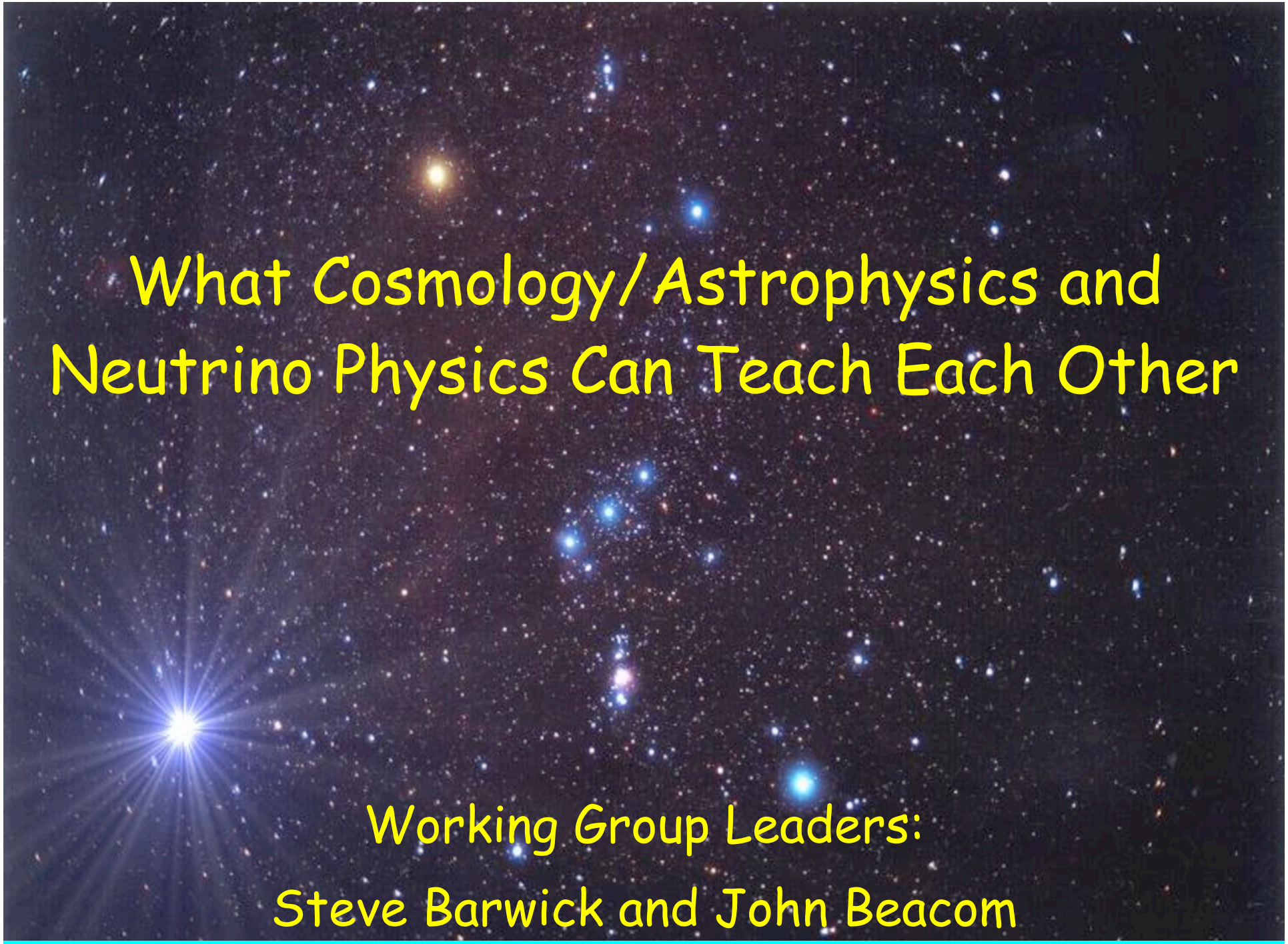


What Cosmology/Astrophysics and Neutrino Physics Can Teach Each Other

Working Group Leaders:
Steve Barwick and John Beacom

Participants

Steve Barwick, John Beacom

External participants

Baha Balantekin
Nicole Bell
Dick Boyd
Mu-Chun Chen
Vince Cianciolo
Mike Dragowsky
Ernie Henley
Albrecht Karle
Teppei Katori
Boris Kayser
Paul Langacker
John LoSecco
Doug McKay
Paul Nienaber
Keith Olive
Tatsu Takeuchi
Jon Thaler
Neil Weiner

Perspective

"If [there are no new forces] ---- one can conclude that there is no practically possible way of observing the neutrino." Bethe and Peierls, Nature (1934)

Cosmological

- Big-bang nucleosynthesis consistency
- Neutrino hot dark matter models ruled out

