# Advanced design (incl. size) of Endplate and Module

Anyway, that is the assigned title.

I gave a talk, November 2008, at the LCWS, University of Illinois – Chicago, regarding plans to study the design of a low-material endplate.

There has been no progress since then;
funding became available September 15 ( 1 week ago ).

In this talk, I will review those plans,
and give an update on the funding level.

(From November 2008)

In discussing a “next endplate” we could be looking at 3 time frames:

1) revision of the current endplate,
could be used with the current field cage and modules,
to be built in a ~ 2 years,

2) an endplate that would be used on LP2,
something which would allow investigation of lighter construction
but would be at a much smaller size,
and therefore not address all issues,

3) an endplate that would be direct R&D for the ILD TPC.

Technologies: and personal opinions

thinning the aluminum (1)
all beryllium (1, 2 ), not (3) because the “forging” is prohibitive
composites (2? ,3), not (1) because the cost is not supported
hybrid of composites with metal (1, 2, 3)
space-frame construction (2 , 3)

The current LP,
machined aluminum

**bare endplate** …

$\rho$ = 18750g/5000 $cm^2$

= 3.75 $g/cm^2$

Effective thickness:
1.4 cm Aluminum

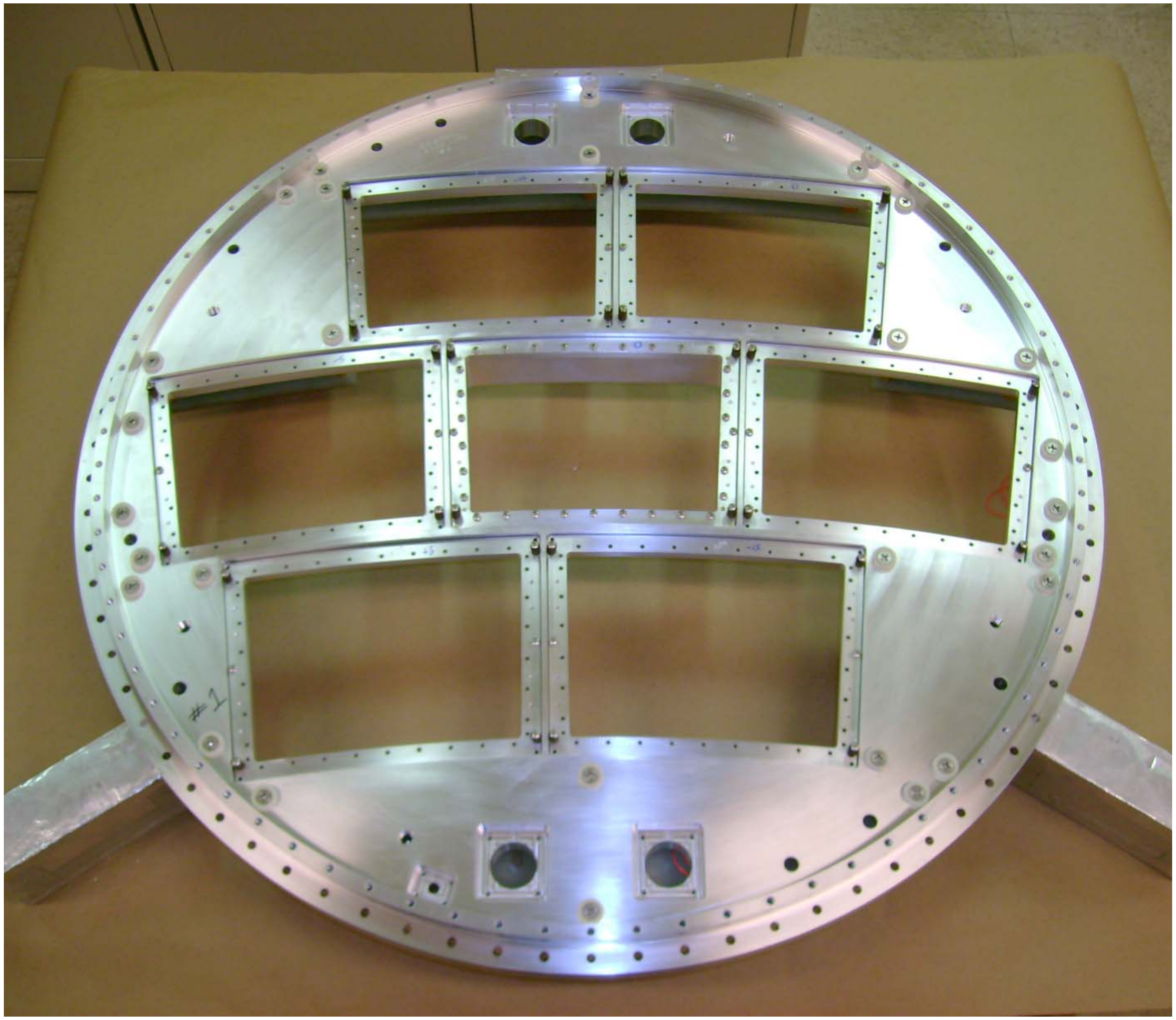
**loaded endplate** …

80 lbs

$\rho$ = 36000g/5000 $cm^2$

= 7.2$g/cm^2$

Effective thickness:
2.6 cm (1 inch) aluminum



2.6cm of aluminum is 29% $X_o$; goal is 15%.

Next few slides:

describe the some of the technology options that
are currently interesting because they fit into the funded project descriptions.

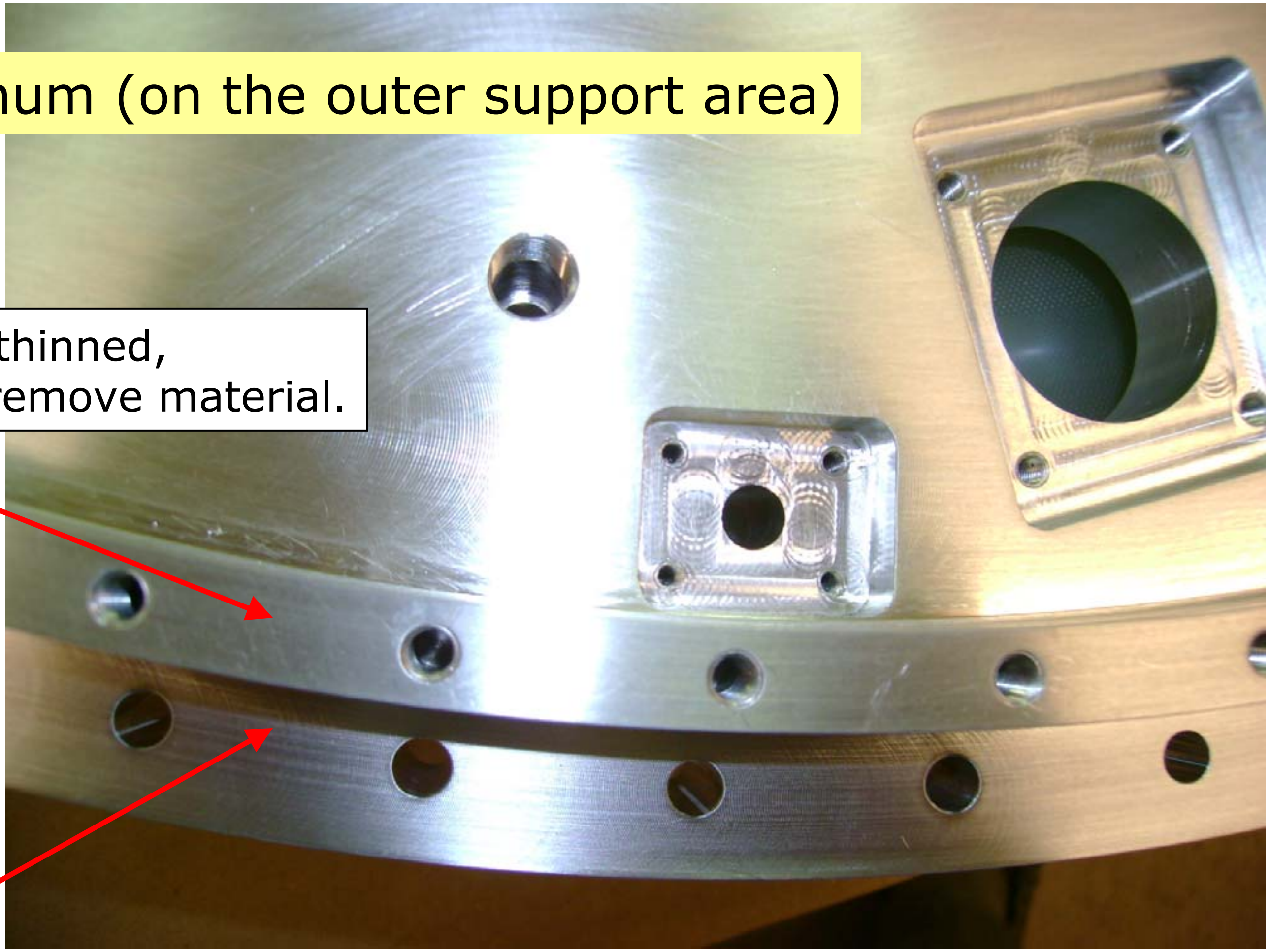
thinning the aluminum (1)
hybrid of composites with metal (1, 2, 3)

