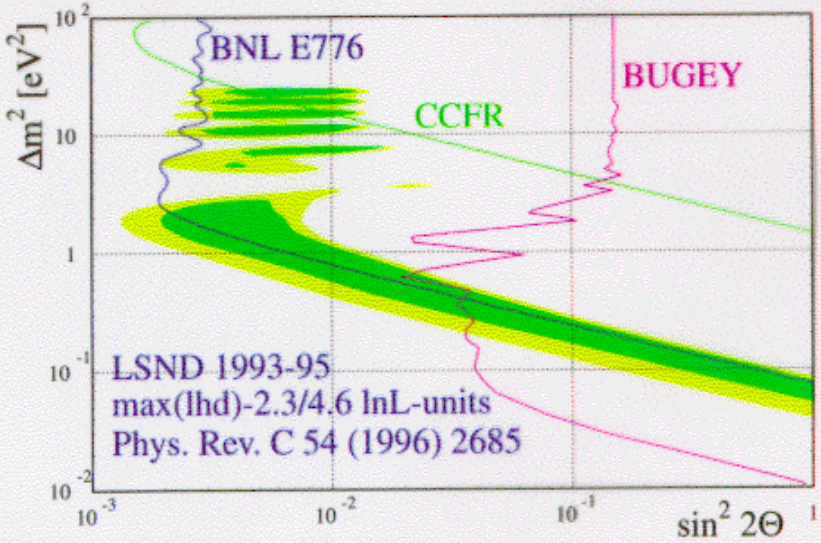
Forschungszentrum Karlsruhe
Technik und Umwelt

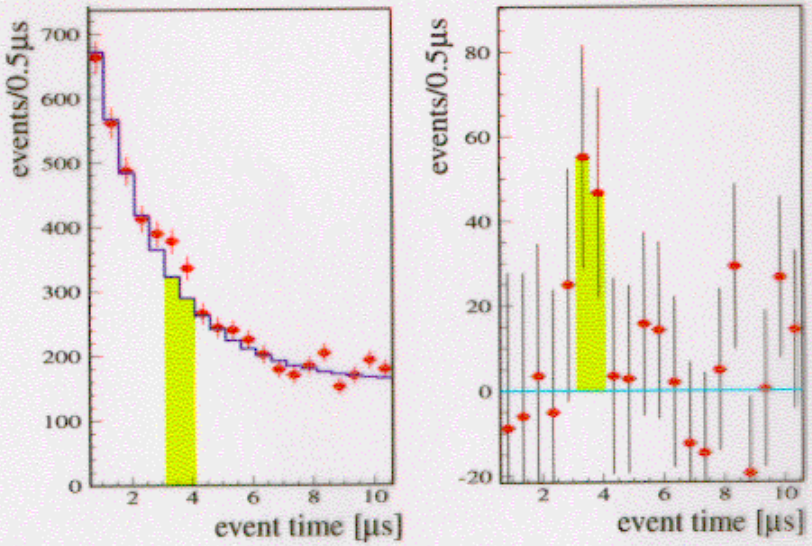
Latest Results of the KARMEN2 Experiment

KARMEN2 data from Feb.1997 through March 2000

Search for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ oscillations



Status of the time anomaly



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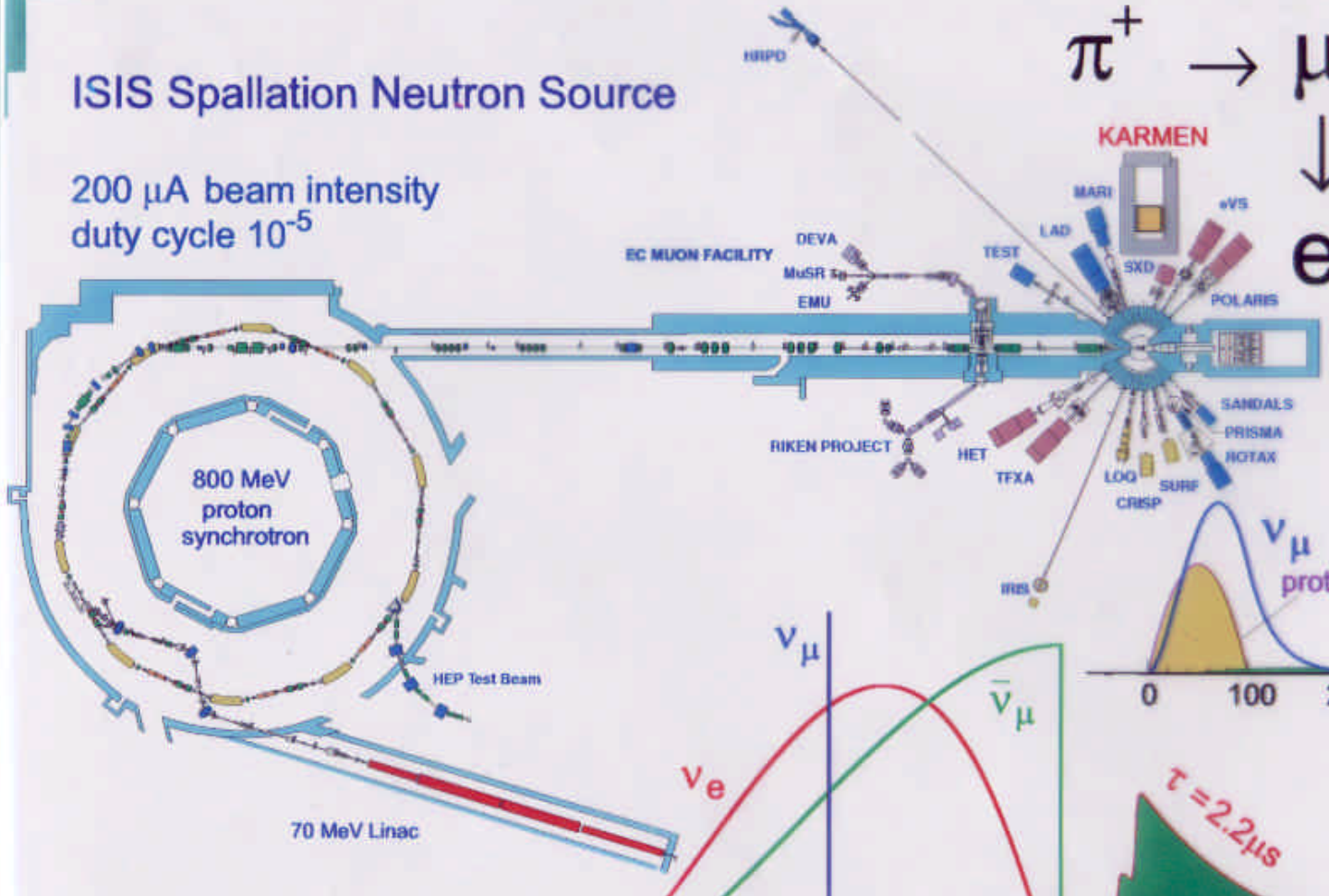
Neutrino 2000
Sudbury, Ontario, Canada
June 16th-21st 2000

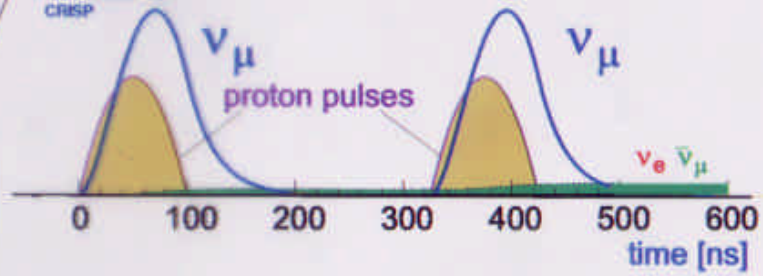
ν production at ISIS

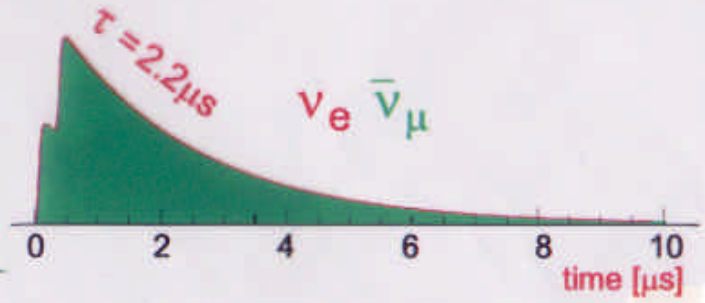
ISIS Spallation Neutron Source

200 μA beam intensity
duty cycle 10^{-5}

$$\pi^+ \rightarrow \mu^+ + \nu_\mu$$
$$\downarrow$$
$$e^+ + \nu_e + \bar{\nu}_\mu$$

