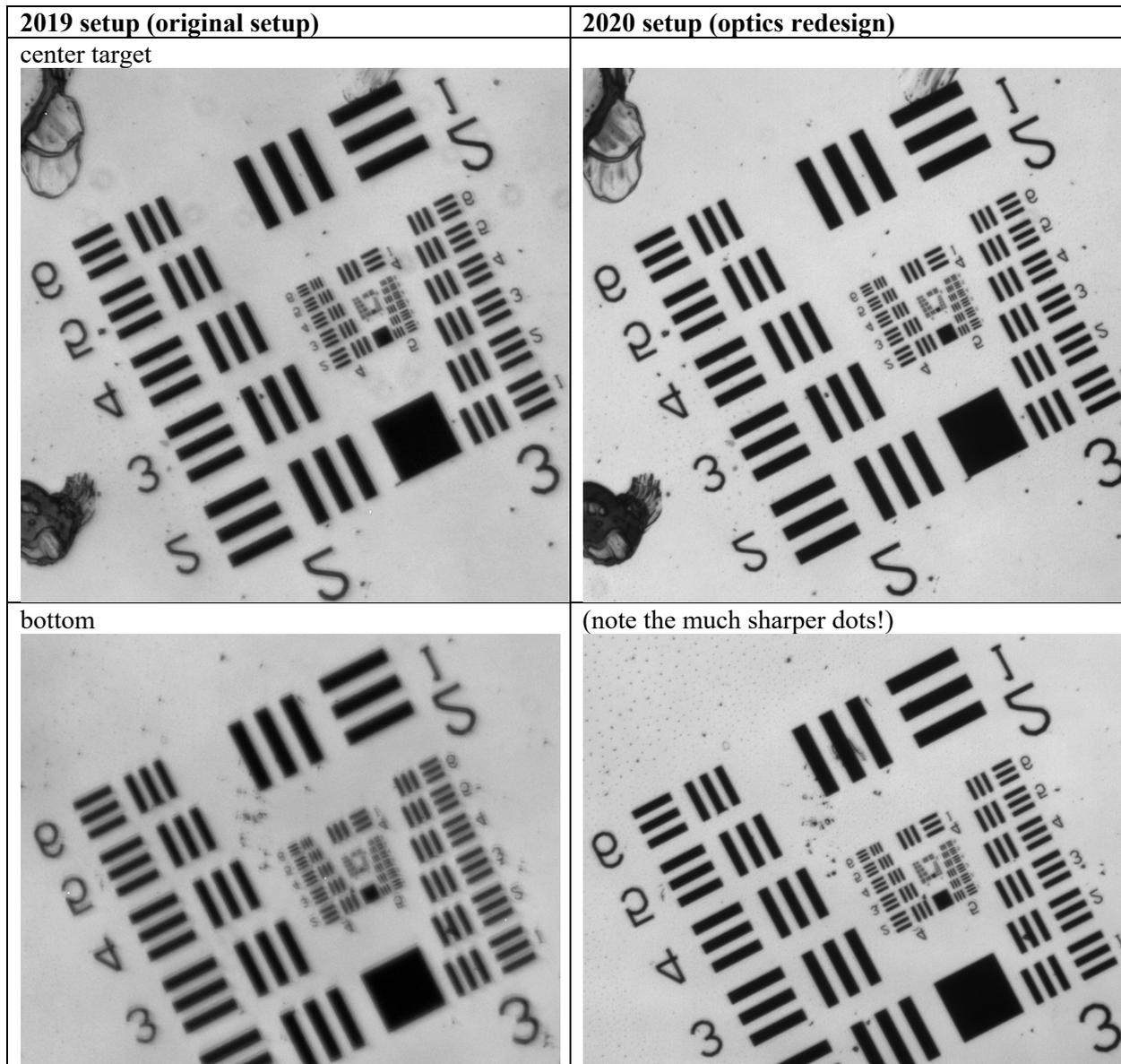
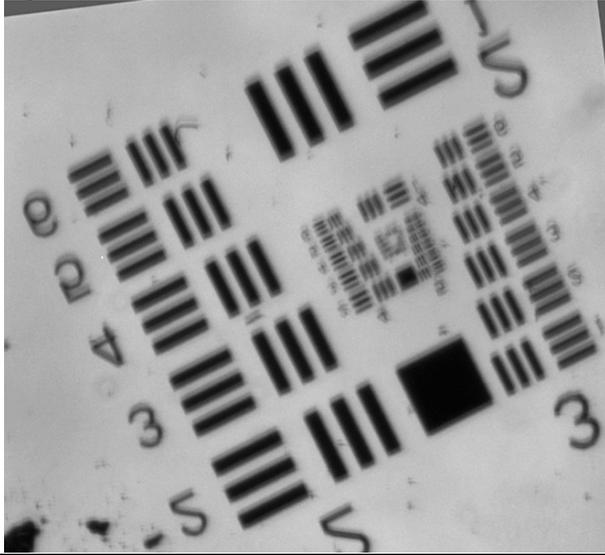


