T2K and Double Chooz

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T2K Discussion

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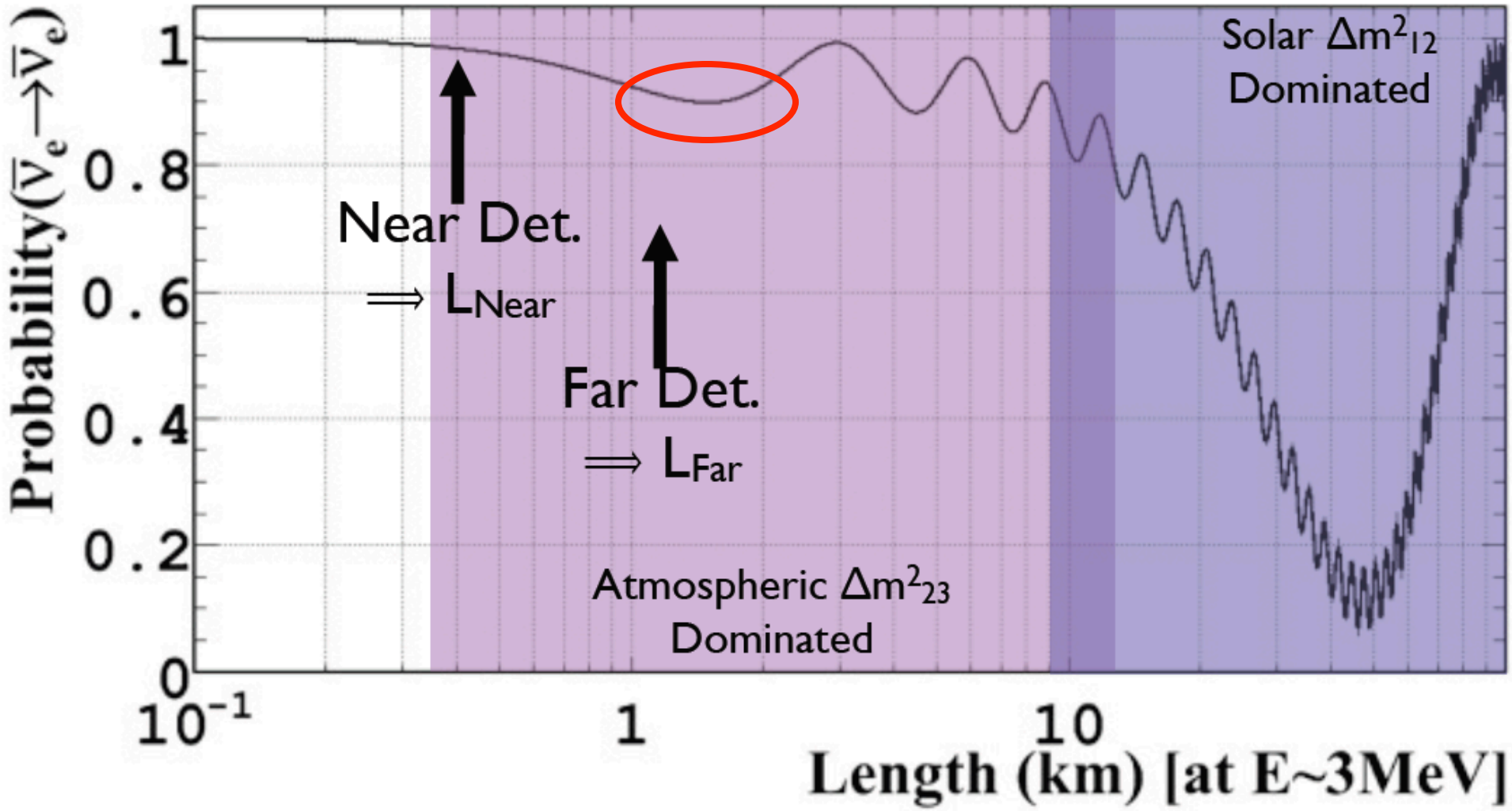
How Do We Measure θ_{13}?

