

Double Chooz Status Update




Cara Nichole Henson - UC Davis/CEA Saclay
GDR Neutrino - 28 April 2009


Outline

- Physics Motivation
- Detector Concept
- Overview of Installation
- Near Lab Update
- Current Schedule

Double Chooz Collaboration


 **France:** APC Paris, CEA/Dapnia Saclay, Subatech Nantes, IPHC Strasbourg


 **Germany:** Aachen, MPIK Heidelberg, TU München, EKU Tübingen, Hamburg


 **Spain:** CIEMAT Madrid


 **UK:** Sussex

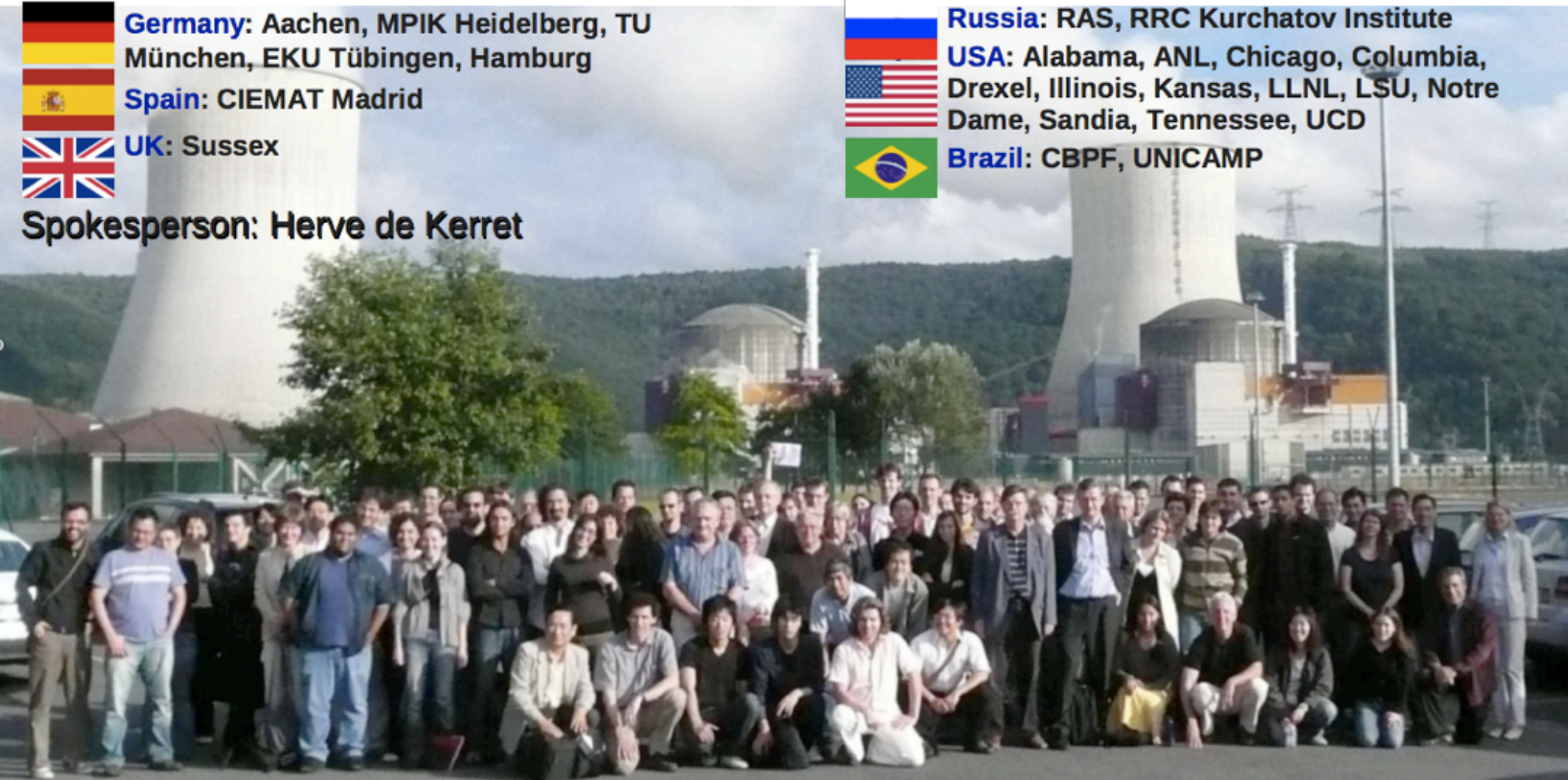
Spokesperson: Herve de Kerret

 **Japan:** HIT, Kobe, MUE, Niigata, TGU, TIT, TMU, Tohoku

 **Russia:** RAS, RRC Kurchatov Institute

 **USA:** Alabama, ANL, Chicago, Columbia, Drexel, Illinois, Kansas, LLNL, LSU, Notre Dame, Sandia, Tennessee, UCD

 **Brazil:** CBPF, UNICAMP



~ 150 people, 8 countries

Photo: June 2008

Physics Motivation

Searching for θ_{13}

$$U = \begin{bmatrix} U_{e1} & U_{e2} & U_{e3} \\ U_{\mu1} & U_{\mu2} & U_{\mu3} \\ U_{\tau1} & U_{\tau2} & U_{\tau3} \end{bmatrix}$$

$$= \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & c_{23} & s_{23} \\ 0 & -s_{23} & c_{23} \end{bmatrix}}_{\theta_{\text{atm}}} \underbrace{\begin{bmatrix} c_{13} & 0 & s_{13}e^{-i\delta} \\ 0 & 1 & 0 \\ -s_{13}e^{i\delta} & 0 & c_{13} \end{bmatrix}}_{\text{still unknown}} \underbrace{\begin{bmatrix} c_{12} & s_{12} & 0 \\ -s_{12} & c_{12} & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{\theta_{\text{sol}}} \underbrace{\begin{bmatrix} e^{i\alpha_1/2} & 0 & 0 \\ 0 & e^{i\alpha_2/2} & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{\text{Majorana phases}},$$

