



<http://kicp-workshops.uchicago.edu/Neutrino2012/>

## WORKSHOP MATERIALS



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The 4th Neutrino workshop will take place from Friday May 18th to Saturday May 19th in Chicago, IL. The workshop is being hosted by the Kavli Institute for Cosmological Physics (KICP) in the Laboratory for Astrophysics and Space Research (LASR) building at the University's of Chicago main campus in Hyde Park.

**The main topics of the workshop are:**

- \* Neutrino and Cosmic Microwave Background
- \* Neutrino and Big Bang Nucleosynthesis
- \* Current bounds on  $N_\nu$  and  $\sum m_\nu$  from cosmology
- \* Sterile Neutrinos in the Early Universe
- \* Sterile Neutrinos in Astrophysics
- \* Terrestrial "hints" for sterile neutrinos: short-baseline anomalies
- \* Reactor Neutrino Experiments
- \* Theoretical understanding of neutrinos from nuclear reactors
- \* Theoretical Models of neutrino mass

### Scientific Organizing Committee

**Kevorg Abazajian**  
University of California, Irvine

**Andre de Gouvea**  
Northwestern University

### Local Organizing Committee

**Bradford Benson**  
University of Chicago

**Angela Olinto**  
Kavli Institute for Cosmological Physics

**Lian-Tao Wang**  
Kavli Institute for Cosmological Physics

**List of Participants**

1. Kevork N. Abazajian                      University of California, Irvine
2. Bradford A Benson                      University of Chicago
3. Lindsey Bleem                              University of Chicago
4. Edward Blucher                           University of Chicago
5. David Caratelli                            Northwestern University
6. Marcela S Carena                         Fermilab/U. of Chicago
7. Abigail Crites                              University Of Chicago, Dept of Astronomy and Astrophysics
8. Sudeep Das                                 University of California, Berkeley
9. Andre de Gouvea                         Northwestern University
10. Scott Dodelson                            Fermilab/Chicago
11. JiJi Fan                                      Princeton University
12. George M. Fuller                         Physics Professor-CASS Director/UC San Diego
13. Steve Geer                                 FNAL
14. Craig Hogan                               KICP
15. Gil Holder                                 McGill University
16. Daniel Holz                                KICP
17. Hao Huan                                 Kavli Institute for Cosmological Physics
18. Patrick Huber                              Virginia Polytechnic Institute & State University
19. Elise Jennings                            KICP
20. Aniket Joglekar                         University of Chicago
21. Shahab Joudaki                         University of California, Irvine
22. Ryan Keisler                               University of Chicago
23. Joachim Kopp                              Fermilab
24. Paul Langacker                            IAS and Princeton University
25. Yin Li                                        Kavli Institute for Cosmological Physics
26. William Louis                             LANL
27. Matthew Low                              University of Chicago
28. Ken Nollett                                Argonne National Laboratory
29. Angela V. Olinto                         Kavli Institute for Cosmological Physics
30. Pedro Schwaller                         Argonne/UIC
31. Kyle Story                                 University of Chicago
32. Arun M Thalapillil                       University of Chicago
33. Carlos E.M. Wagner                     University of Chicago and Argonne National Laboratory
34. Lian-Tao Wang                         Kavli Institute for Cosmological Physics
35. Yvonne Wong                             RWTH-AACHEN University
36. Alan Zablocki                              KICP, University of Chicago

## Workshop Program

May 18-19, 2012 @ LASR conference room

### May 18, 2012

8:30 AM - 9:00 AM

*BREAKFAST*  
In Meeting Room - at KICP in LASR Building

#### MORNING SESSION

9:00 AM - 9:40 AM

**Ryan Keisler**, University of Chicago  
*Results from the SPT*

9:40 AM - 10:20 AM

**Sudeep Das**, University of California, Berkeley  
*Results from the ACT*

10:20 AM - 10:50 AM

*BREAK*

10:50 AM - 11:30 AM

**Shahab Joudaki**, University of California, Irvine  
*CMB+LSS recent global results*

11:30 AM - 12:10 PM

**Gil Holder**, McGill University  
*The CMB Neutrino Connection*

12:10 PM - 2:00 PM

*LUNCH*

#### AFTERNOON SESSION

2:00 PM - 2:40 PM

**Ken Nollett**, Argonne National Laboratory  
*BBN and Neutrinos*

2:40 PM - 3:20 PM

**Yvonne Wong**, RWTH-AACHEN University  
*CMB and Large Scale Structure Overview*

3:20 PM - 4:00 PM

**George M. Fuller**, Physics Professor-CASS Director/UC San Diego  
*Sterile Neutrinos in the Early Universe*

4:00 PM - 5:00 PM

*BREAK AND DISCUSSION*

**May 19, 2012**

8:30 AM - 9:00 AM

*BREAKFAST*  
In Meeting Room - at KICP in LASR Building

**MORNING SESSION**

9:00 AM - 9:40 AM

**Edward Blucher**, University of Chicago  
*Reactor Neutrino Experiments*

9:40 AM - 10:20 AM

**William Louis**, LANL  
*Summary of terrestrial "hints" for sterile neutrinos: short-baseline anomalies*

10:20 AM - 10:50 AM

*BREAK*

10:50 AM - 11:30 AM

**Joachim Kopp**, Fermilab  
*Fitting short-baseline anomalies*

11:30 AM - 12:10 PM

**Patrick Huber**, Virginia Polytechnic Institute & State University  
*Theoretical understanding of neutrinos from nuclear reactors*

