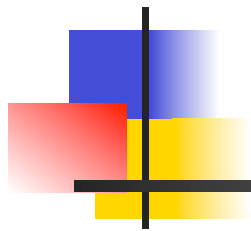# A New Type of Optical Distance Sensor for Mice
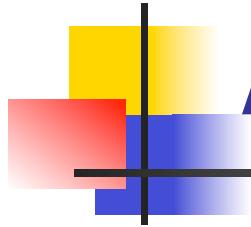
By Ken Hewitt

Minos 2011

Well Minos would not be Minos without someone giving a presentation about sensors.

So This time I thought it may as well be me.

A Bit of History

- 20+ Years ago I had a project looking at how to measure the capacity of Gas Holders.

- I came across a distance measuring instrument and have always thought how could I use this on a mouse.

- Until now it was always going to be too big.
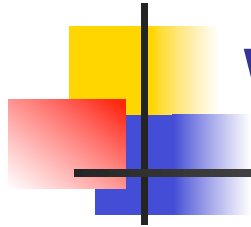
What do we want from a sensor

- Immune to Ambient ligh
- Immune to Reflectivity of wall
- Fast readings
- Repeatable readings
- Linear readings
- Direct mm readings

What do we have now

- **Reflective sensors**
  - Visible or IR
  - Seem to be the most common in use

- **Analogue PSD sensors**
  - Not used by many people (may be only 1)

Reflective sensors

- **Pro's**
  - Very simple to build
  - Easy to use

- **Con's**
  - Can be sensitive to ambient light changes
  - Very dependent on wall reflectivity

Analogue PSD sensors

- **Pro's**
  - Less sensitive to ambient light changes
  - Not so dependent on wall reflectivity

- **Con's**
  - Harder to build
  - More software overhead $I2-I1/I1+I2=2x/L$
  - Longer time to read sensor

So What's different

- **Pro's**
  - Not effected by ambient light
  - Not effected by wall reflectivity
  - Easy to drive in software
  - Possible to drive many in parallel

- **Con's**
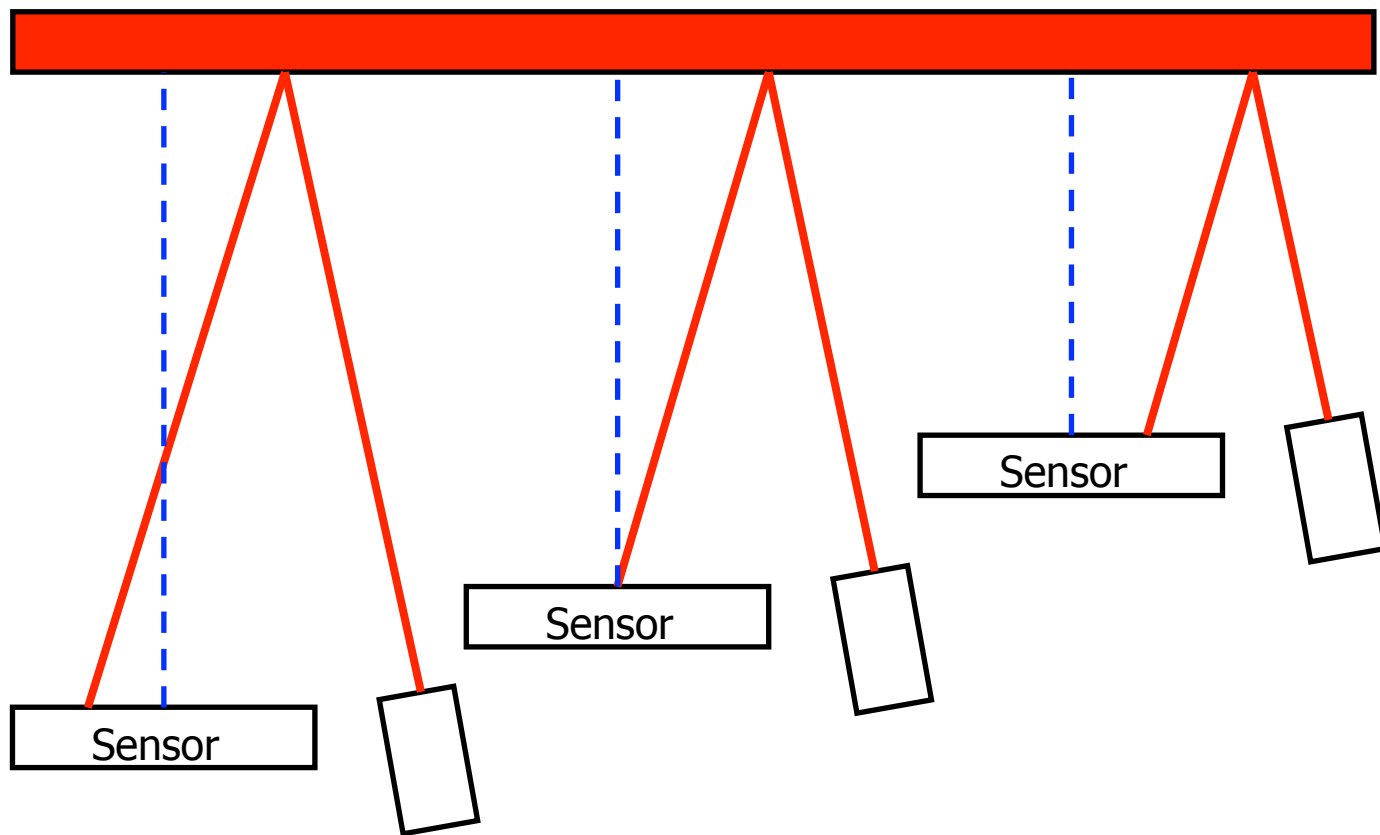 - Not easy to build (same as analogue PSD)