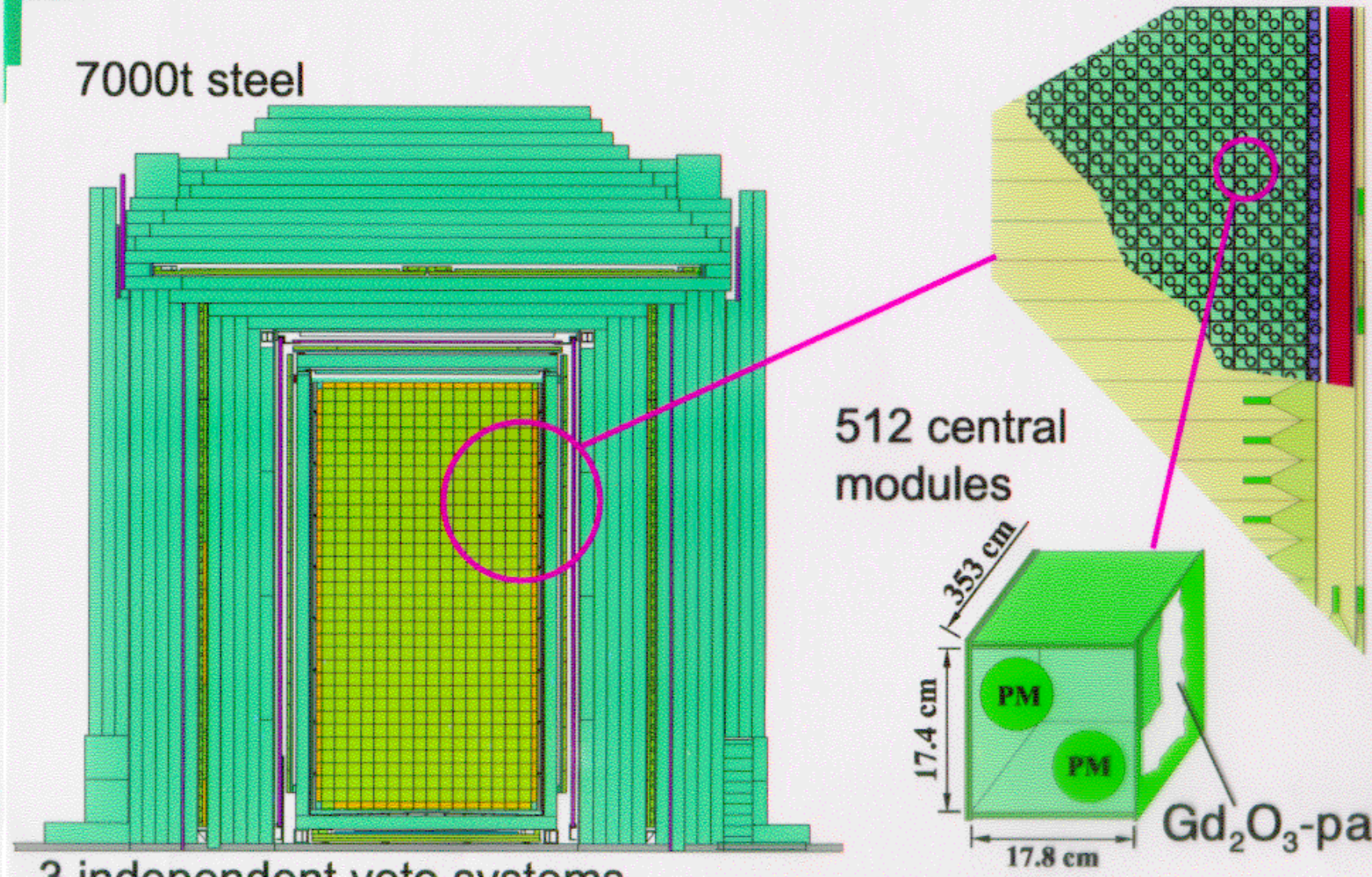






Eitel - 02

KARMEN2 detector system



Eitel - 03

$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ oscillation signature

$\bar{\nu}_e + p \rightarrow n + e^+$

$Q = -1.8$ MeV

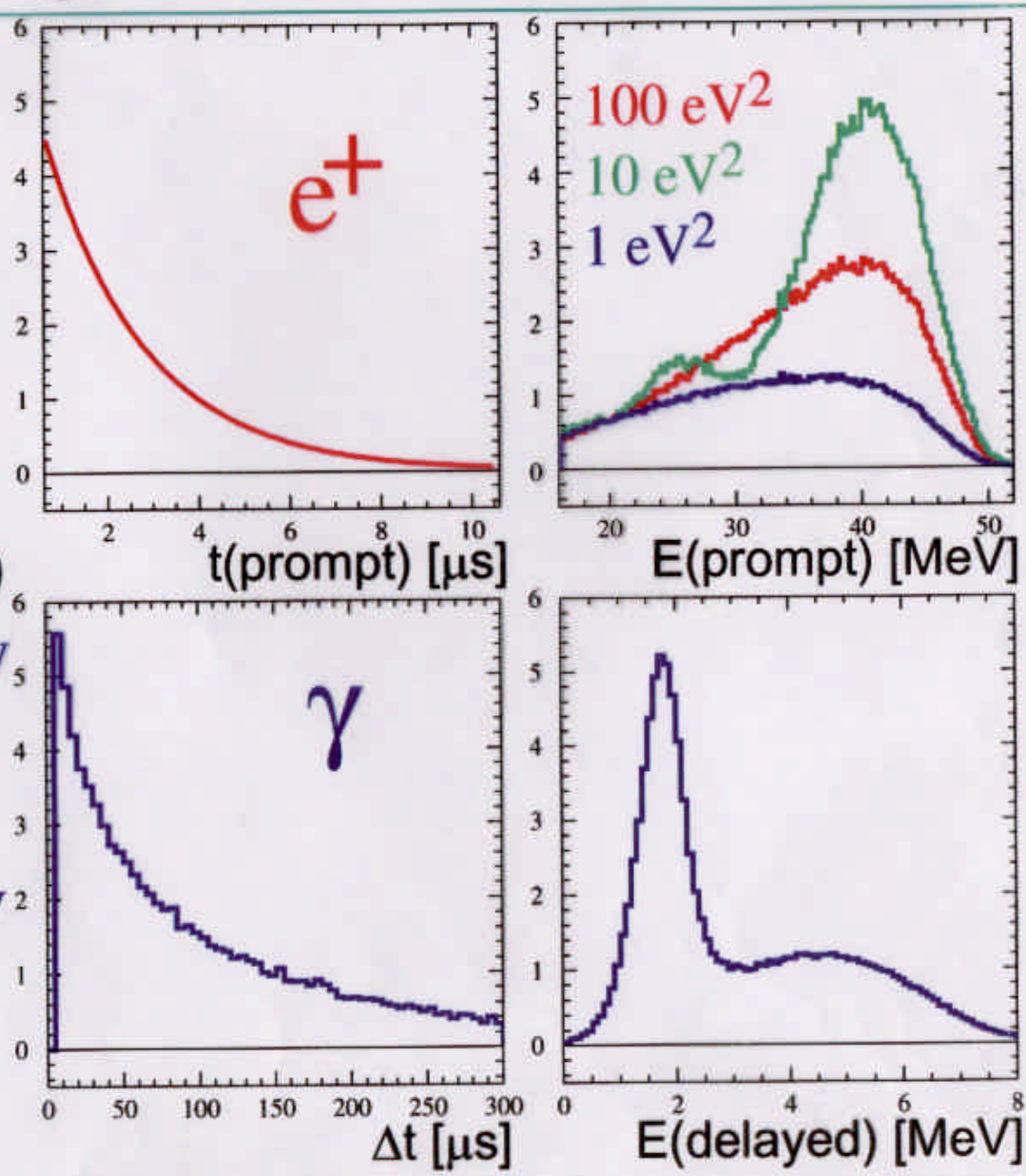
thermalization + capture

$\rightarrow Gd(n, \gamma)$

$\Sigma E_\gamma = 8$ MeV

$\rightarrow p(n, \gamma)$

$E_\gamma = 2.2$ MeV



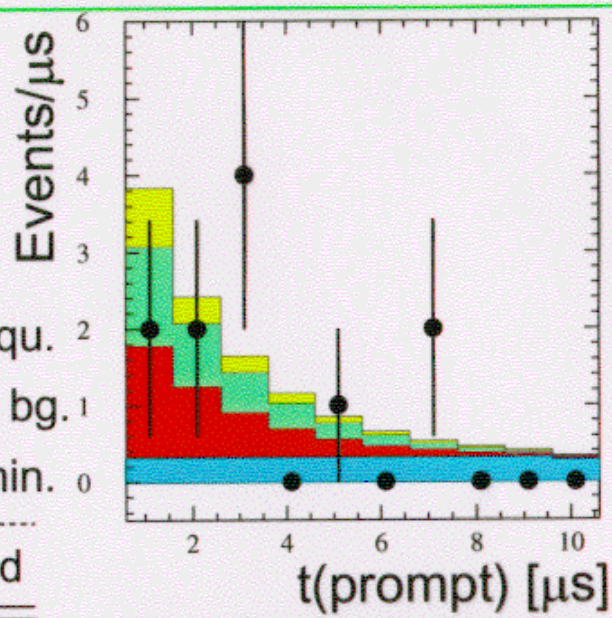
data set after final cuts

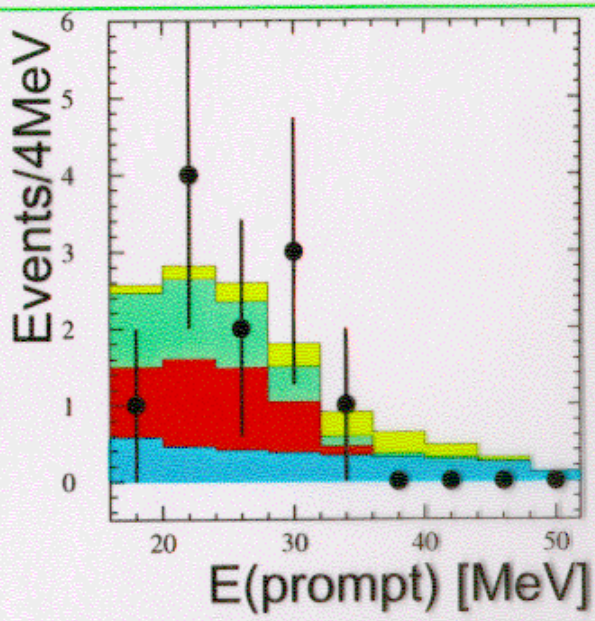
11 candidates

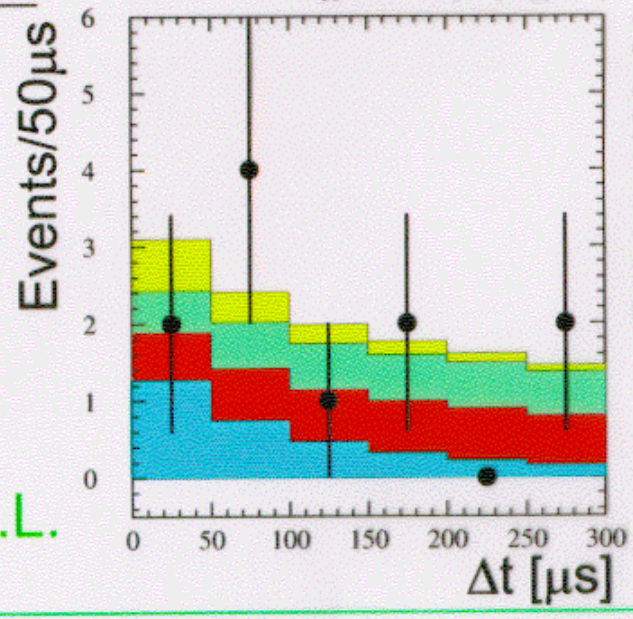
94 +- 0.51	ν_e-induced CC sequ.
52 +- 0.30	ν-induced random bg.
67 +- 0.17	$\bar{\nu}_e$ intrinsic contamin.
17 +- 0.17	cosmic background
29 +- 0.63	total background

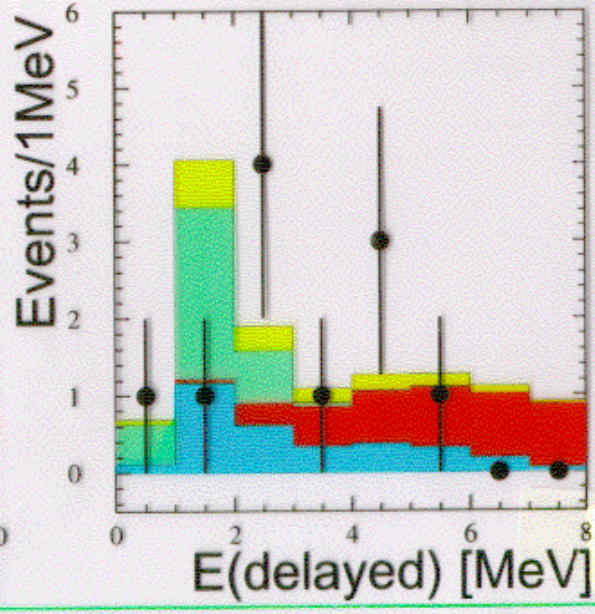
no osci signal

Bayes:
signal > 6.3 evts
excluded @ 90% C.L.









