Progress Toward Cooperative Low Background Infrastructure

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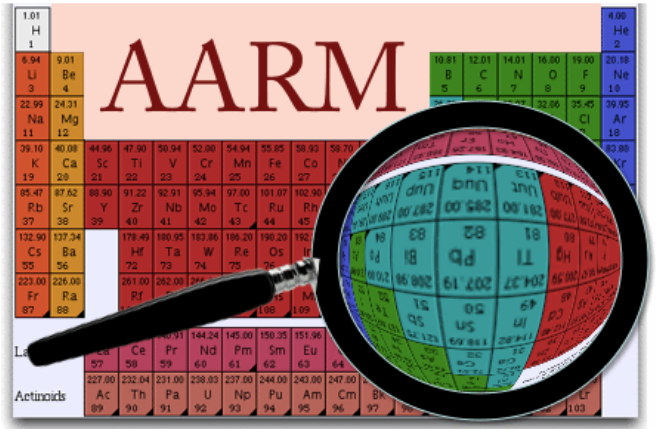


What Cooperative Model Works Best?

Overlapping Entities with different purposes

Organically growing up in a competitive environment

Laboratories

Universities

Experimental Collaborations

Is there there added value in connecting disjoint groups?

We think so or we wouldn't be here

What kind of model will

1. Enhance the science
2. Optimize (share) scarce resources
3. Be sustainable

Short History of Efforts in Cooperative Models

Low Radioactivity Techniques Workshop Planning began in 2003

Identify need for shared information
and expertise in a growing
Underground Science Community

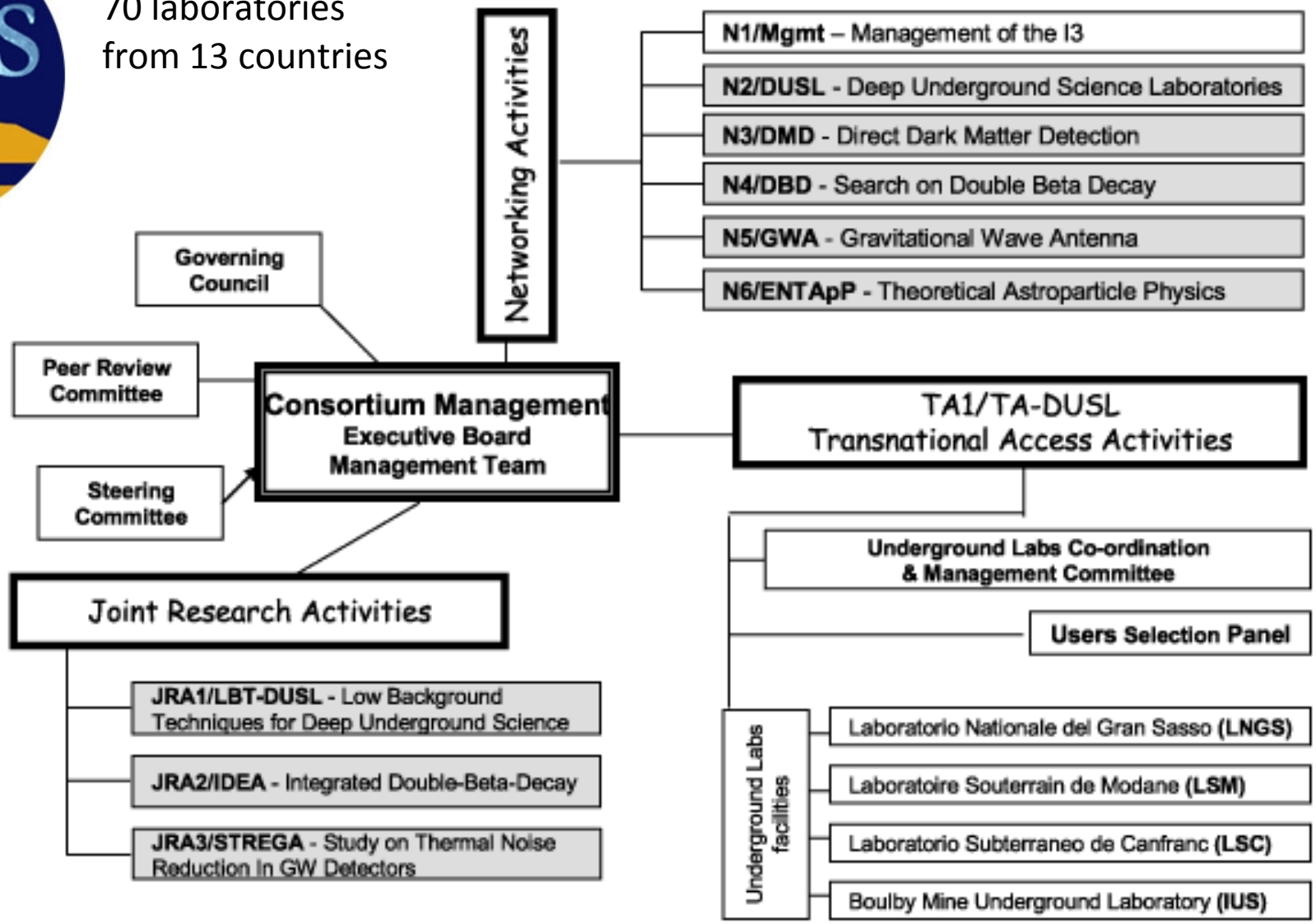
LRT2004	Laurentian University (Sudbury, Canada)
LRT2006	Modane (Aussois, France)
LRT2010	SNOLAB (Sudebury, Canada)
LRT2013	LNGS (Assergi, Italy)
LRT2015	University of Washington (Seattle, WA USA)

