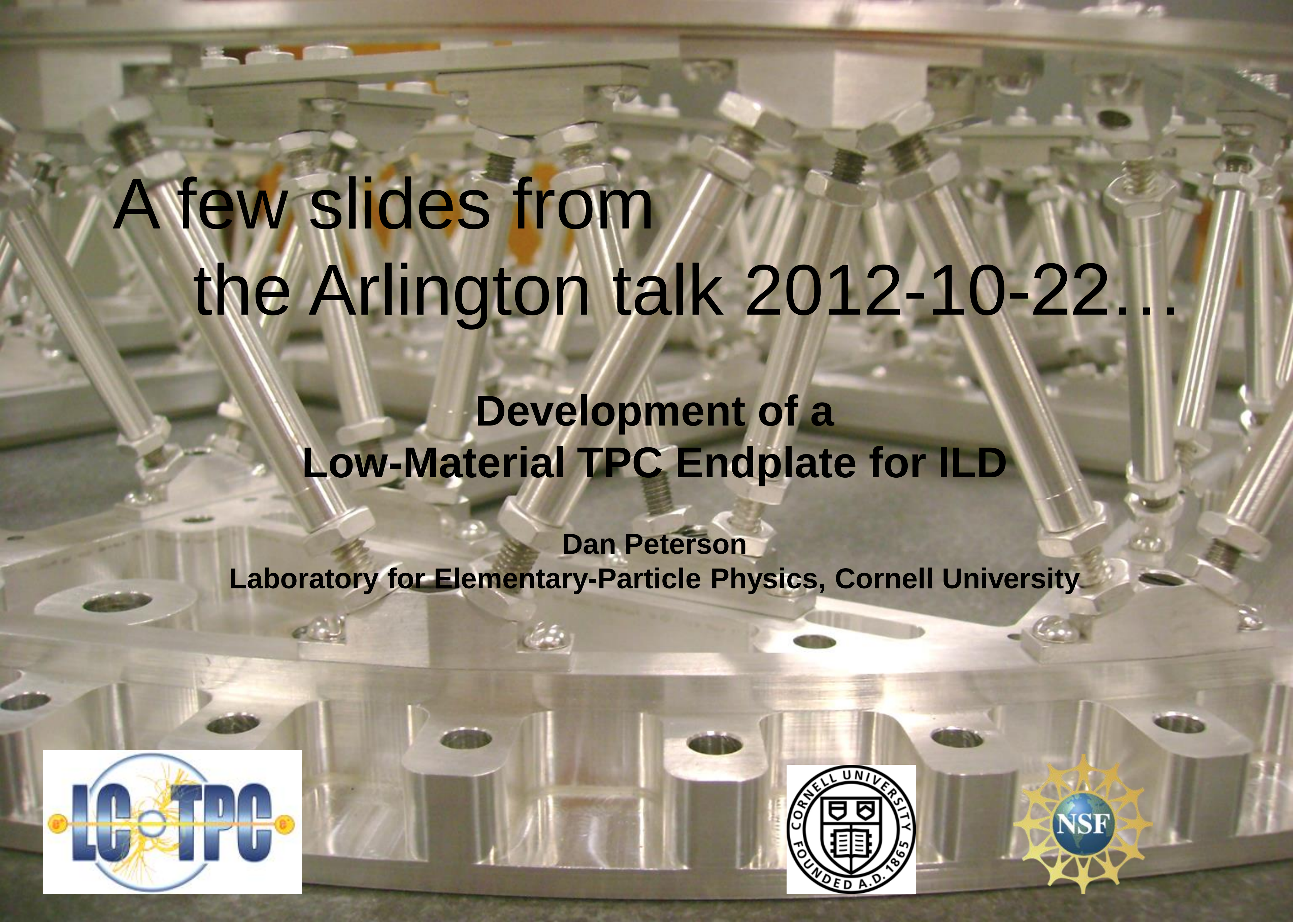


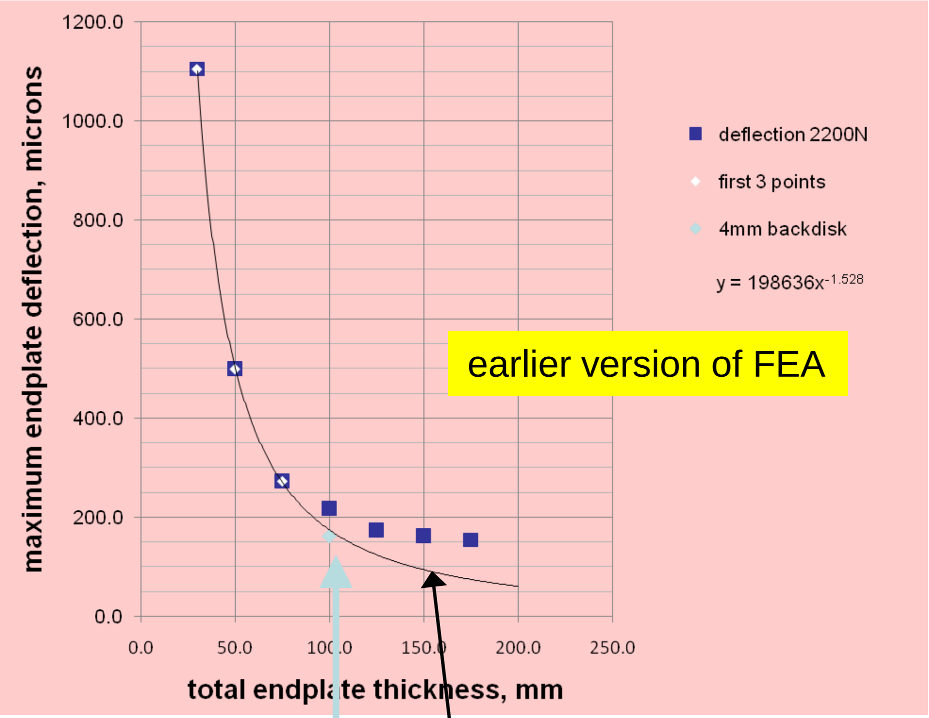
A few slides from the Arlington talk 2012-10-22…

Development of a Low-Material TPC Endplate for ILD

Dan Peterson
Laboratory for Elementary-Particle Physics, Cornell University

Further analysis of the ILD design: effect of increasing the endplate thickness

rigidity vs thickness



It was initially expected that the strength could be improved by asking ILD for more longitudinal space.

