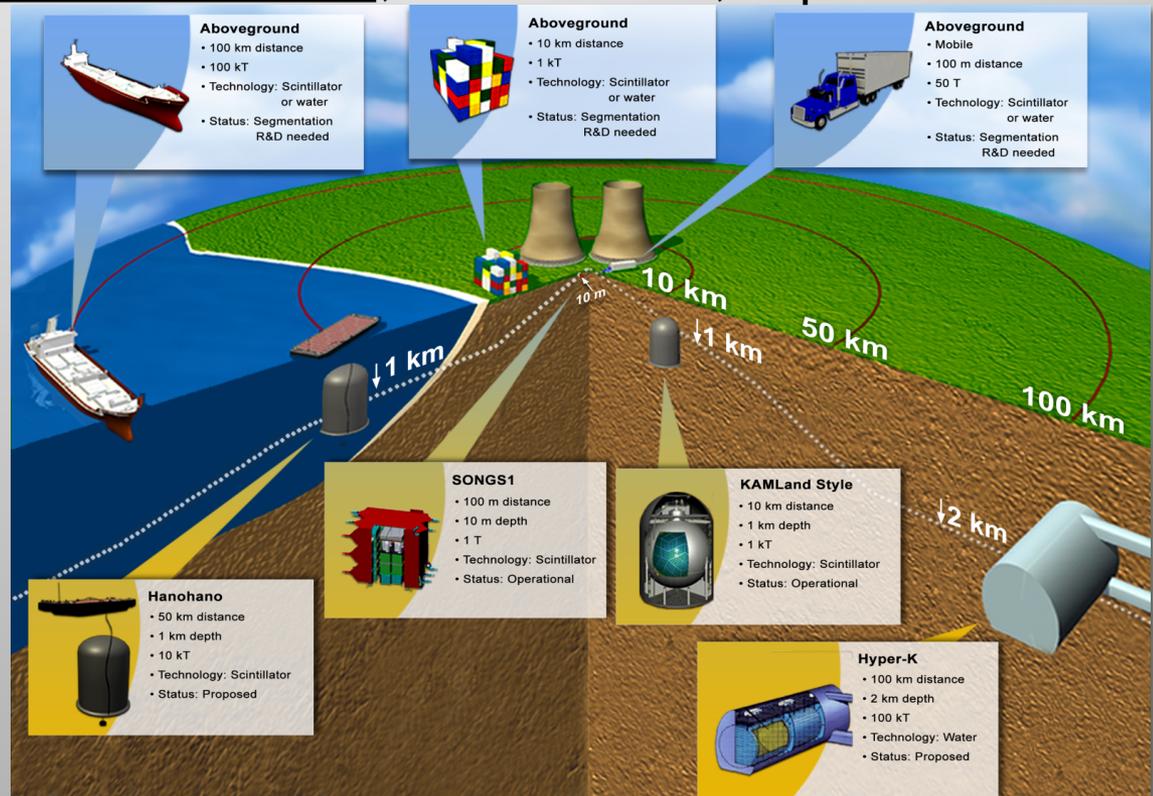


Nu7 Neutrinos and Society – Working Group Charge and Topic Overview

SLAC SNOWMASS Intensity Frontier Workshop
Wednesday, March 6, 2013

Adam Bernstein, Jose Alonso, Topic Conveners



This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

Neutrinos and Society Working Group Charge

1. Recognize and take advantage of the natural synergies between fundamental and applied neutrino science (Bowden, Svoboda, Sorensen)
 - Reactor antineutrinos
 - Geoantineutrinos (no talks in this session, but relevant)
2. Encourage physicists to learn how neutrino detection technology applies to problems of broad social import (Van Bibber)
 - Requires educating physicists in nonproliferation and arms control
3. Effectively present the short but eventful history of neutrino science to non-scientists. (Alonso)

Rare neutral particle detection

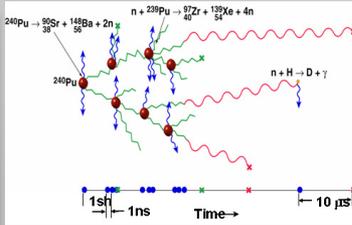
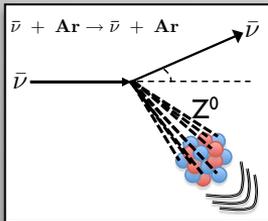
underlies nuclear security and fundamental nuclear science

Fissile Material Search and Monitoring are top priorities for global nuclear security