These can be done on the same device.
I have funding to develop an endplate with this technology for LP1.
This prototype is useful in examining technology for ILD.

composites (2? ,3), not (1) because the cost is not supported
space-frame construction (2 , 3)

I have funding to do a design study.

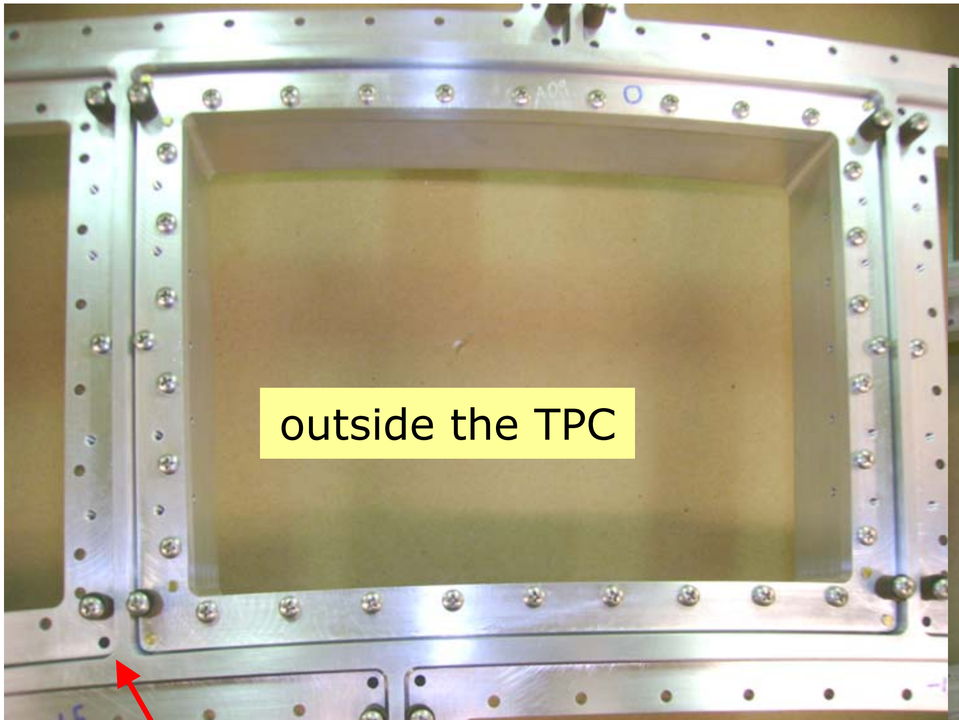
# Thinning the aluminum (on the outer support area)