Figure 4: First light target image of the new optics setup

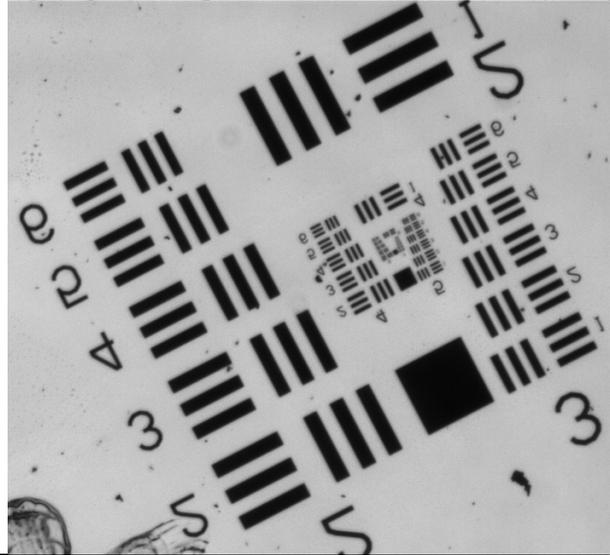
For comparison, we show selected subimages in comparison with data from March 2019 (we also verified July and August 2019 and they are similarly bad, if not worse).



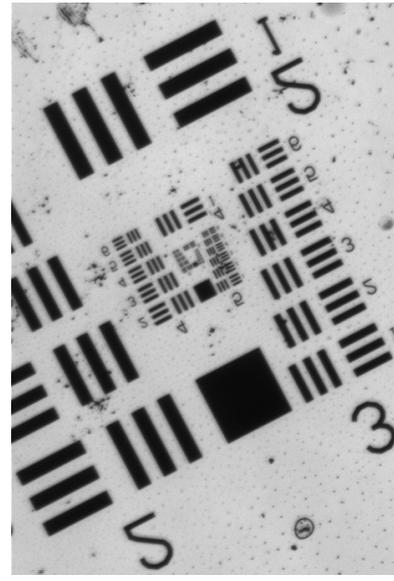
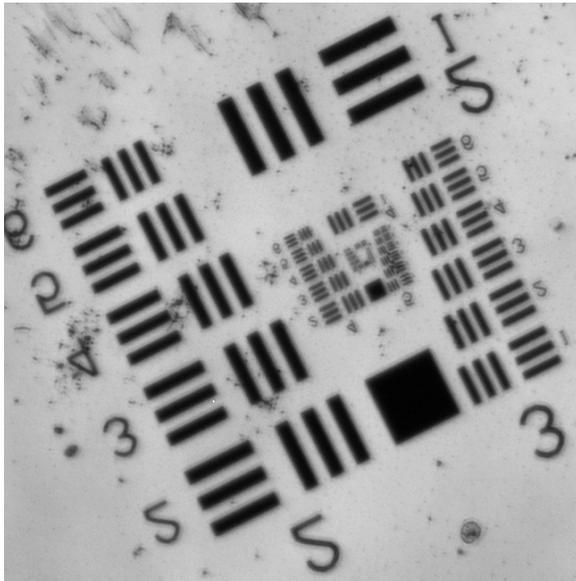
top