Eitel - 05

maximum likelihood analysis

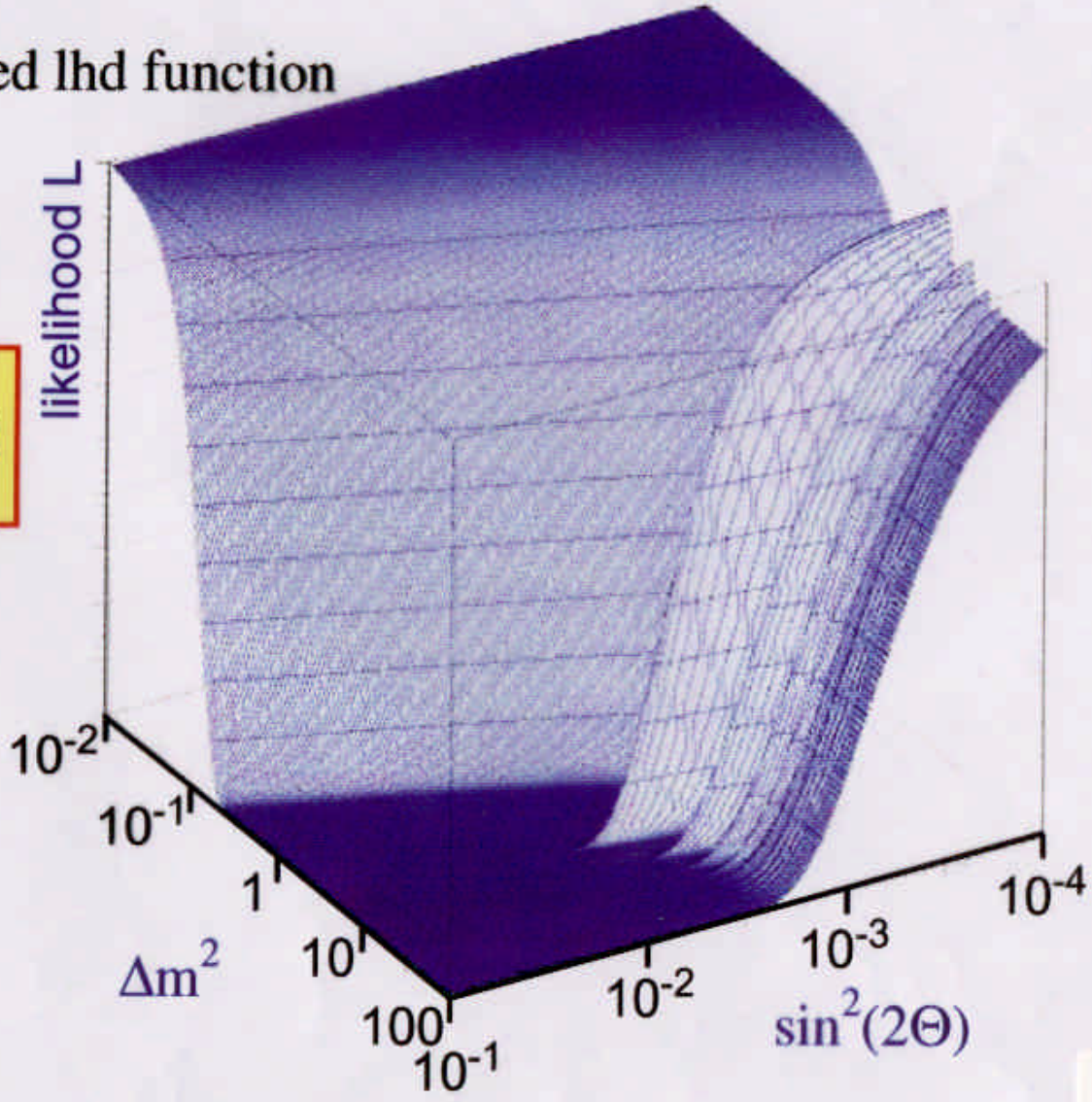
event-based lhd function

N events

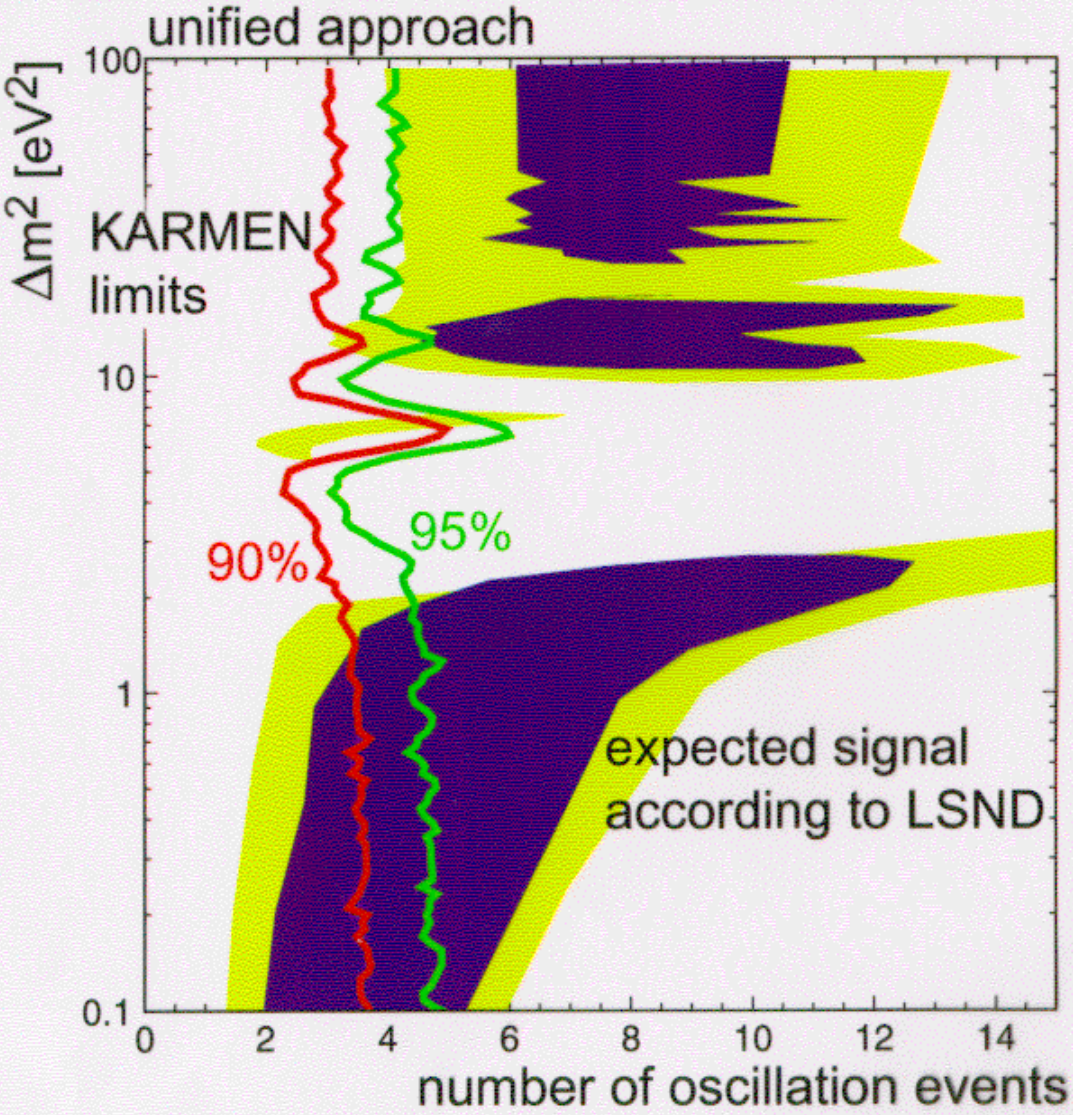
$$L = \prod_{i=1}^{N} f(\vec{x}_i, \Delta m^2, \sin^2(2\Theta))$$

with

$$\vec{x} = (E_{pr}, E_{del}, t_{pr}, \Delta t, \Delta\vec{r})$$