$$= \begin{bmatrix} c_{12}c_{13} & s_{12}c_{13} & s_{13}e^{-i\delta} \\ -s_{12}c_{23} - c_{12}s_{23}s_{13}e^{i\delta} & c_{12}c_{23} - s_{12}s_{23}s_{13}e^{i\delta} & s_{23}c_{13} \\ s_{12}s_{23} - c_{12}c_{23}s_{13}e^{i\delta} & -c_{12}s_{23} - s_{12}c_{23}s_{13}e^{i\delta} & c_{23}c_{13} \end{bmatrix} \begin{bmatrix} e^{i\alpha_1/2} & 0 & 0 \\ 0 & e^{i\alpha_2/2} & 0 \\ 0 & 0 & 1 \end{bmatrix},$$

Characterized by:

3 mixing angles: $\theta_{12}, \theta_{23}, \theta_{13}$

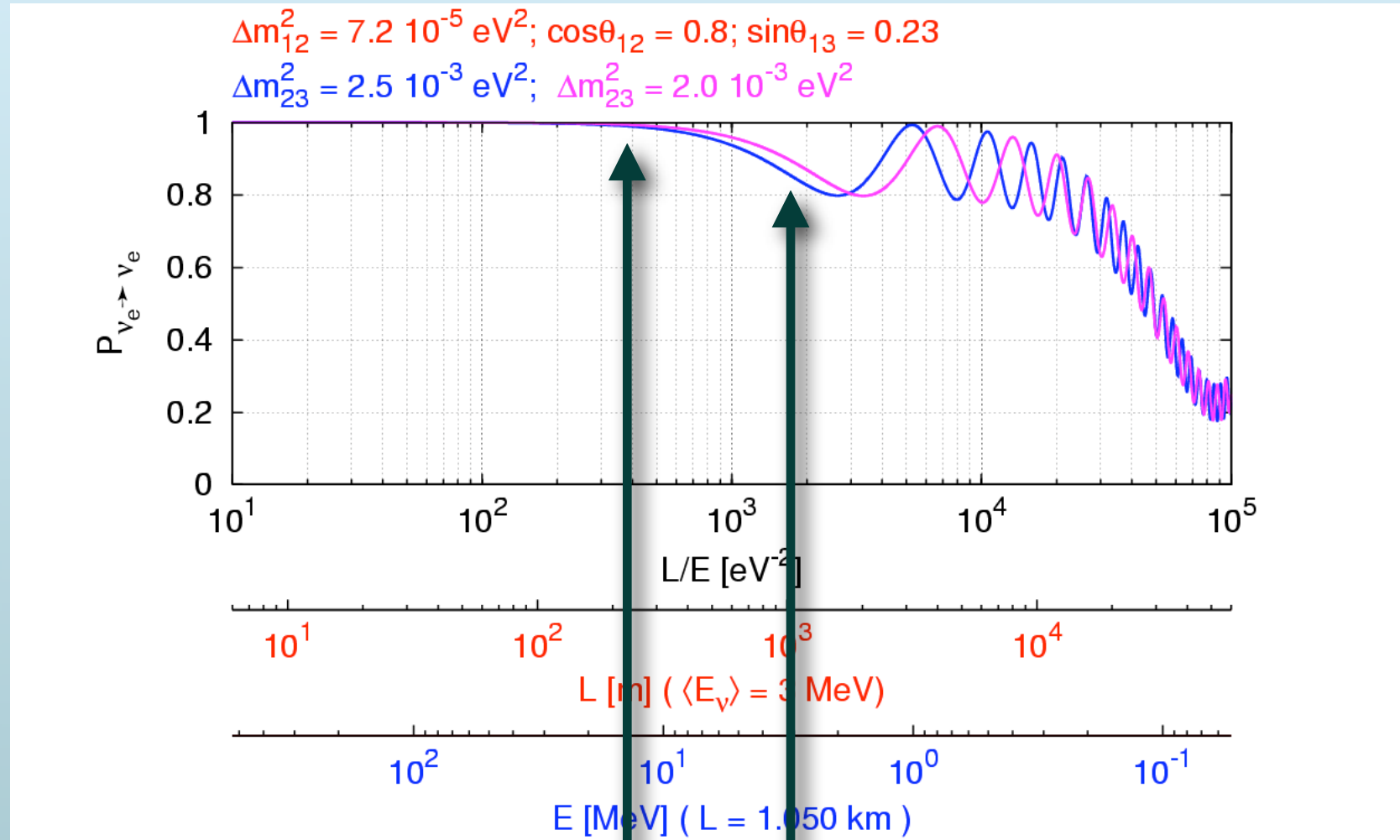
1 CP Violating phase: δ

2 Majorana phases: α_1, α_2

$$s_{ij} = \sin\theta_{ij}$$

$$c_{ij} = \cos\theta_{ij}$$

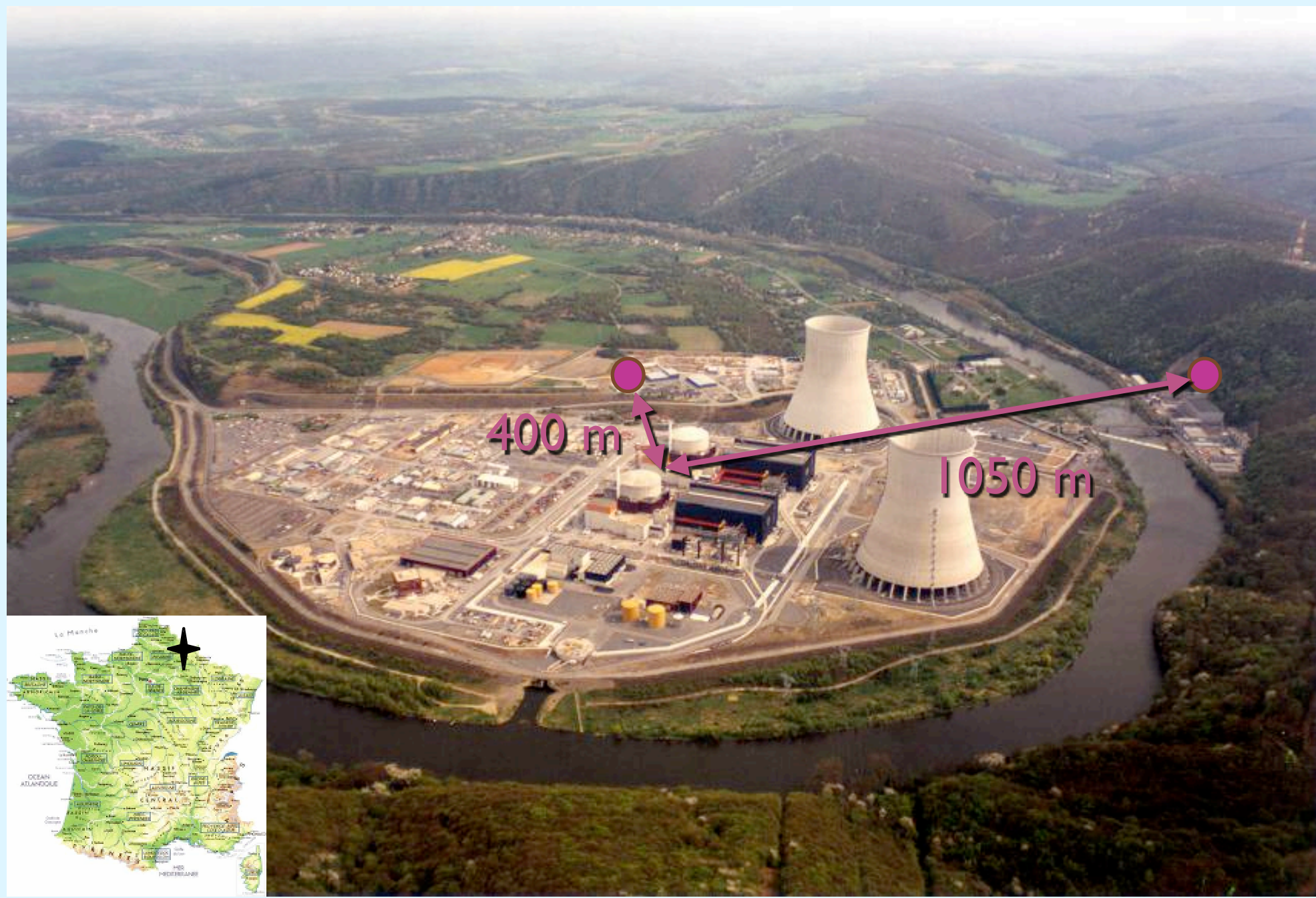
Detector Concept



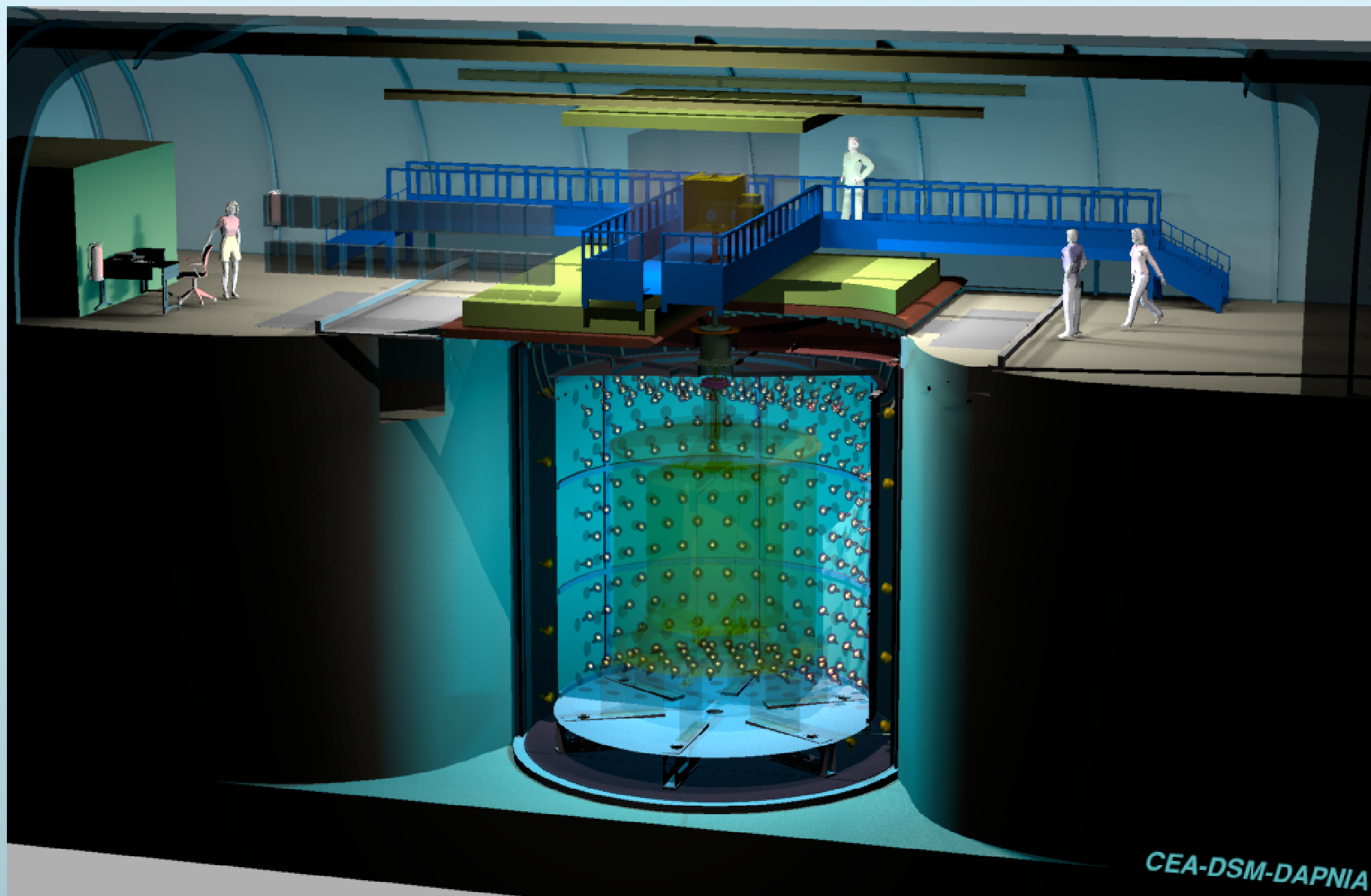
1 detector here

and 1 here

Detector Concept



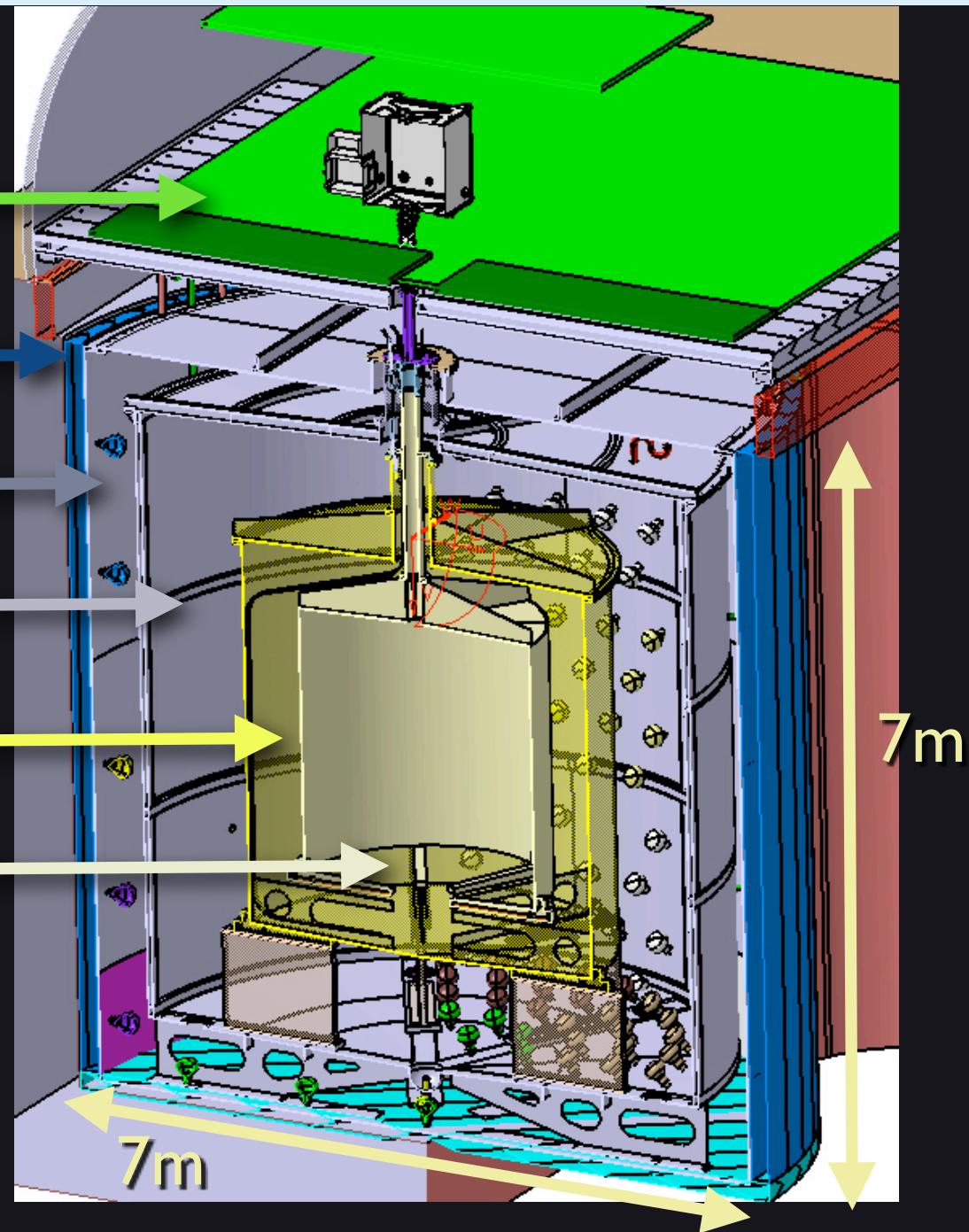
Detector Concept



CEA-DSM-DAPNIA

Detector Concept

- Outer Veto
Plastic Scintillator Strips
- Shielding
15 cm of steel
- Inner Veto
90 m³ liquid scintillator
- Buffer
110 m³ mineral oil in a stainless steel vessel
- γ -Catcher
22.3 m³ liquid scintillator in an acrylic vessel
- ν -Target
10.3 m³ liquid scintillator doped with 0.1% Gd in an acrylic vessel



Installation Status

Outer Veto

Plastic Scintillator Strips

INSTALLED!

