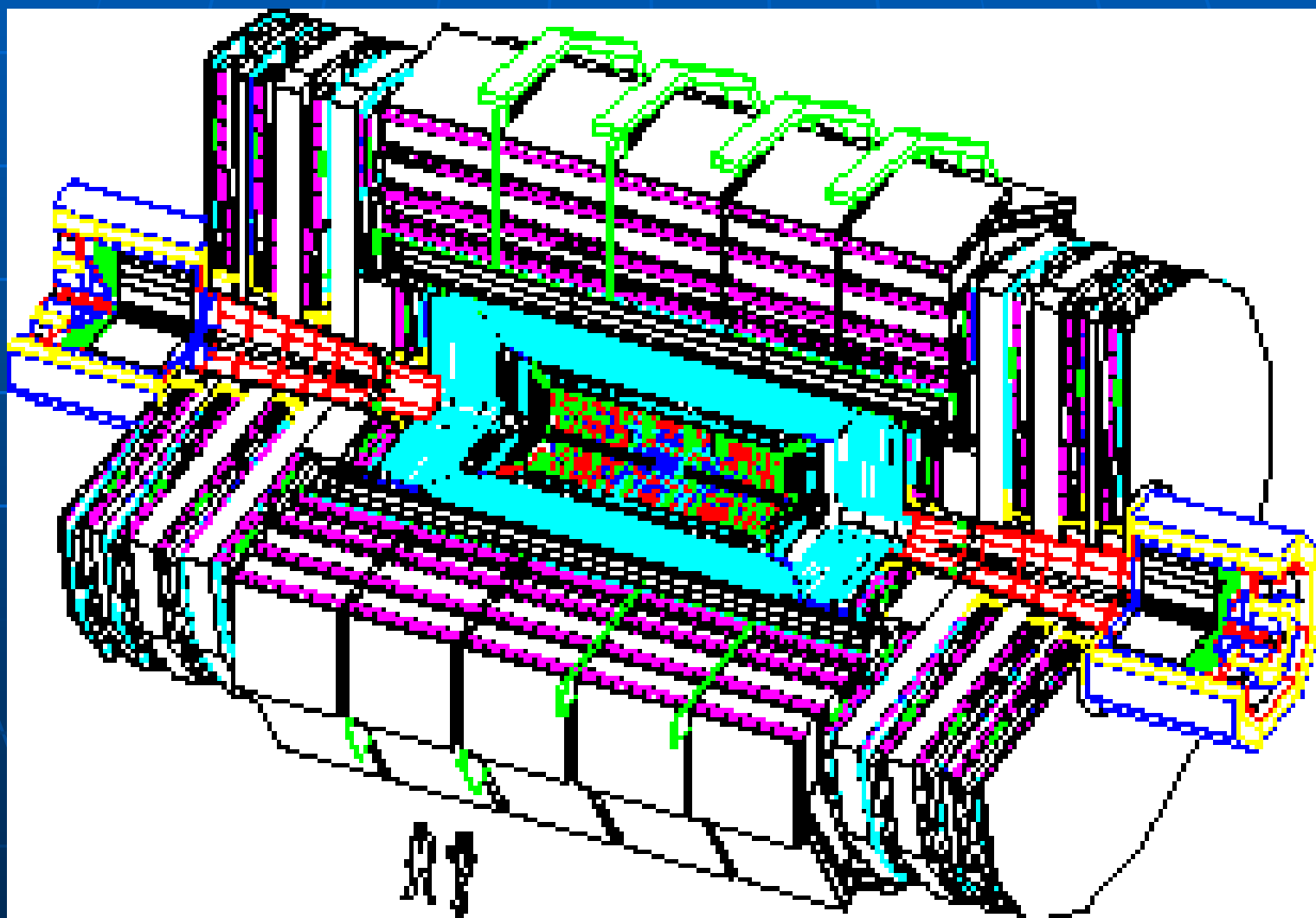


Calibration of clinometers for the alignment of muon chambers in the CMS experiment.