So What is it

- Linear sensor array 128 x 1 pixels
  - Can get up to 1024 x 1 arrays
  - Output clocked serially
  - A simple device is TSL1401R from TAOS

- Small laser diode
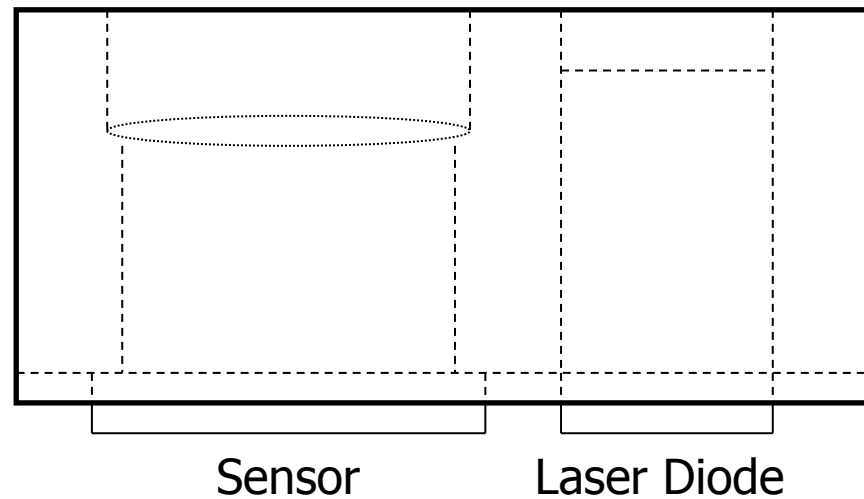 - Could use an LED but the smaller the spot the better the resolution
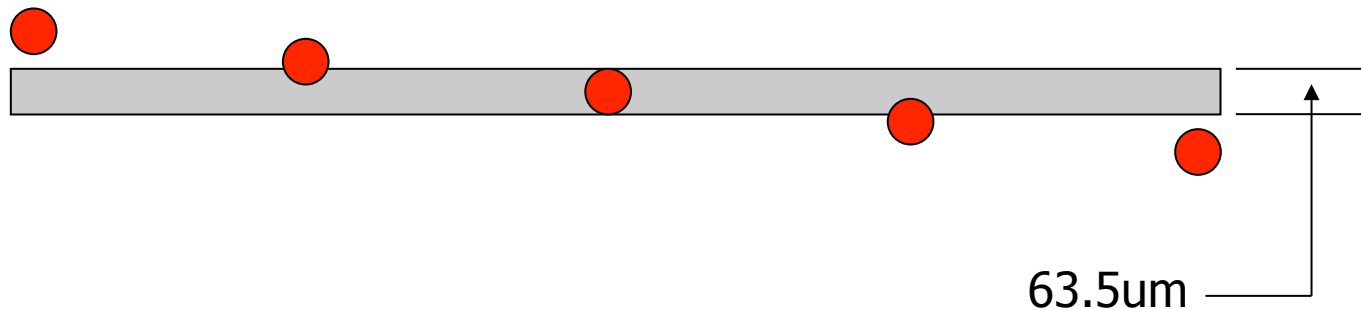
How does it work

