NEUTRINO MISTERIES AND HOW TO SOLVE THEM

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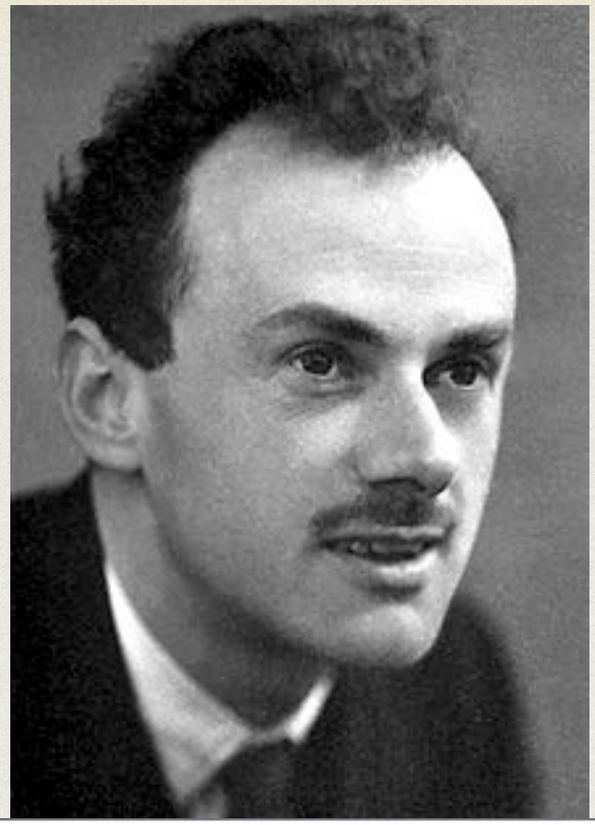
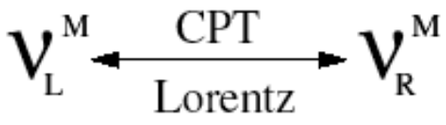
PHYSICS FIRST

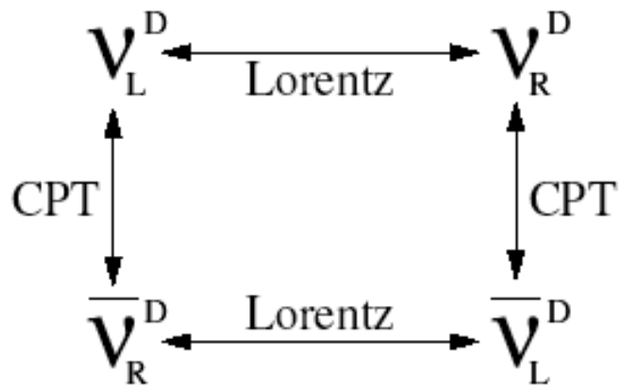
- Neutrino nature: Dirac vs. Majorana
- more neutrinos besides those we know (sterile please !)
- CP-phase in P-MNS mixing matrix
- neutrino mass ordering

MAJORANA VS. DIRAC



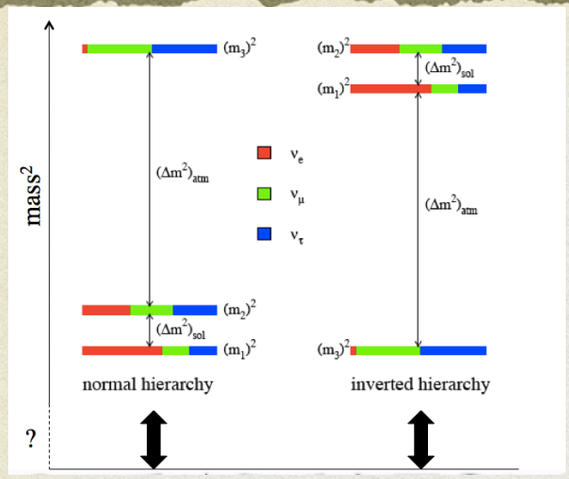


Majorana



Dirac

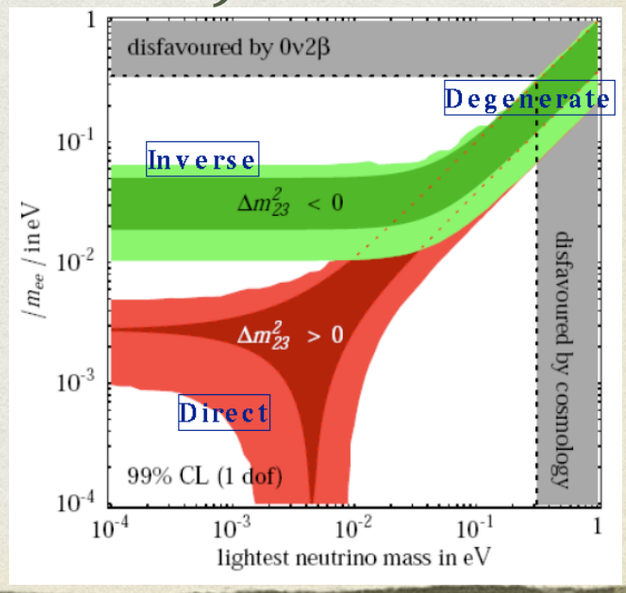
EXPERIMENTAL OUTCOMES



- mass hierarchy is inverted and (reasonably sensitive) DBD experiment does not see any signal: DIRAC

- mass hierarchy is inverted and (reasonably sensitive) DBD experiment does see a signal: MAJORANA

- mass hierarchy is direct: prognosis reserved !



