TAUP03: Some Comments

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‘Let’s keep the lecture room cold so they won’t fall asleep,’ said Wick to Frank.

Outline

- Overview of TAUP03 (1 slide)
- Dark matter
- Solar neutrinos
- The quirky Universe
- Precision cosmology (translation)
- A personal impression

The golden era of particle astrophysics

- Ultra-high energy cosmic rays
- Dark matter, dark energy (precision cosmology)
- Solar and terrestrial neutrino astrophysics
- High energy neutrino & gamma-ray astronomy
- Gravity wave astronomy
- Double-beta, neutrino properties (CP ?, Majorana ?,angles, masses), nucleon decay

This is fabulous!

Whose name (experiment) should be cited?

I will just list the Not great talks. All the others were great.

Did not give great science talk:

Dark Matter Searches

- May be most important ‘solvable’ problem facing physics and astronomy
- Lots of excellent experiments; hard to find something if you don’t know what you are looking for
- Progress is being made
- Breakthrough could be near (or not)
- Worry: is this the 21st Century aether?

DAMA

- DAMA sees a modulation at 6.3s
- Potentially, this is extremely important.
- Existing experiments cannot check this result directly.
- Therefore,
  - Appoint blue-ribbon committee with subpoena power
  - If no mistakes found, repeat experiment but better

Neutrinoless double beta-decay

$$(A, Z) \rightarrow (A, Z+2) + 2e^-$$

- Discovery of lepton violation within reach
- 14 proposed experiments ? m_{atmos} sensitivity
- Require multiple experiments, but 14 too many
- Should be an orderly process for decision
- Inferences limited because of nuclear matrix element uncertainties and dependence upon multiple neutrino parameters.

Solar neutrinos

- **SNO(^{8}B) : 5.21(1 ± 0.08) [100%]**
- **SSM(^{8}B) : 5.05(1 ± 0.18) [0.01%]**
- New data: GNO, SAGE, SK
- **pp(all data + LC) = 1.01(1 ± 0.02)**

[free fluxes: hep-ph/0305159]

SNO: How precision big physics should be done

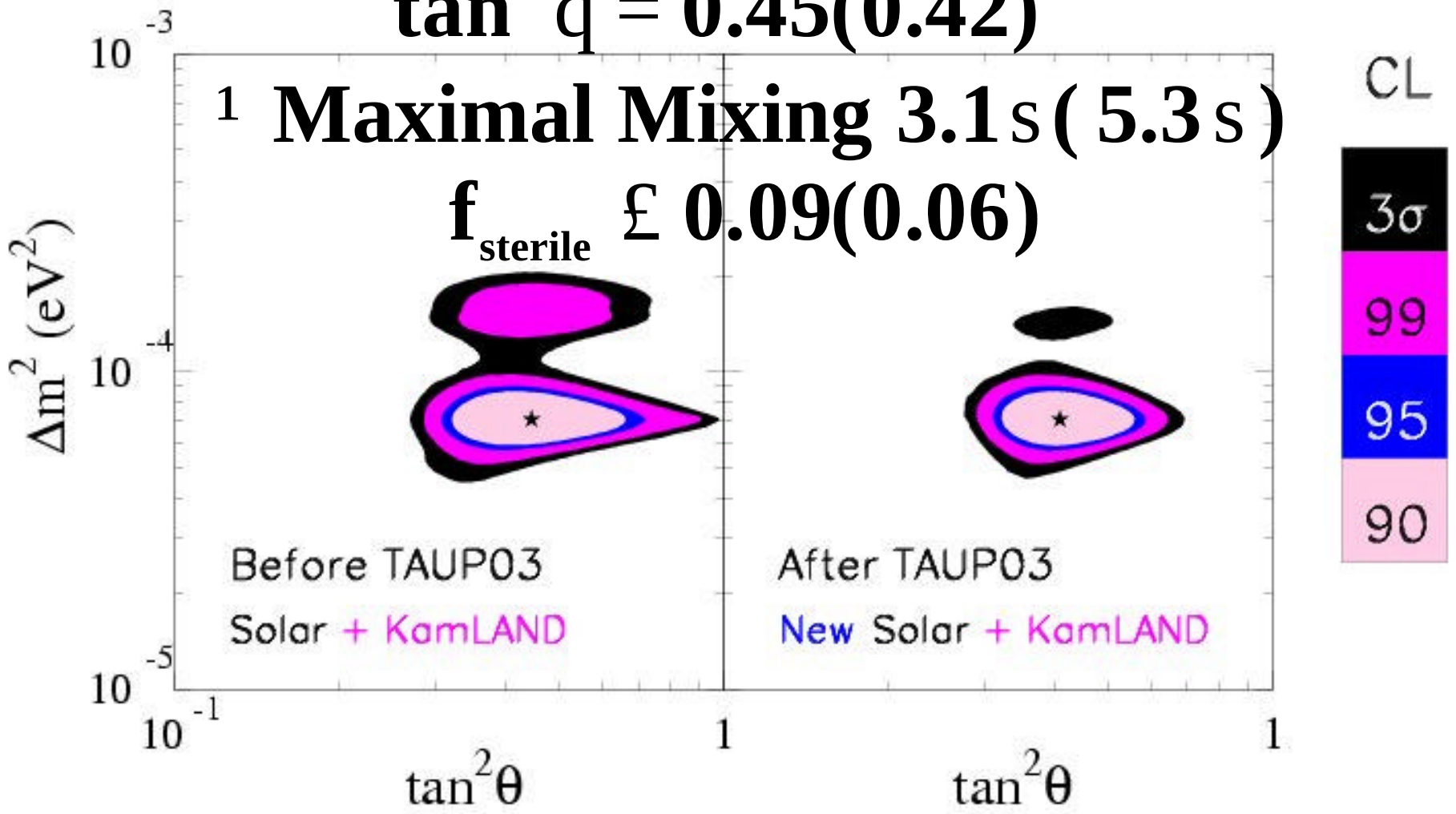
- Blind analysis
- Data, and instructions on use, made public
- Cordiality (a class act)

$\Delta m^2 = 7.1 \times 10^{-5}\ eV^2$

$\tan^2 \theta = 0.45(0.42)$

^{1} **Maximal Mixing 3.1 s (5.3 s)**

$f_{sterile} \leq 0.09(0.06)$



96 data points

(jnb + Splendid Speedy Spaniards)

Why measure low-energy solar n`s?

^{7}Be + pp

- **Unique test of stellar fusion reactions**
- $f(^{7}Be) = 0.97^{+0.28}_{-0.54}$ **(today)**
- **Test for vacuum-matter transition**
- **Explore for new physics (e. g., steriles)**
- **Measure solar luminosity via n`s**
- **Measure q_{12} precisely**

We live in a quirky universe

- $\Omega_b = 0.05$ (a bit of ordinary stuff)
- $\Omega_m = .27$ (mostly dark matter)
- $\Omega_\Lambda = 0.73$ (mostly dark energy)
- $\Omega_n \approx 0.001$ (dark matter, a bit)

Precision Cosmology

- $\Omega_m = 0.27 \pm 0.07 (1\sigma, \mathrm{WMAP})$
- $\Omega_{total} = 1.00; w = -1 (\mathrm{Priors})$
- ν analogy: $\Delta m^2, \tan^2\theta$ (assumed)
- $[\Omega_m : \pm 26\%; \mathrm{NC}_{SNO} : \pm 8\%, \mathrm{pp}_{all} : \pm 2\%]$

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