

## **Workshop on Measuring the Neutron Lifetime**

Amherst Center for Fundamental Interactions

19-21 September 2014

Sponsored by ACFI and the University of Tennessee

### **Summary Report**

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### **Workshop Goals**

The beta decay lifetime of the free neutron is of great importance in cosmology, nuclear, and particle physics. There is, at present, a significant uncertainty in the precise value of the neutron and a number of U.S. researchers are engaged in projects to make improved measurements. This community met at the ACFI to discuss the prospects for improved measurements and to prepare a “roadmap” for future US research in this area. A specific outcome of this workshop was the preparation of written document that could be used to provide input into future programmatic planning within the US nuclear physics community.

### **Participation**

The workshop was attended by 11 university faculty, 6 national laboratory staff, 4 postdoctoral fellows, and 2 graduate students and included 4 women. While most of the participants were experimentalists who are currently engaged in neutron lifetime measurements in the US, they also included a number of theorists who helped focus the scientific justification for future work. As noted below, this mix of theory and experiment was particularly useful in developing a plan with a coherent intellectual motivation.

### **Structure/organization**

The meeting was organized with the specific goal of preparing a consensus plan for future research in this area. As a result, a significant portion of time was allotted to discussions and breakout groups. The first day of the workshop was devoted to overview talks that included theoretical and experimental reviews. This was followed by presentations outlining future experimental opportunities. The second day of the workshop was devoted to breakout “writing” groups with a goal of having a rough draft of each section completed and available for discussion by the end of the day. The last (half) day included final discussion about the completed draft.

A detailed workshop agenda is shown in Appendix 1.

### **Outcome**

There was a general consensus that the workshop was very successful. The high level goal of completing a “white” paper was met and that document has been posted on the arXiv: <http://arxiv.org/abs/arXiv:1410.5311> and is also contained in the workshop summary documents. This document will be extremely useful in the upcoming process for the preparation of a national Long Range Plan for nuclear physics now underway under the auspices of the US Nuclear Sciences Advisory Panel.

As noted in the whitepaper, the proposed neutron lifetime program has two phases. In the first phase the goal is to provide two independent measurements with an uncertainty of  $\sim 1$  second in the neutron lifetime. In the second phase, a next generation of apparatus will aim for an uncertainty of a few times 0.1 sec. An important accomplishment of the workshop, that arose from the interaction between the theorists and experimentalists, was a thoughtful justification for each of these along with credible plan for their realization.

The workshop brought together people who were working on the same scientific problem, albeit with different techniques. As a result it provided a forum for discussion of common problems by scientific “competitors.” When conducted in a harmonious atmosphere this type of interaction can be extremely useful. This is not surprising a thoughtful competitor is likely to be a knowledgeable critic. The ACFI Workshop provided an ideal forum in which this “criticism” could be discussed in constructive fashion.

### **Summary**

The ACFI Workshop on Measuring the Neutron Lifetime was viewed by all the participants as productive and successful. Similar meeting in the past have usually been held at national laboratories. An academic environment, that is also “neutral territory,” was very useful. The facilities at the ACFI were very well suited for such a meeting and the proximity of smaller rooms that could be used for breakout session was most helpful. The facilities at the ACFI were near capacity for a meeting of 26 but the facilities were very comfortable.

## Appendix 1 Workshop Agenda

### Friday, September 19

- 9:00a **Welcome**  
Michael Ramsey-Musolf  
UMass Amherst
- 9:15am **Introduction & Workshop Goals**  
Geoff Greene  
University of Tennessee & Oak Ridge National Laboratory
- 9:30am **Neutron Lifetime & CKM Unitarity: The Standard Model & Beyond**  
Michael Ramsey-Musolf  
UMass Amherst
- 10:15am **Coffee Break**
- 10:45am **Astrophysics/Cosmology and the Neutron lifetime**  
Ken Nollett  
University of South Carolina and San Diego State University
- 11:30am **Overview/Status of the Beam Method**  
Scott Dewey  
National Institutes of Standards & Technology
- 12:15pm **Lunch**
- 1:30pm **Overview/Status of the Bottle Method**  
Albert Steyerl  
University of Rhode Island
- 2:15pm **The Next Beam Experiment**  
Fred Wietfeldt  
Tulane University
- 3:00pm **Coffee Break**
- 3:15pm **The Next Bottle Experiment - what is required sources/R&D/resou**  
Andy Saunders / Chen-Yu Liu  
Los Alamos National Laboratory / Indiana University

4:00pm **Discussion of White Paper**

Susan Seestrom

Los Alamos National Laboratory

4:30pm **Convene Breakout Writing Groups**

6:30pm **Workshop Dinner**

**Saturday, September 20**

9:00am **Writing Breakout Groups Continue**

10:30am **Coffee Break**

10:45am **Writing Breakout Groups Continue**

12:00pm **Lunch**

1:30pm **Updates from writing groups – Discussion**

2:30pm **Writing Breakout Groups Continue**

3:30pm **Coffee Break**

4:00pm **Writing Breakout Groups Continue**

6:00pm **Dinner**

**Sunday, September 21**

9:00am **Reports from Writing Groups - Discussion**

10:30am **Coffee Break**

11:00am **Completion White Paper First Draft**

## **Appendix 1 Workshop White Paper**