

Pivot Solution for Detector Mechanics

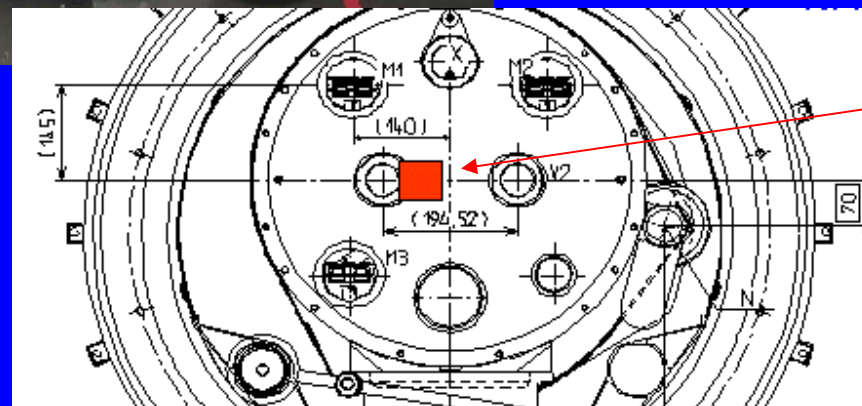
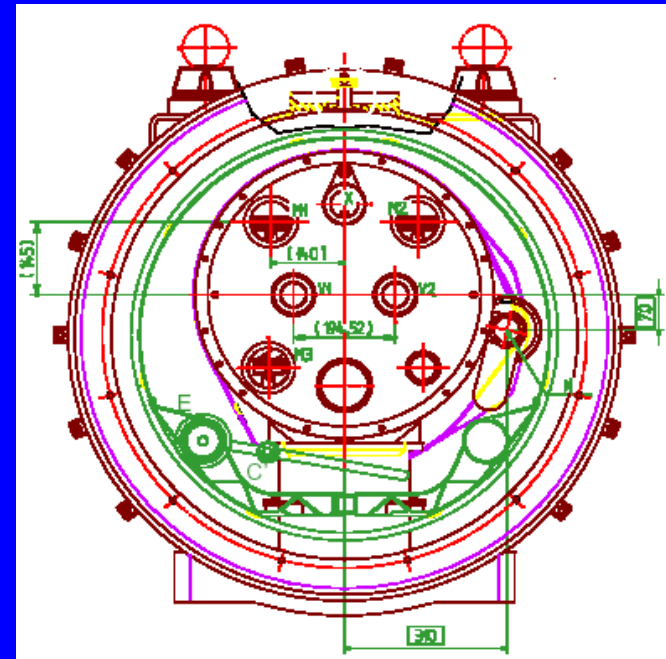
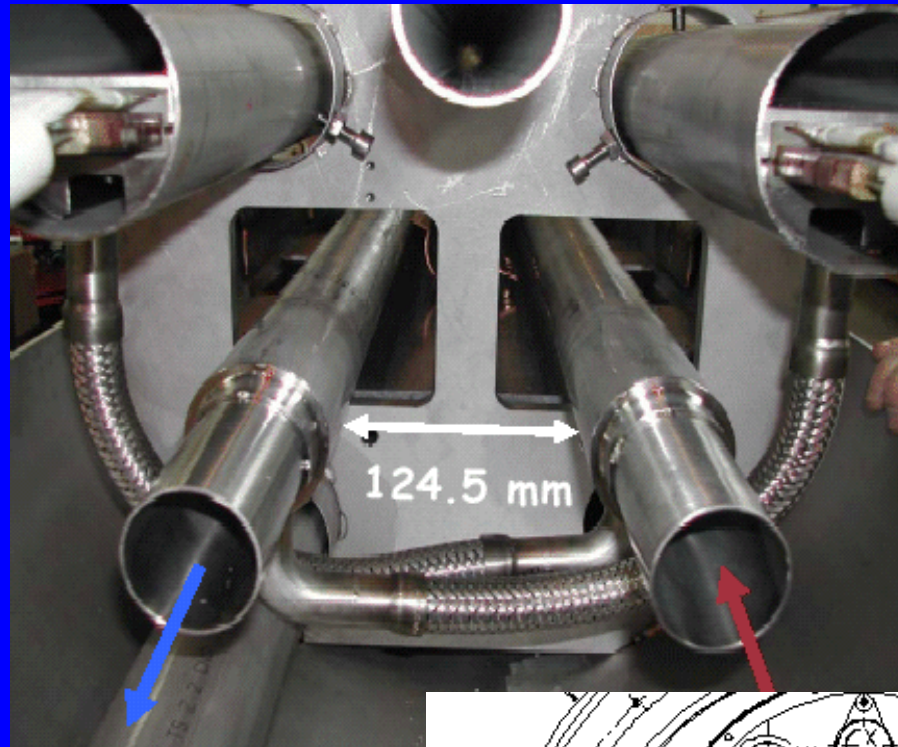
Problem:

Get track detectors a few (~ 3) mm from the LHC beam.
Ability to move in and out with high precision.
Cannot affect beam significantly.
Detectors cannot be affected by beam significantly.
Signals etc to outside world.

Possible Solutions:

Classical roman pots ... but space between beam pipes only 12.5 cm
Microstations (Helsinki)
Sideways-Translating beam pipe (Louvain)
Pivot (Fermilab)

We can have a warm section – cryogenic bypass, needs study
But not much space between beam pipes!



p' here

PIVOT Solution

Detector swings sideways from an above/below PIVOT (axle)

Detector is in secondary vacuum in a thin envelope.

Envelope provides RF pick-up shielding.

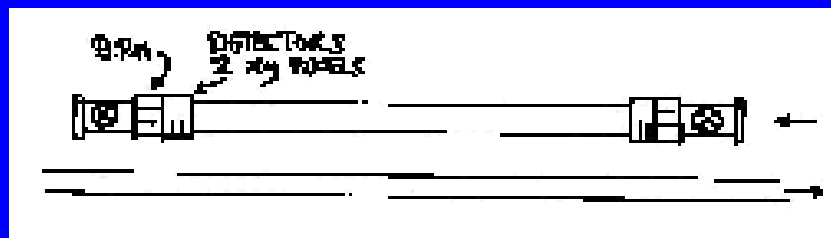
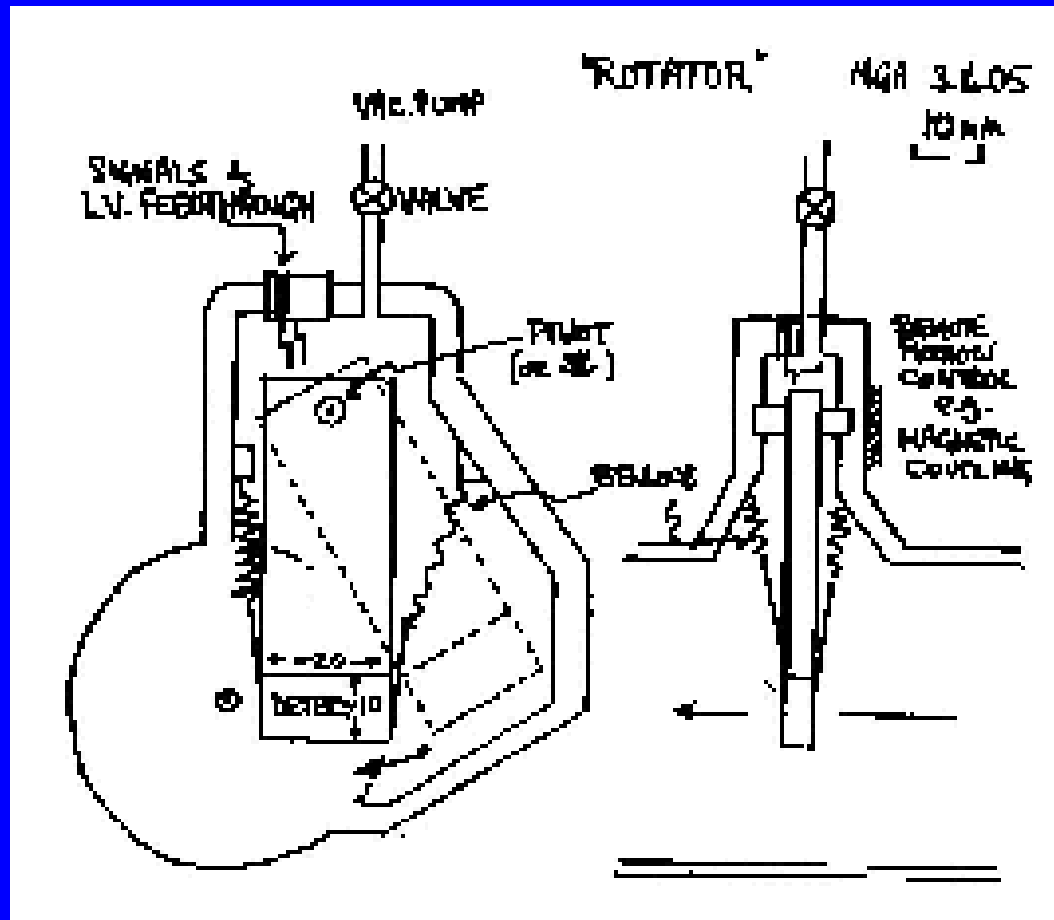
Short Stainless Steel bellows allows sideways motion.