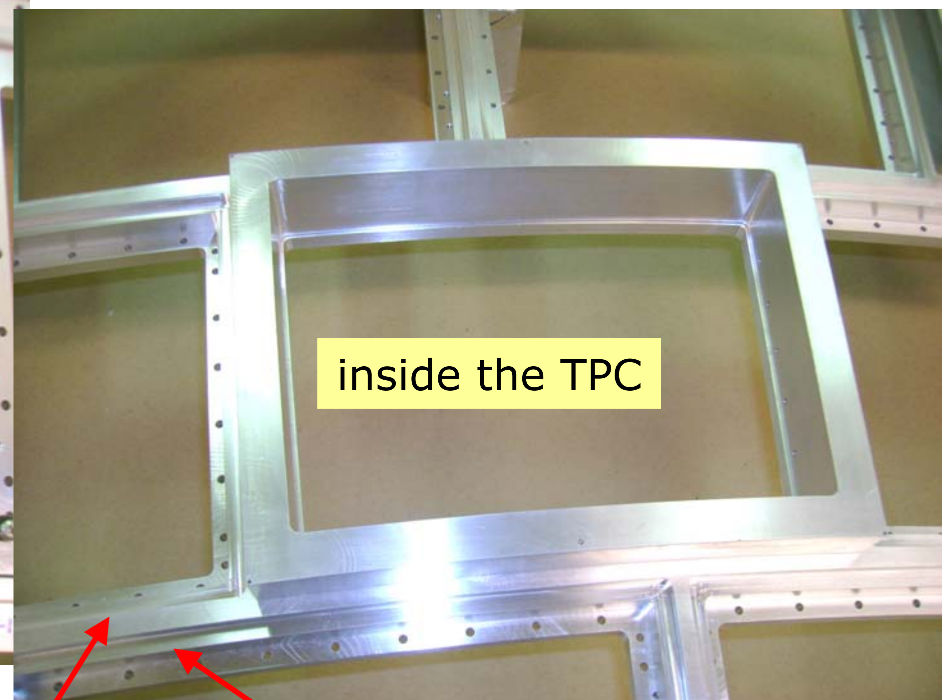


Stiffening ring can be thinned,
radial holes added to remove material.

Flange area can be thinned
and pockets of material removed

# hybrid composite/aluminum (on the mullions)




The stiffening rib could be made of fiber.

The inside surface would remain aluminum, or could expose the fiber in places.

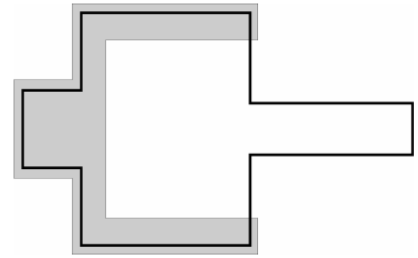
Precision surfaces and gas seal would remain aluminum

The process (for the hybrid aluminum/composite) ….

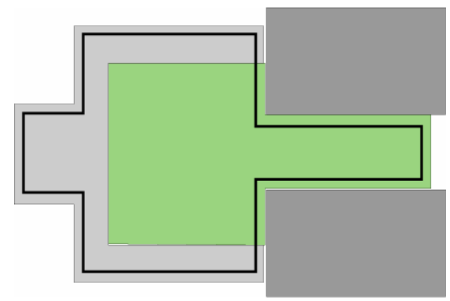
The outline at right shows the current "mullion".

multi-stage fabrication…

Start with aluminum shape, oversize, with cut-out.

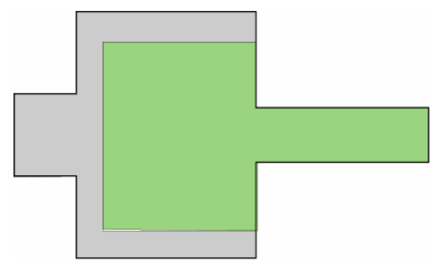


Add temporary mold. Fill with fiberglass.



Cut to final shape.