WHERE ?

- INFN is proud to offer LNGS infrastructure where already GERDA is taking data on Ge, CUORE will start soon with Te and a vibrant R&D on scintillating bolometer is going on (Se, Mo)

FOR ANSWERING THE OTHER QUESTIONS.....

- You need a neutrino beam (reactors gladly accepted)

STERILE NEUTRINOS

- a long and confused story (born in ……. with LSND but not limited to it)

- Message: once for all do the right experiment to clean up the field (and perhaps become famous)

MASS HIERARCHY (I)

- the best experiment for mass hierarchy does not possibly coincide with the best experiment for CP measurement
- i.e. : reactor experiments would only do MH
- i.e. : given an existing accelerator and an available cavern the L/E does not likely look optimal for solving both problems at once

MASS HIERARCHY (II)

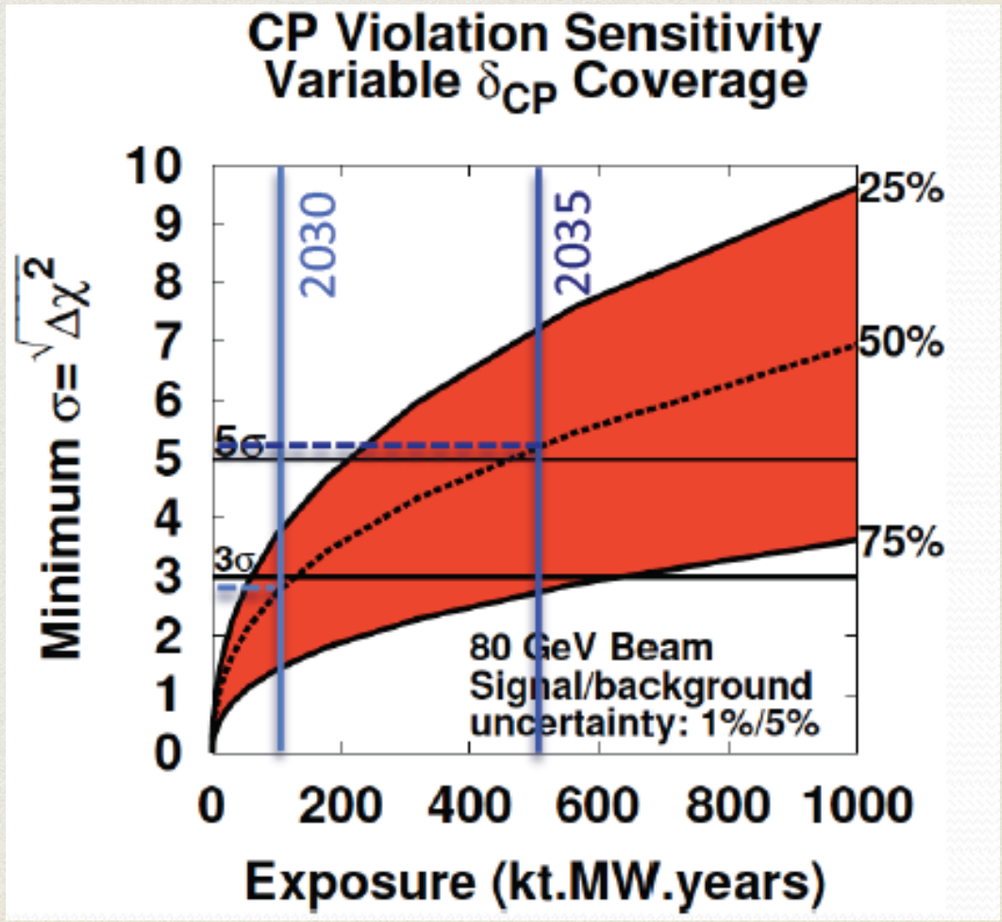
- do not see a single experiment in the next 10 years that can measure it with the (in)famous 5 sigma

- however there are a couple of projects running, in construction, on the way of being approved whose combined results might yield the answer

- JUNO, NOvA, T2K, PINGU, INO……

WE ARE LEFT WITH

- requirement on MW from the beam and tonnage of detectors are stringent
- 1 MW*Mton*y is a parameter to have in mind



FOLLOWING CERN STRATEGY

- find a place somewhere in the world where to execute the right experiment with the spirit of a ‘global project’

- just to be clear as the LHC upgrade or the ILC adventure

- the place looks like FermiLab + Homestake

- not perfect (limited by the fact that you can’t move either object !) but possibly sufficient with and additional bonus…..

