Laser positioning system

Status

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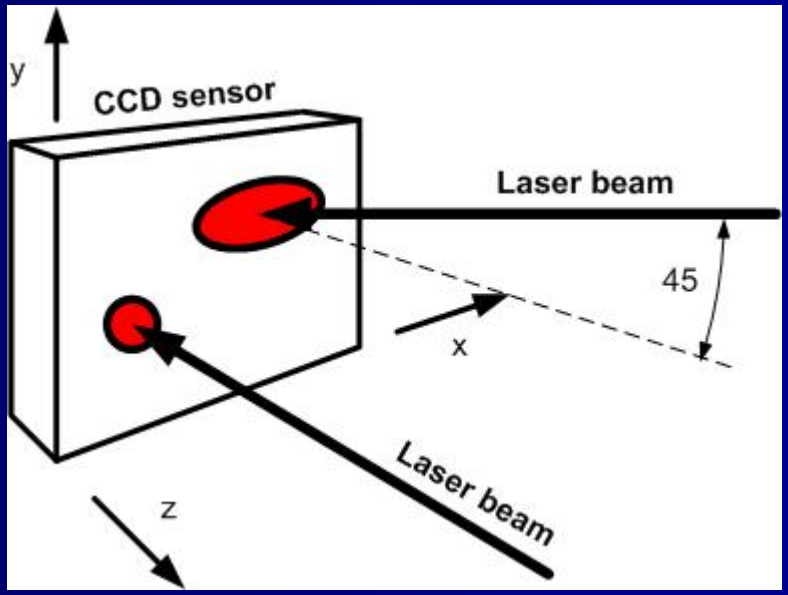
Content

- Laser positioning system for calorimeter with respect to the beam pipe
- Proposed solutions for the online measurement of the sensor planes

Present setup – dual laser beam

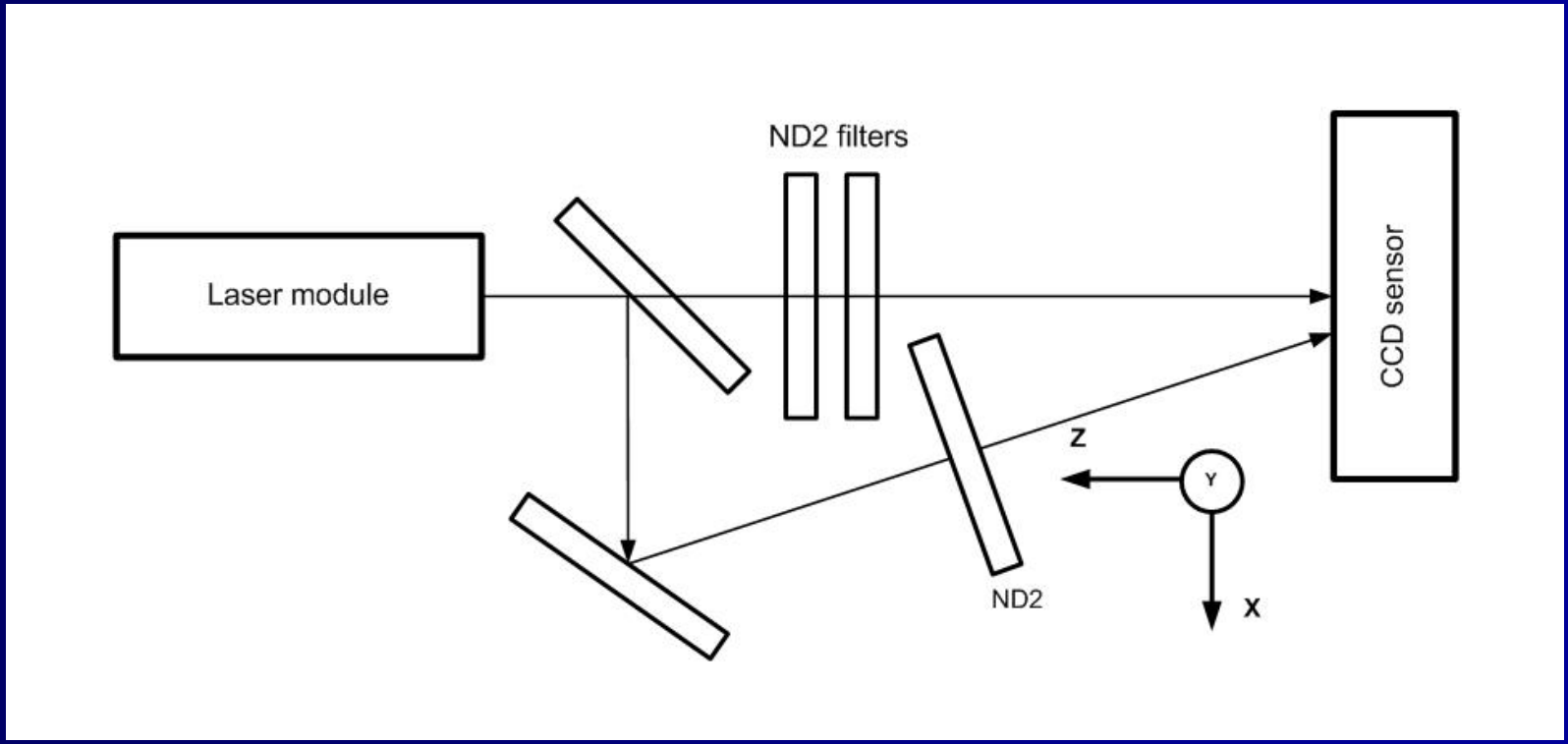
- BW camera DX1-1394a from Kappa company 640 x 480 with Sony ICX424AL (70€) sensor 7.4 µm x 7.4 µm unit cell size
- Laser module LDM635/1LT from Roithner Lasertechnik
- ThorLabs ½" travel translation stage MT3 with micrometers (smallest div. 10 µm)
- Neutral density filters ND2
- Half transparent mirror
- New support for mirrors and filters
- Renishaw RG24 optical head (0,1 µm resolution) to control movement of the camera