MOSCHOUTIS Thomas

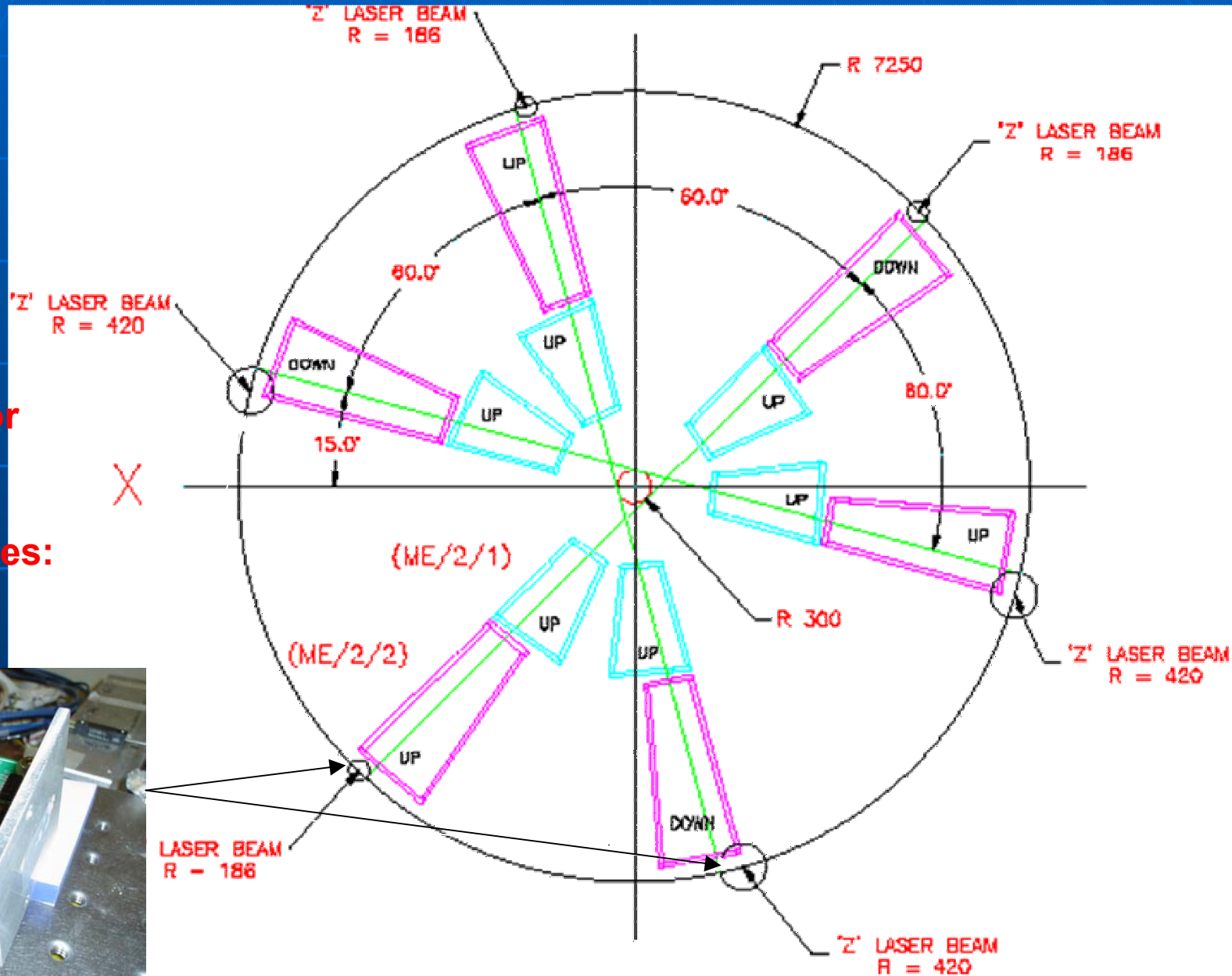
FAS meeting – Orlando, 12 March 2004

Global view of the Compact Muon Solenoid



Compact Muon Solenoid

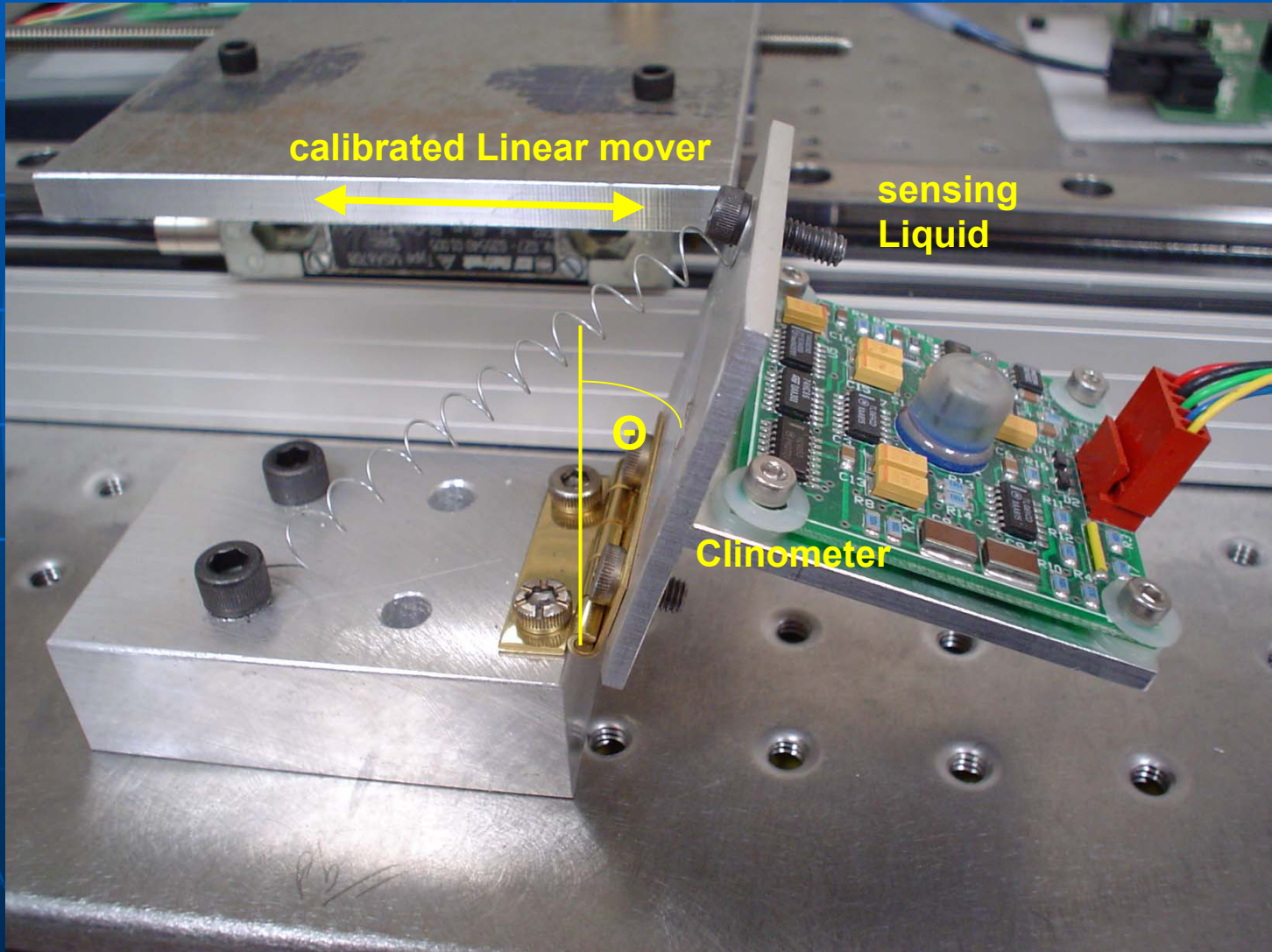
View of one Disk