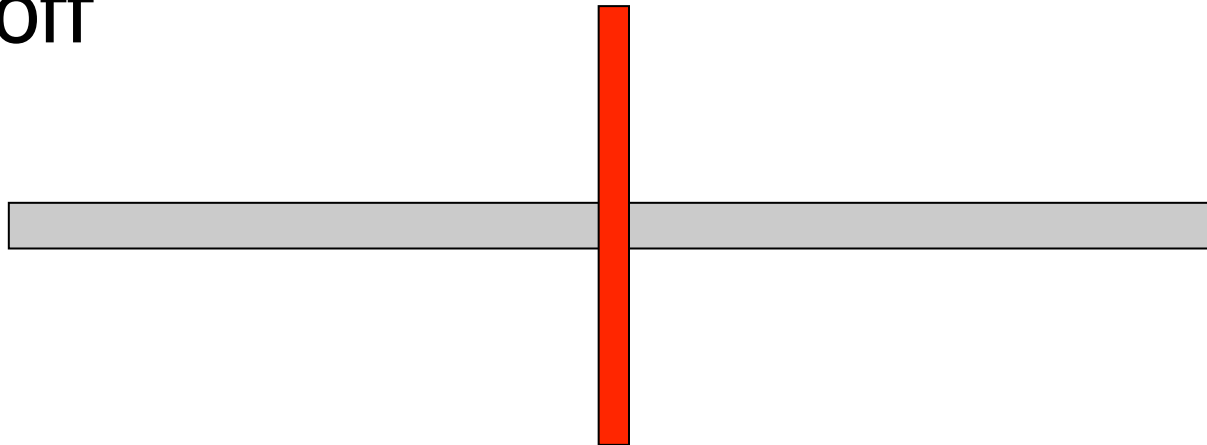# Sensor Construction

- Approx Size 17 x 10 x 10mm

Sensor   Laser Diode

Alignment Issue
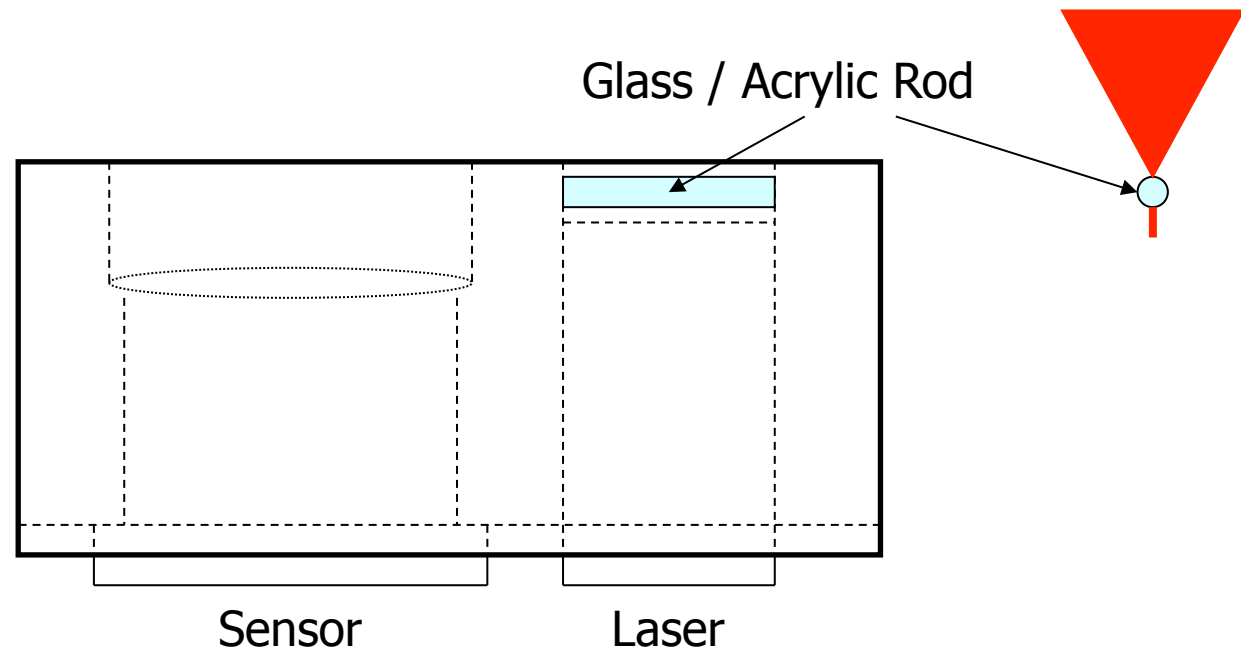
- If the horizontal plane of sensor is off