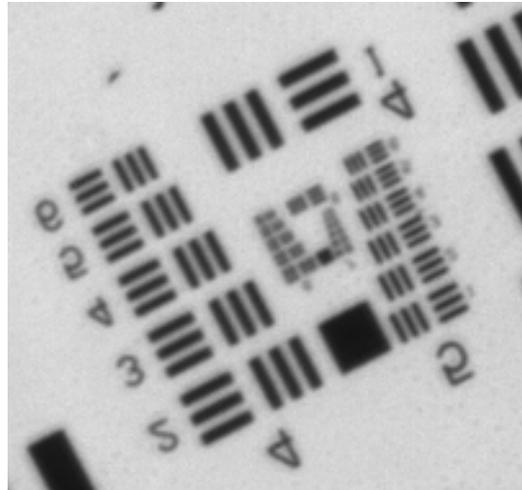
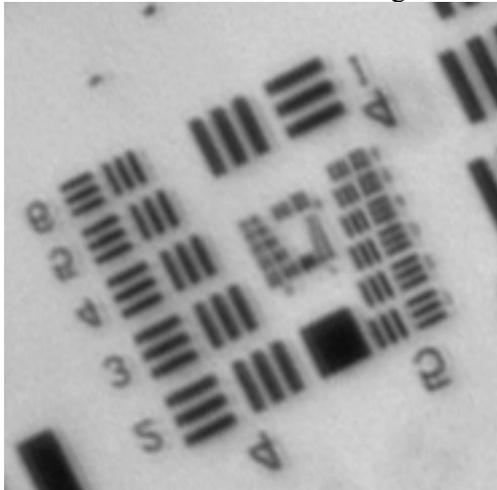
top (adjacent target because the other was cut)

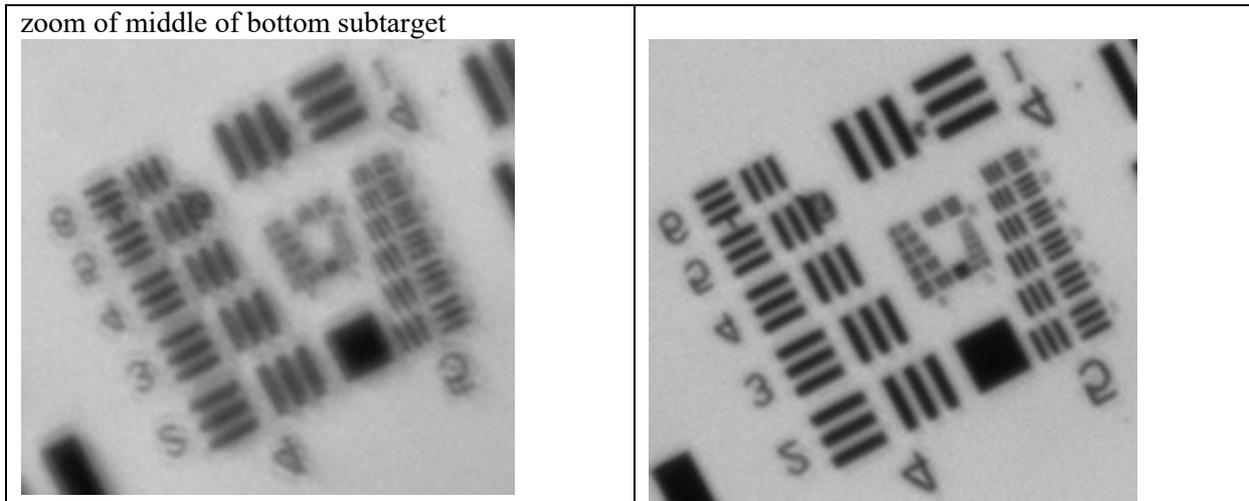


left



zoom of middle of middle subtarget





All target images from 2019 and before show strong astigmatism (“shadows”) outside of the image center. Also the “dust” (or imperfections on the target) showed astigmatism and/or coma during and before 2019, which is now completely gone.

We shifted the camera to record all subtargets on March 21 and all of them are perfectly sharp.

We conclude that the image quality problem of GREGOR is solved.