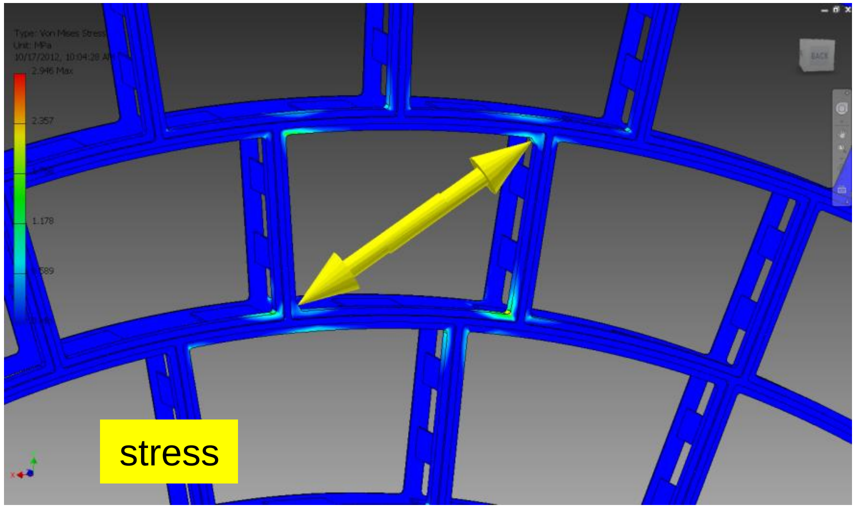
However, the improvement with thickness diminishes (deviates from power law) above 100mm. The deflection decreases from 220 microns to 160 microns with a 200mm total thickness.

The cause for the deviation from a power law is small buckling, (most visible in inner layer) . Thus, the same improvement in deflection can be found with a modest increase in the back-disk thickness.