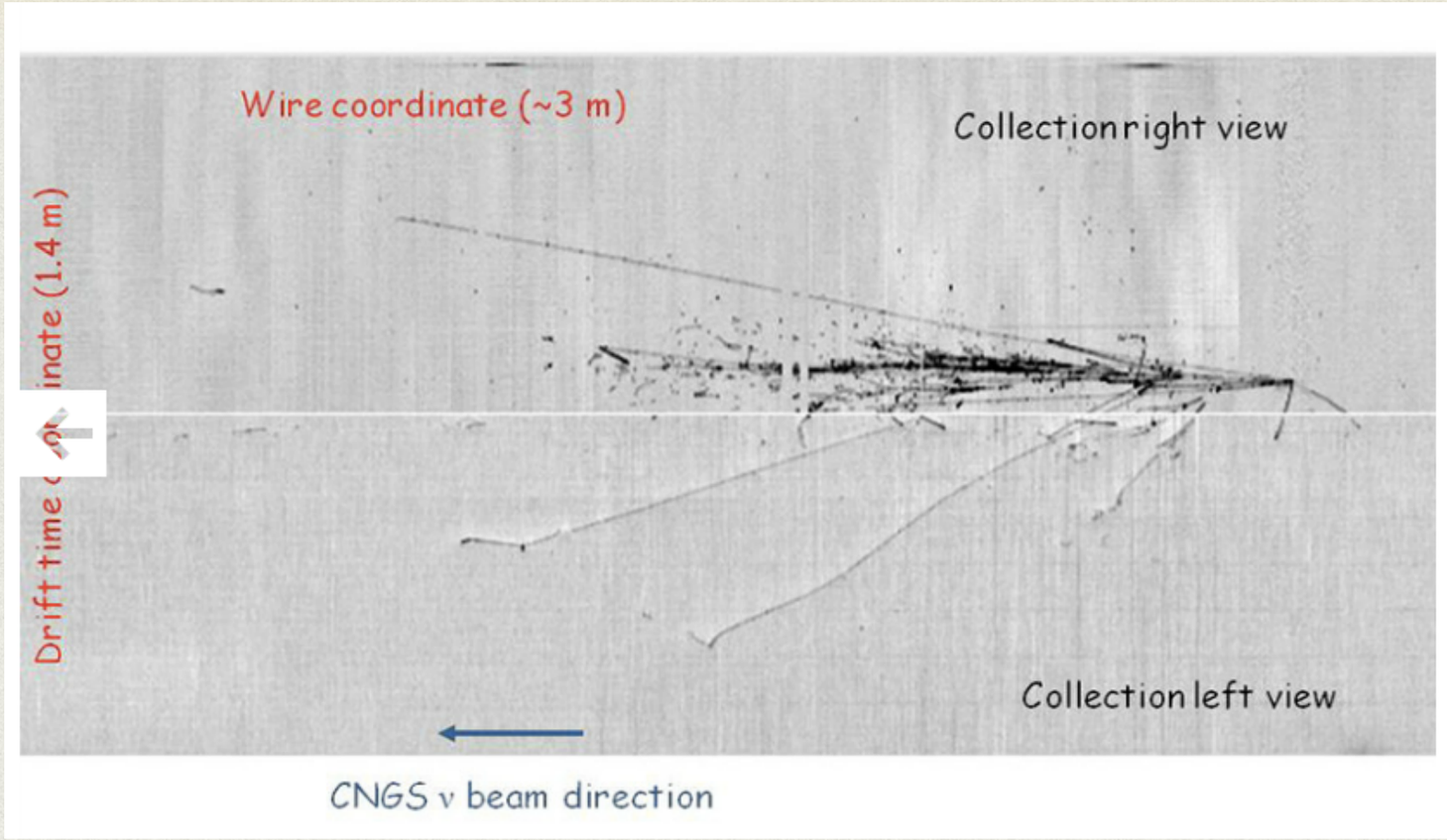
FERMILAB BONUS

- The lab has already a working (actually two) neutrino beam
- it can host SBL experiment(s) that would serve at cleaning up the field (or send somebody to Stockholm), to expose new R&D detectors to a real neutrino beam and , more important of all, to gather around real experiments and million of events a community that shall form the core of the future LB(NE) collaboration
- I assume that the technology is LAr

JUST AN INFN POINT OF VIEW

- We know what LAr is
- We have run for a couple of years a 600 Ton detector at LNGS exposed to CNGS
- We have presented a proposal for a SBL experiment at FNAL
- An italian group is already committed to LB(NE)
- (when I say we, I mean Carlo Rubbia group fully supported by INFN)

THE T600 (2*T300)



It is being disassembled at LNGS.

It goes to CERN where it will be refurbished.

It can be reassembled into two detectors of equal or even unequal size

AND CERN

- shall play a fundamental role in the preparation of a common and coherent neutrino program, offering help for detector construction and a testing facility with a charged beam

BUT……

- The neutrino community does not express a coherent view
- in general there is nothing wrong with this
- except in a few special cases
- and a global project is one of those cases