maximum likelihood result

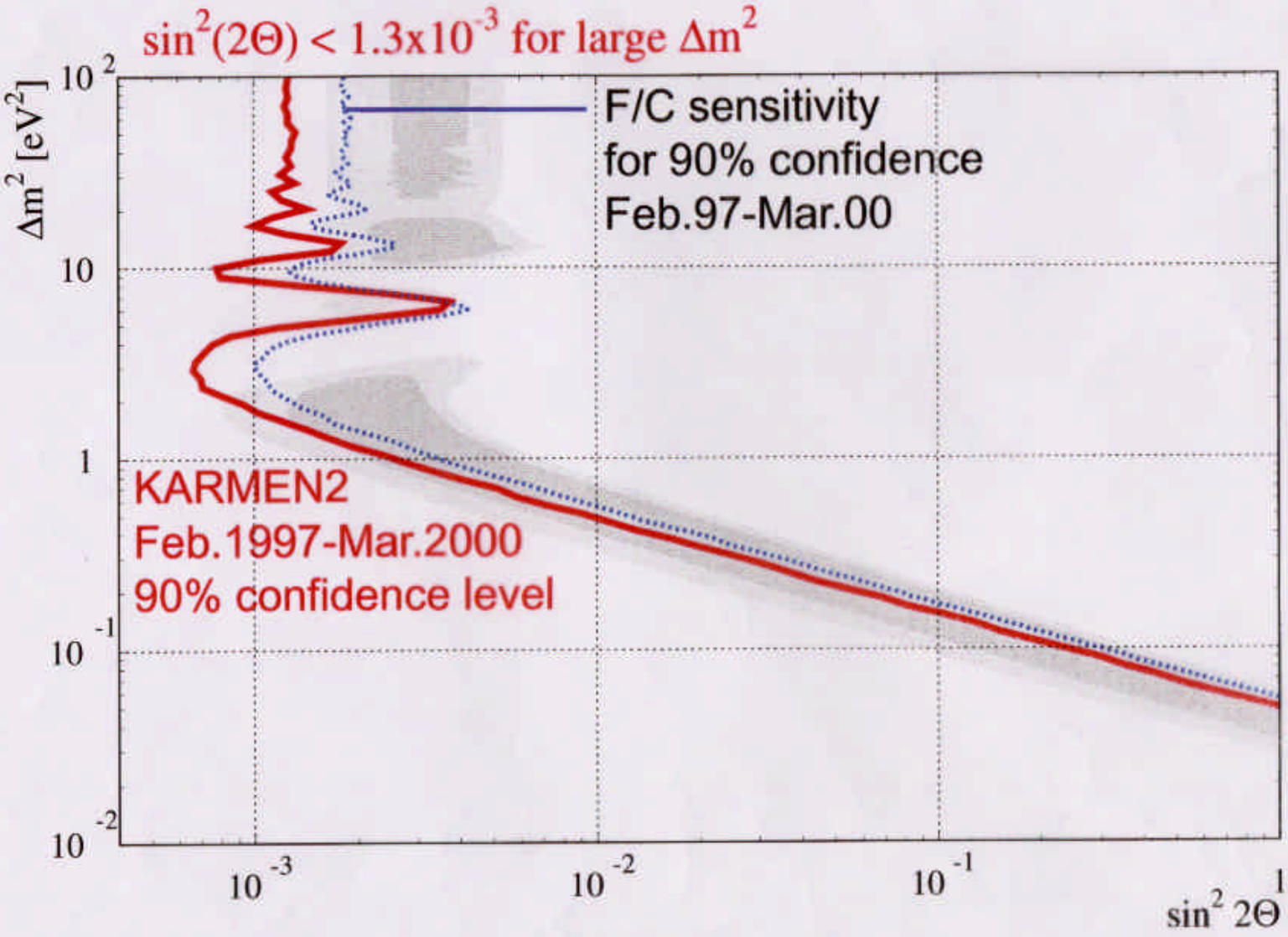


N(expected)=2442 for
$\sin^2(2\Theta)=1$

N(osc)<**3.1** (90% CL)
$\Delta m^2=100 eV^2$

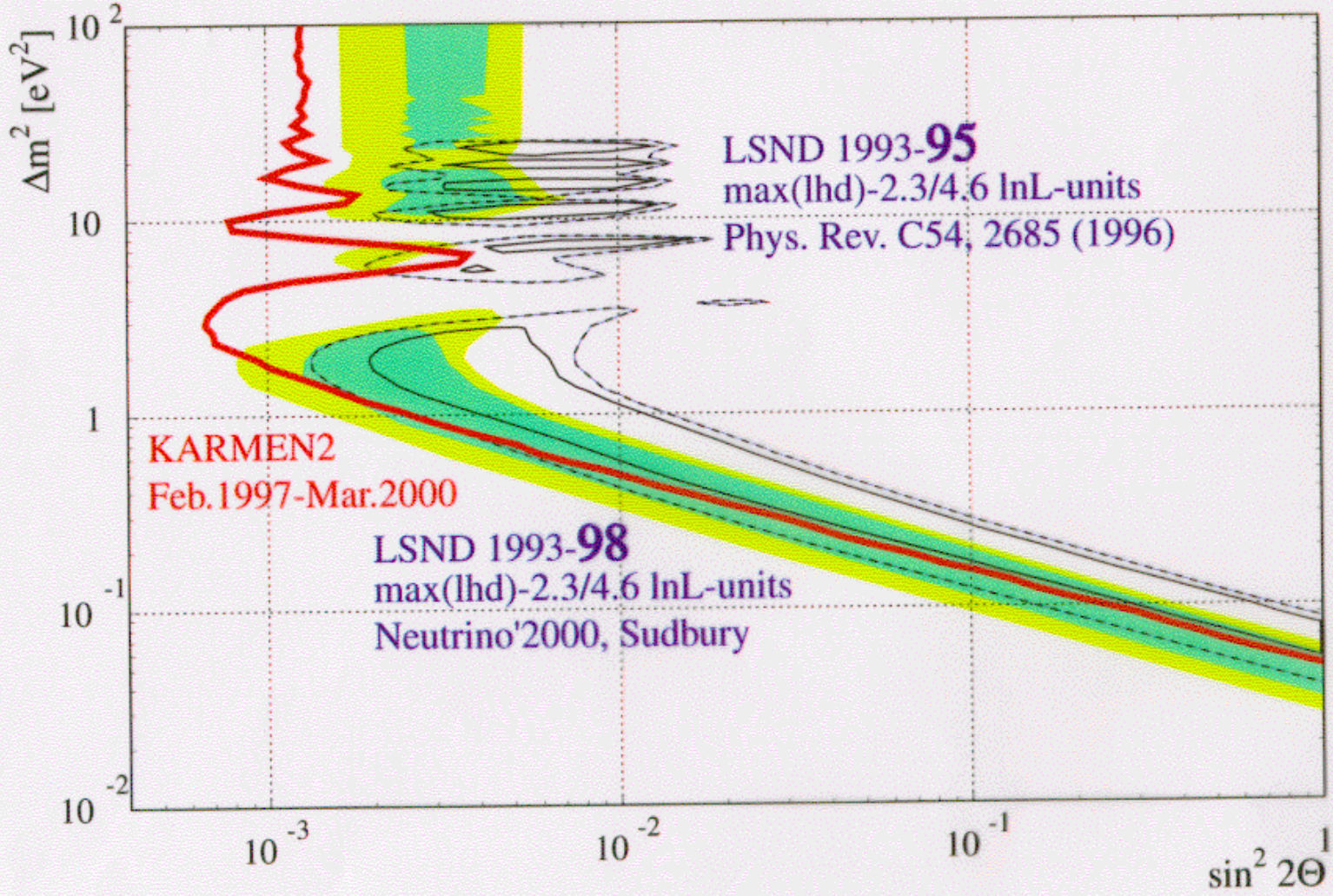
N(osc)<**3.8** (90% CL)
$\Delta m^2=0.1 eV^2$