Further analysis of the ILD design:
effect of installing an out-of-tolerance module

Add a stress which is equivalent to
~ 0.02 mm total strain, across diagonal.

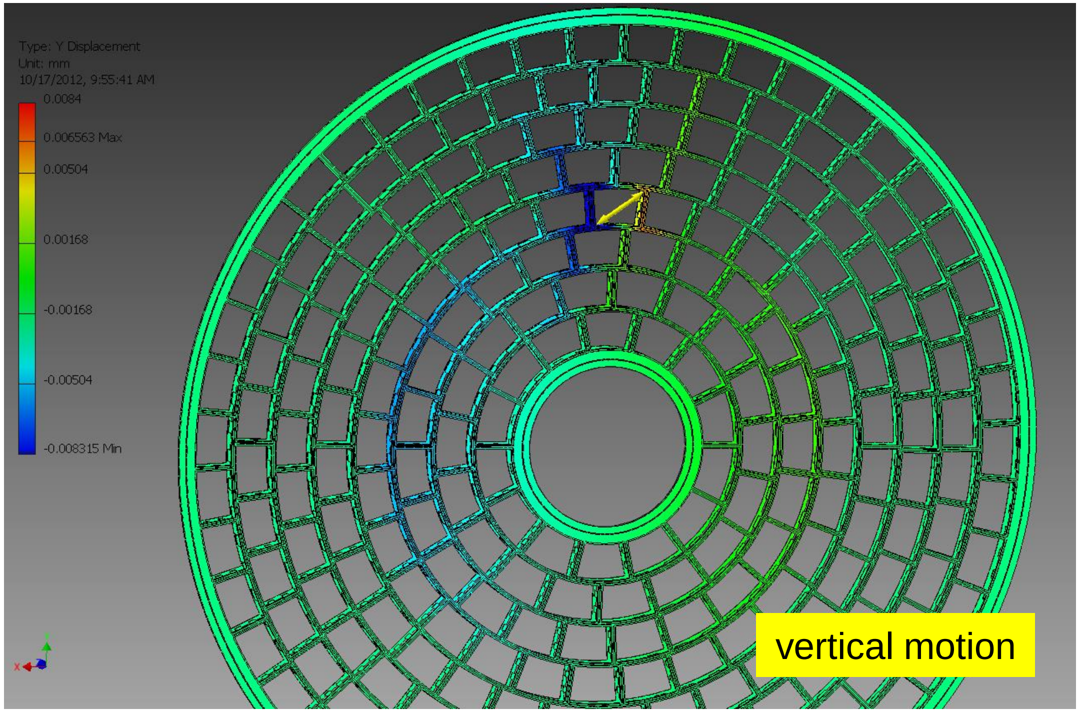
This acts like a module with misaligned locating holes.



(Assuming that there are no other modules to lock the endplate alignment) the effect travels a long distance through the endplate.

At a distance of 5 modules, module displacement is ~50% of the applied strain.

The inner ring can be seen to rotate on the order of 10% of applied strain.