63.5um

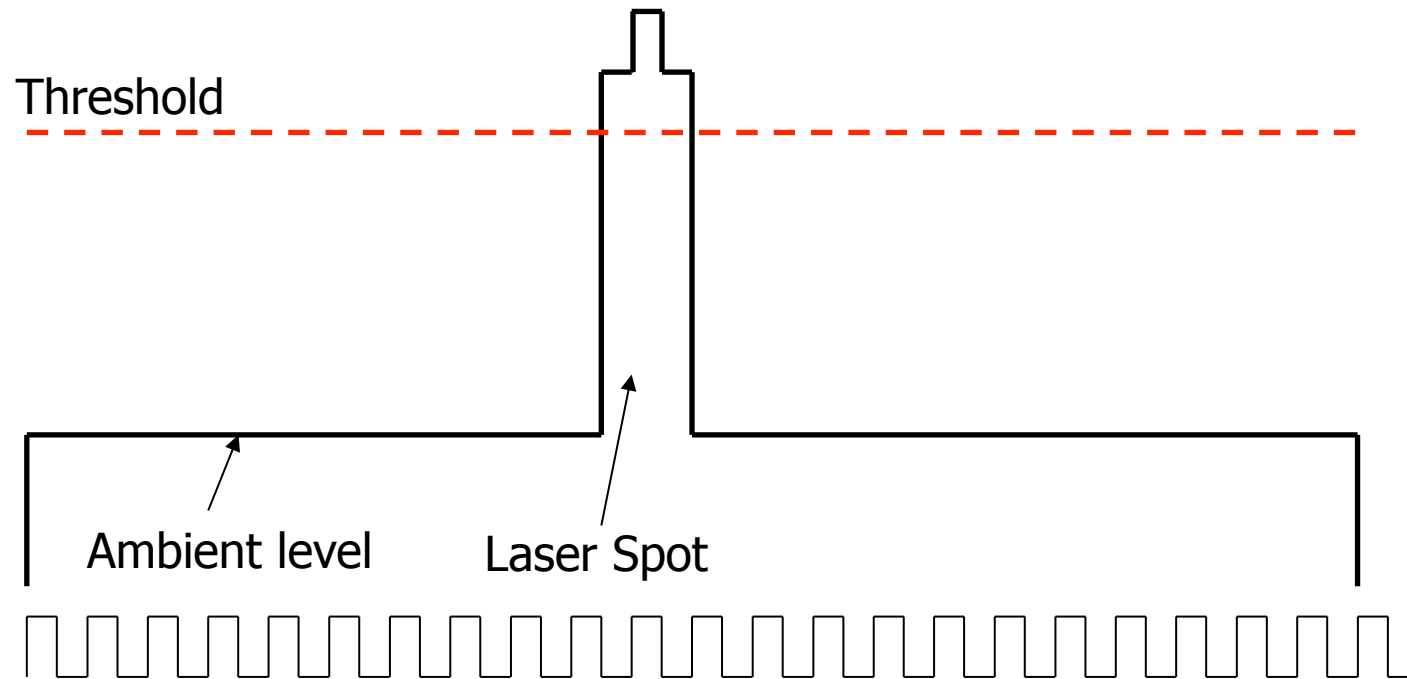# Alignment Issue Fix

- So what if horizontal plane of sensor of off

Sensor Construction Fix

- Add clear Acrylic rod across laser output

Glass / Acrylic Rod

Sensor

Laser

Output from Sensor

Threshold

Ambient level

Laser Spot

How would it be used

- **Calibrate**
  - Clock out all 128 pixels with Laser Off
  - Look for the highest output
  - Set threshold to highest output + some %