KARMEN sensitivity plot



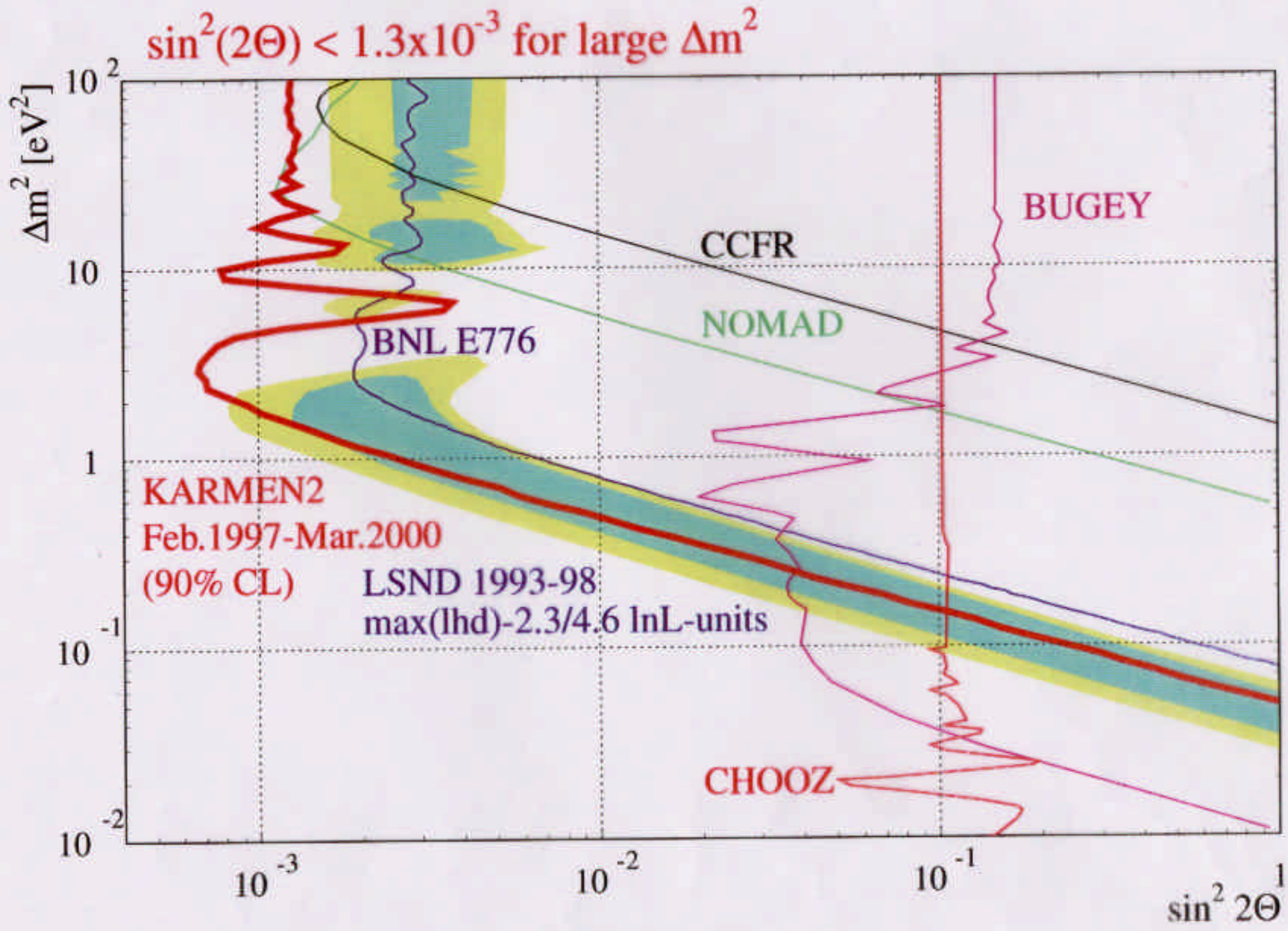
Eitel - 08

LSND favored regions



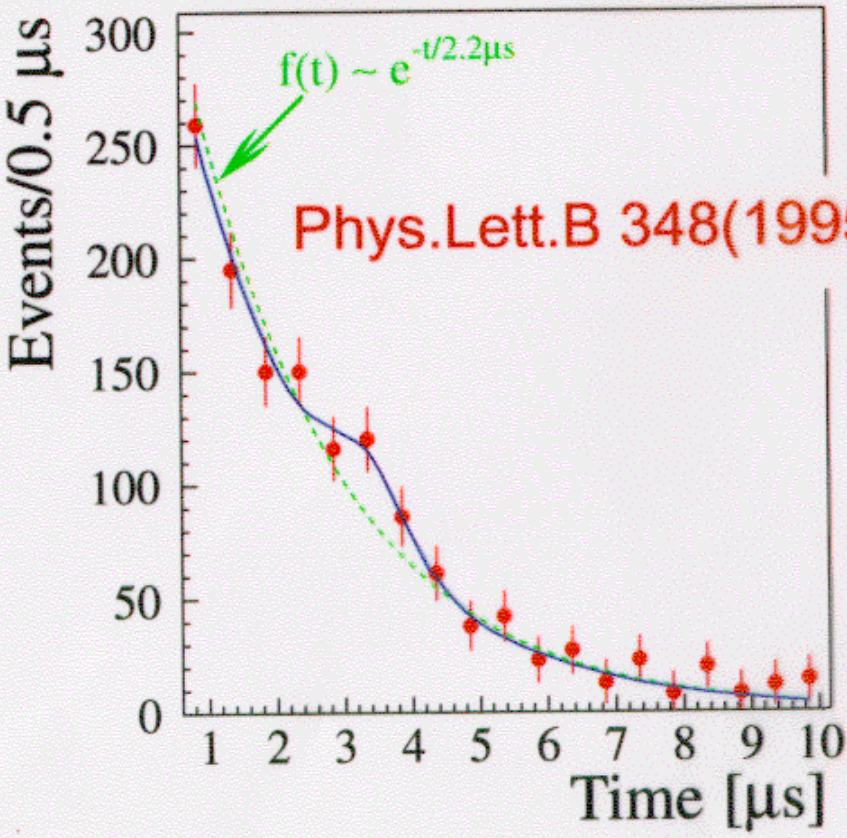
Eitel - 09

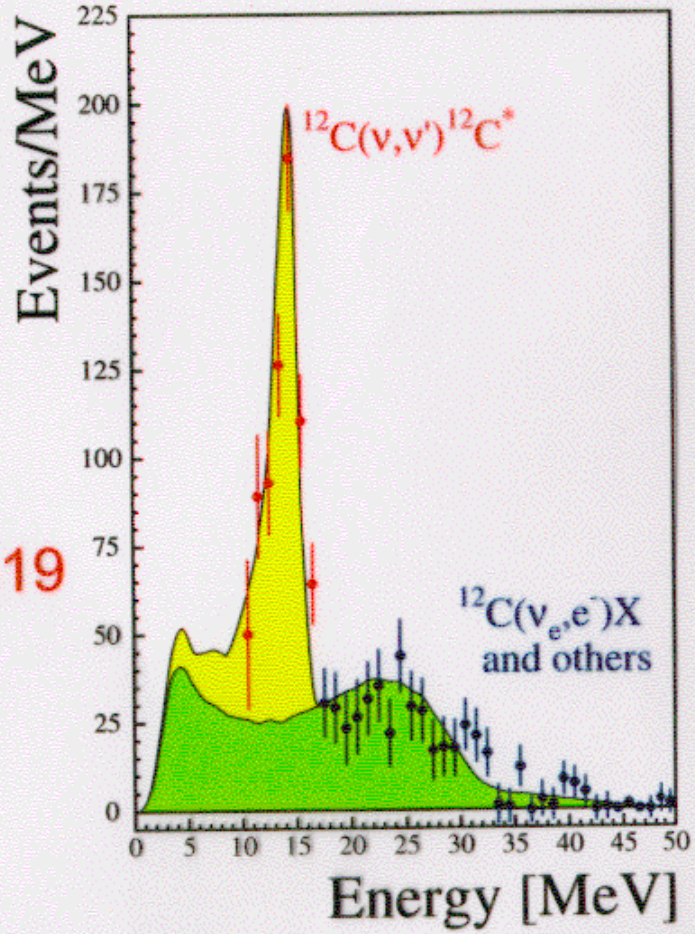
neutrino oscillation plot



the time anomaly

"single prong" spectrum
induced by ν_e and $\bar{\nu}_\mu$
energy interval 10-36 MeV





