The Central Detector of JUNO

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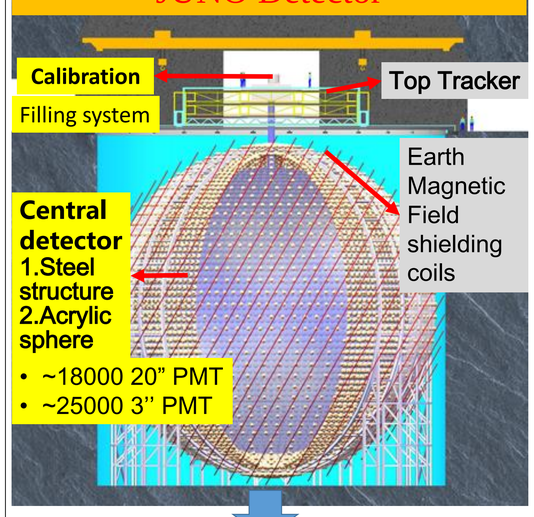
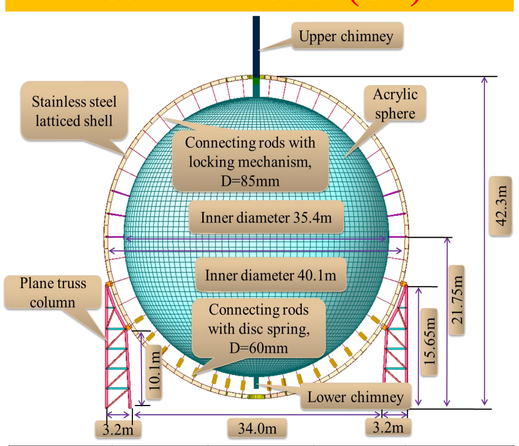
Main aim

Determine MH with Reactors

JUNO Detector



Central Detector (CD)



	KamLAND	BOREXINO	Daya Bay	JUNO
Target Mass	1 kt	300 t	8×20 t	20 kt
PE Collection (PE/MeV)	250	500	160	1200
Photocathode Coverage	34%	34%	12%	75%
Energy Resolution	6%/√E	5%/√E	7.5%/√E	3%/√E
Energy Calibration	2%	1%	1.5%	<1%

1.Increasing statistics of photoelectrons:
- Photocathode coverage: ~ 75%,
- PMT photon detection eff.:~27%
- LS attenuation length: >20 m
  ➔ abs. 60 m + Rayl. scatt. 30m

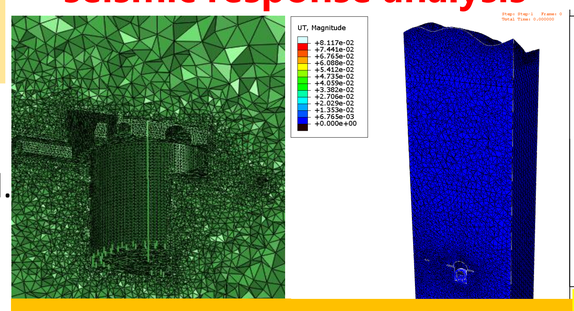
2.Reduce the systematic error:
good calibration

General R&D

Static analysis and seismic analysis of CD main structure have been finished

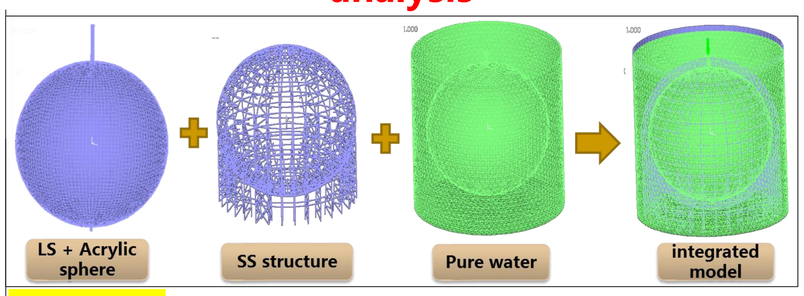
The characteristics of this project's seismic analysis
- located about 700 meters underground. The layout of tunnels and caverns is complex. The basic seismic intensity of this site: VI degree.
- fluid-structure interaction significantly

Near-field seismic response analysis



model simulation

Fluid-structure interaction seismic analysis



Interaction surface: Rock ⟺ Water ⟺ Acrylic sphere ⟺ LS

Seismic analysis review on 2017.1.6 and 2017.10.18, and the design criteria of ground motion have been selected