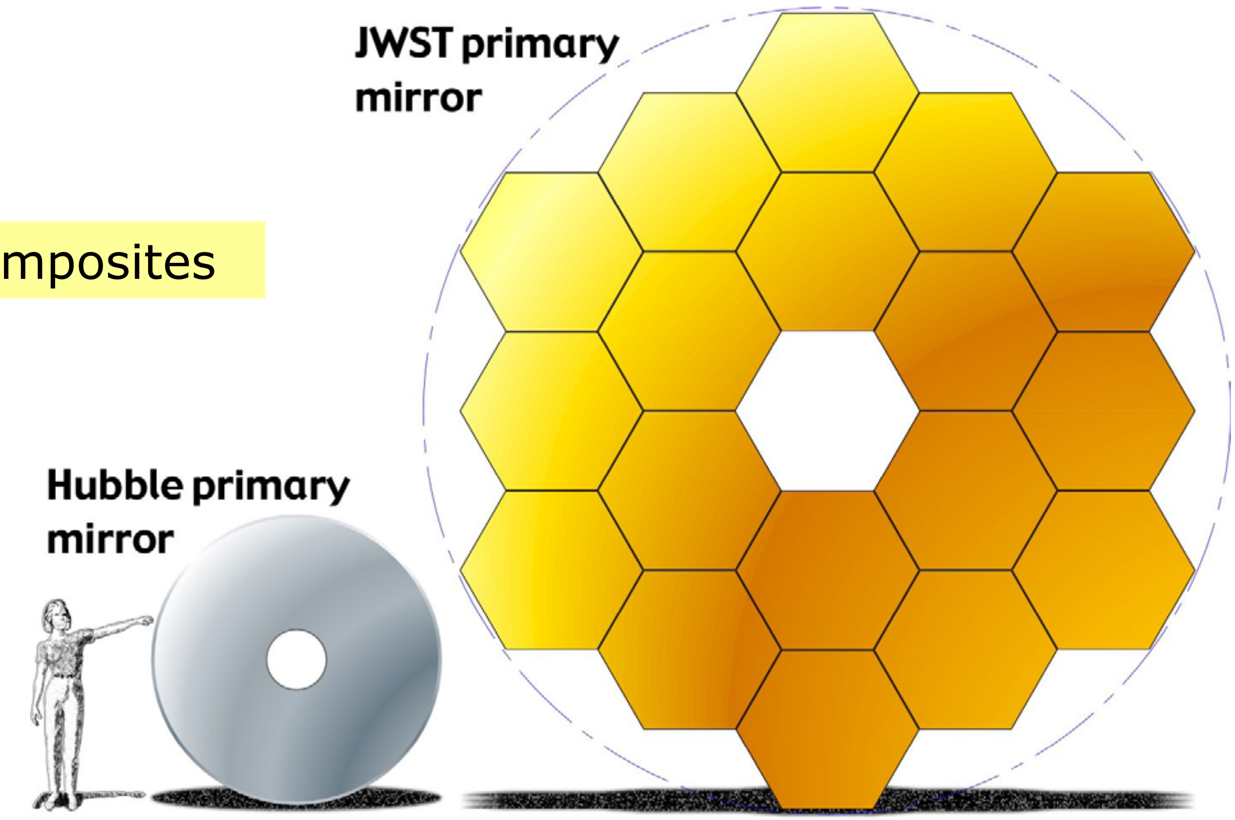
The resulting endplate meets ILD TPC material goals.



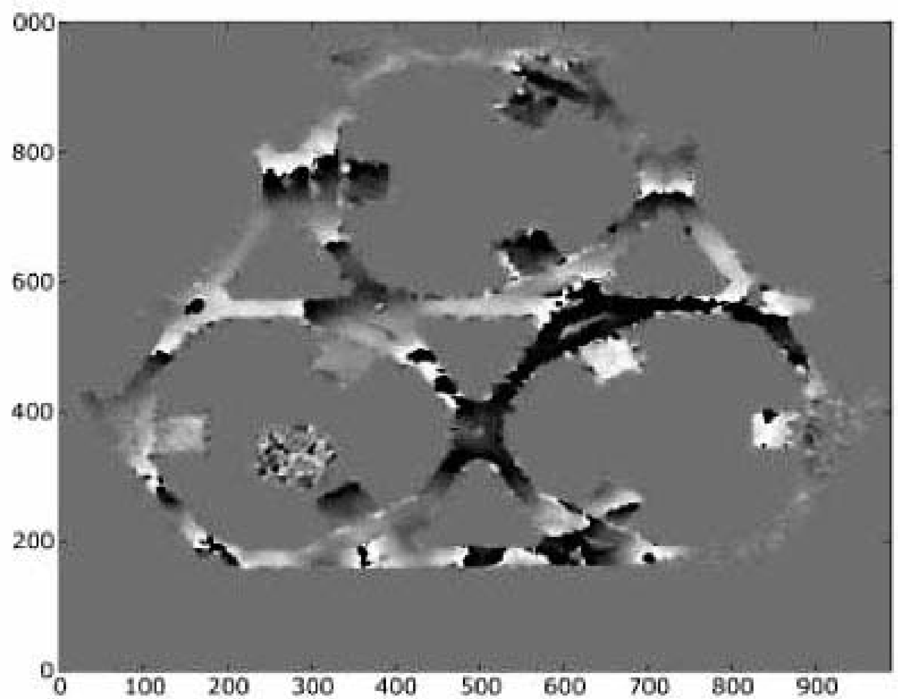
The FY2008 US LCDRD supplementary funding is specifically to build a 2nd generation LP1 endplate.
This is how the project was described in November 2007.