Reactor antineutrino monitoring via inverse beta detectors



Reactor monitoring via coherent scatter; improved fissile material monitoring



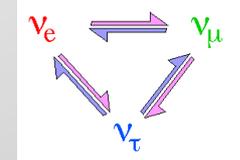
Rare Event Detection

1-10 MeV antineutrinos

1 keV to 10 MeV
Neutrons and Gamma-rays

Dark Matter and Neutrino Physics are top priorities in 21st century physics

Neutrino Physics:
oscillations and mass hierarchy



Dark Matter signatures:
Axions and WIMPS



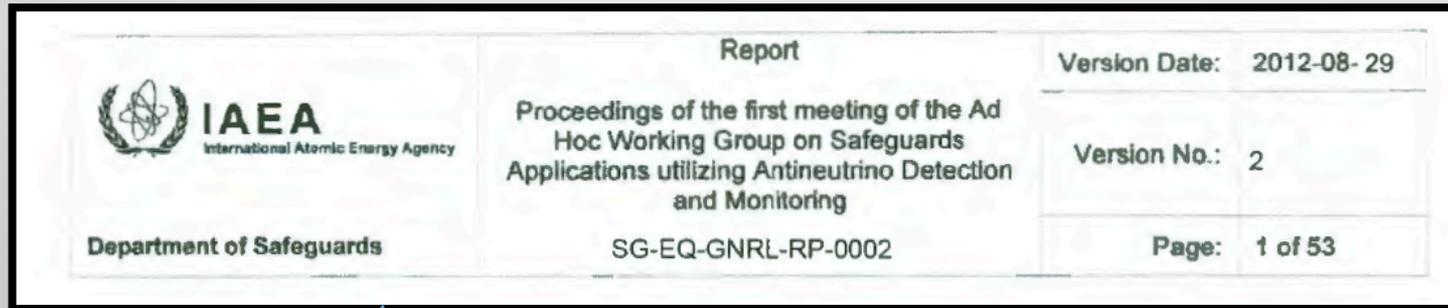
Nuclear Security and Nuclear Science both require improved keV to MeV-scale neutral particle rare event detectors

Aside from the physics and technology connection, a sociological one

- Like science, the nonproliferation regime is inherently open, international, and collaborative
- Classified work is largely irrelevant or inimical to progress in nonproliferation

The IAEA and Nuclear Nonproliferation

- The International Atomic Energy Agency (IAEA) is responsible for implementing the Nuclear Nonproliferation Treaty worldwide
- The IAEA Safeguards Regime tracks fissile nuclear fuel cycle



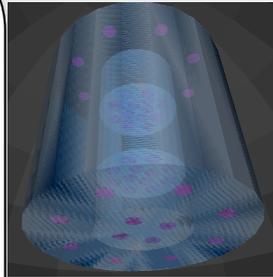
- In a recent report, IAEA encouraged R&D into **antineutrino-based reactor monitoring** for Safeguards:
 1. To monitor the denaturing of weapons-grade plutonium in reactors
 2. To help track fissile content of reactors
 3. Enable long range detection of small reactors
 4. Widen deployment options with smaller above-ground detectors

Research topics in Applied Antineutrino Physics that apply to Neutrino and Dark Matter Physics

Nonproliferation

- Long range reactor monitoring
- Improved neutron detection

Water Cerenkov detectors

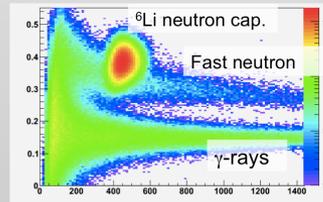


Physics

- Supernovae antineutrinos
- long baseline accelerator oscillations
- Long baseline reactor oscillations*

- Precision neutrino spectra
- neutron/gamma detection

Scintillator detectors



- Sterile neutrinos
- Reactor anomaly

- Small footprint antineutrino detectors for reactor monitoring
- improved reactor spectral measurements*
- neutrino directionality*

Coherent Scatter/ Low threshold detectors



- WIMP or Axion searches
- sterile neutrino search
- Nuclear physics studies

Neutrino scientists need to be educated about nonproliferation

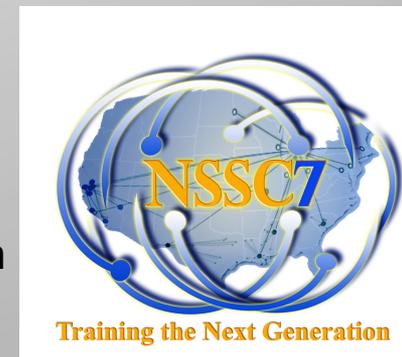
- Despite many common elements, neutrino applications differ from fundamental science in important ways