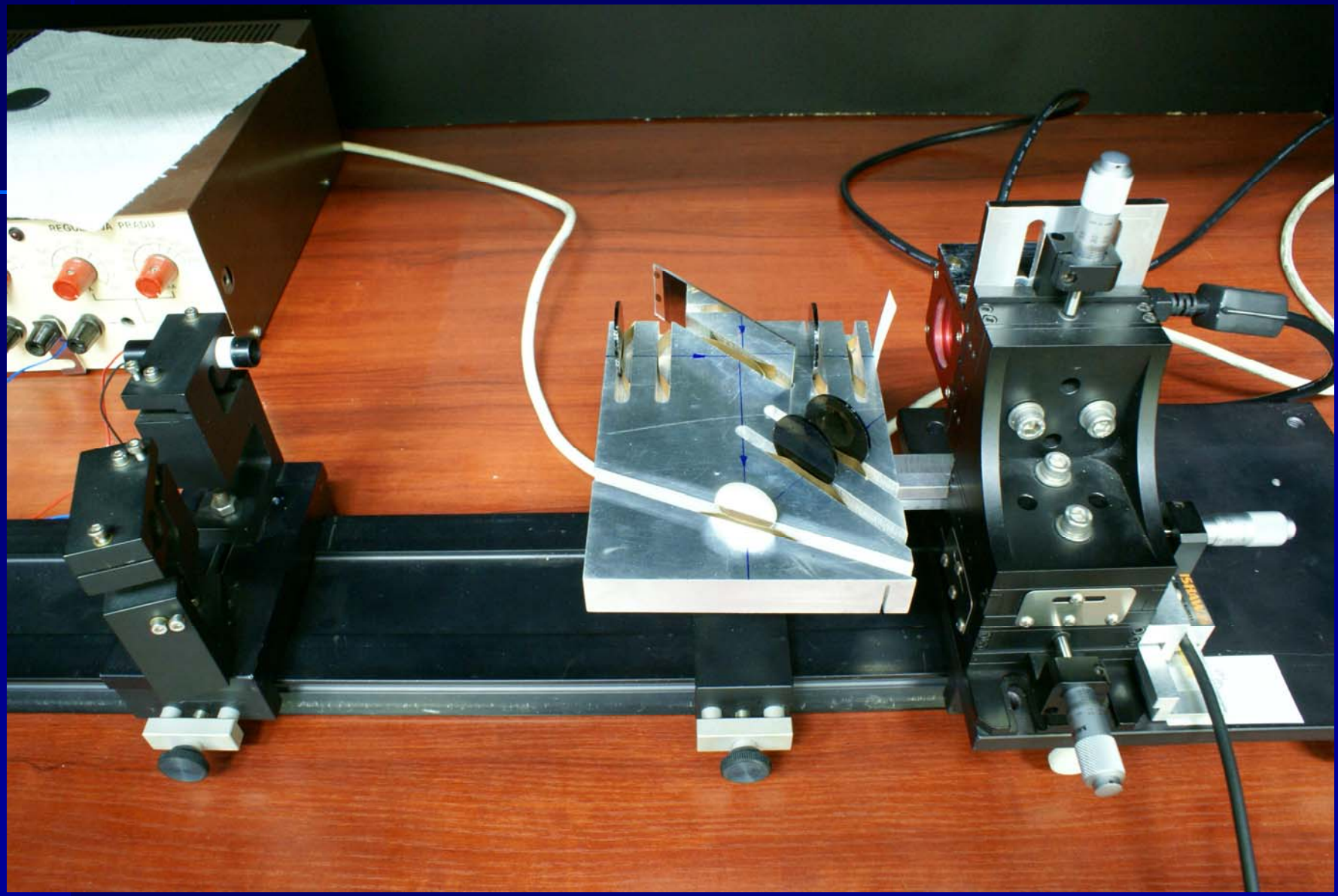
XYZ displacement measurement with two beams