As described below, this prototype also serves as a prototype for advanced designs for ILD TPC.

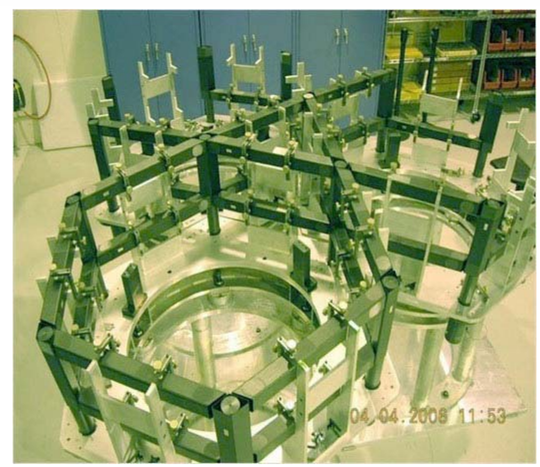
Advances designs: Composites




James Webb Space Telescope
http://www.jwst.nasa.gov/backplane.html

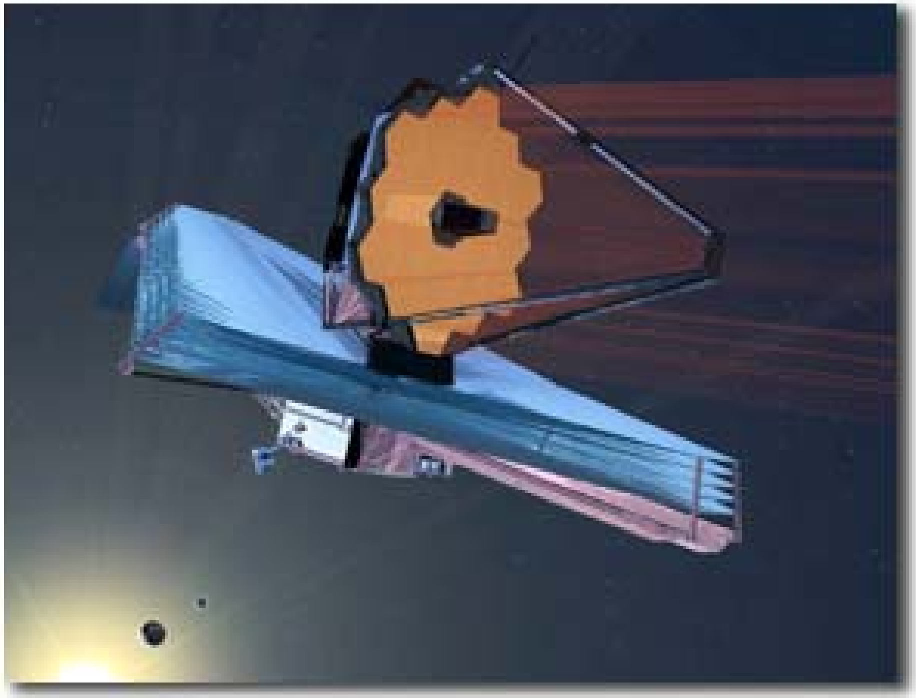



Bonded structure: BackplaneStabilityTestArticle
interferometric fringe
the full size device