Astrophysical

- Neutrinos from SN 1987A observed
- The solution of the solar neutrino problem

Major Topics

- Leptogenesis
- BBN
- Dark energy
- Dark matter
- WIMP detection
- UHE neutrinos
- SN neutrinos

- Number of flavors
- Sterile neutrinos
- Dirac vs. Majorana
- Mass scale
- Mixing parameters
- Cross sections
- Exotic properties

Neutrinos are a key to

New physics in the Universe

New physics beyond the Standard Model

Working Group Goals

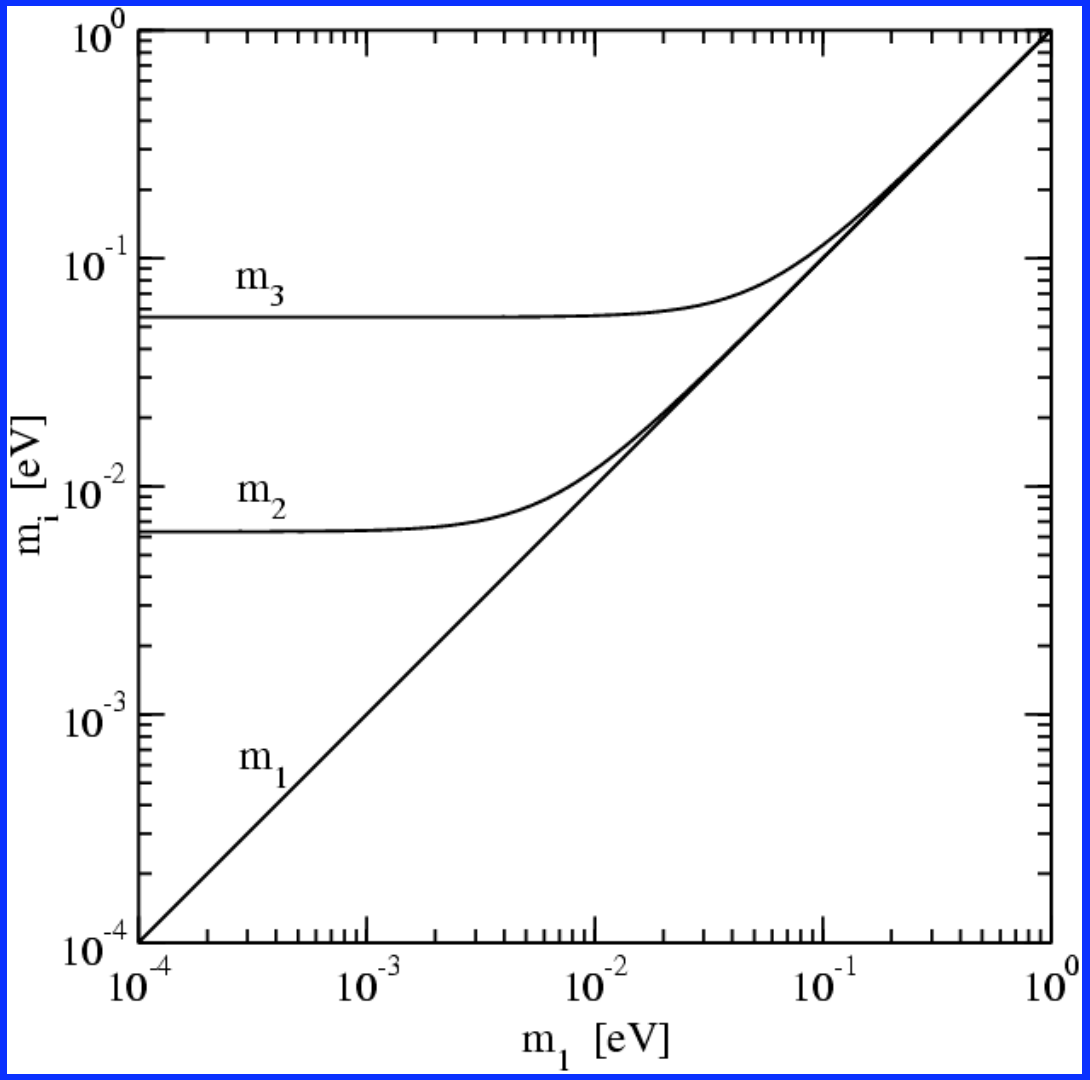
Four guiding goals:

1. New experiments in neutrino astrophysics
2. Added value to cosmological observations
3. Key role of theory in making connections
4. Strong connections to other working groups and nuclear/particle laboratory data

Selected Key Opportunities

- Discovery of neutrino mass using cosmological data
  - Key hint for model-building
  - Guide and foil for beta / double beta experiments
- Discovery of astrophysical neutrinos
  - Unique probe of extreme environments
  - Unique probe of neutrino properties, energy frontier
- Connections to new astrophysical/cosmological data
  - Detailed astrophysical models
  - Quest for identifying the particle dark matter
  - Fundamental theory towards the GUT scale

