Contribution ID: **211** Type: **Talk**

Neutrino Tomography of the Earth: the Potential of ORCA Detector

Sunday, 31 July 2022 11:25 (25 minutes)

Using PREM as a reference model for the
Earth density distribution we present results on
the sensitivity of ORCA detector to deviations of the Earth
i) outer core (OC) density, ii) inner core (IC) density,
iii) total core density, and iv) mantle density,
from their respective PREM densities.
The results are obtained in EPJ C82 (2022) 461
by studying the effects of the Earth matter
on the oscillations of atmospheric ν_μ, ν_e, $\bar{\nu}_\mu$
and $\bar{\nu}_e$. We show that the ORCA sensitivity
to the OC, IC, core and mantle densities
depends strongly on the type of systematic uncertainties
used in the analysis, on the value of the atmospheric neutrino mixing
angle θ_{23}, on whether the Earth mass constraint is implemented
or not, and on the way it is implemented,
and on the type - with normal ordering (NO) or
inverted ordering (IO) - of the light neutrino mass spectrum.
We show, in particular, that in the most favorable" NO case of
implemented Earth mass constraint,minimal" systematic errors and $\sin^2\theta_{23} = 0.58$,
ORCA can determine, e.g., the OC (mantle)
density at 3σ C.L. after 10 years of operation
with an uncertainty of (-18\%)/+15\% (of (-6\%)/+8\%). In the most disfavourable" NO
case ofconservative" systematic errors
and, e.g., $sin^2\theta_{23} = 0.50$ and 0.58 the uncertainties read, respectively:
(-37)\%/+30\% and (-30\%)/+24\% ((-13\%)/+16\% and (-11\%/+14\%)).
We find also that the sensitivity
of ORCA to the OC, core and mantle densities
is significantly worse for IO neutrino mass spectrum.

Attendance type

In-person presentation

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Session Classification: Workshop

Track Classification: Multi-messenger Tomography of Earth (MMTE 2022)