- **Take Readings**
  - Clock out 128 pixels with Laser On
  - When Output exceeds threshold clock value = distance reading
  - If sensors clocked in parallel then all sensors could be read in 128 sensor clock cycles

Other Possibilities

- With Laser Off the output could be used to try and find edges of walls, or even just posts
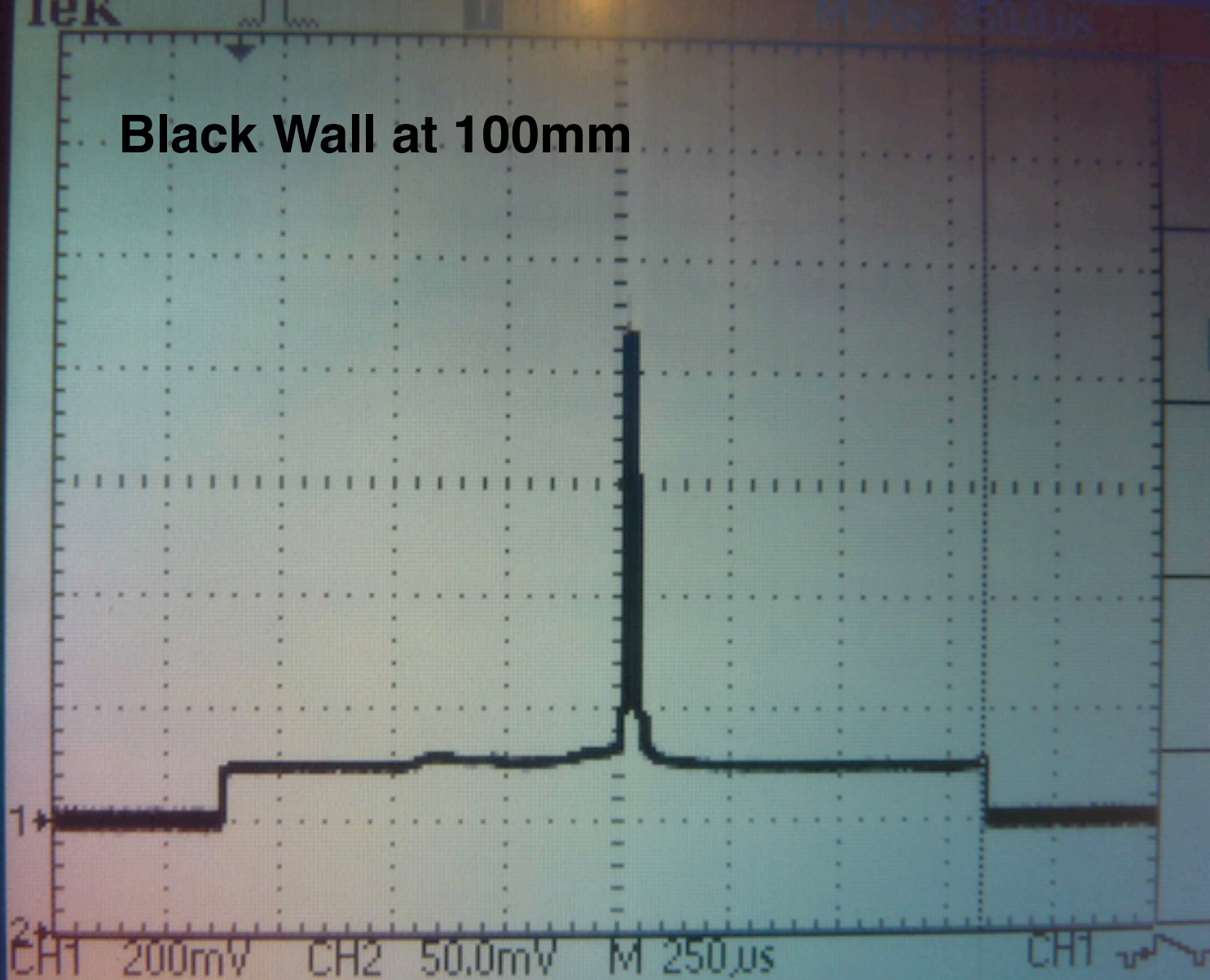
Does It Work

- Well Yes it seems too.