KARMEN1 status 1994/95

changes and developments since 1995

		publication '95	total K1
more data:	KARMEN1	6560C =>	9120C
		-Feb.'99	-Mar.'00
new systematics:	KARMEN2	4670C =>	7160C

(ν-signal/cosmic bg. improved by factor ~5)

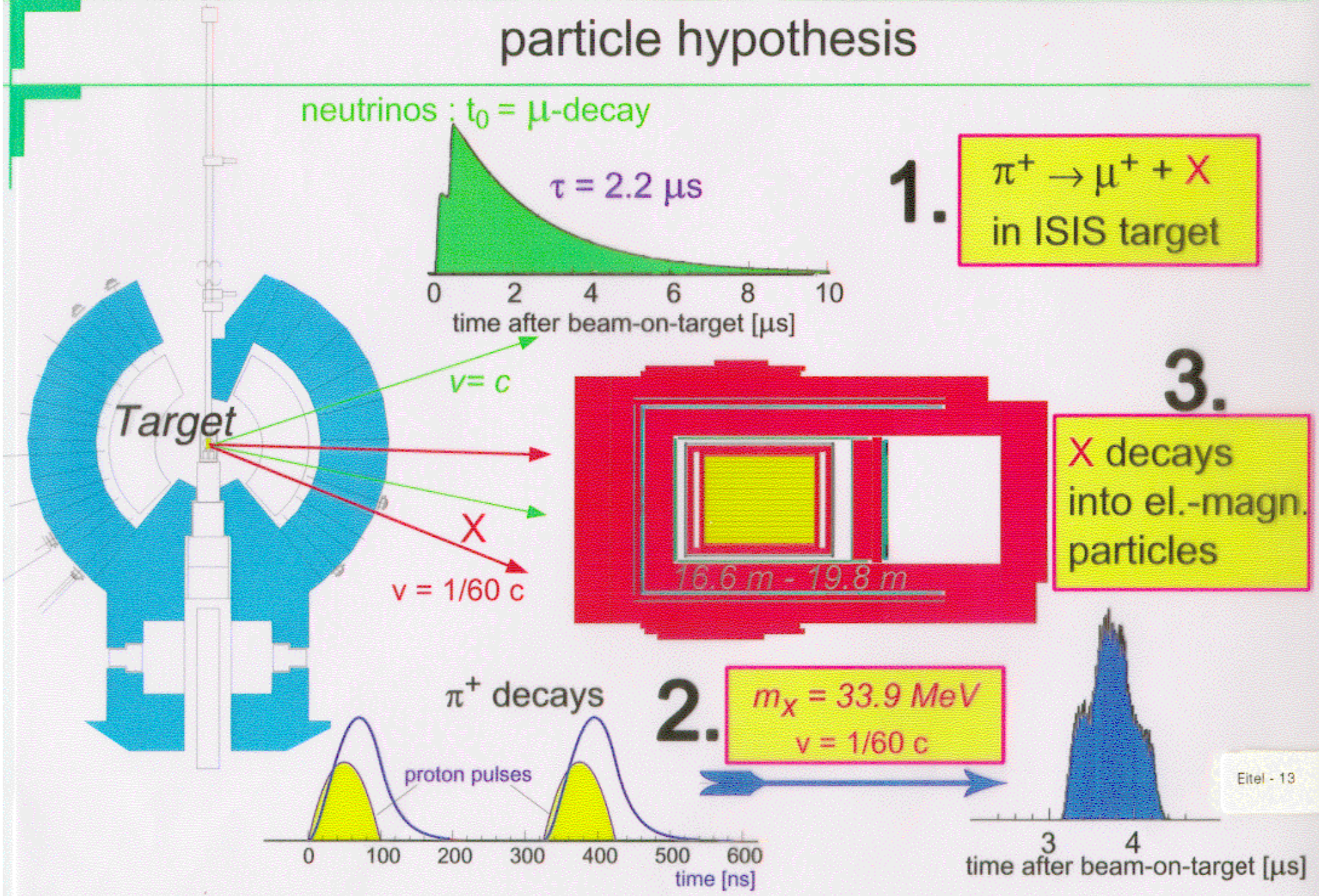
checks of systematics

new analysis: max. likelihood analysis using

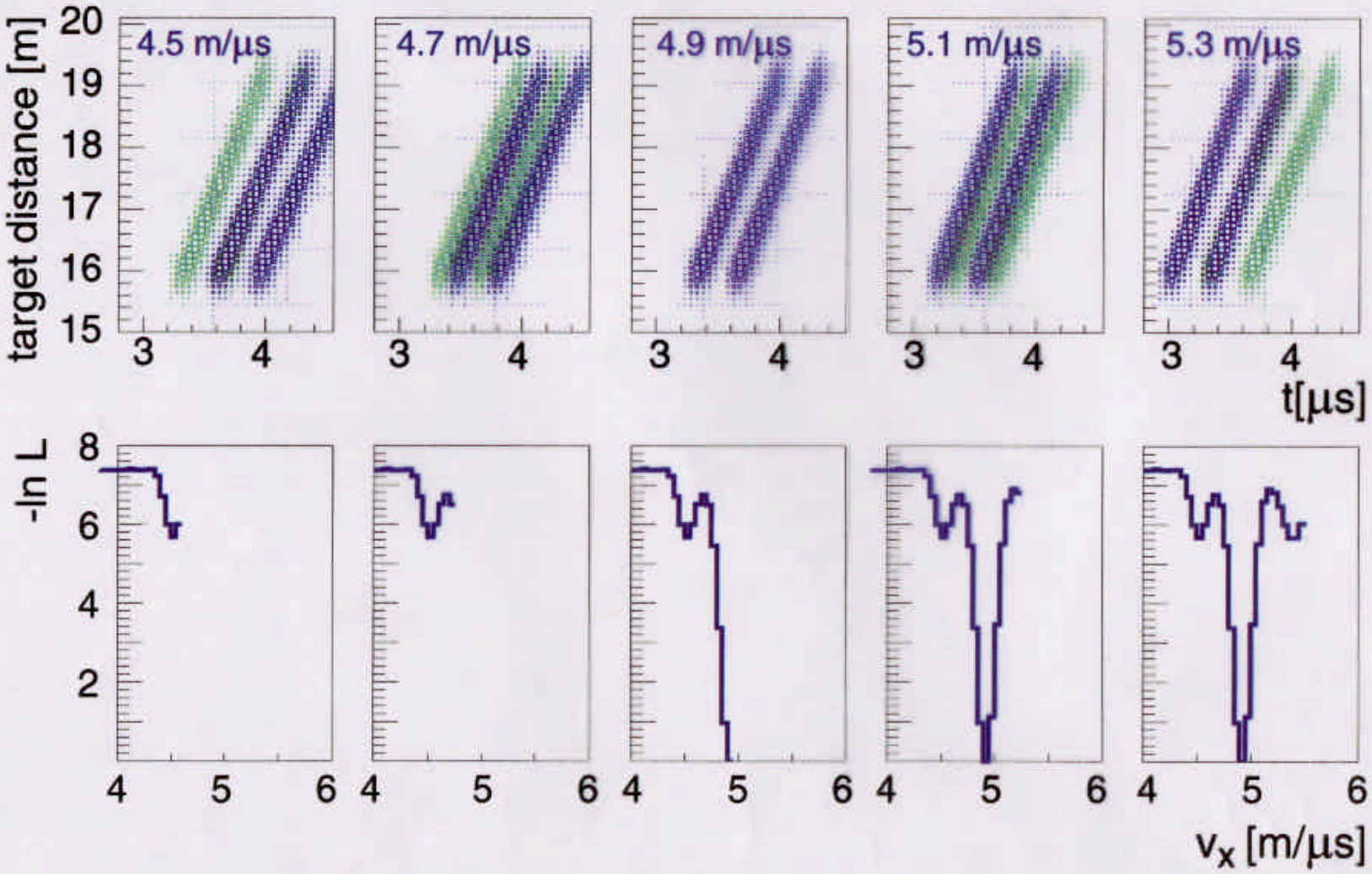
x - t correlated event information with

$\Delta x \sim 10cm, \quad \Delta t \sim 3ns$