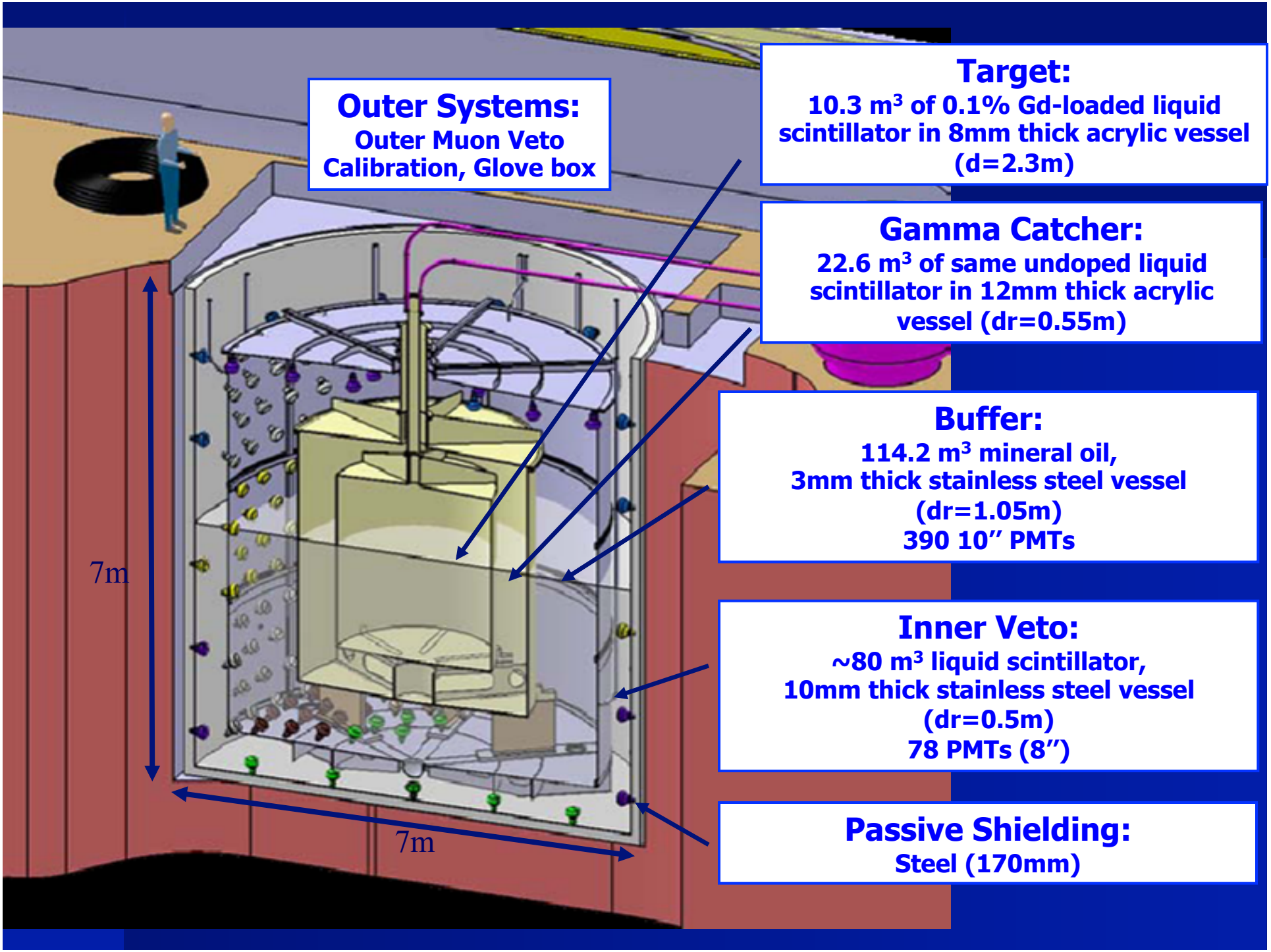
- long-baseline electron neutrino appearance (MINOS, NoVa, T2K)
  - complicated by degeneracies caused by the neutrino hierarchy and the CP-violating phase (or to be an optimist, they have sensitivity to these parameters)
- reactor electron neutrino disappearance
  - decoupled from hierarchy and CP-violating phase

$$P_{ee} \approx 1 - \sin^2 2\theta_{13} \sin^2 \frac{\Delta m_{31}^2 L}{4 E_\nu} + O\left(\left(\frac{\Delta m_{21}^2}{\Delta m_{31}^2}\right)^2\right)$$

How Do We Measure θ_{13}?