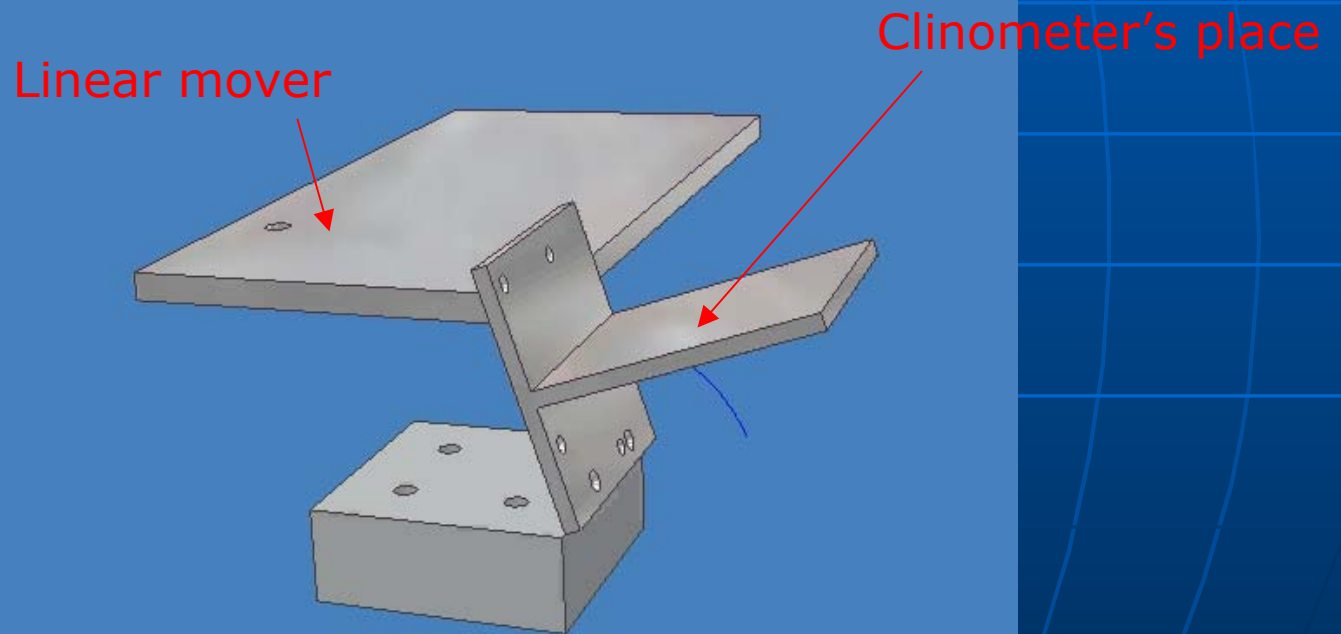
Dual-axis
clinometers for
monitoring
orientation
of transfer pates:



Calibration bench

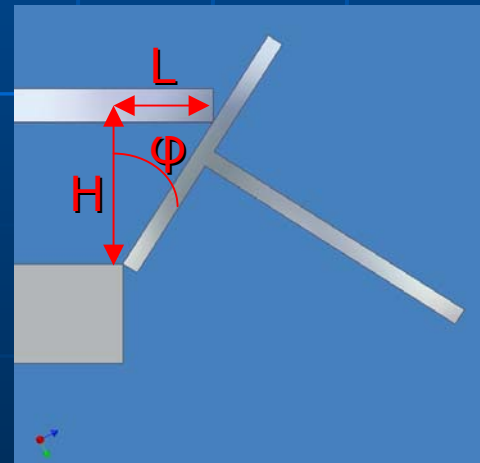
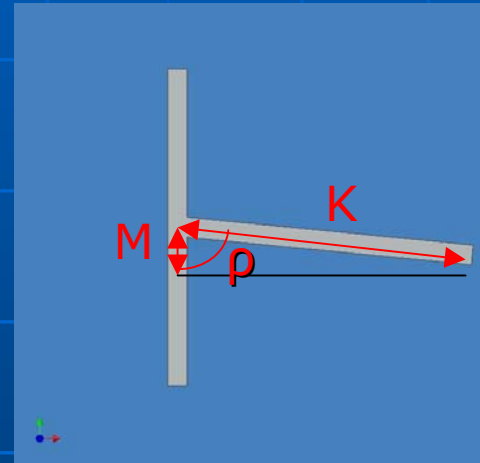