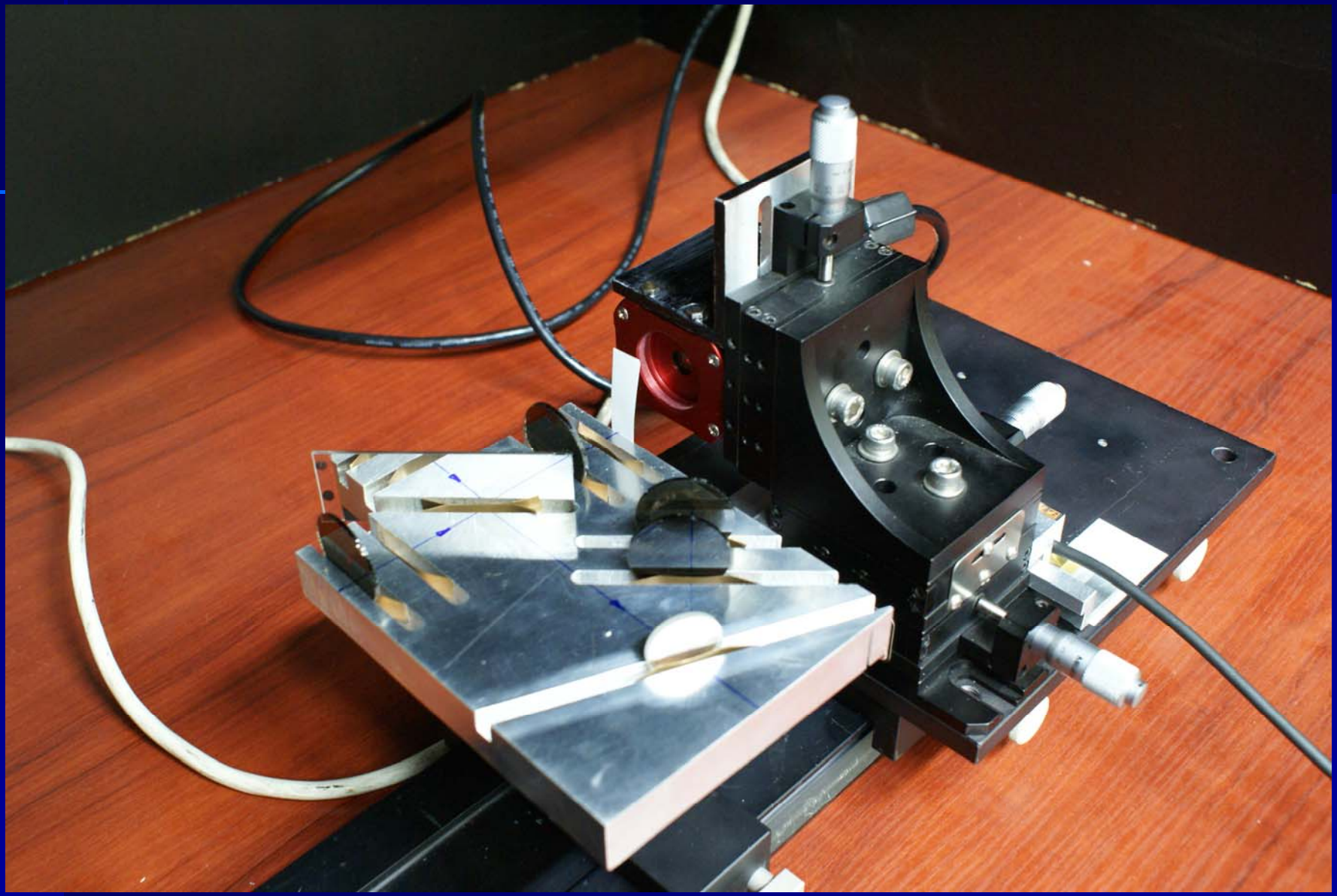


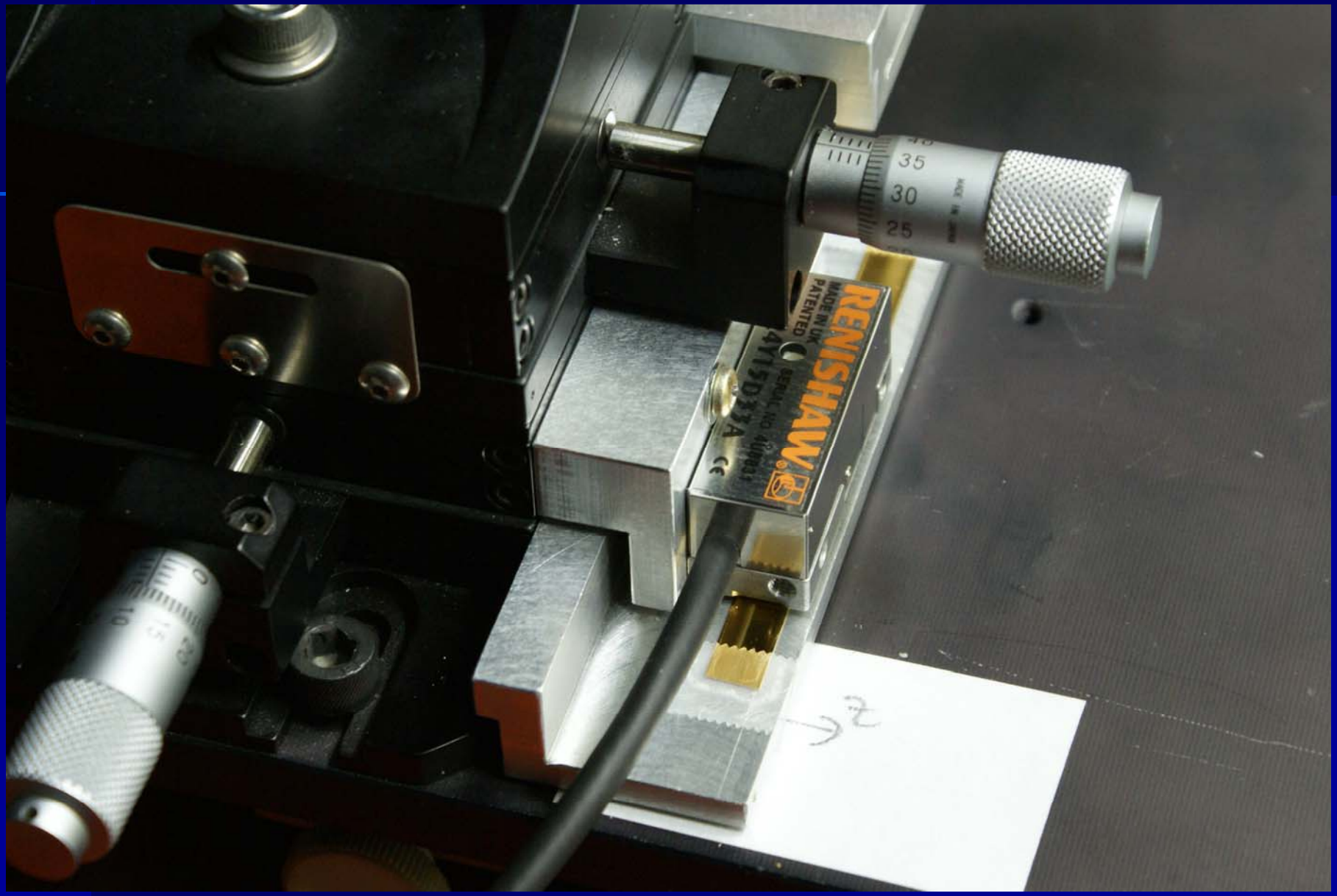
Two laser beams (one perpendicular, second with 45° angle to the sensor plane) allows us to measure XYZ translation in one sensor

Setup with two beams