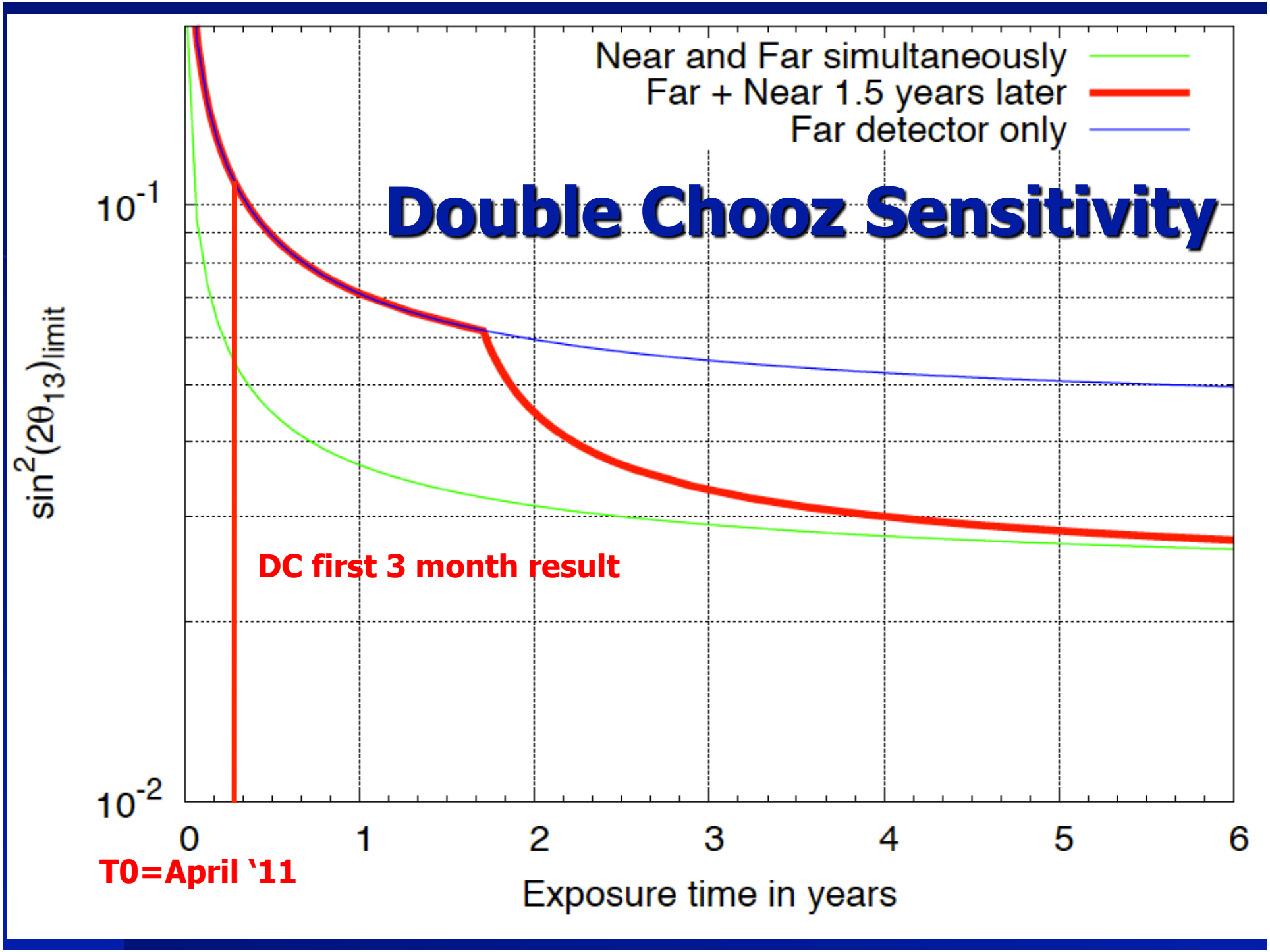
$\sin^2 2\theta_{13} = 0.1$ $\Delta m^2_{23} = 2.5 \times 10^{-3}$