First setup



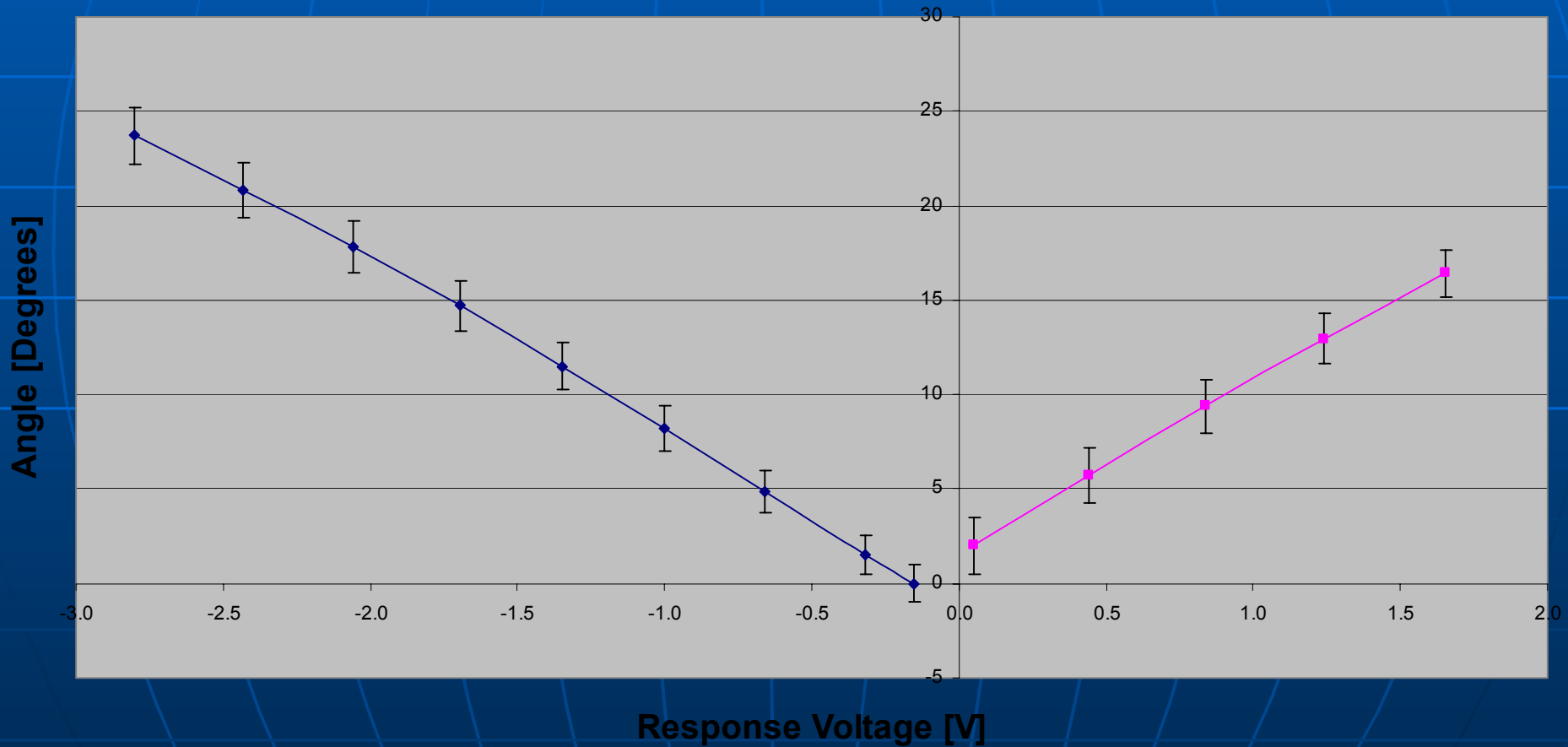
Error calculation

- Error in φ :
 - $\varphi = \text{Tan}^{-1}(L/H)$
 - $\Delta\varphi = (\partial\varphi/\partial L)*\Delta L + (\partial\varphi/\partial H)*\Delta H$
 $= (1/(L+H))*\Delta L - 2L/(H^2+H*L)*\Delta H$
- Using the same formula:
 - $\Delta\Omega = (1/(L+M))*\Delta L -$
 $2L/(M^2+M*L)*\Delta M$
- Taking $\rho = \cos^{-1}(M/K)$ and $M=0$
 - $\Delta\rho = \Delta M/K$
- So the total error is:
 - $\Delta\theta = (\Delta\varphi^2 + \Delta\Omega^2 + \Delta\rho^2)^{1/2}$