- I have a proof of concept prototype

- There are issues which I think are just down to the optics of the prototype not being optimised to match the sensor used.
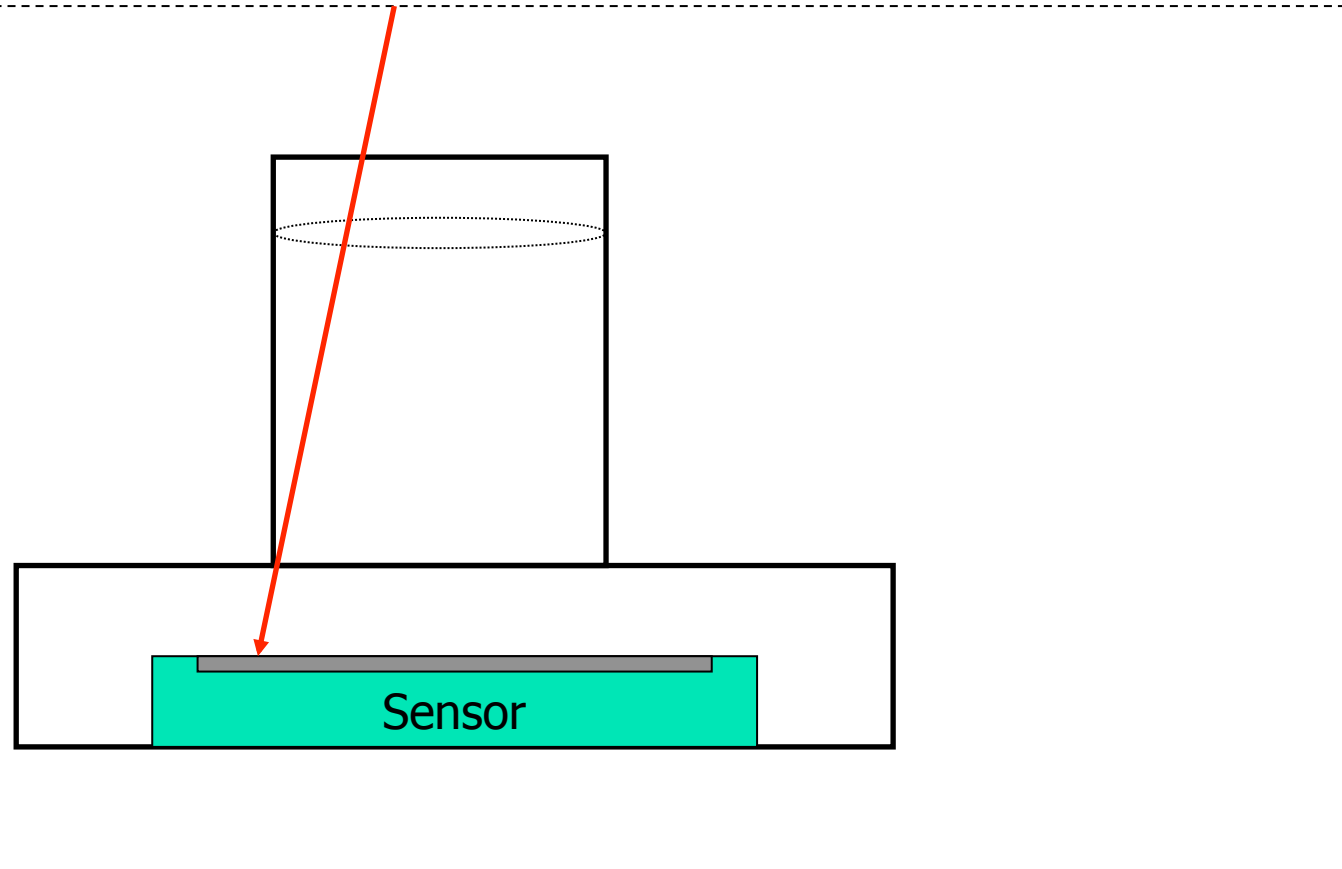
White Wall at 100mm

