

# Neutrino oscillations: personal memories

Francesco Ronga

References:

F. Ronga: "A story of neutrino oscillations in the book" Neutrino the mutant particle" Aracne editions  
<http://www.aracneeditrice.it/index.php/pubblicazione.html?item=9788854895805>

also in

[http://www.dmf.unisalento.it/~gpc/Ithaca\\_VI\\_2015.pd](http://www.dmf.unisalento.it/~gpc/Ithaca_VI_2015.pd) (english v

## Takayama neutrino 1998 conference, agenda June 5

9.10 Contained events and Soudan2 (E. Peterson) main result the **muon deficit in iron in agreement with water detector and in agreement with oscillations**

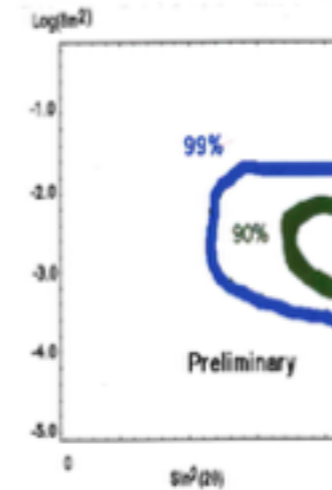
9.35 Upward-going muons and MACRO (F.Ronga) I was quite nervous. Our results **different from the one** of Kamiokande. Possibility to have an immediate denial by a much better experiment like Superkamiokande. Paolo Bernardini already presented our results to the Vulcano workshop.

9.55 Results from Kamiokande and SuperKamiokande (T.Kajita) strong evidence for neutrino oscillations!!!

I was very happy after the Kajita talk. **Our results were in complete agreement with SK and new Kamiokande data.** Of course the statistical evidence was much lower (3  $\sigma$  in 1998  $\implies$   $\sigma$  with the full data set in 2000.

## NEUTRINO 98 MACRO (F RONGA)

Confidence regions for oscillation parameters (Feldman-Cousins)



• Note : In this kind of plots there is **no information** on the goodness of the agreement of data with the hypothesis You assume that the model is correct (Pbest=17%).

• The regions are smaller than the one expected from the "sensitivity" (statistical fluctuation?)

## Conclusions

MACRO Upgoing Muons (Through-going):  
 $E_\nu \approx 100$  GeV

- Peak probability  $\nu_\mu \rightarrow \nu_\tau$  17%
- Probability for No oscillations 0.1%
- Peak Probability  $\nu_\mu \rightarrow \nu$  sterile 2%

Low energy events:

	R=data/predict [uncert]	No oscillations	With oscillations $10^{-3} < \Delta m^2 < 10^{-2}$
Internal Up	$0.53 \pm 0.15$	1	0.56
Internal Down + Stopping Up	$0.71 \pm 0.21$	1	0.73

Conclusion: a  $\nu_\mu \rightarrow \nu_\tau$  oscillation with maximum mixing and  $\Delta m^2 \approx$  a few units in  $10^{-3} \text{ eV}^2$  is consistent with all the MACRO Data

Only Warning :  
 The peak probability for the angular distributions of the Upgoing Muons (Through-going) is low (4.6%)  $\implies$  Statistical Fluctuation or Hidden Physics?