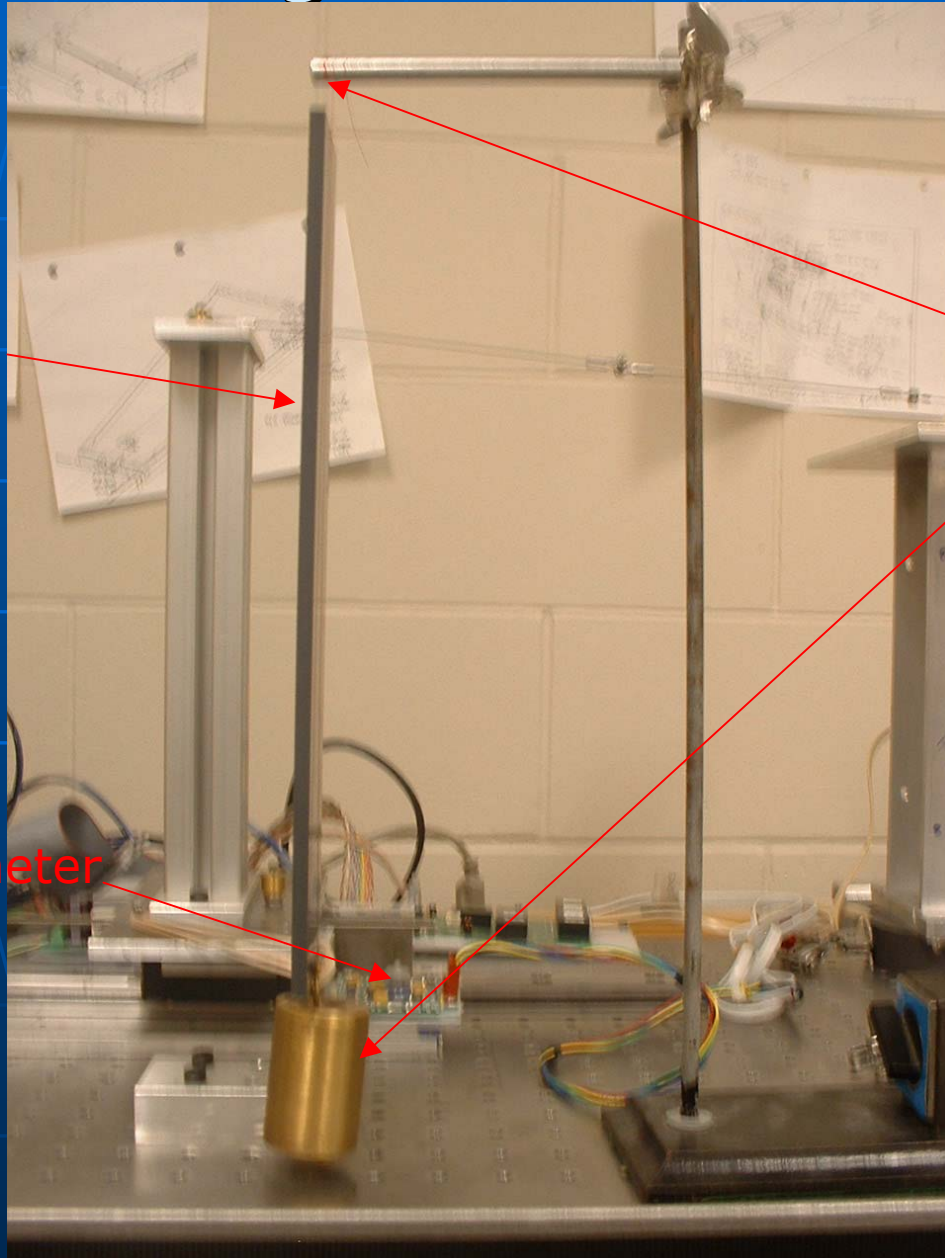


First test curve

Angle vs clinometer voltage output