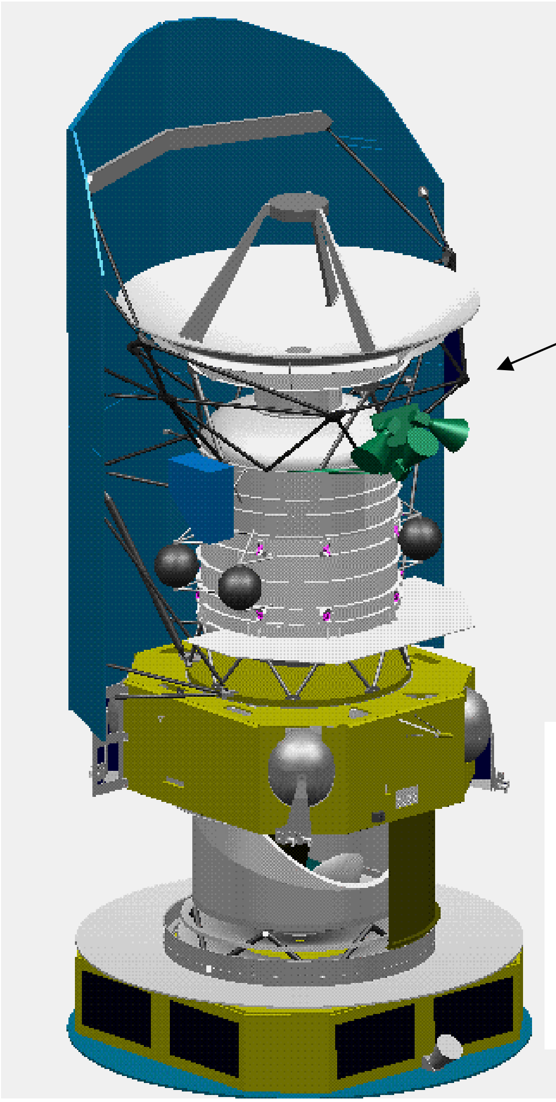



We could think of building a rigid bonded structure,
attached to a relatively thin
gas-seal and module support structure.

Advances designs: space-frame of adjustable struts



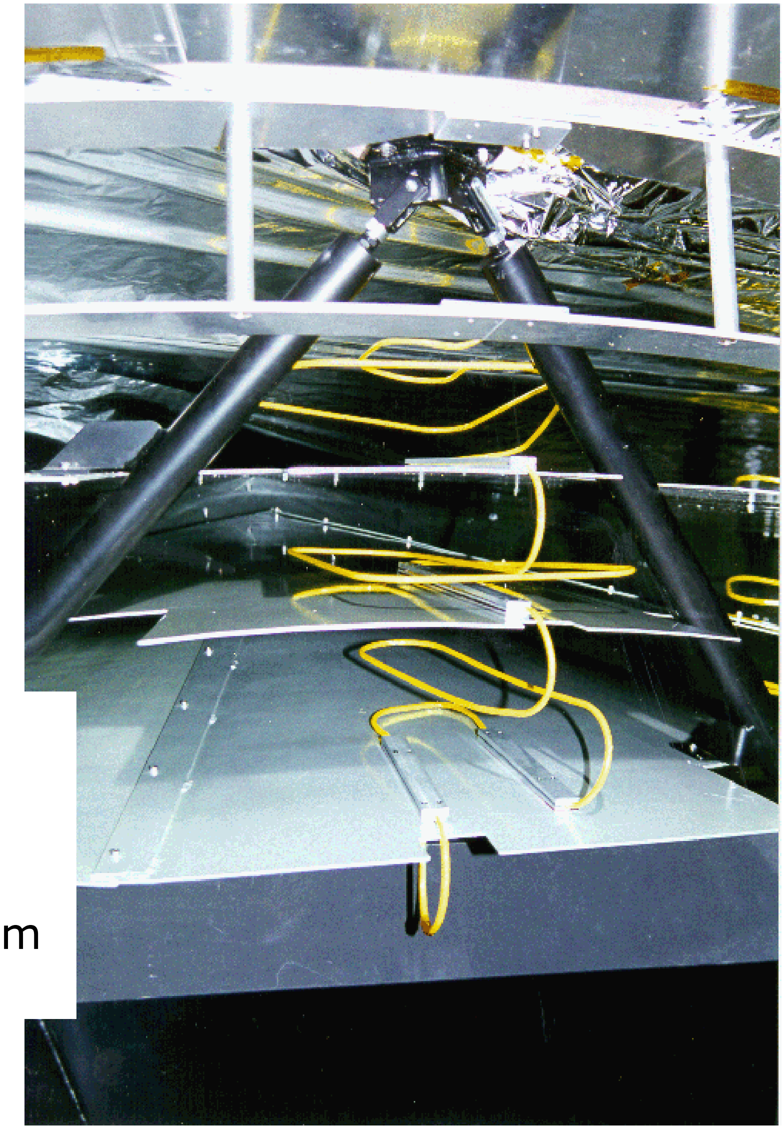
Plank Telescope
http://www.rssd.esa.int/index.php?project=PLANCK&page=index
Launch April 2009