Shielding

15 cm of steel

Inner Veto

90 m³ liquid scintillator

Buffer

110 m³ mineral oil in a stainless steel vessel

γ -Catcher

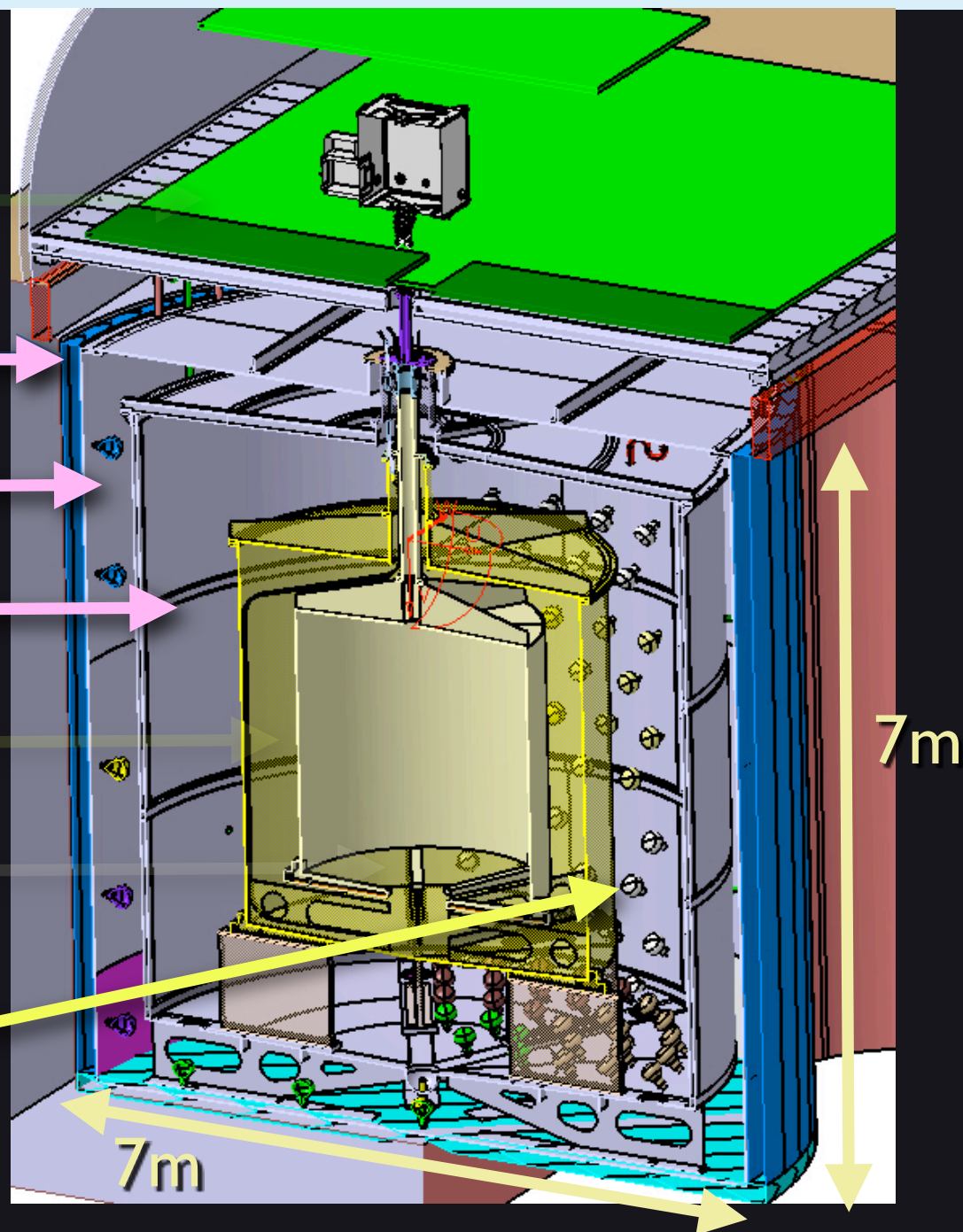
22.3 m³ liquid scintillator in an acrylic vessel

ν -Target

10.3 m³ liquid scintillator doped with 0.1% Gd in an acrylic vessel

Next Week:

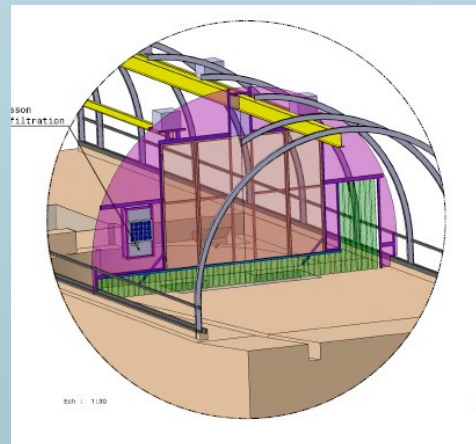
Buffer PMT Installation



Installation Status

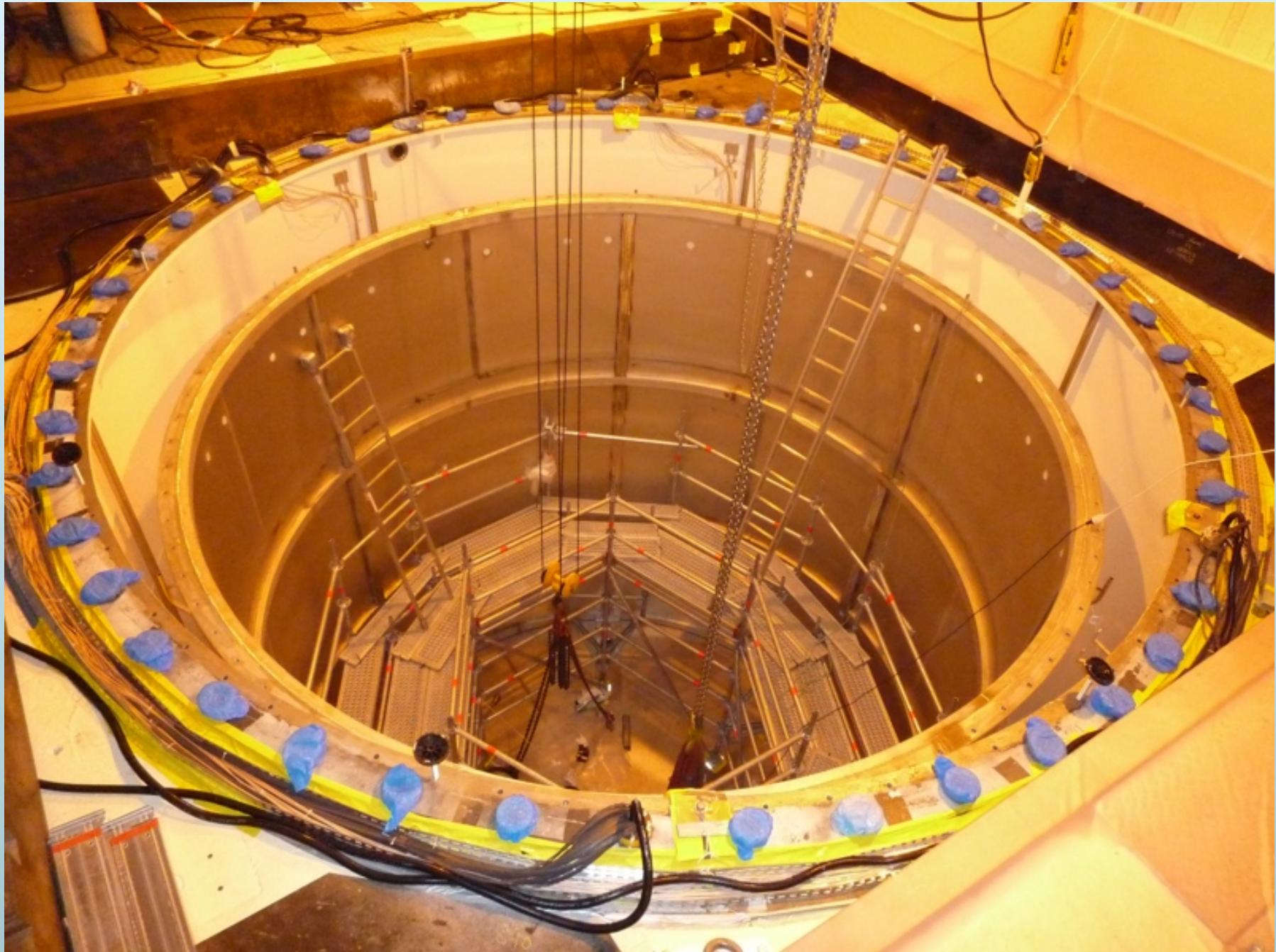
Recent Work in 2009 at the Chooz Far Lab

- Lab Professionally Cleaned and Painted - Patrick Perrin
- Inner Veto Vessel Sandblasted & Painted - APC
- Splitter Boxes & Cable Trays Installed - CIEMAT & CEA
- Clean Tents for IV PMT Testing & Installation Constructed
- Inner Veto PMT's Installed & Tested - Tübingen, Strasbourg, Tennessee, Drexel
- Front Pit Wall Installed
- Buffer Vessel Installed - CEA
- Thermal Control System Installed - CEA
- VM2000 Installed - Tübingen



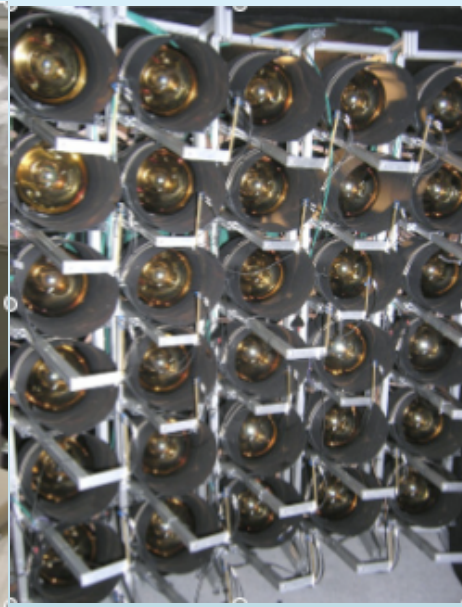
Installation Status

Current Detector Status



Installation Status

PMT's



Current Status:

- Production Complete - Japanese Groups
- Support Structures Complete - CIEMAT
- PMT's tested in Japan & MPIK
- The Japanese Team has begun to arrive at Chooz
- PMT rails will be installed by the end of next week - CIEMAT & CEA

Schedule

May - June 2009
PMT Installation & Further Testing
Starts May 11 - In conjunction with
LED calibration system