Tek   Trig'd   M Pos: 60.00us

CH1   200mV   CH2   50.0mV   M 250us   CH1
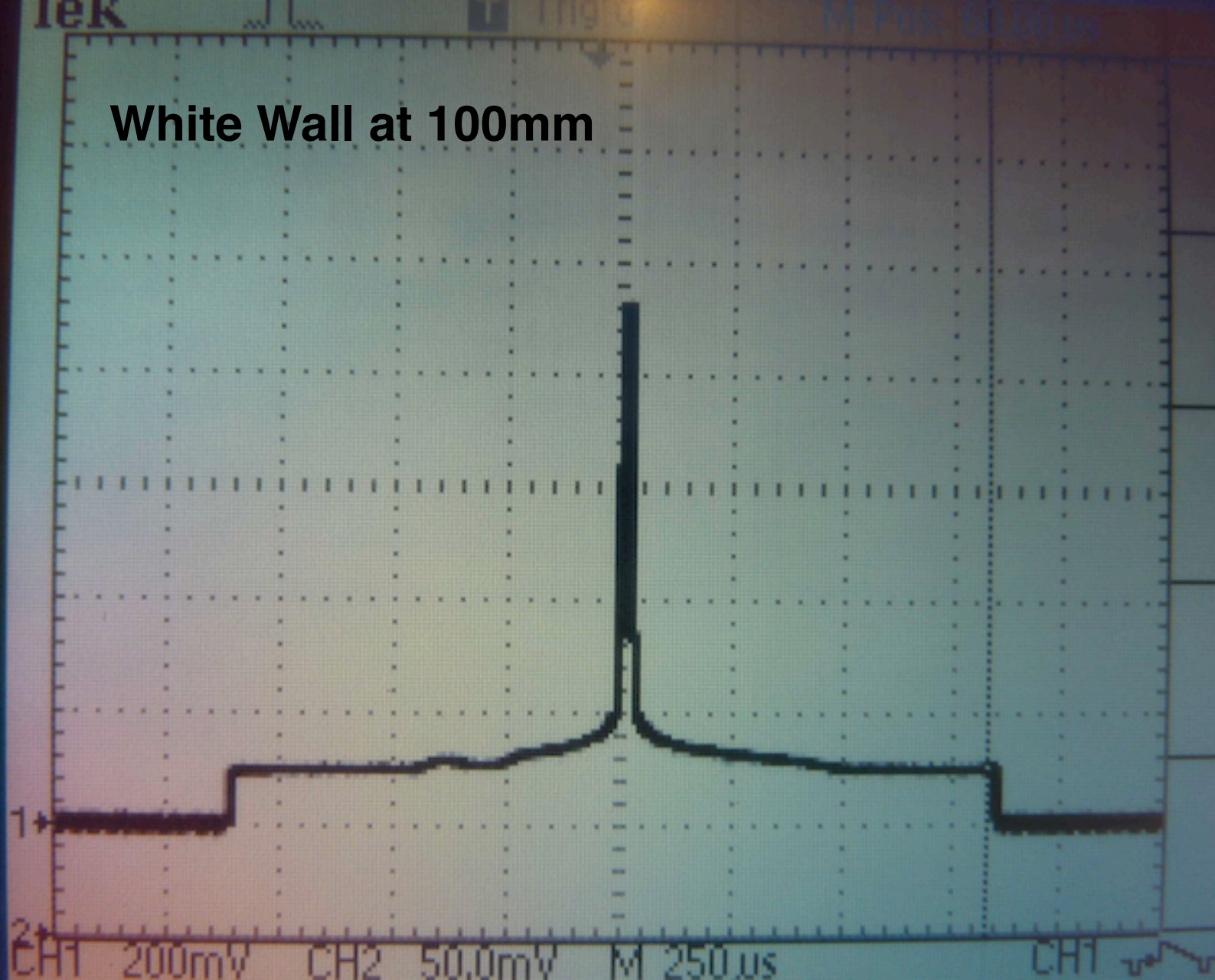
Black Wall at 100mm

Prototype Problem ?

Sensor

What Next

- May need to use 1024 pixel device.

- Sense distance 20 to 100mm
  6mm sensor requires 25mm centres

- Optimise Sensor length/ measuring distance/ centre to centre distance/ Resolution.

That's All Folk's

Any Questions