particle hypothesis

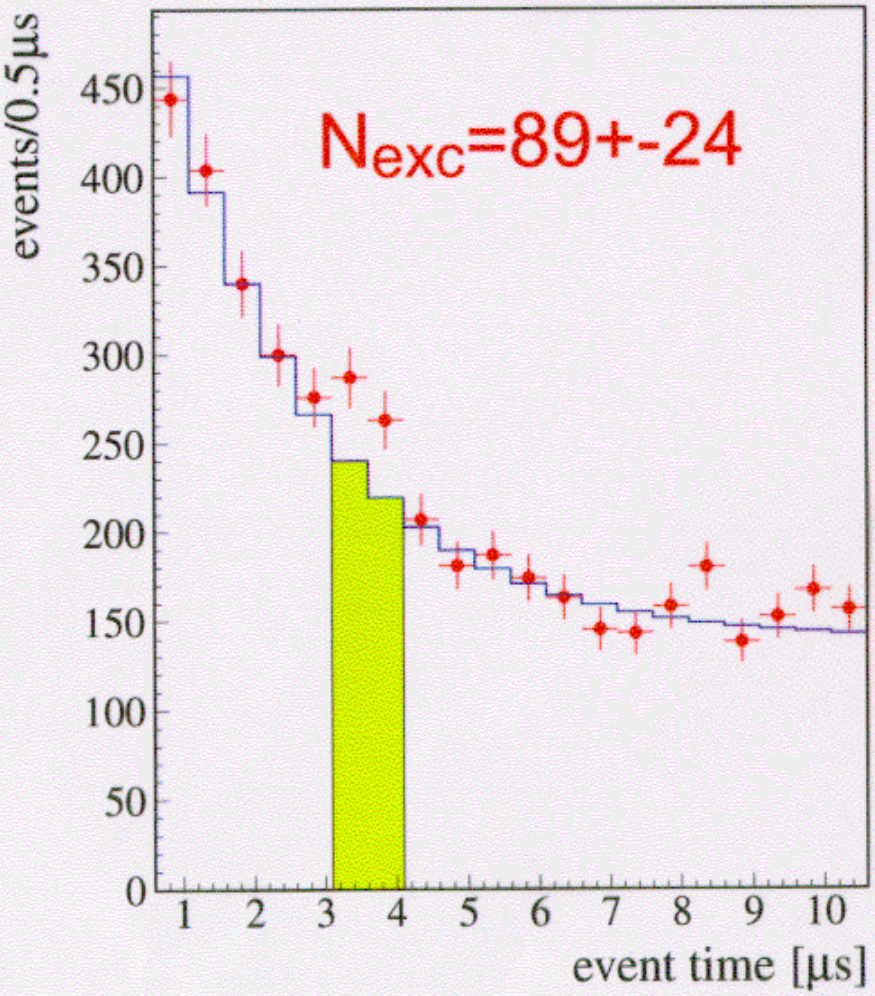


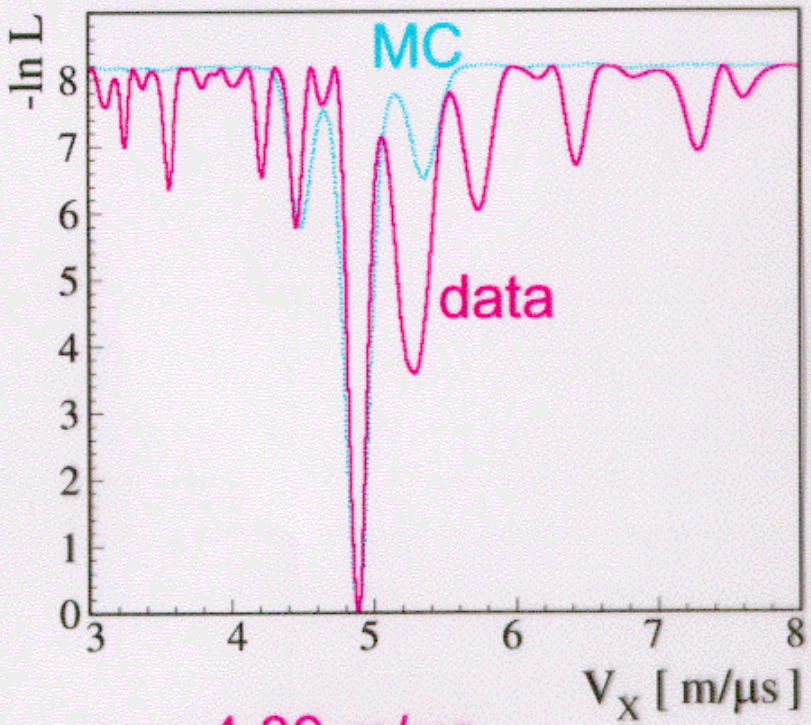
likelihood analysis (Monte Carlo) of x-t correlation



maximum likelihood analysis

KARMEN1 data





v_X = 4.89 m/µs

N_{lhd} = 57+-25

Δ(lnL) = 8.2

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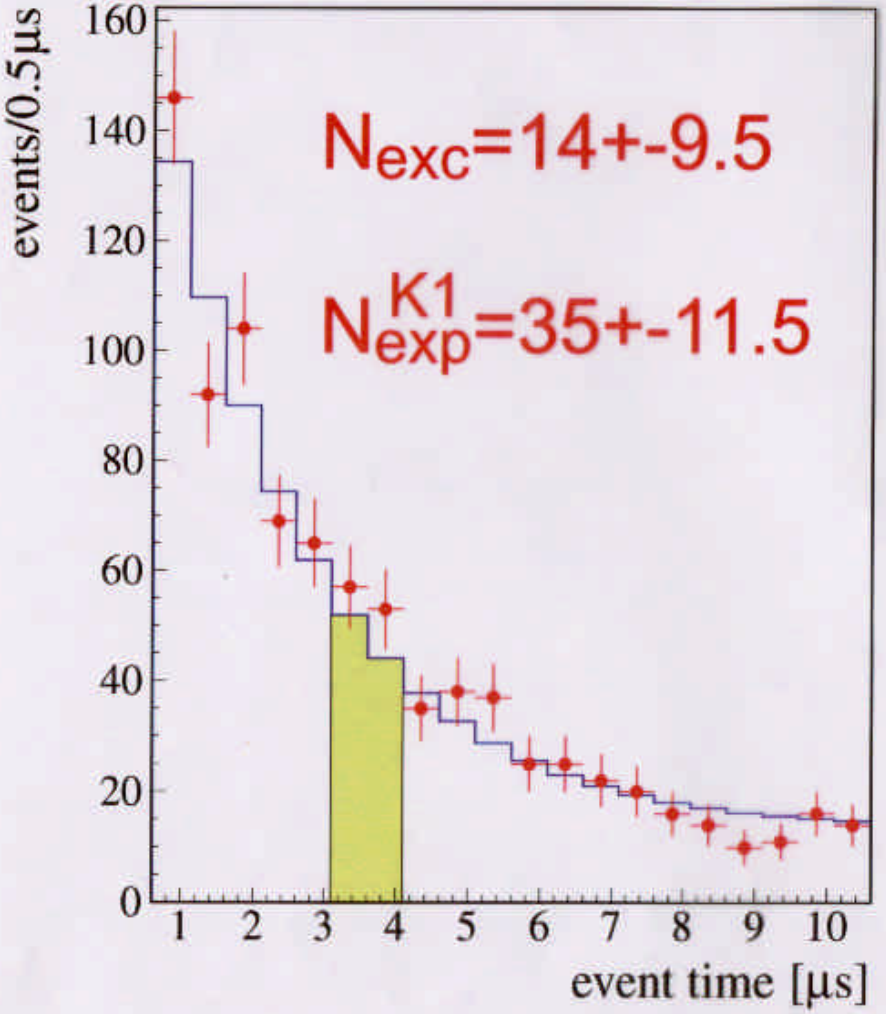
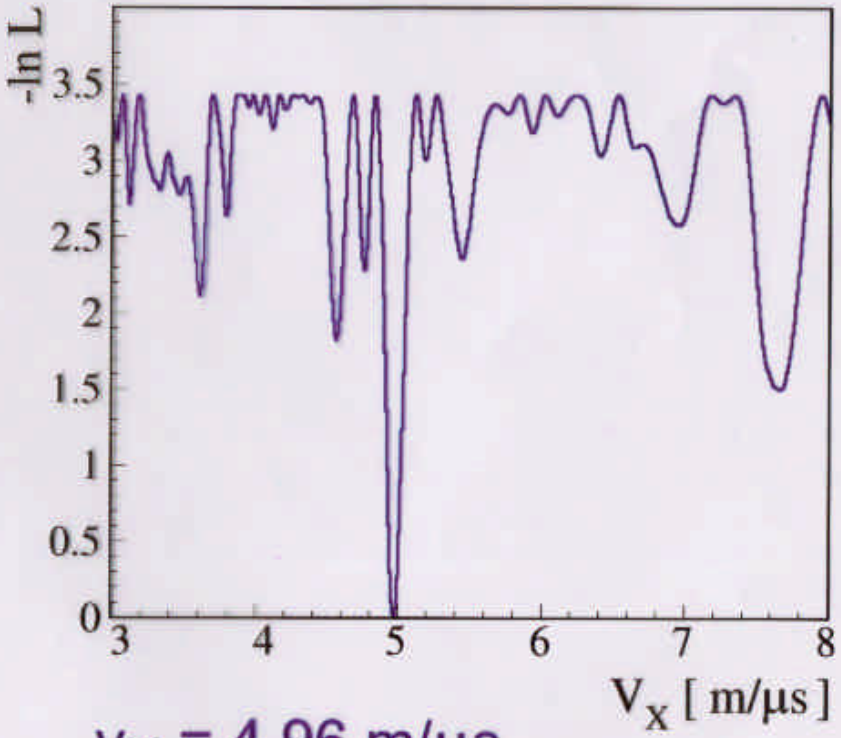
maximum likelihood analysis

KARMEN2 (Feb.'97-Feb.'99)