Precision position measurement with capacitative probe.

Mostly off-the-shelf components ... ~ \$12K each (parts and labor)

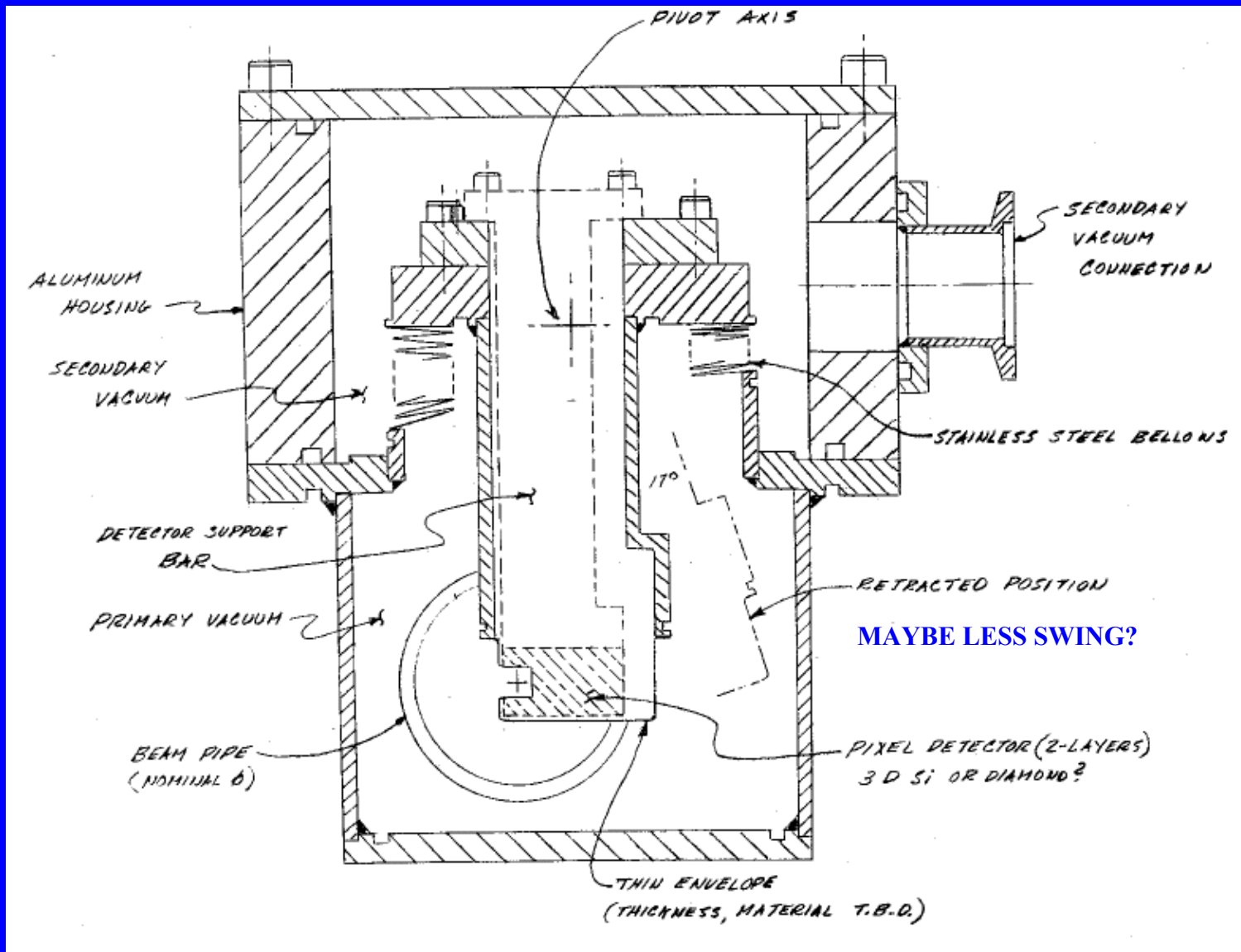
(Would need 6 = 3 + 3 per experiment)