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RENISHAW
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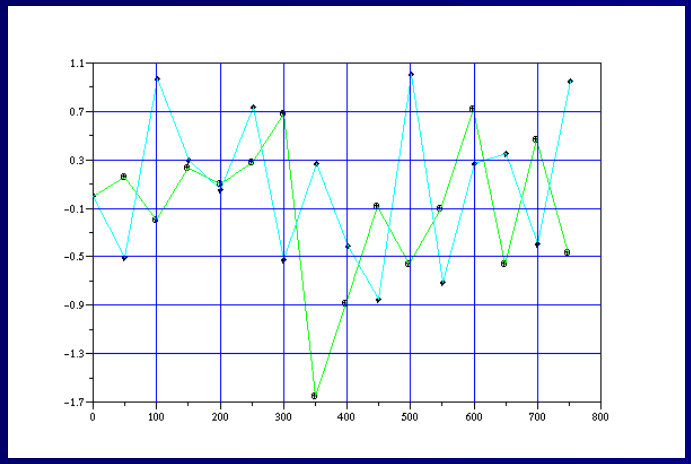
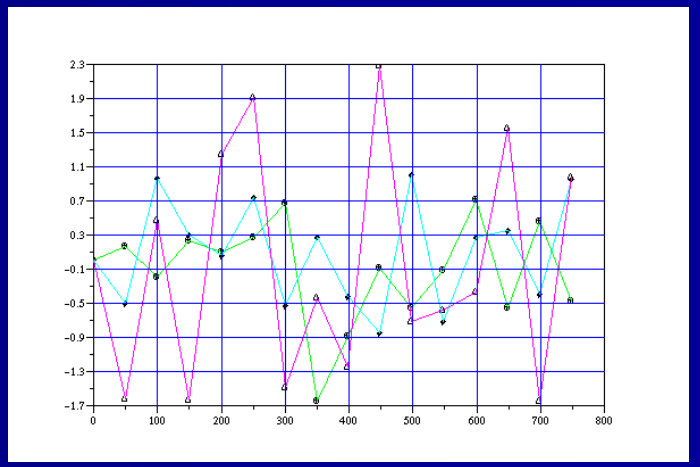
XY measurement

Difference between points [µm]