N_{exc}=14+-9.5

N_{exp}^{K1}=35+-11.5



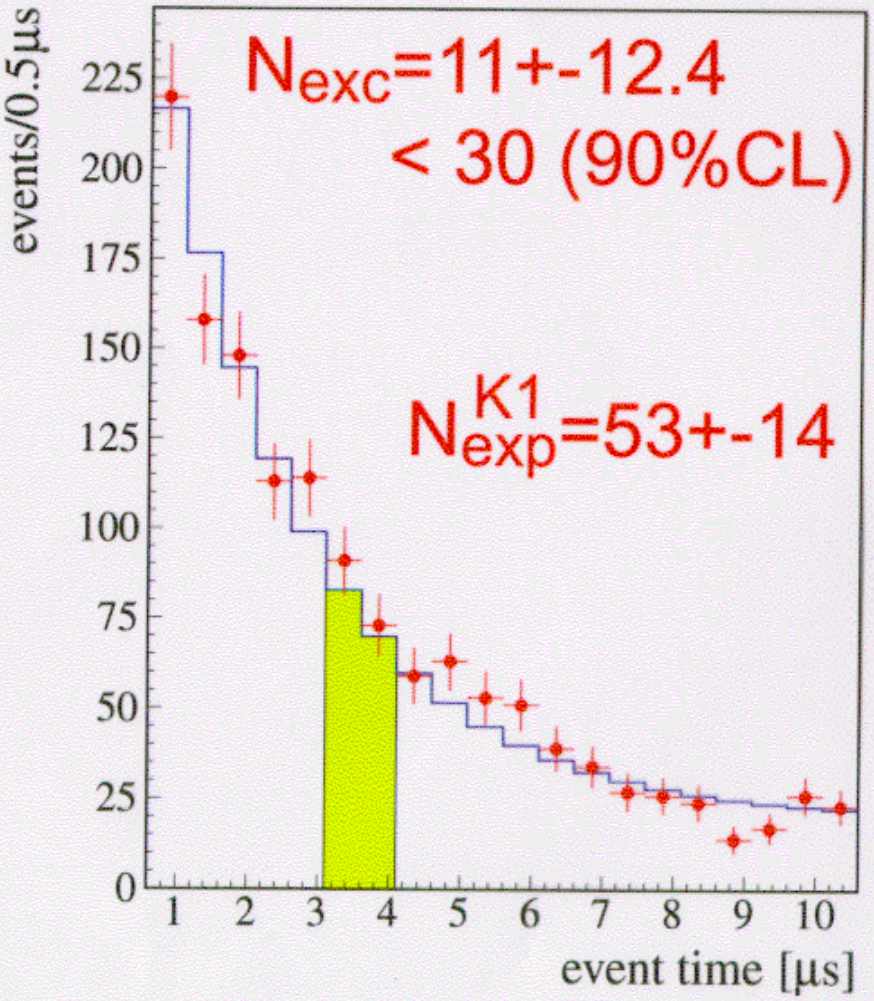
v_X = 4.96 m/μs

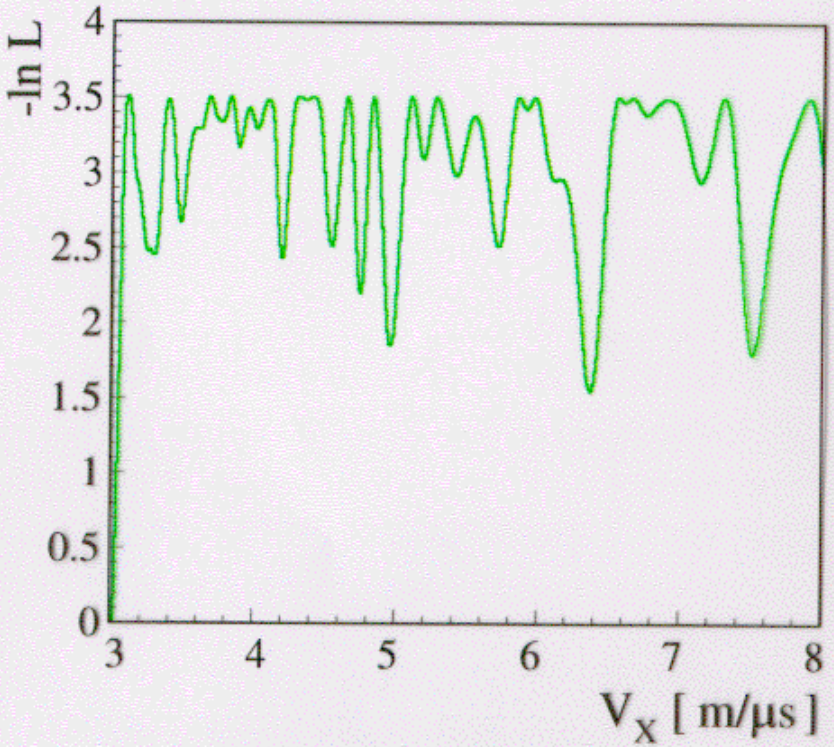
N_{lhd} = 17+-11 N_{lhd}^{K1}=22+-10

Δ(lnL) = 3.4

maximum likelihood analysis

KARMEN2 (Feb.'97-Mar.'00)





v_X fixed at 4.96 m/µs:

N_{lhd} = 14+-12 N^{K1}_{lhd}=34+-15

Δ(lnL) = 1.7

Eitel - 17

conclusions

time anomaly:

no effect anymore in KARMEN2

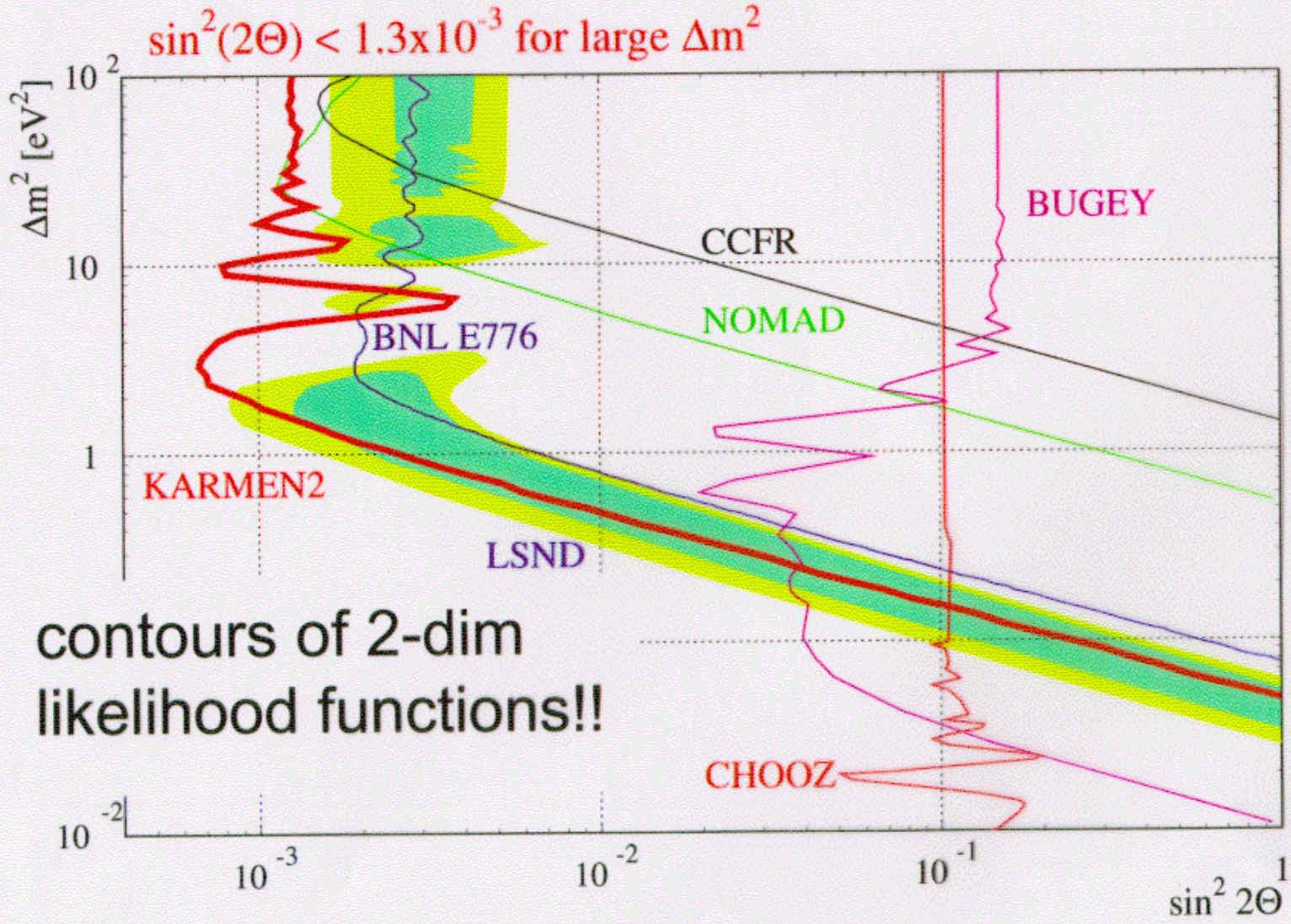
oscillation search:

improved sensitivity by factor 3 (last data April 2001)

no signal ⟶ most stringent limits ~ $1eV^2$

KARMEN — does not confirm / excludes at high $\Delta m2$ / leaves statistical space at low $\Delta m2$ — LSND

neutrino oscillation plot



contours of 2-dim likelihood functions!!