Concept Sketch from CMS Week Mar 16th 05

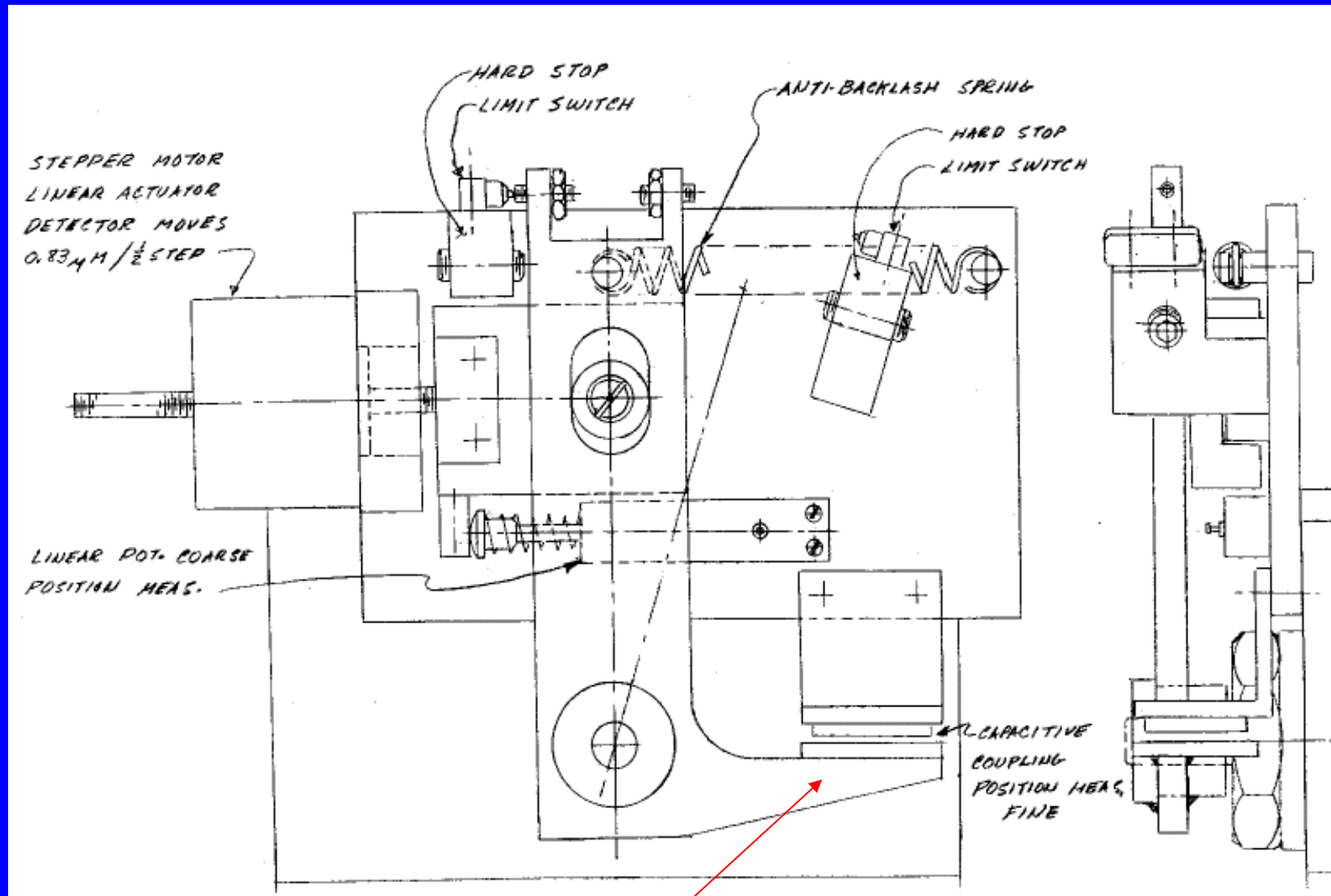


Would have 3 stations over ~ 10m
 Each with a doublet of xy pixel layers