Y position

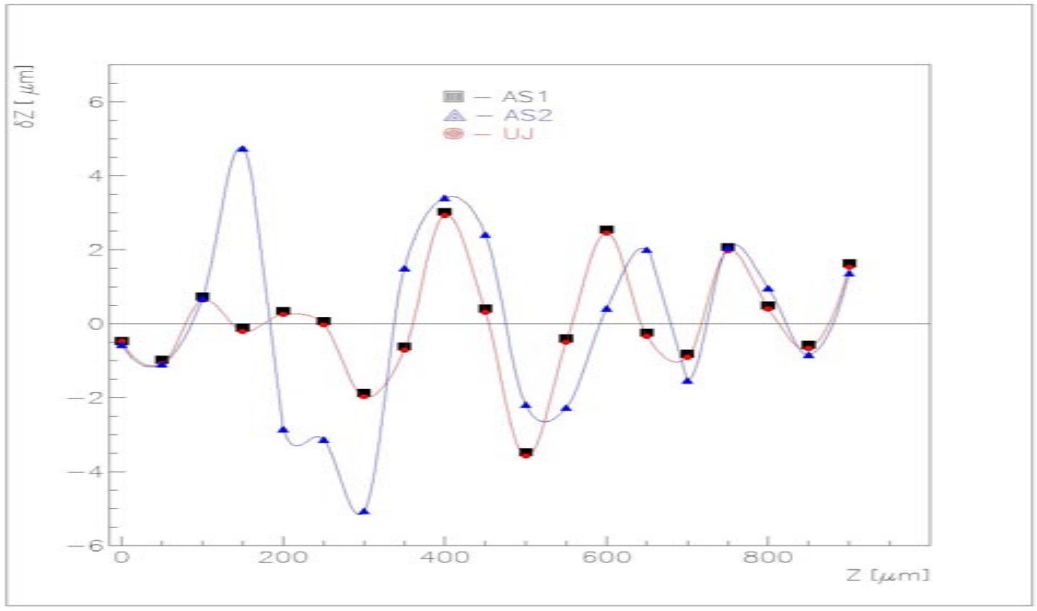
Difference between points [µm]