October - December 2009
PMT Tuning

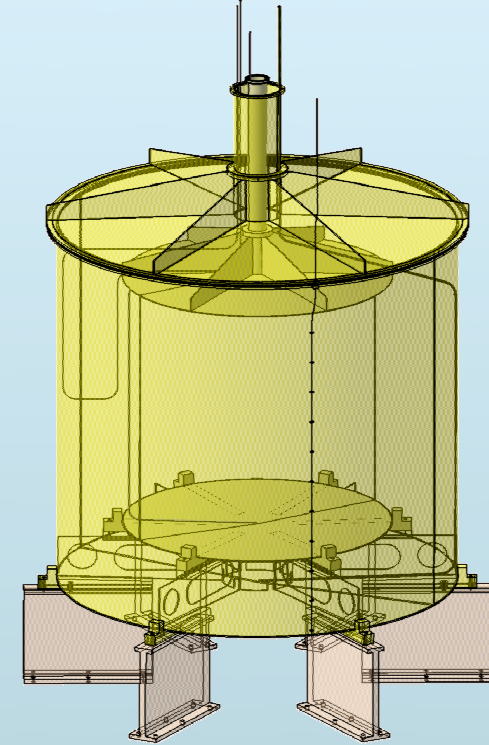
Installation Status



Current Status:

- Transport Structures Ready - CIEMAT & CEA
- Acrylic Ready - CEA & Neotec

Acrylic Vessels



Schedule

May 2009

'Cleaning' Acrylic & Gluing Target Vessel

July - August 2009

Installation of Acrylic Vessels

Installation Status

Liquid Scintillator



Current Status:

- Chemicals Ready - MPIK
- Iso-Containers Ready - MPIK
- Operating Systems on Schedule - MPIK & TUM

Credit: Christian Buch

Schedule

April - May 2009
Purification of Chemicals
Prepare for Mixing

Summer 2009
Scintillator Production
On-Site work of Trunk-Line System

September - October 2009
Transport to Chooz
On-Site Preparation for filling

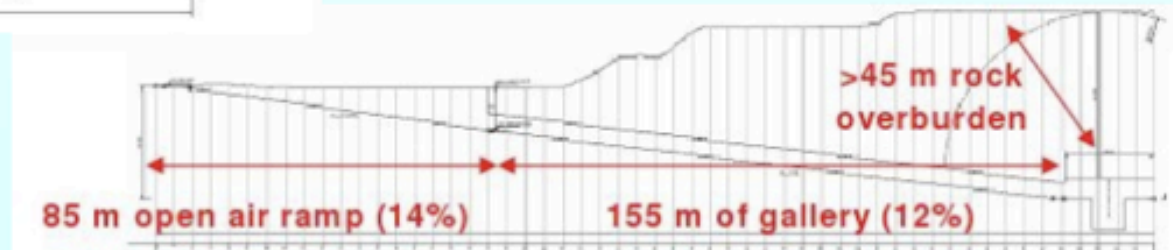
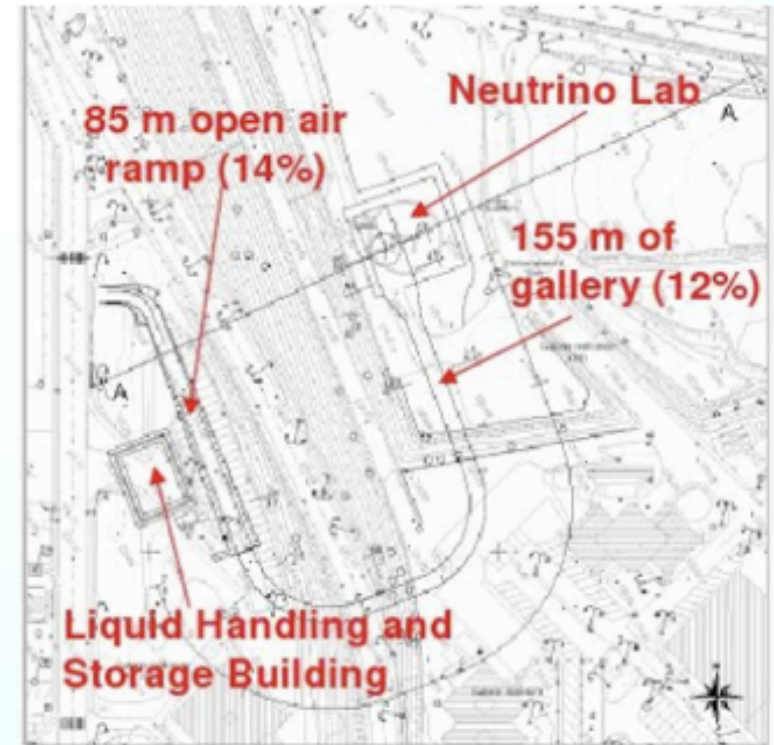
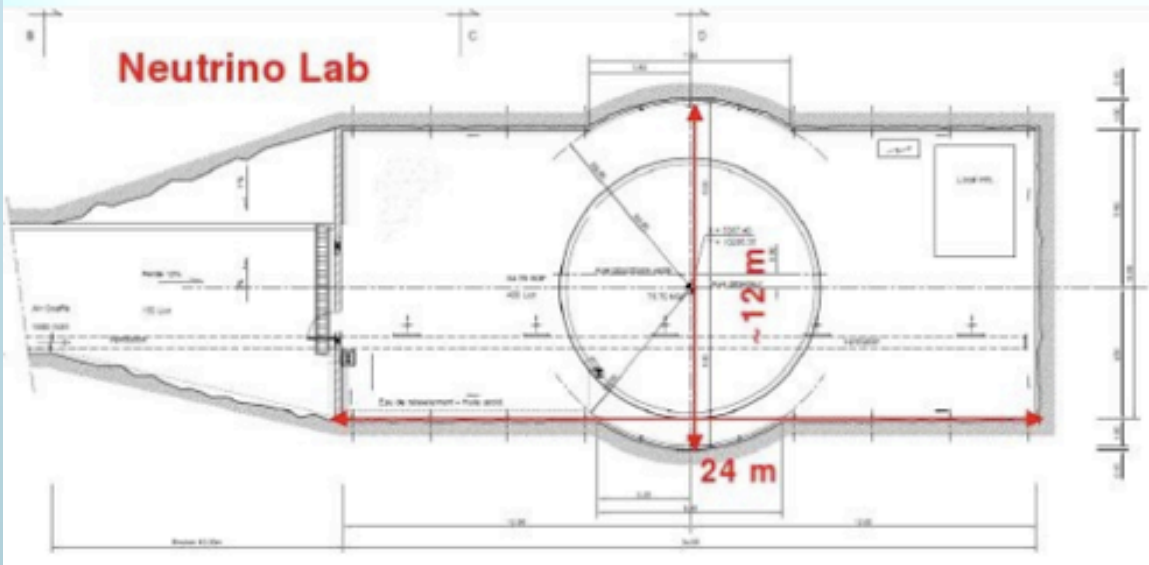
Installation Status