12:10 PM - 2:00 PM

*LUNCH*

**AFTERNOON SESSION**

2:00 PM - 2:40 PM

**Steve Geer**, FNAL  
*Putting the short-baseline anomalies to the test*

2:40 PM - 3:20 PM

**Carlos E.M. Wagner**, University of Chicago and Argonne National Laboratory  
*Sterile neutrinos and long baseline neutrino experiments*

3:20 PM - 4:00 PM

**JiJi Fan**, Princeton University  
*Theory of Sterile Neutrinos*

4:00 PM - 5:00 PM

*BREAK AND DISCUSSION*

## Workshop Talks

1. **Edward Blucher**, University of Chicago  
*Reactor Neutrino Experiments*  
May 19, 2012 (9:00 AM - 9:40 AM)
2. **Sudeep Das**, University of California, Berkeley  
*Results from the ACT*  
May 18, 2012 (9:40 AM - 10:20 AM)
3. **JiJi Fan**, Princeton University  
*Theory of Sterile Neutrinos*  
May 19, 2012 (3:20 PM - 4:00 PM)
4. **George M. Fuller**, Physics Professor-CASS Director/UC San Diego  
*Sterile Neutrinos in the Early Universe*  
May 18, 2012 (3:20 PM - 4:00 PM)
5. **Steve Geer**, FNAL  
*Putting the short-baseline anomalies to the test*  
May 19, 2012 (2:00 PM - 2:40 PM)
6. **Gil Holder**, McGill University  
*The CMB Neutrino Connection*  
May 18, 2012 (11:30 AM - 12:10 PM)
7. **Patrick Huber**, Virginia Polytechnic Institute & State University  
*Theoretical understanding of neutrinos from nuclear reactors*  
May 19, 2012 (11:30 AM - 12:10 PM)
8. **Shahab Joudaki**, University of California, Irvine  
*CMB+LSS recent global results*  
May 18, 2012 (10:50 AM - 11:30 AM)
9. **Ryan Keisler**, University of Chicago  
*Results from the SPT*  
May 18, 2012 (9:00 AM - 9:40 AM)

10. **Joachim Kopp**, Fermilab  
*Fitting short-baseline anomalies*  
May 19, 2012 (10:50 AM - 11:30 AM)
  
11. **William Louis**, LANL  
*Summary of terrestrial "hints" for sterile neutrinos: short-baseline anomalies*  
May 19, 2012 (9:40 AM - 10:20 AM)
  
12. **Ken Nollett**, Argonne National Laboratory  
*BBN and Neutrinos*  
May 18, 2012 (2:00 PM - 2:40 PM)
  
13. **Carlos E.M. Wagner**, University of Chicago and Argonne National Laboratory  
*Sterile neutrinos and long baseline neutrino experiments*  
May 19, 2012 (2:40 PM - 3:20 PM)

*Co-authors: Arun Thalapilil, Bhubanjyoti Bhattacharya*

We revisit some of the recent neutrino observations and anomalies in the context of sterile neutrinos. Based on a general parametrization motivated in the presence of sterile neutrinos, the consistency of the MINOS disappearance data with additional sterile neutrinos is discussed. We also explore the implications of sterile neutrinos for the measurement of  $|U_{\mu 3}|$  in this case. Regarding the determination of  $|U_{e 3}|$ , we observe that the existence of sterile neutrinos may induce a significant modification of the  $\theta_{13}$  angle in neutrino appearance experiments like T2K and MINOS, over and above the ambiguities and degeneracies that are already present in 3-neutrino parameter extractions. The modification is less significant in reactor neutrino experiments like Double-CHOOZ, Daya Bay and RENO and therefore the extracted  $|U_{e 3}|$  value when sterile neutrinos are present is close to the one that would be obtained in the 3-neutrino case. We also conclude that the results from T2K imply a 90% C.L. lower-bound on  $|U_{e 3}|$ , in the "\$,3+2\$" neutrino case, which is still within the sensitivity of future reactor neutrino experiments like Daya Bay, and consistent with the one- $\sigma$  range of  $\sin^2\theta_{13}$  recently reported by the Double-CHOOZ experiment. Finally, we argue that for the recently determined best-fit parameters, the results in the "\$,3+1\$" scenario would be very close to the medium/long baseline results obtained in the "\$,3+2\$" case analyzed in this work.

14. **Yvonne Wong**, RWTH-AACHEN University  
*CMB and Large Scale Structure Overview*  
May 18, 2012 (2:40 PM - 3:20 PM)