Neutrino Masses



Beacom and Bell, PRD 65, 113009 (2002)

Normal Hierarchy

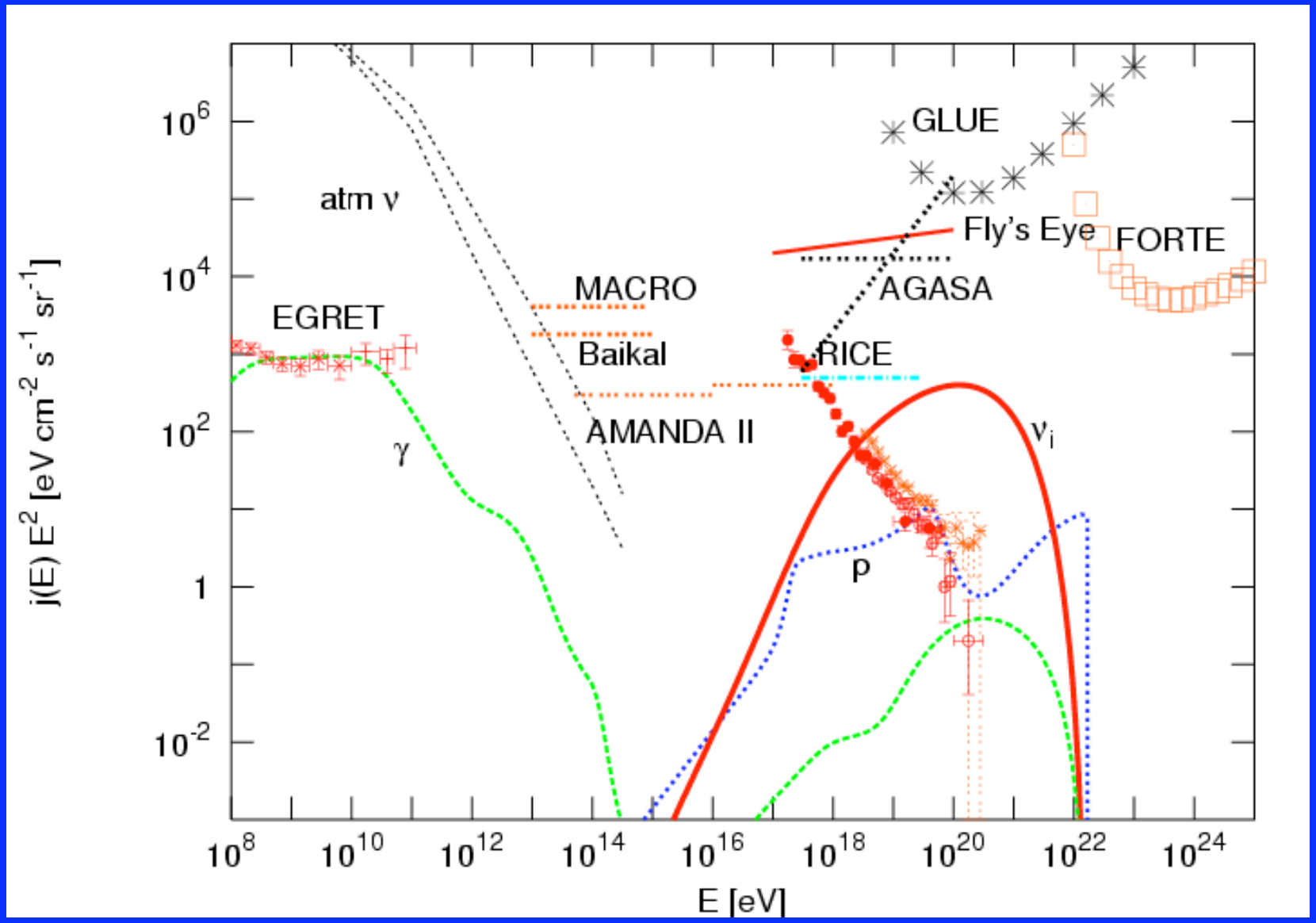
$$m_1 = m_1$$

$$m_2 = \sqrt{m_1^2 + \delta m^2_{solar}}$$

$$m_3 = \sqrt{m_1^2 + \delta m^2_{solar} + \delta m^2_{atm}}$$

$$\frac{m_3}{m_2} \leq \frac{\sqrt{\delta m^2_{atm}}}{\sqrt{\delta m^2_{solar}}} \leq 10$$

Existing Neutrino Limits



Semikoz, Sigl, hep-ph/0309328

Working Group Plans

- Have defined key topics and physics questions
- Have begun assembling working group
- Will provide updates through a web page
- Your participation and comments are welcomed
- Contact information:

Steve Barwick barwick@hep.ps.uci.edu

John Beacom beacom@fnal.gov