 (+valves, pump, BPMs)

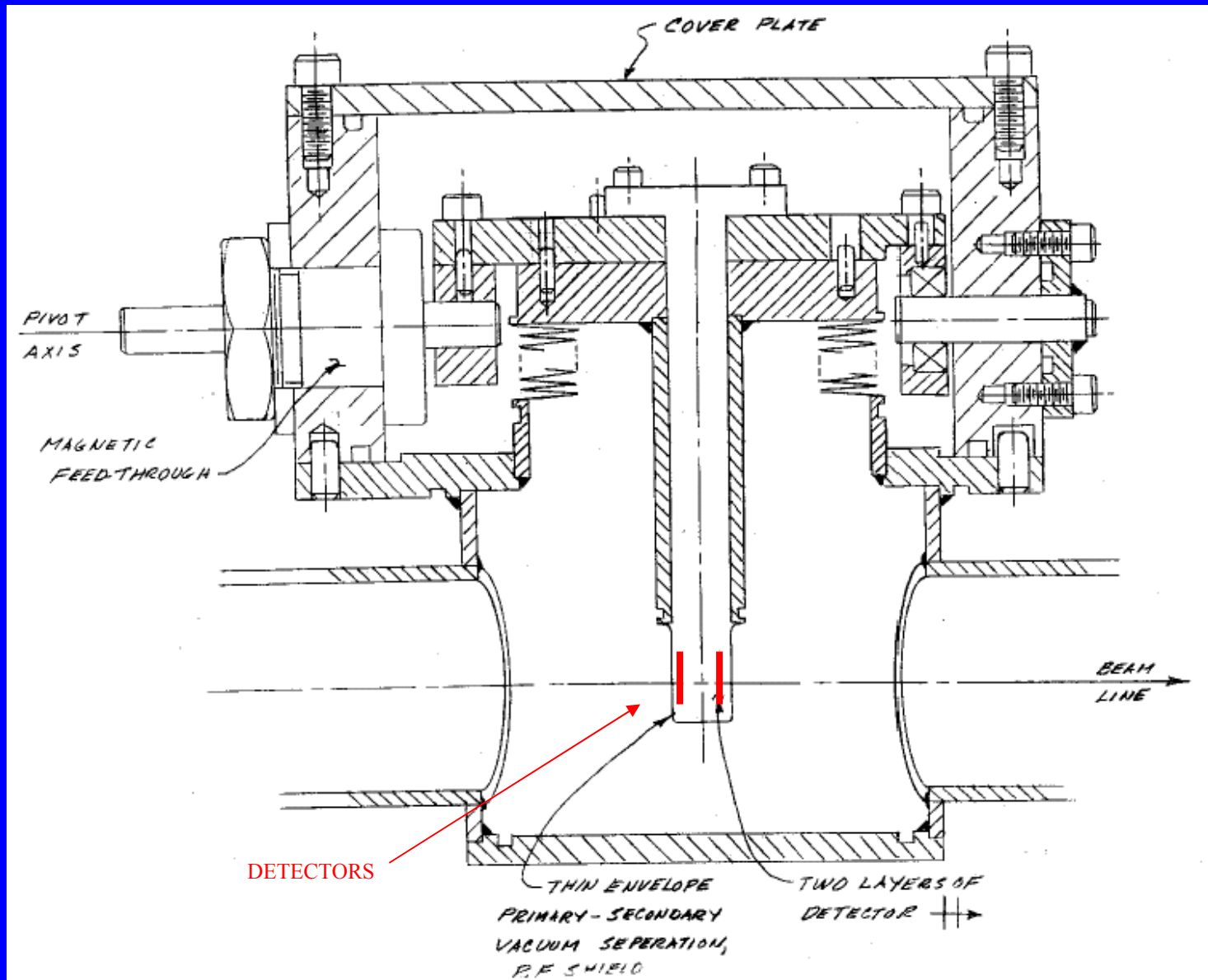
Conceptual Engineering Drawings ... Carl Lindenmeyer (Fermilab)