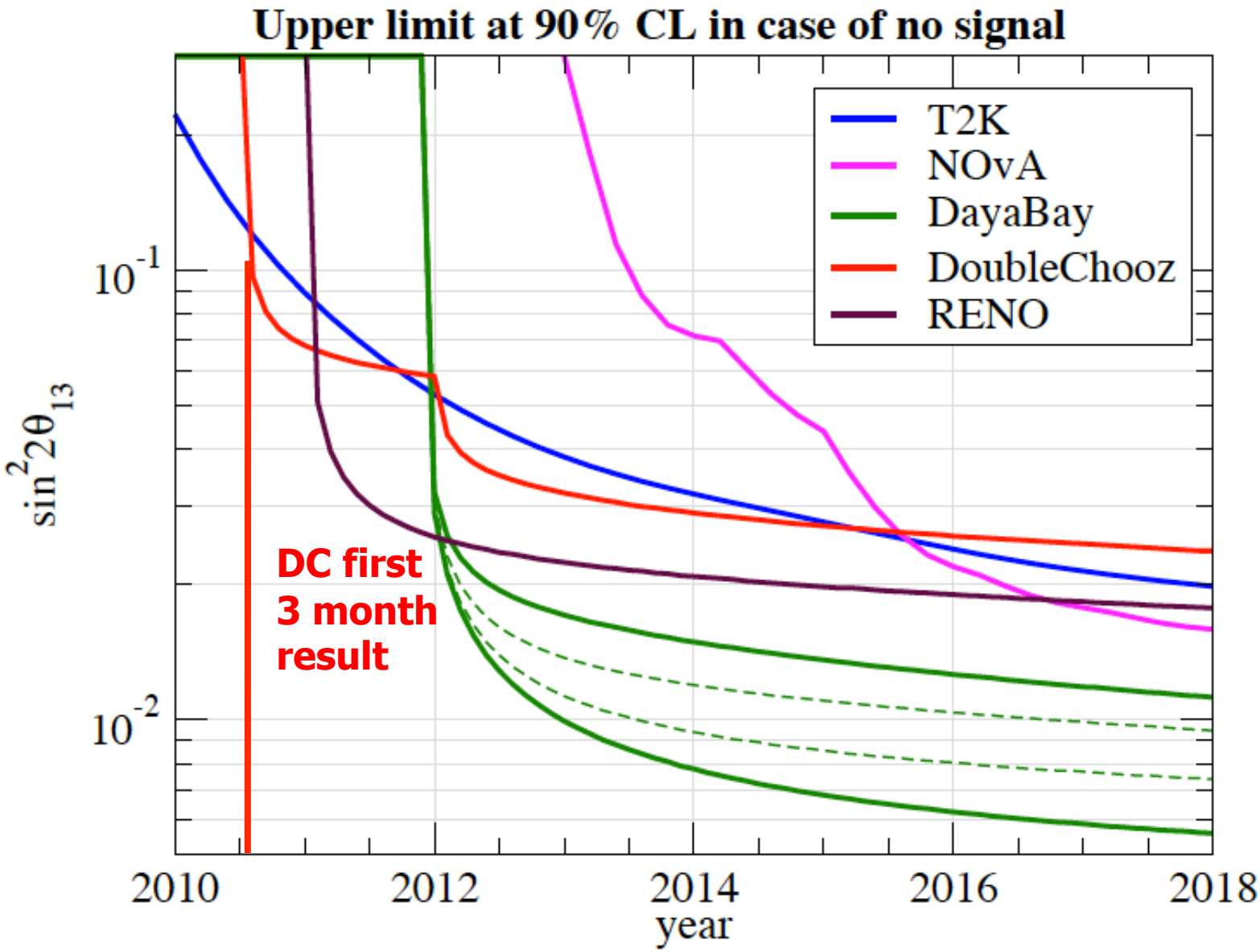

Outer Systems:
Outer Muon Veto
Calibration, Glove box
Target:
10.3 m³ of 0.1% Gd-loaded liquid scintillator in 8mm thick acrylic vessel (d=2.3m)
Gamma Catcher:
22.6 m³ of same undoped liquid scintillator in 12mm thick acrylic vessel (dr=0.55m)
Buffer:
114.2 m³ mineral oil,
3mm thick stainless steel vessel
(dr=1.05m)
390 10" PMTs
Inner Veto:
~80 m³ liquid scintillator,
10mm thick stainless steel vessel
(dr=0.5m)
78 PMTs (8")
Passive Shielding:
Steel (170mm)
7m
7m