Very Successful. A workshop is a simple and established format. Funding is one-shot
It is up to the participant to act on any new information.

Short History: ILIAS

Integrated Large Infrastructures for Astroparticle Science

2004-2009 with a total EC financial contribution of € 7,5 M Connect
70 laboratories
from 13 countries



Short History: ILIAS

Ambitious Project…. **But** LIAS-NEXT (5 year follow-on) was not funded.

Hard to sustain large umbrella infrastructure in harsh budget climates

***However, It accomplished a lot*.**

We still use the collected data on assayed materials !!
(now ported into the new Community Assay Database)

A few interesting examples:

- Coordinated radioactivity measurements of all the ILIAS underground laboratories using same set of detectors (TA1)
- Geophysics/siesmic monitoring survey of ILIAS underground laboratories (TA1)
- Creating a standard library of tested simulation codes, including benchmarking MC with comparisons to underground and accelerator data. (JRA1)
- Improved health and safety, via exchange of best practice experience.
  Create a common approach on safety procedures specific to underground sites. (N2)
- Build an extensive database on isotopically enriched isotopes and the nuclear matrix elements to guide future experimental choices in double β decay (N4)

+ training of young scientists, exchange programs, new collaborations, etc etc etc.

Short History: AARM

Assay and Acquisition of Radiopure Materials

*The **AARM** Scientific collaboration*

Continues as a loose collaboration of interested parties who communicate within working groups and host workshops to share information.

But the Model and the Funding have evolved

2009-12: NSF grant (DUSEL S4)

- *Characterize backgrounds at all levels of Homestake*
- *Design a common low background counting facility*
- *Develop common screening tools (R&D as needed)*

2012-14: Cooperate to help understand and mitigate backgrounds.

Simulation recognized as a major "infrastructure"

Validate and improve current simulation tools

Background characterization more broadly defined as

Community Materials Assay Database

Neutron benchmarking (data vs sim)

Integration/Promotion of existing assay resources around the world and the development of a unified plan to increase availability

Current NSF grant = "Integrative Tools for Underground Science"

Principle Investigators

Priscilla Cushman (University of Minnesota)
Jodi Cooley (Southern Methodist University)
Toni Empl (University of Arkansas, Little Rock)
Angela Reisetter (Evansville University)
Richard Schnee (Syracuse University ➔ SDSM&T)

Funding model:
NSF Grant for Specific Tasks identified by the community as high priority,
but not covered directly by the experiment. Not clear that this is sustainable!

AARM is
Organized by working group.

Bi-annual workshops combine talks on new developments with Working Group sessions devoted to work and planning.

- Cosmogenic Simulation Group
- Universal Materials Database
- Radiogenic Cross Section Working Group
- FLUKA-Geant4 Comparative Study Group
- Neutron Benchmarking Data Group

Short History: Snowmass Community Planning

2013: APS Div. of Particles and Fields planning exercise for HEP

Resulted in a strong case for Underground Infrastructure in the main document and in accompanying white papers.

Underground Space is a “Laboratory Capability”
“Experimental needs worldwide far outstrip current assay capability. Operation as a user facility across multiple sites with existing expertise is the most efficient use of resources and personnel.”

