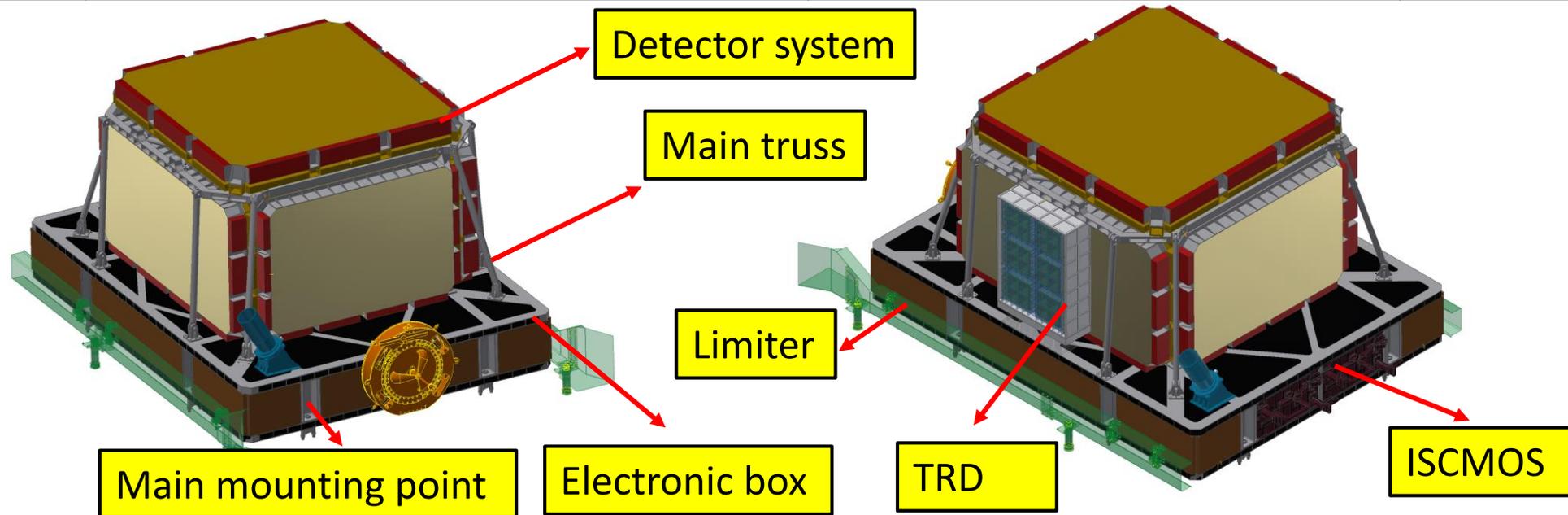


# HERD Mechanical design

Ruijie Wang

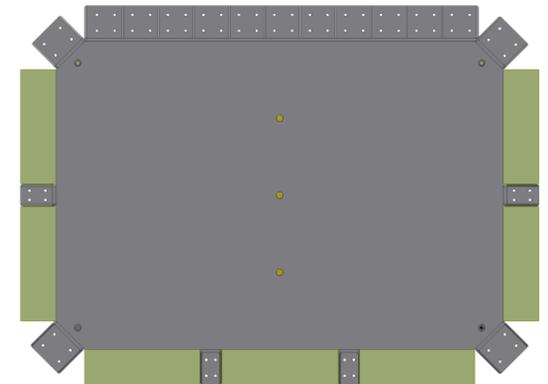
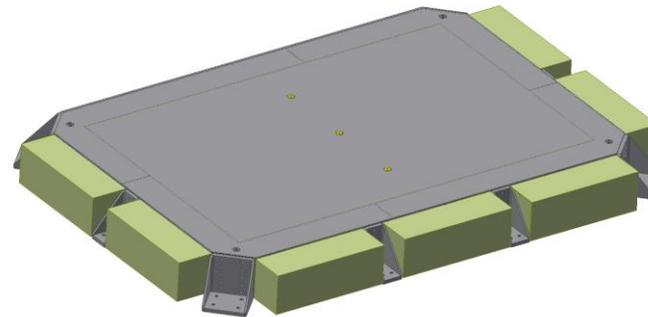
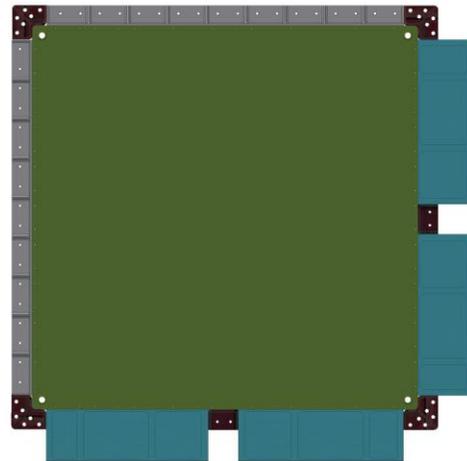
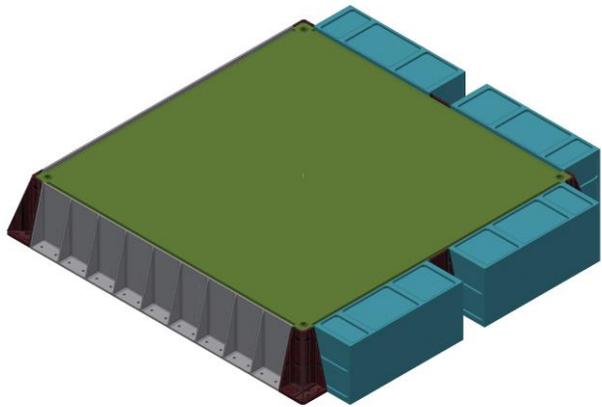
# General structure