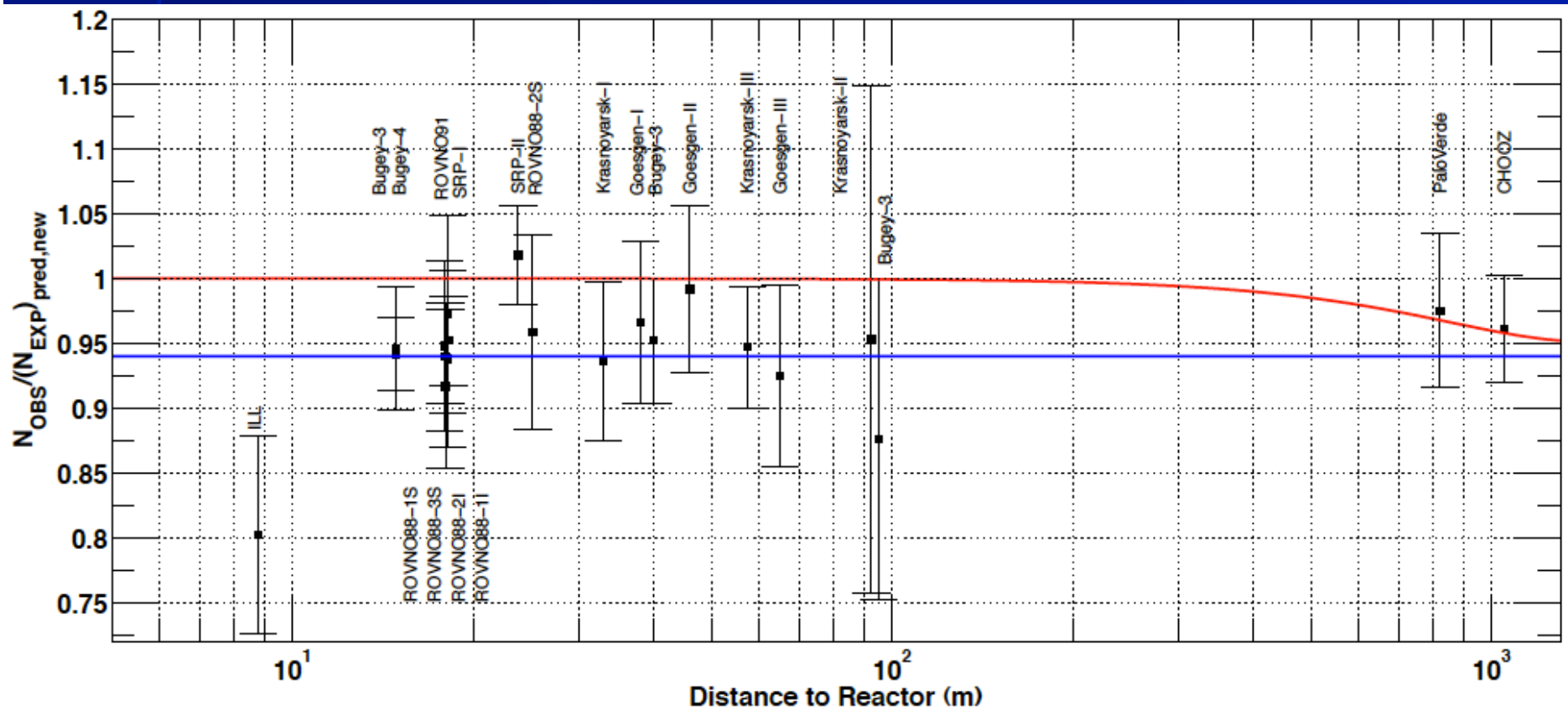
Double Chooz Status

- we’ve been taking stable physics data with the far detector only since the middle of April, so we have two months on tape
- first publication is targeted for three months of data, likely in the fall
- the near detector will likely come online next summer


Double Chooz Sensitivity
Near and Far simultaneously
Far + Near 1.5 years later
Far detector only
10^{-1}
10^{-2}
$\sin^2(2\theta_{13})_{limit}$
DC first 3 month result
0
1
2
3
4
5
6
T0=April `11
Exposure time in years

Global θ_{13} Outlook



Reactor Anti-Nu Anomaly

- recent re-evaluation of the reactor flux calculations found a 3% increase
- complicates flux understanding for far detector only running