Zero degree measurement

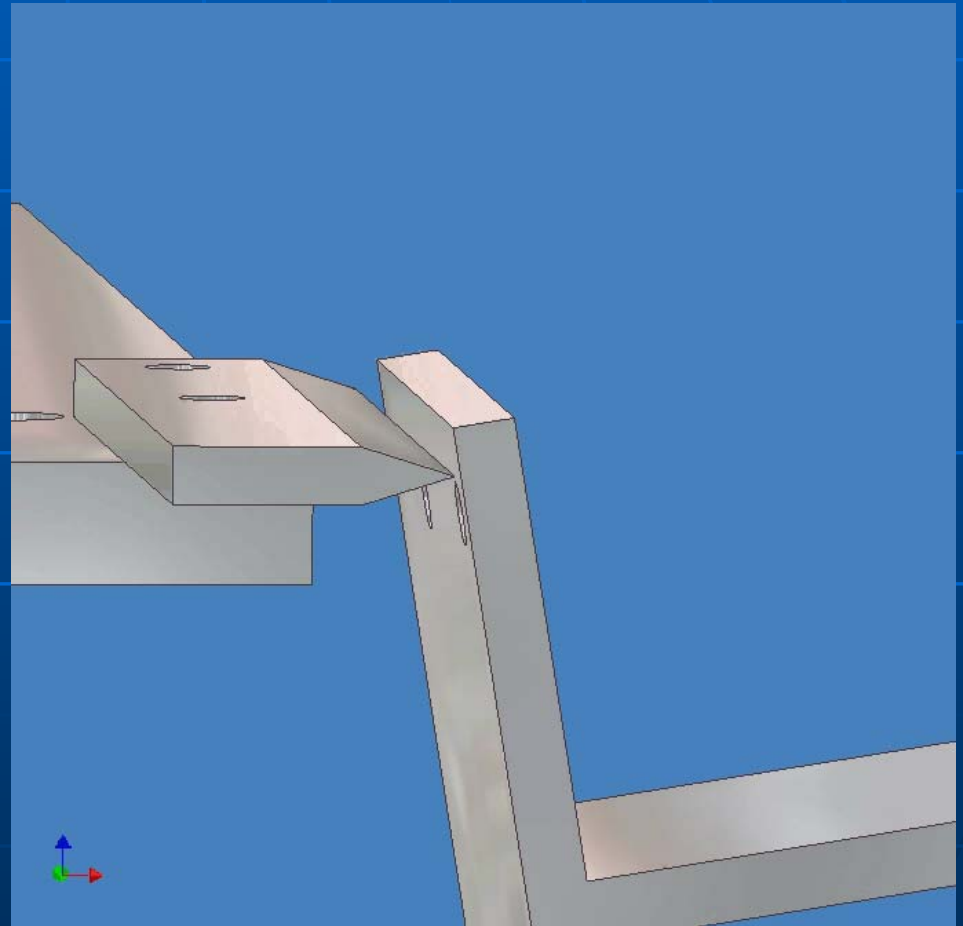
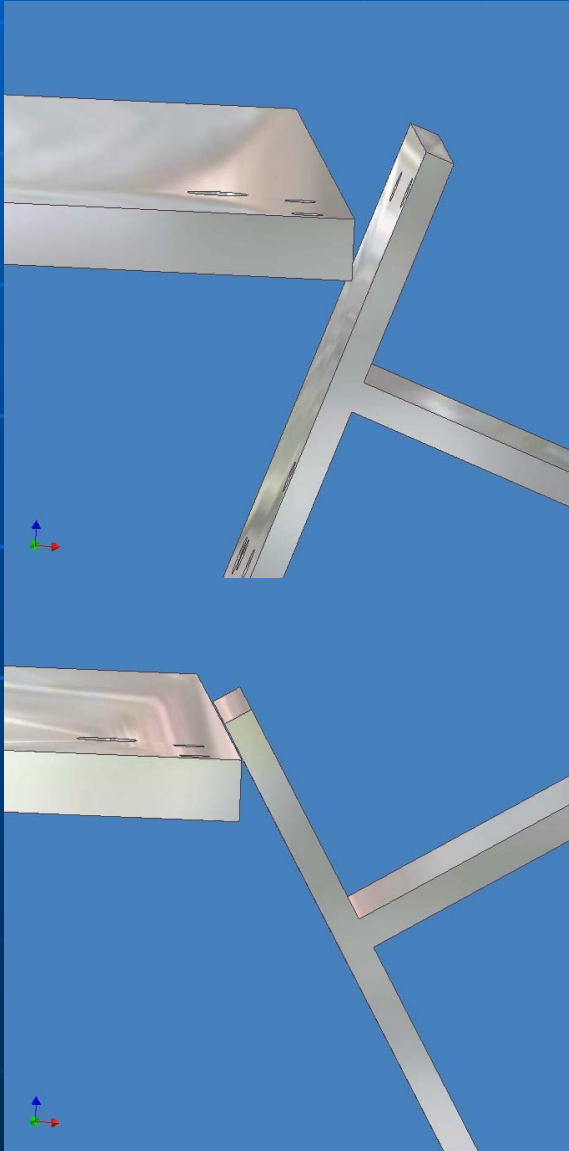