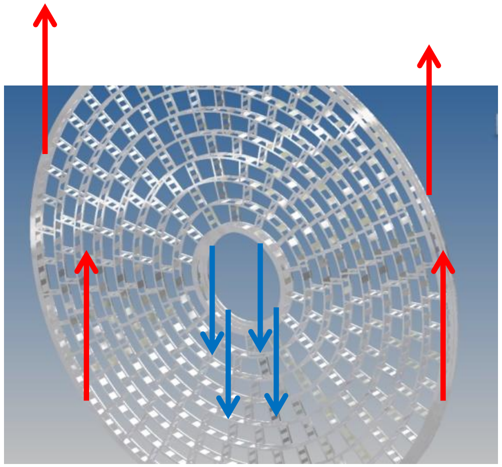


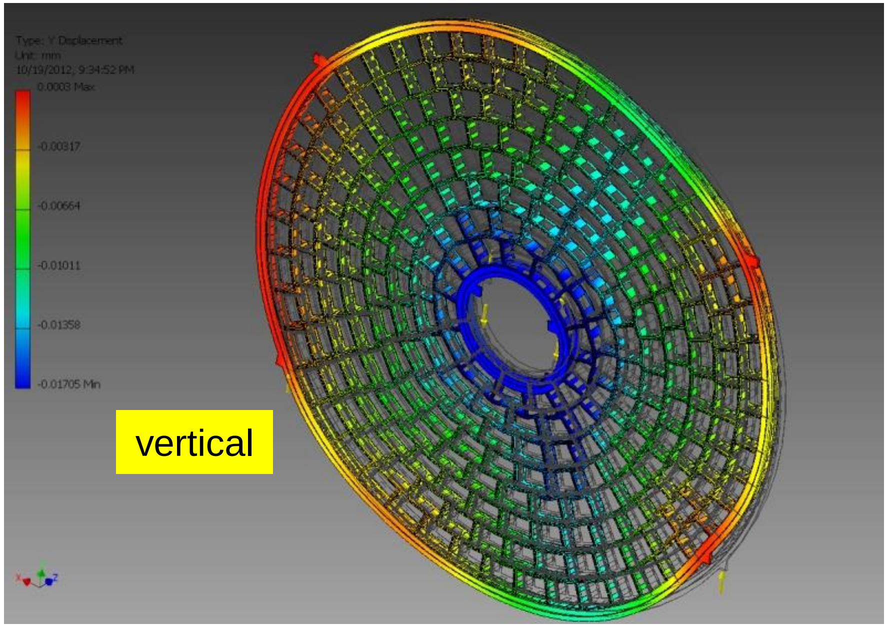
A tolerance of ~0.030 mm is required for locating holes on the endplate and modules

to avoid propagating misalignment into the endplate,

while defining the location of the modules on the endplate.

Further analysis of the ILD design:
chamber support points

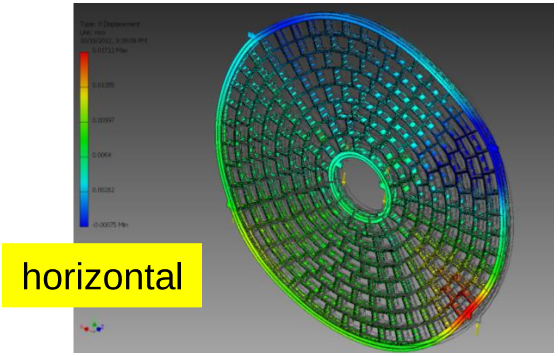




Endplate is supported at 4 points (*red arrows*)
upper points are constraints, right fixed, left sliding
lower points are forces

Endplate load at center, 4 points, 400 N total (***blue arrows***)

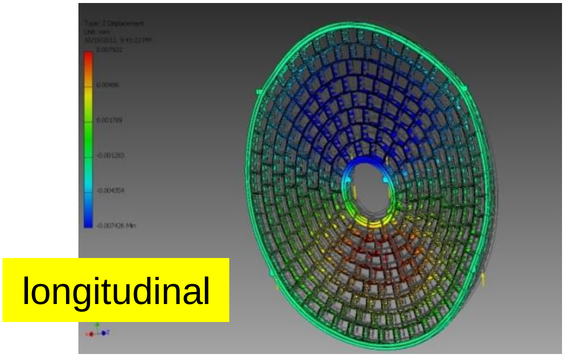
Longitudinal position at outer o-ring is fixed (by the field cage).



Total vertical motion, center w.r.t mount, is 0.017mm/400N

If the total load per endplate is 1000kg, or 10,000N,
total vertical motion is 0.43mm .

However, the motion is smooth over the distance;
the motion over a module is ~50μm .



This is at the threshold of loading the modules.

