Status of MaGe
(sort of)

Reyco Henning

U. of North Carolina at Chapel Hill

and

Triangle Universities National Laboratory

On Behalf Of The
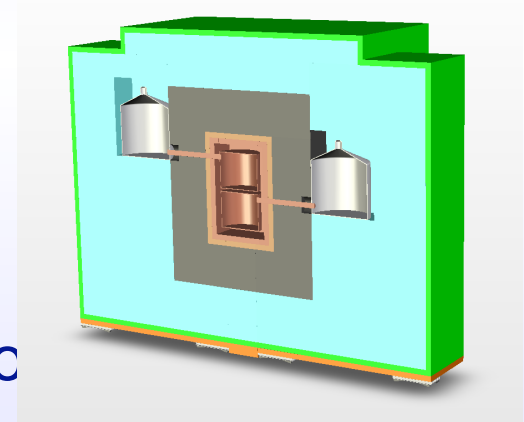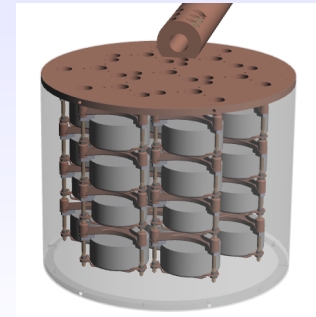
MAJORANA Collaboration

THE MAJORANA EXPERIMENT

The MAJORANA Demonstrator Module

- **R&D towards tonne-scale.**
- **60-kg of Ge detectors**
  - 30-kg of 86% enriched ^{76}Ge crystals required for science goal; 30-kg ^{nat}Ge for background sensitivity
  - Examine detector technology options, mostly point-contact.
- **Low-background Cryostats & Shield**
  - ultra-clean, electroformed Cu
  - naturally scalable
  - Compact low-background passive Cu and Pb shield with active muon veto
- **Agreement to locate at 4850' level at Sanf**
- **Background Goal** in the $0\nu\beta\beta$ peak region of interest (4 keV at 2039 keV) ~ 1 count/ROI/t-y (after analysis cuts)

The MAJORANA Collaboration (Feb. 2009)
Note: Red text indicates students

Black Hills State University, Spearfish, SD
Kara Keeter

Duke University, Durham, North Carolina , and TUNL
James Esterline, Mary Kidd, Werner Tornow

Institute for Theoretical and Experimental Physics, Moscow, Russia
Alexander Barabash, Sergey Konovalov,
Igor Vanushin, Vladimir Yumatov

Joint Institute for Nuclear Research, Dubna, Russia
Viktor Brudanin, Slava Egorov, K. Gusey,
Oleg Kochetov, M. Shirchenko, V. Timkin, E. Yakushev

Lawrence Berkeley National Laboratory, Berkeley, California and the University of California - Berkeley
Mark Amman, Marc Bergevin, Yuen-Dat Chan,
Jason Detwiler, Brian Fujikawa, Kevin Lesko, James Loach,
Paul Luke, Alan Poon, Craig Tull, Kai Vetter,
Harold Yaver, Sergio Zimmerman

Los Alamos National Laboratory, Los Alamos, New Mexico
Steven Elliott, Victor M. Gehman, Vincente Guiseppe,
Andrew Hime, Kieth Rielage, Larry Rodriguez, Jan Wouters

North Carolina State University, Raleigh, North Carolina and TUNL
Henning Back, Lance Leviner, Albert Young

Oak Ridge National Laboratory, Oak Ridge, Tennessee
Jim Beene, Fred Bertrand, Thomas V. Cianciolo, Ren Cooper,
David Radford, Krzysztof Rykaczewski, Robert Varner, Chang-Hong Yu

Osaka University, Osaka, Japan
Hiroyasu Ejiri, Ryuta Hazama, Masaharu Nomachi, Shima Tatsuji

Pacific Northwest National Laboratory, Richland, Washington
Craig Aalseth, James Ely, Tom Farmer, Jim Fast, Eric Hoppe, Brian Hyronimus,
Marty Keillor, Jeremy Kephart, Richard T. Kouzes, Harry Miley, John Orrell,
Jim Reeves, Bob Thompson, Ray Warner

Queen's University, Kingston, Ontario
Art McDonald

University of Alberta, Edmonton, Alberta
Aksel Hallin

University of Chicago, Chicago, Illinois
Phil Barbeau, Juan Collar, Nicole Fields, Charles Greenberg,

University of North Carolina, Chapel Hill, North Carolina and TUNL
Melissa Boswell, Padraic Finnerty, Graham Giovanetti, Reyco Henning, Mark Howe,
Michael Akashi-Ronquest, Sean MacMullin, Jacquie Strain, John F. Wilkerson

University of South Carolina, Columbia, South Carolina
Frank Avignone, Richard Creswick, Horatio A. Farach, Todd Hossbach

University of South Dakolta, Vermillion, South Dakota
Tina Keller, Dongming Mei, Chao Zhang

University of Tennessee, Knoxville, Tennessee
William Bugg, Yuri Efremenko

University of Washington, Seattle, Washington
John Amsbaugh, Tom Burritt, Peter J. Doe
Robert Johnson, Michael Marino, Mike Miller, Allan Myers, R. G. Hamish Robertson,
Alexis Schubert, Tim Van Wechel

1/18/10

Henning -- MaGe Status

4

A BIT OF HISTORY:

Concluding Slides from:

Joint Majorana/Gerda Workshop
LNGS, Oct 2004 (>5 years ago!)