Instrument	Configuration	Envelope* (mm)	Mass*(kg)
CALO	7497 crystals	950*950*800	1767
FIT	9 super-layers on TOP; 7 super-layers on 4 sides	1147*1147*180 1140*750*180	367
PSD	Two 5mm tile (10*10cm <sup>2</sup> ) layers on all 5 sides	1750*1750*50 1834*1000*50 1460*1000*50	225
SCD	4 super-layers on all 5 sides	1750*1750*115 1834*1000*115 1460*1000*115	502



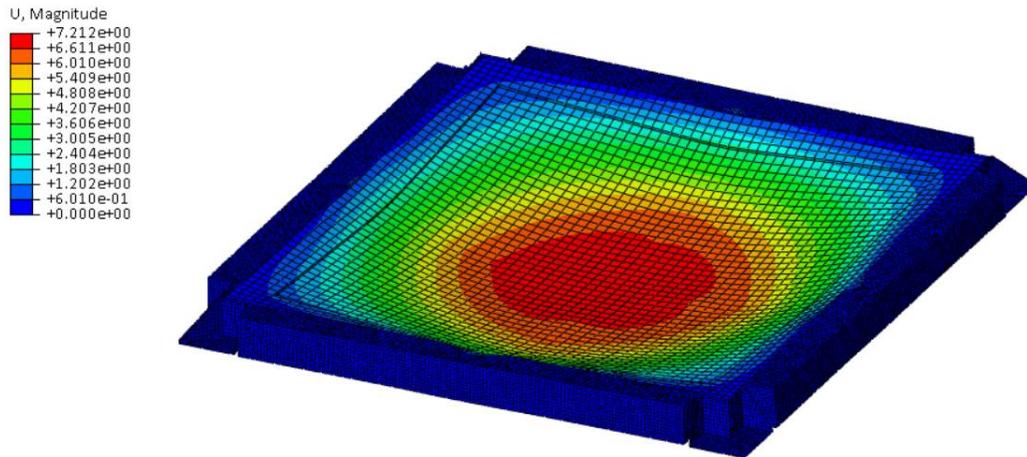
# Common interface of SCD/PSD/FIT in the current FEA

- Mechanical interfaces on four corners for external and inter-layer connection.
- Connection between layers and external mechanical interfaces is on sides without FEB/FRB.
- FEB/FRB on each side is divided into 2-3 groups, intersected by interconnecting structure.



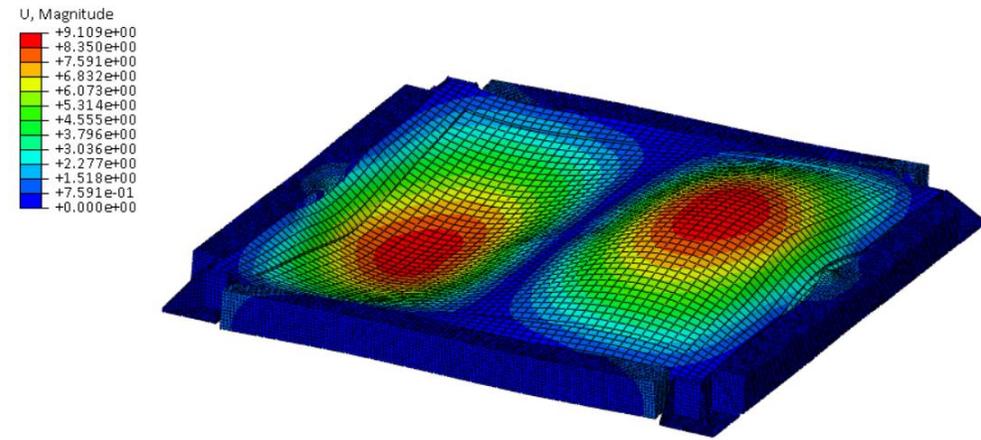
# SCD modal analysis

- TOP SCD 1<sup>st</sup> modal frequency is 94 Hz.
- Mechanical interfaces on four corners. Two connection ports on each side.
- Each honeycomb core panel is embedded with cross-shape stiffener for inter-layer connection.