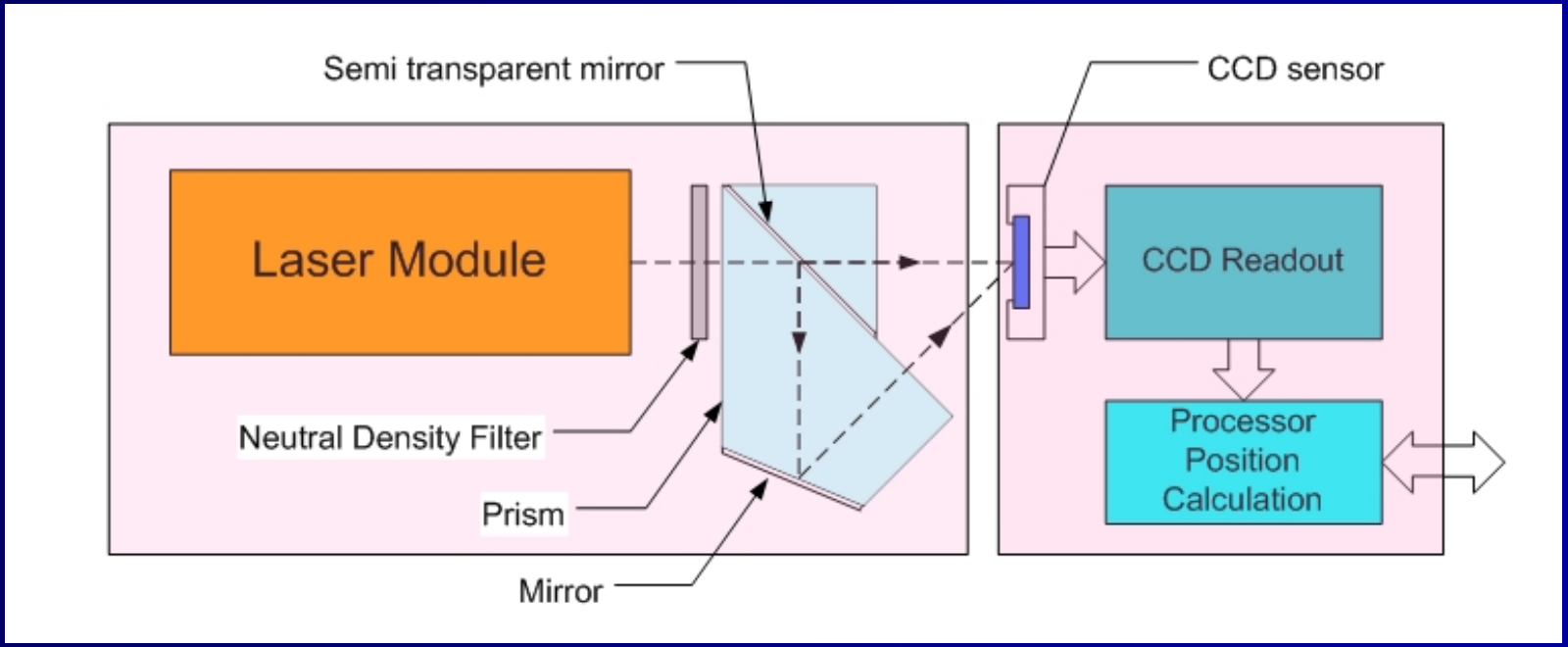
X position

Camera has been translated in 50 µm ± 2 µm (estimated error) steps

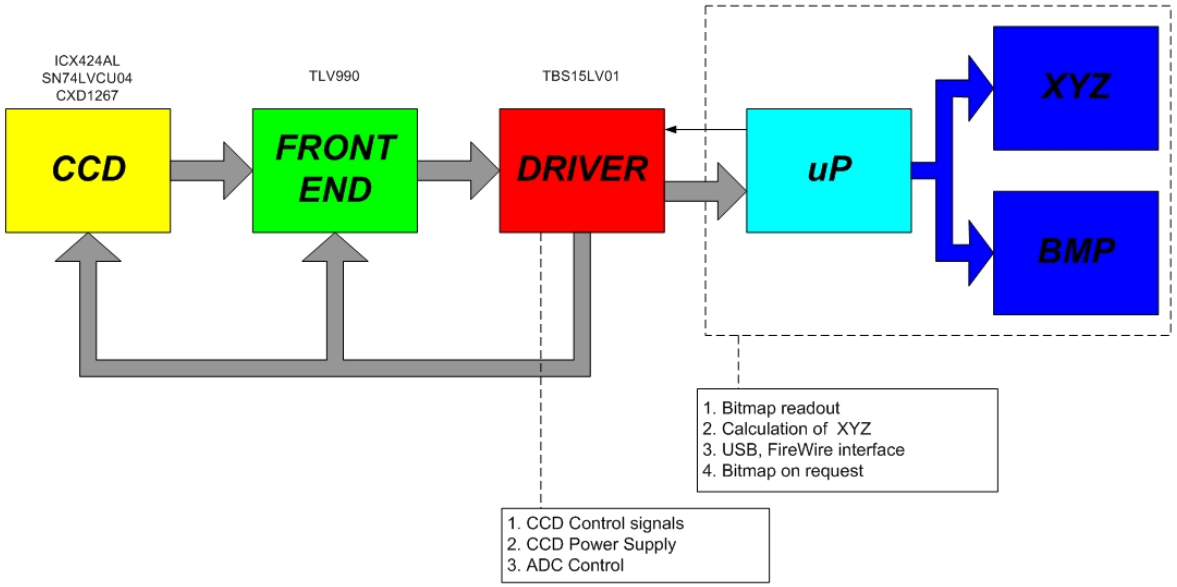
Z displacement measurement (3 different algorithms)



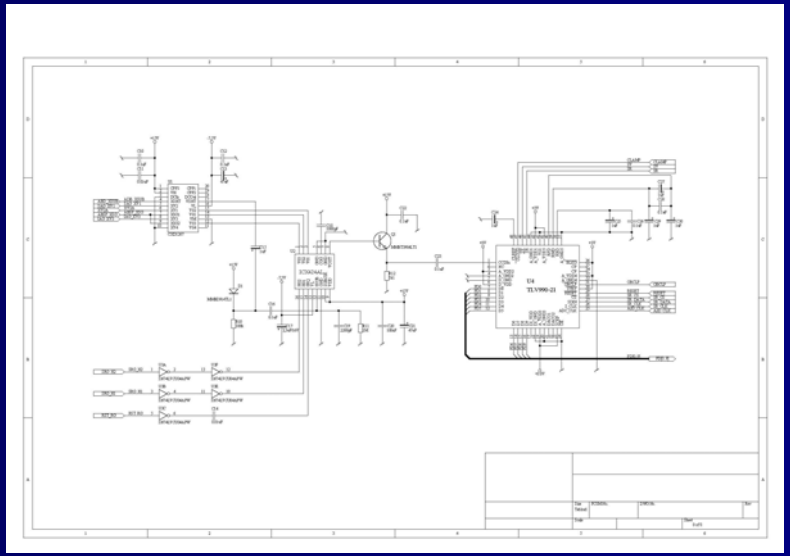
Proposed setup with two beams and prism splitter