R&D about acrylic

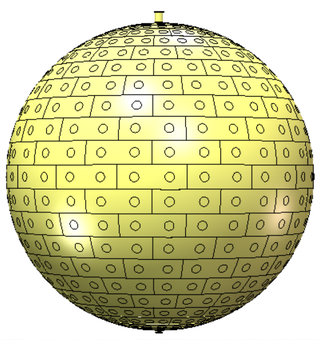
- **How about the life time of acrylic?**
  - –Strength reduce to ~70% for 20 years @ 5.5 MPa
  - –Creep: over 100 years
- **Can the spherical panel be made?**
  - –3 companies made samples
  - –2017.2 Donchamp won the bid.
- **How about the max stress control on acrylic?**
  - –≤ 3.5 MPa, less than 5 MPa in Daya Bay
- **How strong the acrylic node need to be?**
  - –Max pulling load: ~ 8 tons
  - –Break at load: ~100 tons
- **How to control the radiation back- ground and the quality of acrylic?**
- **How to make the bulk-polymerization on site?**

Thermoforming the spherical panel: 3m x 8m x 120mm

Test for bulk-polymerization

Load test of node: break at 100 tons

Acrylic panels and production line



Be composed of 265 spherical panels
Net Weight: ~600 tons

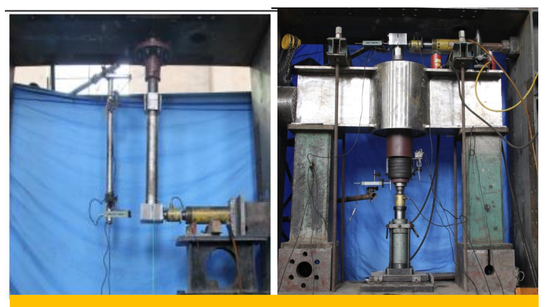
- A new production lines special for JUNO are finished
- A constant temperature workshop is being made for acrylic panels machining and pre-assembly

R&D about steel structure(SS)

Design review of the connecting rod has been passed on 2018.10.24 and the bid will be held in November

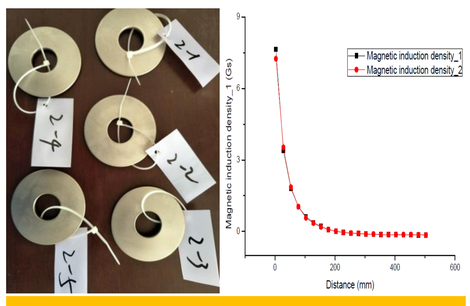
Test of connecting rod prototype(1:1)

1. Installation is convenient.
2.Inner force of the rods can be adjusted as our design
3.No damage appeared



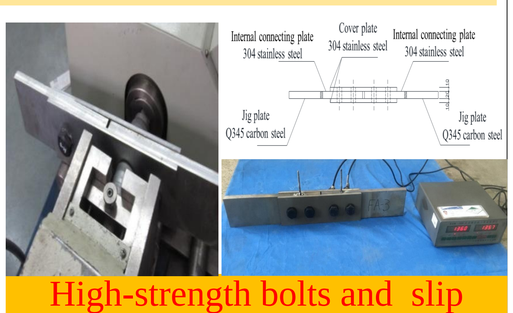
Shell joints test

1.Rotation is smooth with bearing
2.Disc spring stiffness is stable
3.Mechanical properties meet our requirements



Disc spring test

1.No corrosive pitting with improved Ni coating
2.Magnetic field meets our requirements



High-strength bolts and slip coefficient test

1.Different bolt fastening methods are under test
2.Coating can meet our slip coefficient requirement

SS Production

Zhejiang Southeast space frame CO. won the bid on 2017.09

Production line

Sample

Special workshop

1.Detailed design is almost finished
2.Production scheme and quality management are OK.
3.The material meets the low radioactive requirements.
4.The stainless steel workshop special for JUNO is prepared
5.Critical techniques are tested and should work
6.Preassembly is important.

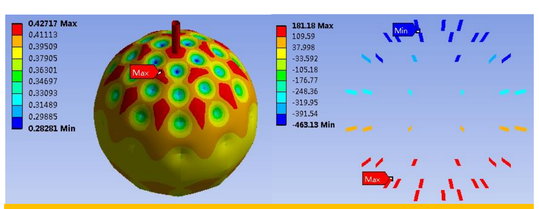
First batch of stainless steel with low background met our requirement

Techniques and Production Readiness Review of Stainless Steel Main Structure of CD has been held on 2018.10.12

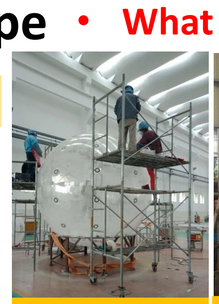
1:12 scaling CD prototype

- **What we have done:** 1.Prototype has finished 2.The laboratory has been set up 3.Water tank also has been finished

Manufacturing, assembly and test



Design and finite element analysis



Acrylic sphere

Aluminum alloy structure

Pre-assembly

Lifting test

Our lab

Water tank

- **Tests to be done**
  1.Verify the FEM calculation
  2.Check the spring effects
  3.Check the temperature load
  4.Test the monitor system
  5.Test the filling/overflow