1. Policy context matters as much or more than the technology
2. Detectors have to be robust, safe, and easy to deploy
3. Outputs must be easy to interpret



- For neutrino physics to have an impact on nonproliferation, physicists need an education in the history and practice of nonproliferation, and the coming challenges –Karl Van Bibber talk shows a highly effective example at UC Berkeley, Davis, Irvine, San Diego – **NSSC**

- Many schools - mostly nuclear engineering but also some physics departments - are starting to provide training in nonproliferation



The public and Congress need to be educated about neutrino physics

- The field's diversity makes this a challenge compared to eg. finding the Higg's Boson
- However we enjoy a rich record of discovery and a bright future
- Symmetry Magazine article and 30 page SNOWMASS summary are important opportunities
- Jose Alonso will discuss possible ways to improve outreach and public education

Applied Antineutrino Physics – a growing global community with strong ties to Dark Matter and Neutrino Science

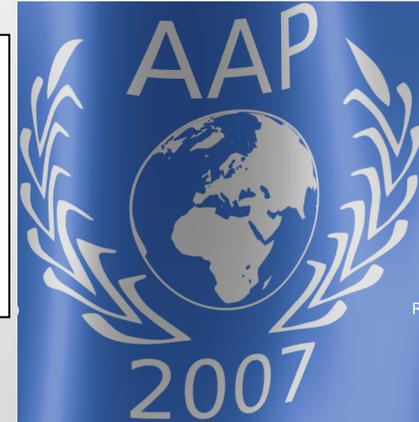
Neutrinos and Arms Control Workshop

5-7 February 2004, University of Hawaii

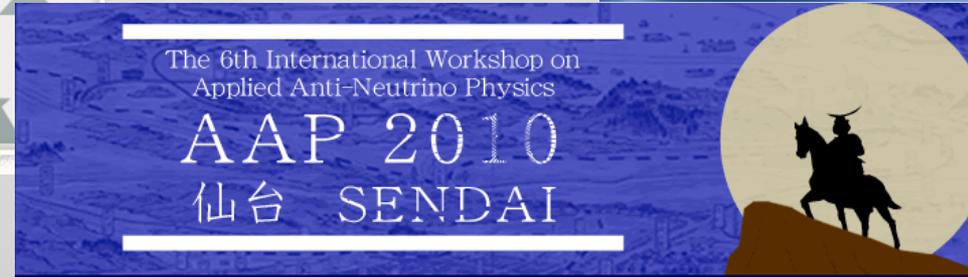
Neutrino Sciences 2005 Neutrino Geophysics

Honolulu, Hawaii

December 14-16, 2005



AAP 2006 WORKSHOP SEPT 24-26 LIVERMORE, CA



The meeting will be dedicated to discuss applications of antineutrino detection in the field of non proliferation, geophysics and other applied areas.

AAP-2009

V Applied Antineutrino Physics Workshop



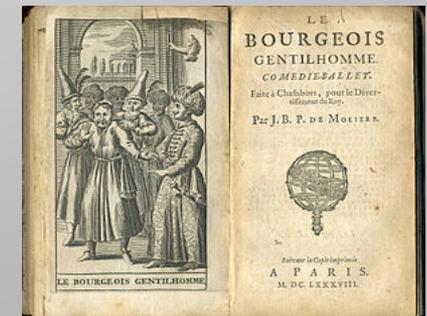
Vienna, Austria



AAP 2012 at the University of Hawai`i

Summary – defending the country and speaking prose

- Applied antineutrino physics is a burgeoning and exciting field
- The potential impact on immediate international security problems should strengthen the case for fundamental neutrino physics with the public and the government
- Nonproliferation applications and related physics can at once make the country “worth defending” (R. Wilson FNAL Director ‘67-’78, defending FNAL) *and* contribute to the national defense (NSF and DOE Science Mission Statements)
- « Par ma foi ! il y a plus de quarante ans que je dis de la prose sans que j'en susse rien, et je vous suis le plus obligé du monde de m'avoir appris cela. – Le Bourgeois Gentilhomme, Moliere



Next Steps

- Circulate draft white paper for comments – this month
- Solicit any other contributions
- According to interests, participate in other planning sessions leading into the ‘SNOWMASS on the Mississippi’ August plenary planning meeting

Title for full-page image

(sub information - 20pt type)