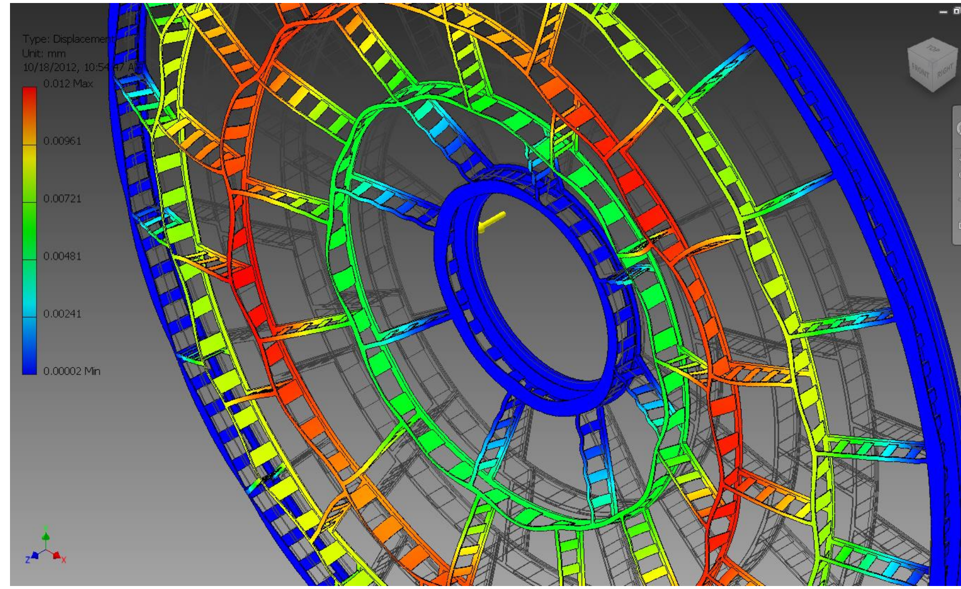
Further analysis of the ILD design: effect of changing the number of module rows

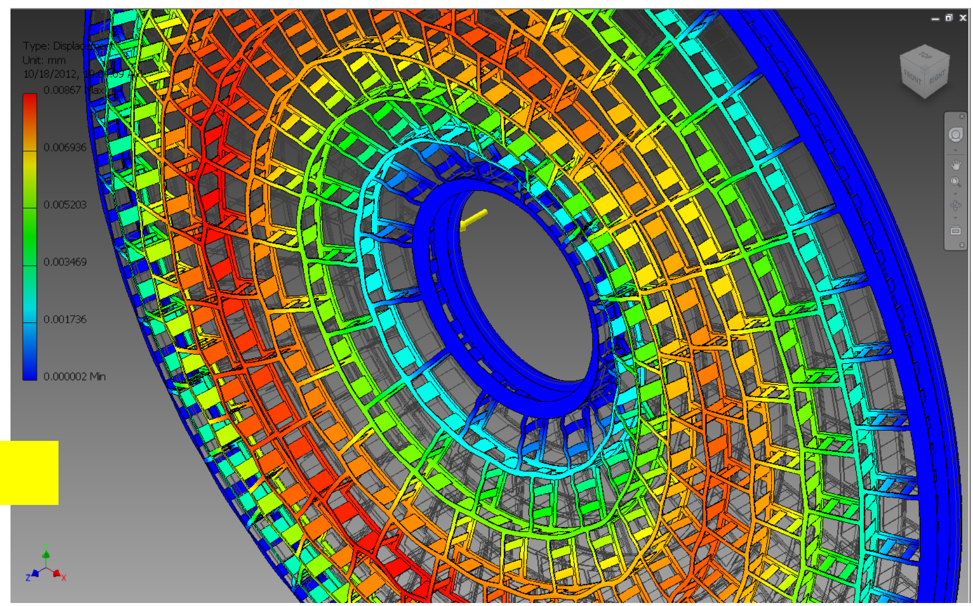
We can consider an endplate with larger modules.

The baseline design has 8 rows of modules,
37700 mm^2 per module.
With 4mm^2 per pad,
there are ~10000 pads/module.

The 4-row design has 145000 mm^2 per module.

Longitudinal displacement increases by a factor of 1.4





Z motion is shown.

In the 4-row design,
local distortions of
44 microns (0.002mm/100 N)
can be seen in the back-disk.

These are not seen in the 8-row design.

However,
this distortion is not in the main plate,
which locates the modules.

And, this is not the maximum stress point.

Maximum stress
is in the inner layer radial sections
and also increases by a factor of 1.4 .

Stress is not close to yield.

The distortion is probably greatly reduced
with a slightly thicker back-disk.