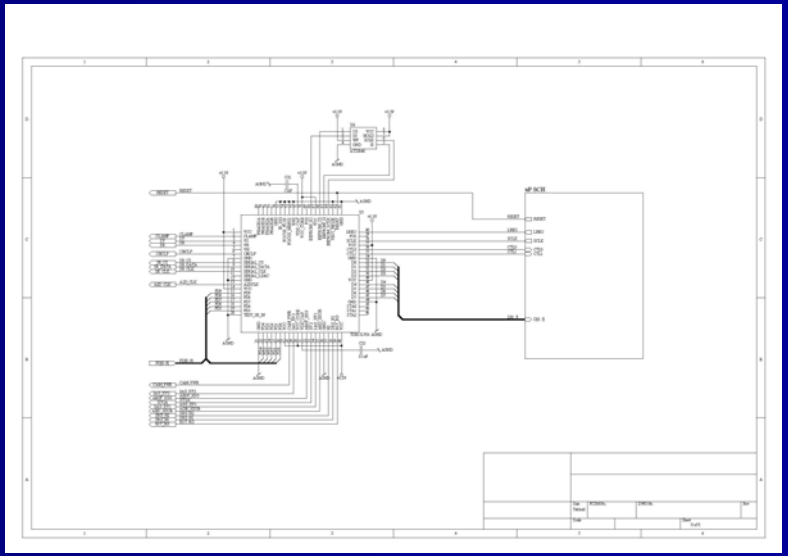


Readout electronics for CCD Prototype



Readout electronics for CCD





Conclusions

- The XY position measurement method with single beam has the accuracy in order of ~2 micrometers
- The different XY algorithm and new measurements shows similar results
- The XYZ position measurement with two beams looks promising, a new algorithm has been developed, the accuracy is in order of ~2 μm in XY and ~4 μm in Z direction
- Both XY & Z uncertainties are in the same order as estimated accuracy of a micrometric screws

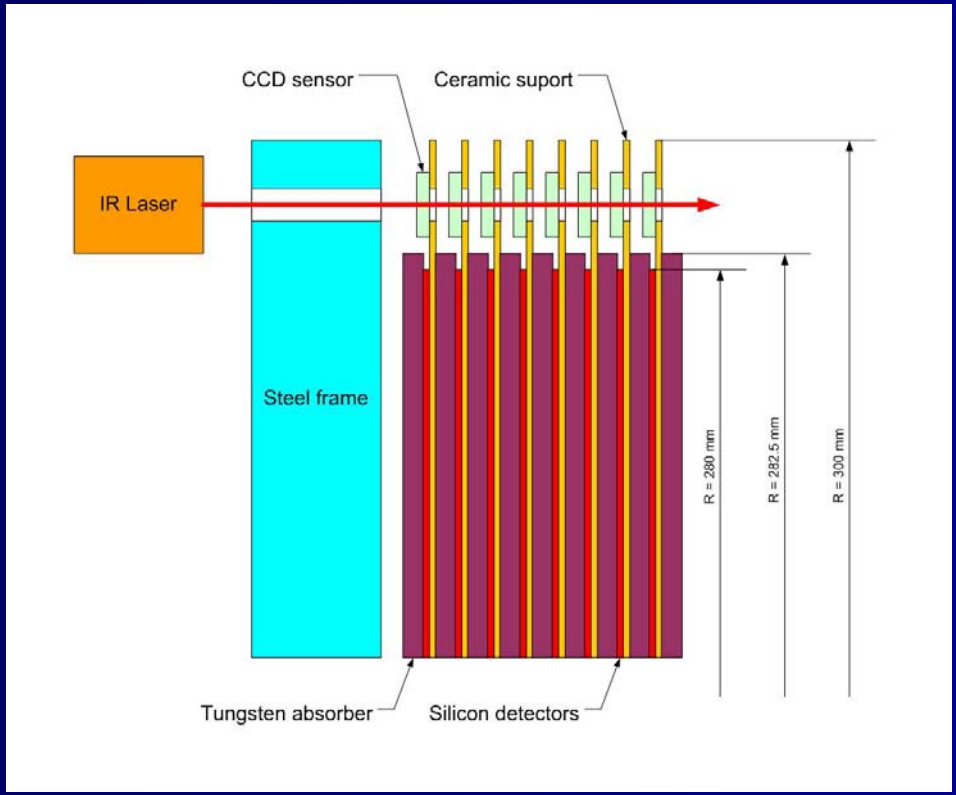
Next steps

- New lasers with aspherical lenses – better spot.
- Beam splitter with half transparent mirror – designed, not ordered yet (probably we will skip it because of manufacturing problems)
- Setup with two lasers – better reliability
- Improvement of algorithm to determine centre of two spots (in progress)
- Discussion on possible errors
- More compact prototype – in progress (new person involved)
- Independent measurement of XYZ translations – Renishaw industrial system (0.1 μm resolution). We are waiting (will come in a few days) for the PC card to read out the signals from the Renishaw RG24 optical head.
- Stability tests