“There is enough U.S. infrastructure space for the future if existing U.S. underground labs are maintained. Substantial past agency investment and future leverage of state, university, private and other agency (e.g., non-proliferation) funds make it cost effective and attractive to maintain these sites for smaller experiments, generic R&D, and as elements of a centrally managed materials assay consortium.”

AARM's Response

March 2014: Workshop at FNAL to create a blueprint for
A sustainable model for infrastructure that
Concentrates on the highest priority items (as defined by the community)

Integrative Website with

- All relevant publications and links organized in one place
  - Including all the AARM workshop talks and the LRT talks/proceedings
- Contact information and scheduling tools for woldwide assay centers
  - Including HPGe, Surface assay, ICPMS, NAA etc
- Community Assay Database, including hooks from the assay centers
- GEANT/FLUKA/MCNP code tools, code benchmarking and updates
- Nuclear Databases, alpha-n, SOURCES4 etc
- Cleaning and Handling Protocols. Standardize Assay Prep
- Cosmogenic Activation, underground storage, transport shielding
- Data on radon plateout and diffusion in various materials

AND the work/computation/research that has to be done to populate those pages!

e.g. Perform experiments to quantify radon plateout and diffusion in many materials
Develop new surface screening techniques
Do neutron benchmark experiments to understand hadronic showers underground

An example of AARM-related work

Neutron Benchmarking

Regular teleconferences with other benchmarking and relevant technology
FaNS, ZEPLIN, He3 NCDs, LVD
Designing a new experiment/concept for definitive experiment & proposal

Meanwhile Minnesota, SDSM&T, USD operate an experiment at Soudan
See Poster (A. Villano)

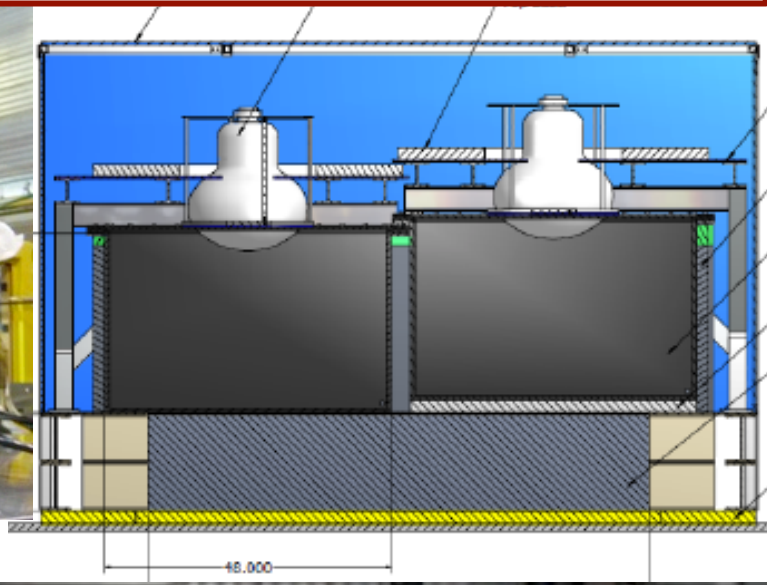
GPS time stamps correlate a liquid scintillator neutron detector (USD), a neutron multiplicity meter (SDSM&T) and a 30' x 40' x 100' cavern lined with proportional tubes for muon tracking

Benchmarking = Constrain GEANT simulations
Examine the *topology* of cosmogenic events deep underground
Tag vertical-going single muons to study multiple-muon (muon bundle) events

Use with existing experiments as active 'veto' or as tag

Combine Muon Tracks with Neutron Detection to get a handle on neutron backgrounds
Benchmark cosmogenic neutron Monte Carlos (Geant4, FLUKA).

The Neutron Multiplicity Meter
UCSB, Case, Syracuse, UCDavis



University of South Dakota Liquid Scintillator Neutron detector

Next Step

A DOE-proposed Workshop (summer 2014)
to define Low Background Infrastructure was delayed

The G2 Down-Select changed the landscape.
Wait for the 2 major dark matter experiments to quantify their needs.

LZ and SuperCDMS recently had a bilateral meeting
to discuss cooperation on background issues

The next step is to fold this into the larger picture.

Conference on Science at the
Sanford Underground Research Facility

SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

Sanford Underground Research Facility

18-20 May 2015 *South Dakota School of Mines & Technology* *Rapid City, South Dakota, USA*
US/Mountain timezone

Followed by an AARM Workshop May 20-21 to put all this in the larger context.

Revisit the work from last March and determine a way forward.

New Demonstration Integration Website

Follow along on your laptop!

http://www.hep.umn.edu/aarm/