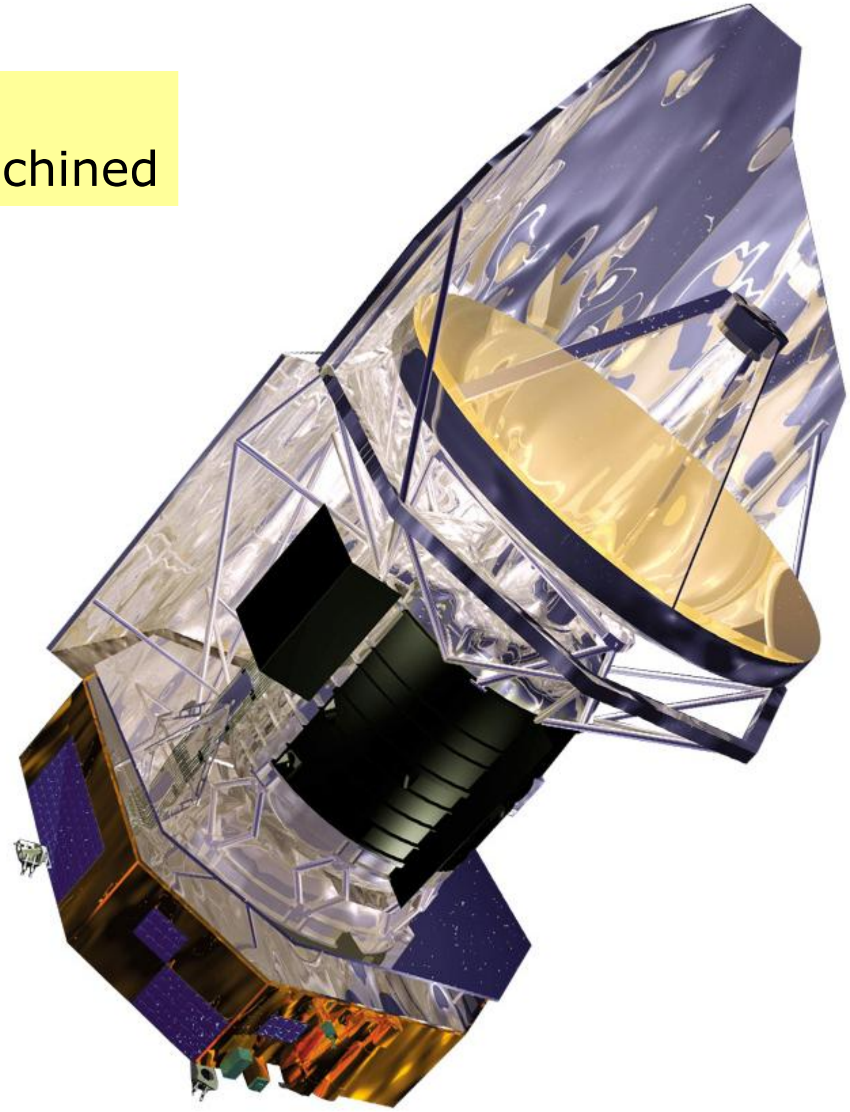
The area of
the space-frame.

Note: these are individual adjustable struts.

The precision comes from adjusting the struts.



Advances designs:
space-frame, precision machined



Hershel Telescope
to be launched with Plank

http://herschel.jpl.nasa.gov/
http://sci.esa.int/science-e/www/area/index.cfm?fareaid=16

This also has a space-frame.
It appears to be a rigid object.

Note the little cones.

Cornell expects to continue endplate development.
There are 2 small grants that will support this work.

1) FY2009 US LCDRD funds (3 years)

applied January 2009, review May 2009, given high priority by ILD
awarded, notice 09-September-2009
75k$ per year

A significant fraction is for support of people doing this work (doesn't go far).
The principal activity is Computer Aided Design for the ILD TPC.

It includes a small amount of prototyping of small parts,
"*to understand properties of composite materials and assemblies, including the joints, which are used in the space-frame models.*"

Also pays for limited drafting professional/student support, travel.

The original proposal provided for significant prototyping which was removed in the final award.

2) FY2008 US LCDRD supplementary funds

applied October 2007, revised April 2008, action April 2009
contract received by Cornell (awarded) 16-September-2009
70k$, ~/> 1/2 of which can be used for endplate development

This is specifically for an LP1, low material endplate.
However, this prototype can be incorporated into the ILD study above.