Online alignment of sensor planes

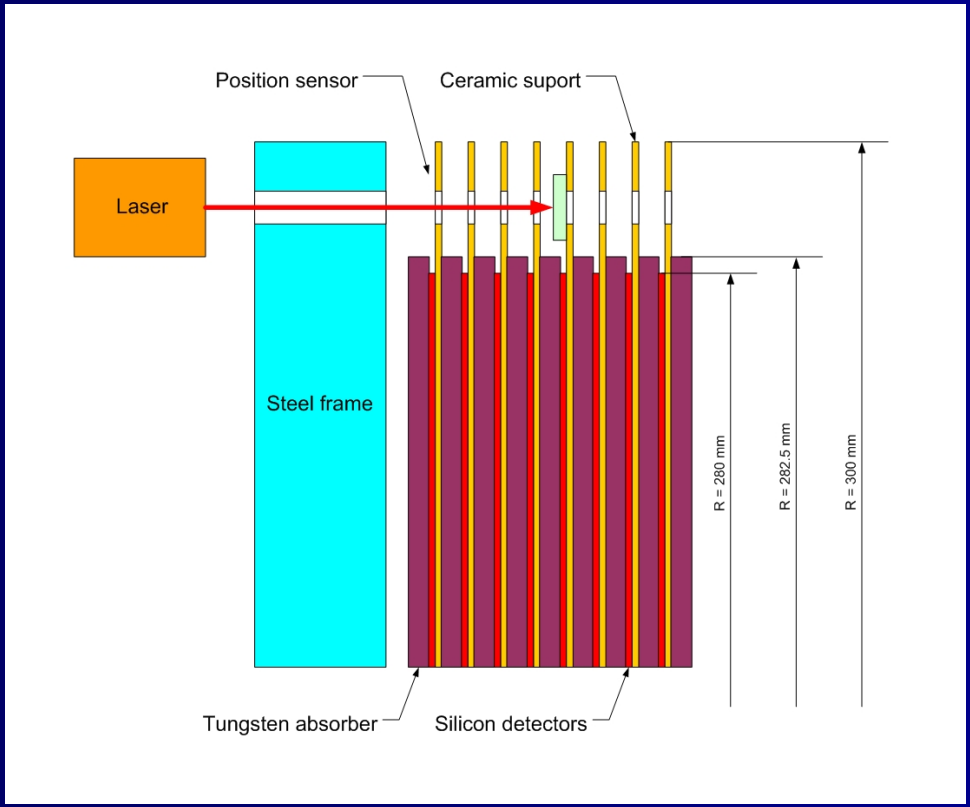
- One laser beam lighting the transparent position sensors placed on each sensors plane
- Individual laser positioning system for each (or only a few) sensor plane
- Spanned wire going through the holes in sensor planes working as an antenna and pickup electrodes to measure the position

Transparent position sensors



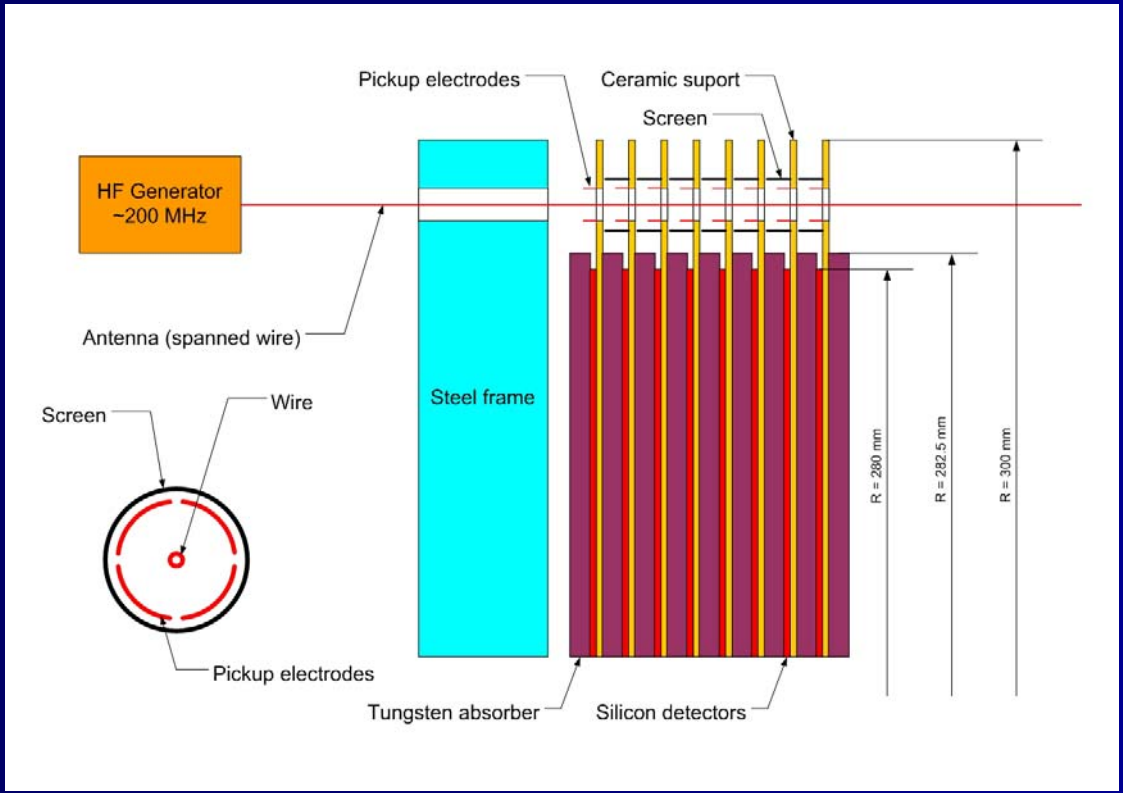
- Special transparent sensors
- Problems with reflections
- Degradation of the beam shape for deeper planes

Idyvidual positioning system for each plane



- Standard CMOS or CCD sensors
- Similar electronics as in position system for calorimeter
- More reliable
- More lasers
- More space necessary

Spanned wire alignment



- Active during time slots between trains
- Possible interferences
- Accuracy up to ~0,5 μm
- Quite simple electronics
- Need 4 coax cables for each plane