Long rod to get more precision

clinometer

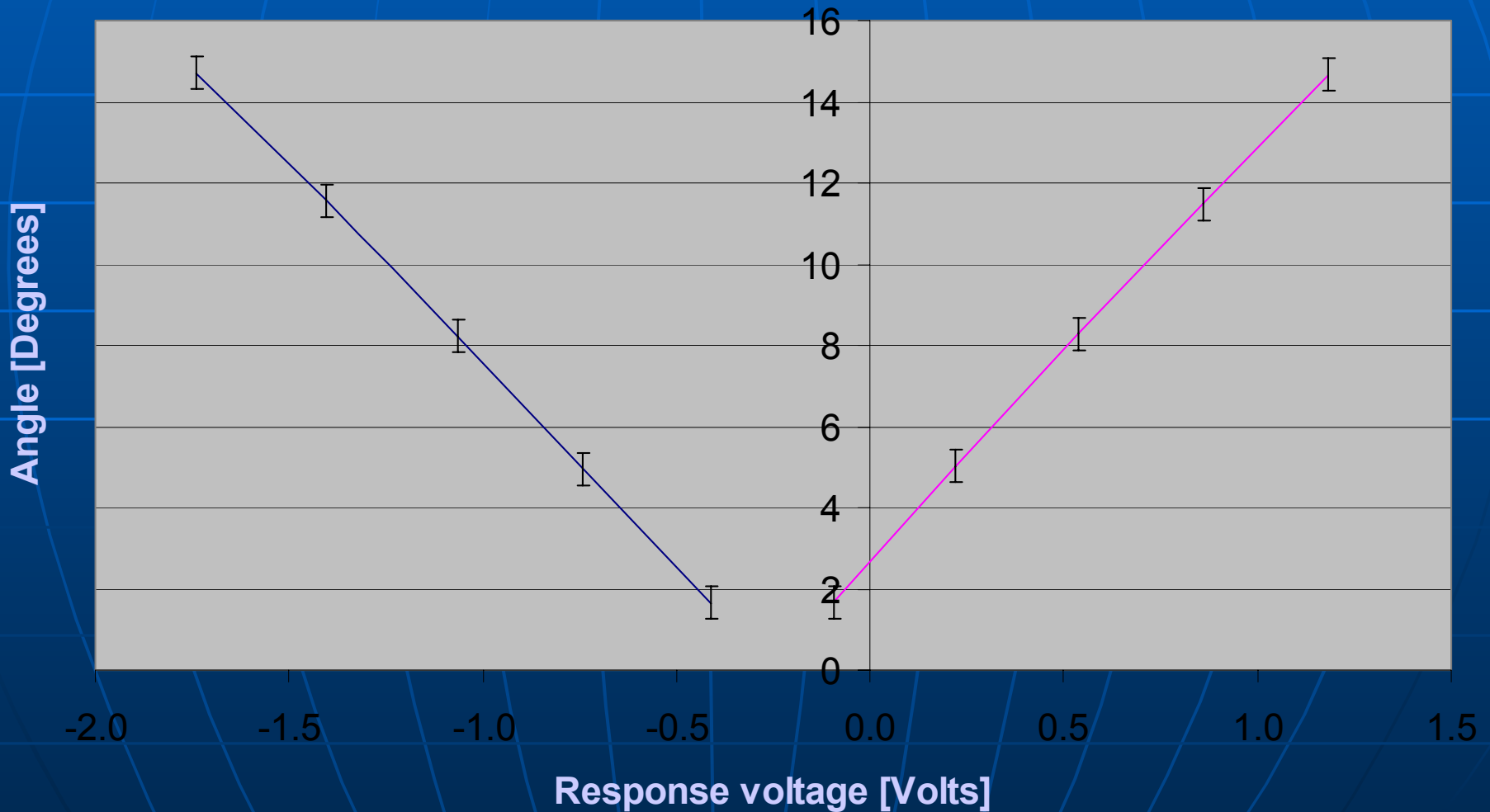
Pendulum

Problem induce by the plate thickness



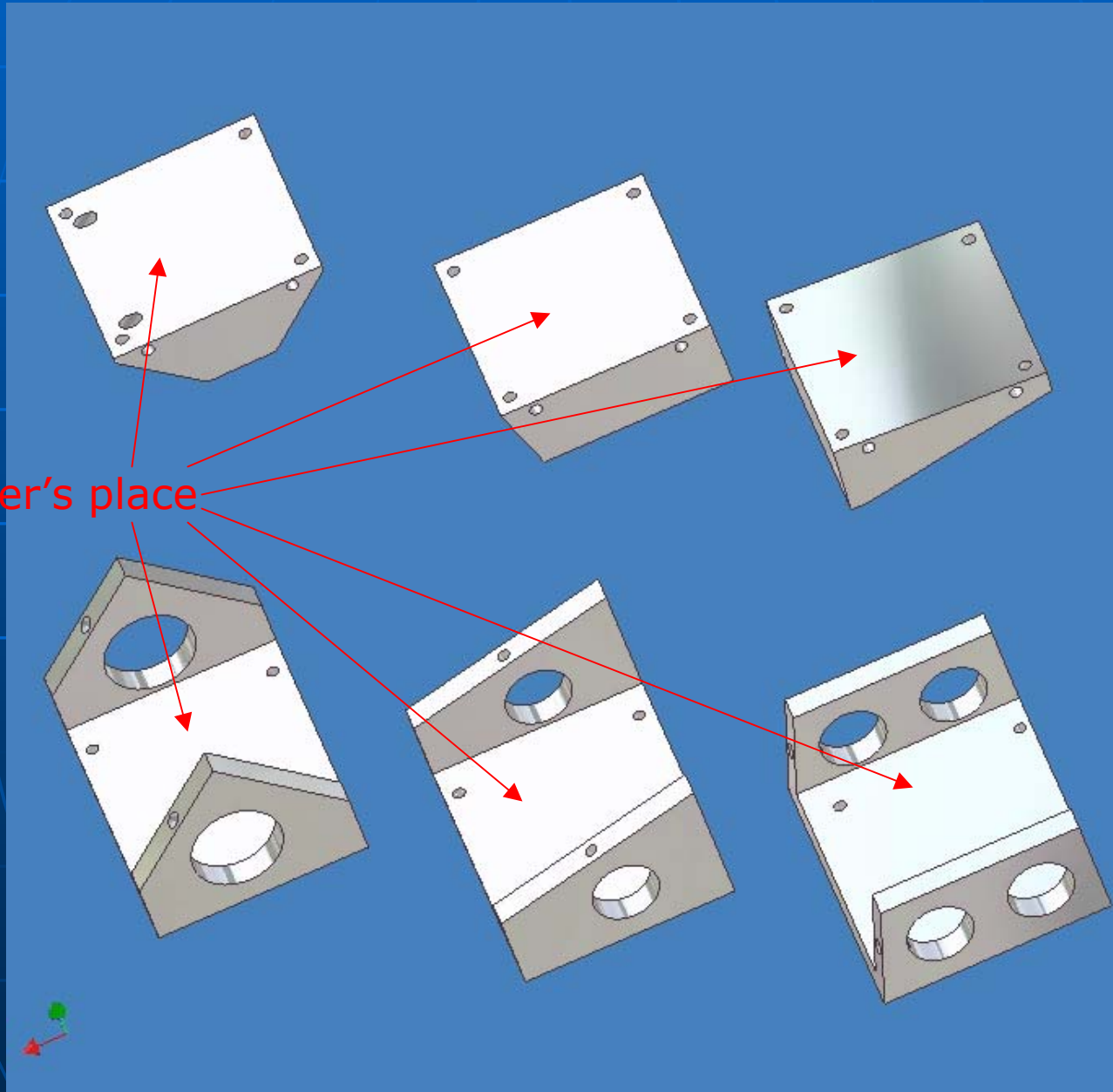
Second test curve