ODB: Job-HERD\_SCD\_top08\_10mode.odb Abaqus/Standard 2020 Fri May 14 08:34:33 ?????? 2021

Step: Step-1  
Mode 1: Value= 3.49402E+05 Freq= 94.077 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +2.419e+01

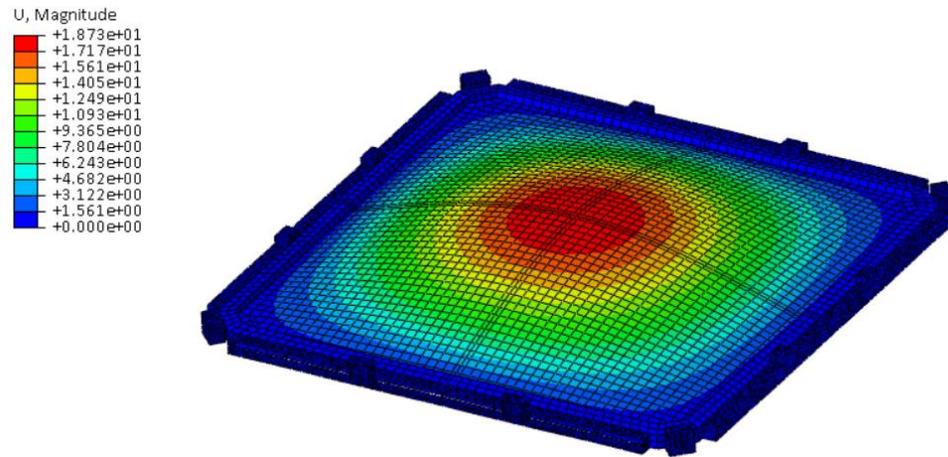


ODB: Job-HERD\_SCD\_top08\_10mode.odb Abaqus/Standard 2020 Fri May 14 08:34:33 ?????? 2021

Step: Step-1  
Mode 2: Value= 1.74816E+06 Freq= 210.43 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +1.917e+01

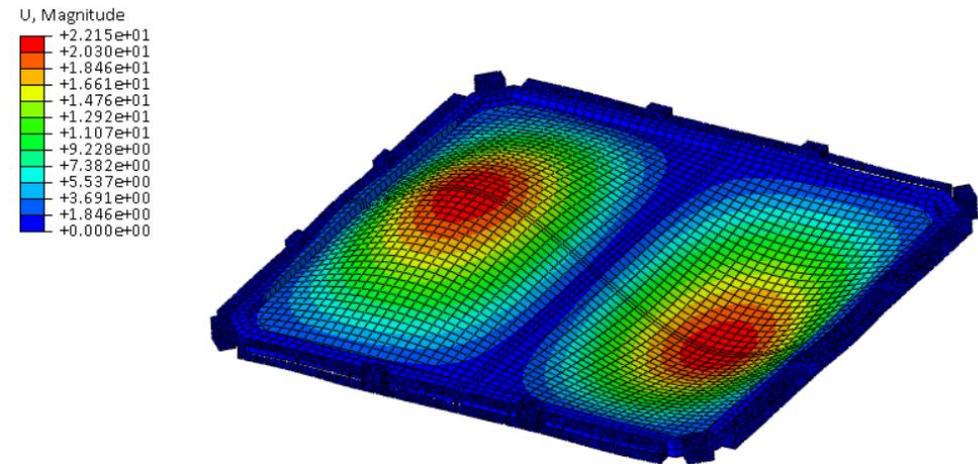
# PSD modal analysis

- One layer of honeycomb core panel + CFRP skins, attached with PS detection units on both faces.
- TOP PSD 1<sup>ST</sup> modal frequency is 70 Hz.
- Mechanical interfaces on four corners. Two connection ports on each side.
- The honeycomb core panel is embedded with cross-shape stiffener for inter-layer connection.