Conclusions of Workshop

- **Proposal:** Majorana and Gerda will pursue a combined simulation package with a set of common tools developed and maintained equally by both groups. The package will include the simulated detectors of both groups.

- Gerda will test the Majorana framework and the next few weeks and decide whether to adopt it. (They did)

Proposal Outline

- Share selected physics results, esp. those compared with real data and "broken" aspects of Geant 4
- **Build ONE portable framework TOGETHER -- ONE executable program.**
- **Share** implementation of common tools -- generators, waveform simulation, base classes, some physics lists/modules.
- Develop **separate** geometries and outputs
- Do production runs on **own** machines

Realization

- Two MC contacts: R. Henning (Majorana) L. Pandola/ X. Liu (Gerda)
  - Ensure requirements of **their** experiment is met.
  - Ensure **their** responsibilities for common tools implementation are met.
  - Ensure no destructive interference.
  - Coordinate development of framework and tools with the other coordinator.
  - Coordinate User Support.
  - Regular (once weekly initially) phone meetings.
  - **NOT** responsible for other experiment's software

Proposed name for combined simulation package:

MaGe

STRUCTURE AND PHILOSOPHY OF MAGE
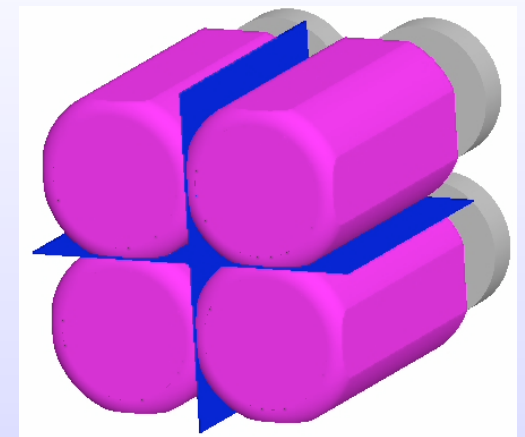
Program (Class) Structure

```
MJ--
    |- Database (database)
    |- Generators (generators)
    |- Geometry (geometry)
    |- Output (io)
    |- Management (management)
    |- Materials (materials)
    |- Processes (processes)
    |- Waveform (waveform)
```

CVS:
```
MJTools
analysis
bin
buildTools
database
doc
generators
geometry
io
macros
management
materials
processes
sandbox
waveform
```

Example 1: Clover with source

`/MJ/manager/mjlog routine` Sets error-reporting level

`/MJ/manager/heprandomseed 92348` Sets random number seed

`/MJ/geometry/detector clover` Selects detector geometry to simulate

`/MJ/eventaction/rootschema LANLCloverNoPS` Selects ROOT Tree schema `/MJ/eventaction/rootfilename /auto/majorana1/MJ/data/ LANLClover/mcdata/Co57_1.root /MJ/generator/select PNNLiso` Selects event generator

`/MJ/generator/PNNL/init /auto/majorana1/MJ/database/generators/ PNNL/Co57_Source.dat`

`/MJ/generator/PNNL/setsourceage 0.0`

`/MJ/generator/PNNL/reportingfrequency 1000`

`/MJ/generator/PNNL/position 0.0 0.0 14.8`

`/run/initialize`

`/run/beamOn 500000`

Example 2: Clover in NaI Barrel at FEL Beam

```
/MJ/manager/mjlog routine
/MJ/manager/heprandomseed 345542
/MJ/geometry/detector cloverinNaIbarrel   Selects different detector geometry.
/MJ/eventaction/reportingfrequency 1000
/MJ/eventaction/rootschema LANLCloverInNaIBarrel
/MJ/eventaction/rootfilename /auto/majorana1/users/rhenning/
testFEL30_1.root
/MJ/generator/select TUNLFEL   Selects different event generator
/MJ/generator/TUNLFEL/energysigma 12 keV
/MJ/generator/TUNLFEL/meanenergy 3.04 MeV
/MJ/generator/TUNLFEL/majorsigma 0.6 cm
/MJ/generator/TUNLFEL/minorsigma 0.6 cm
/MJ/generator/TUNLFEL/origin 1.0 1.0 200.0 cm
/MJ/generator/TUNLFEL/rho 0.0
/run/initialize

/run/beamOn 20000
```

Status of MaGe

- Geometries: ~23 classes for Majorana, ~10 for GERDA + data driven input

- Event Generators: ~16

- Output Classes: ~23

- MGDO.

- Dozen of contributors.

- Many G4 bugs uncovered

- 5+ papers.