Microswitches – hard stops – counterbalances (all outside)

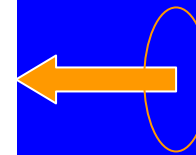
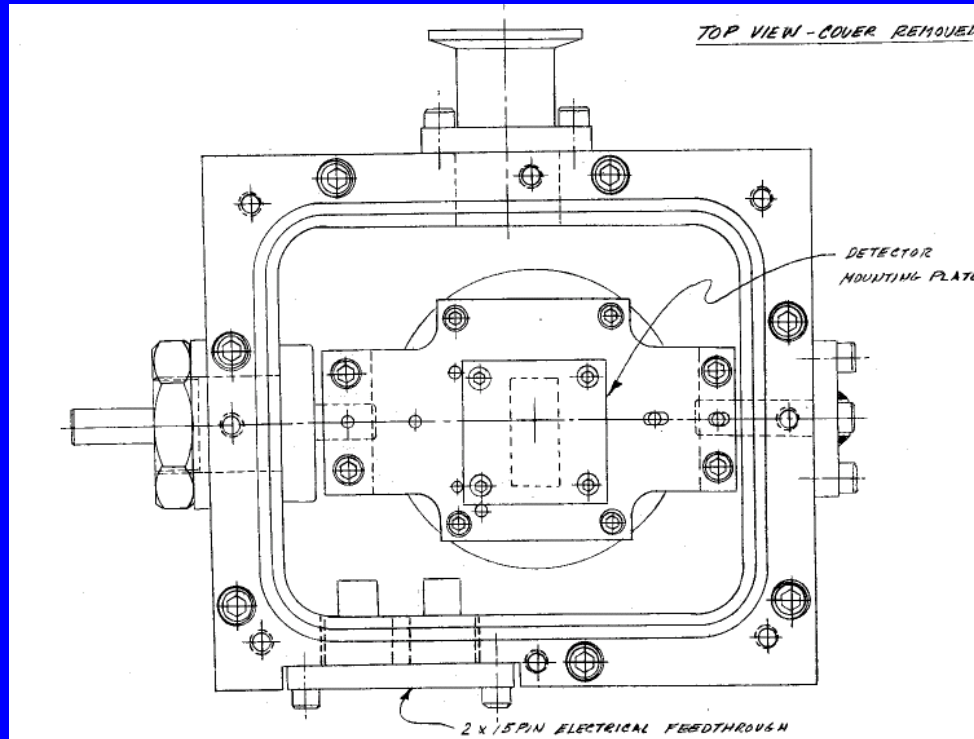


Gap measured capacitively → position



Top view, cover removed

Vacuum
pump



It rocks about this axis

Reactions from LHC engineers (via Keith Potter):

Idea promising

If 17 deg swing (is that necessary?) maybe longer bellows?

Achievable measurement precision wrt beam?

Magnetic coupling and pivot in general.

Form and size of thin window (cf VELO of LHCb)

Beam coupling and beam impedance (RF fingers, cavity damping...)

Can it be turned upside down (avoid heat exchanger tube) ? A: YES

Questions:

How thin can the secondary vacuum “envelope” be (and material):

- (a) for vacuum considerations
- (b) for RF pick-up considerations

Are the LHC beam people happy with this by the beam?

Can we get beam center (x,y) from halo contours in up/down areas?

What shape is the halo at this point? Inclined ellipse?

This calibrates BPM absolute position wrt tracker!

Move device in only when beam centered with calibrated BPM!

Precision tie-together of 3 stations (laser? but the beam does this!)

Proposal:

Make a prototype at Fermilab (after FP420 consideration)

Cost ~ \$16K (parts & labor) + staff time