ODB: Job-HERD\_PSD\_top\_10mode.odb Abaqus/Standard 2020 Sat May 15 14:18:39 ?????? 2021

Step: Step-1  
Mode 1: Value= 1.91966E+05 Freq= 69.732 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +9.334e+00

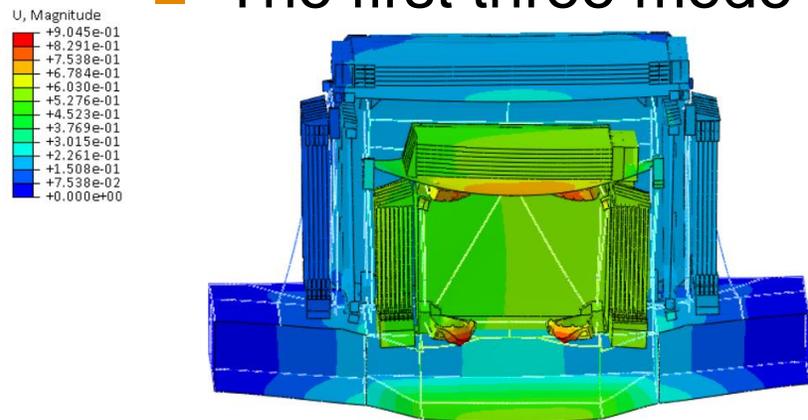


ODB: Job-HERD\_PSD\_top\_10mode.odb Abaqus/Standard 2020 Sat May 15 14:18:39 ?????? 2021

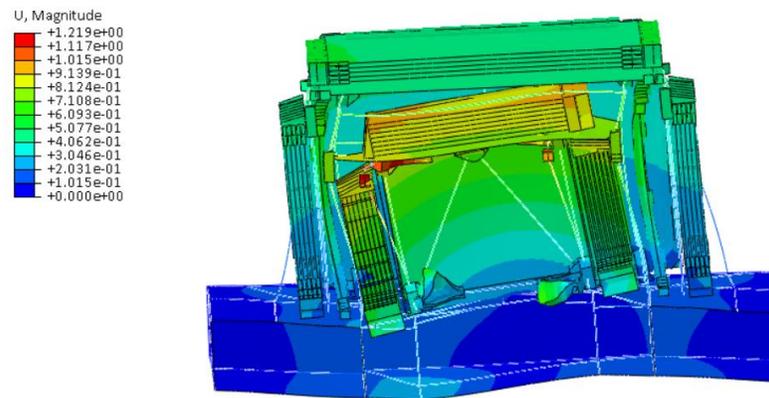
Step: Step-1  
Mode 2: Value= 1.17605E+06 Freq= 172.60 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +7.894e+00

# HERD payload modal analysis

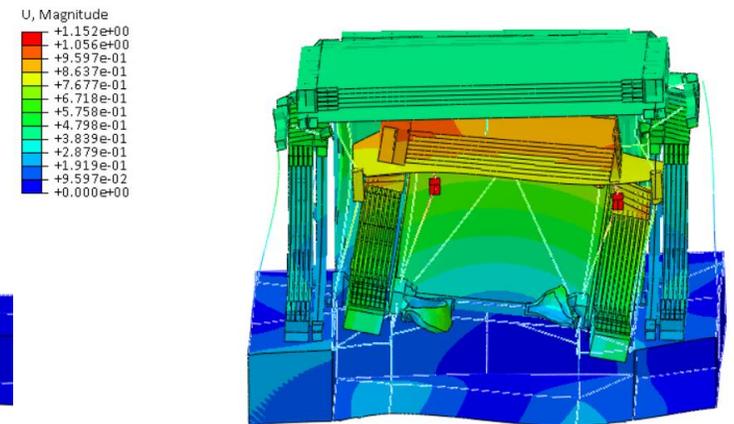
- Full detection model and full frame configuration.
- Crystals and electronics are simplified with point mass.
- Device box is composed of rods and CFRP panels resulting in several regions for allocation of electronics boxes.
- Total mass in the FEA model is 3.78 tons.
- The 1<sup>st</sup> modal frequency of HERD payload is 32 Hz.
- The first three mode shapes are all overall mode shapes.



ODB: Job-HERD02\_003\_SINMBRATION\_1000Hz.odb Abaqus/Standard 2020 Wed May 19 16:44:53 ?????? ;  
Step: Step-1  
Mode 1: Value= 40845. Freq= 32.165 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +3.221e+02



ODB: Job-HERD02\_003\_SINMBRATION\_1000Hz.odb Abaqus/Standard 2020 Wed May 19 16:44:53 ?????? ;  
Step: Step-1  
Mode 2: Value= 56886. Freq= 37.960 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +2.467e+02



ODB: Job-HERD02\_003\_SINMBRATION\_1000Hz.odb Abaqus/Standard 2020 Wed May 19 16:44:53 ?????? 2021  
Step: Step-1  
Mode 3: Value= 57971. Freq= 38.320 (cycles/time)  
Primary Var: U, Magnitude  
Deformed Var: U Deformation Scale Factor: +2.601e+02