Current DC Far Lab Schedule

May - June 2009	Buffer PMT Installation
July - August 2009	Acrylic GC & Target Installation
September 2009	Lid PMT Installation & Closing
October - December 2009	PMT Tuning
October 2009	DAQ Installation
October 2009	Weighting Tank & Expansion Tank Installation
October 2009	DFOS Installation & Nitrogen Flushing
October - November 2009	Electronics Installation
November - December 2009	Filling
January 2010	Start of Far Detector Commissioning
January 2010	Upper Shielding Closing
January - March 2010	Outer Veto Assembly
March 2010	Glove Box Installation
March - April 2010	Construction Complete!!

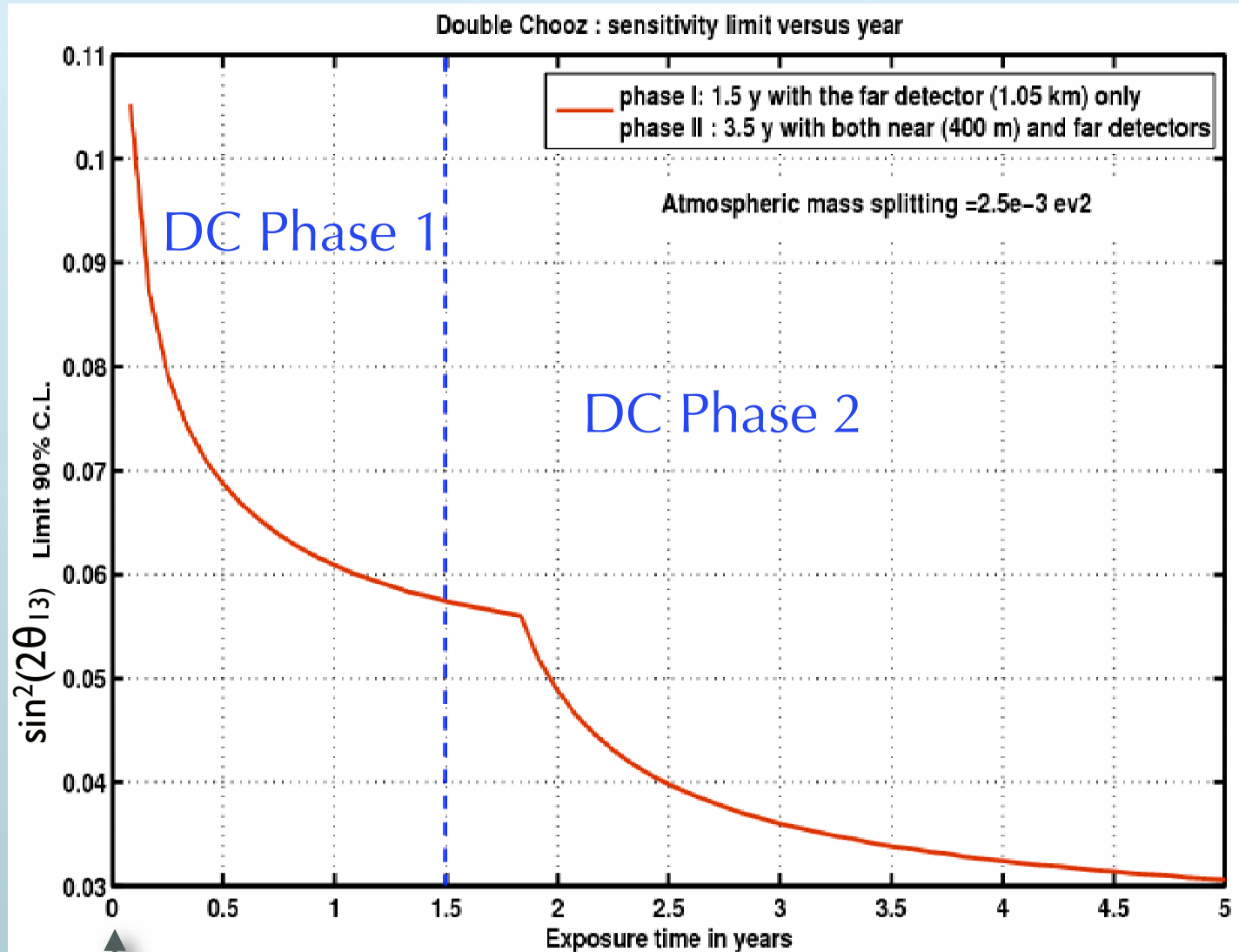
Double Chooz Near Lab

- Site engineering study completed
- Starting of construction soon
- End of construction middle 2011



Current Schedule

Previous Chooz Limit: $\sin^2(2\theta_{13}) < 0.19$



DC Phase 1
Far Detector Only

$$\sin^2(2\theta_{13}) < 0.06$$

DC Phase 2
Near & Far Detectors

$$\sin^2(2\theta_{13}) < 0.03$$

January
2010

Conclusions

- Far Detector Construction is Underway
- Operations will start end of 2009
- Near Lab Excavation will start soon - complete by mid 2011