Angle vs clinometer voltage output



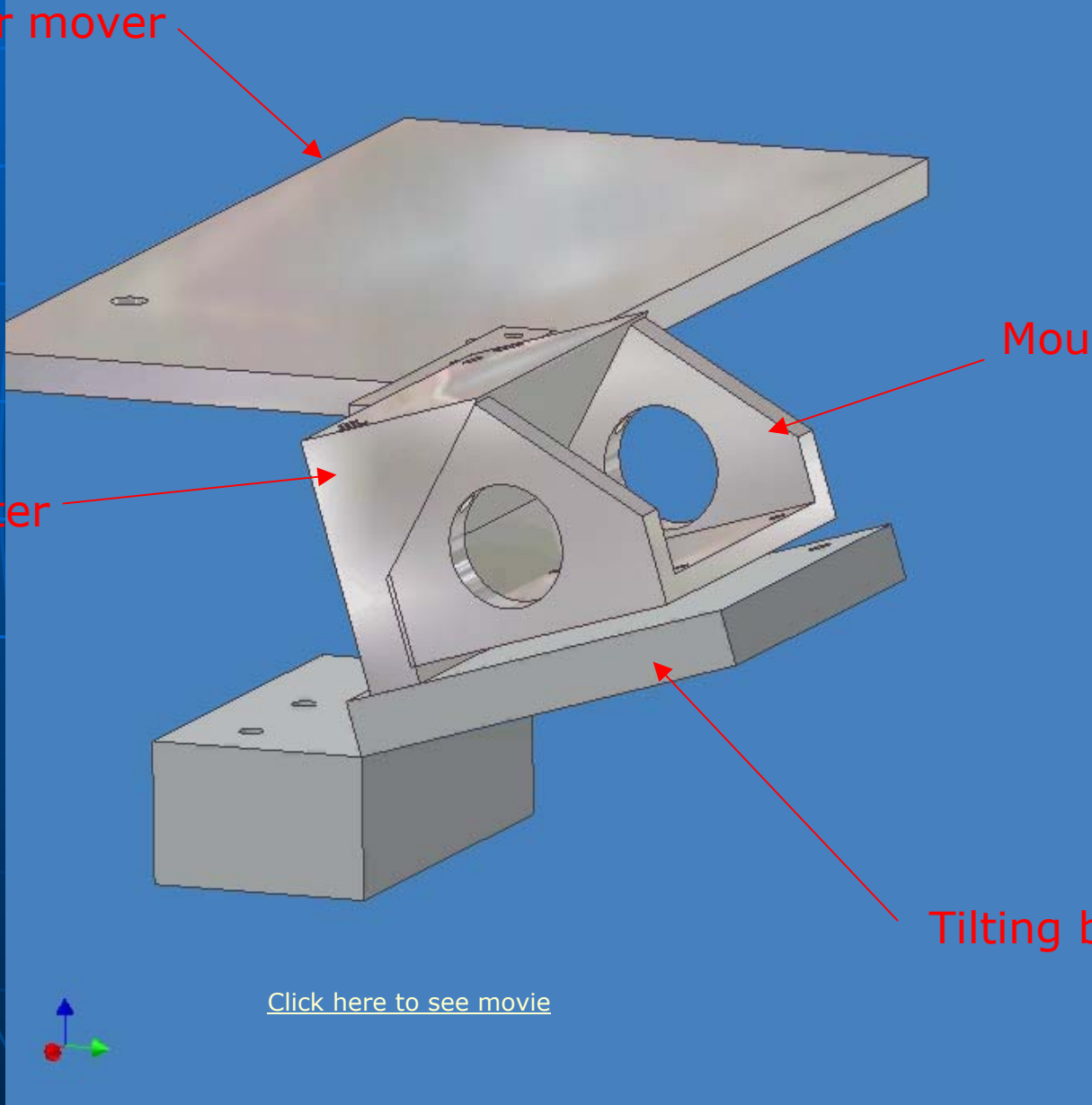
The 6 different mounting plates

Clinometer's place



Next setup

Linear mover



Mounting plate

Adapter

Tilting base

[Click here to see movie](#)

