

BACCARAT:

Basically a Component-Centric Analog Response to AnyThing

Victor M. Gehman, Kareem Kazkaz, Matthew Szydakis
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Outline

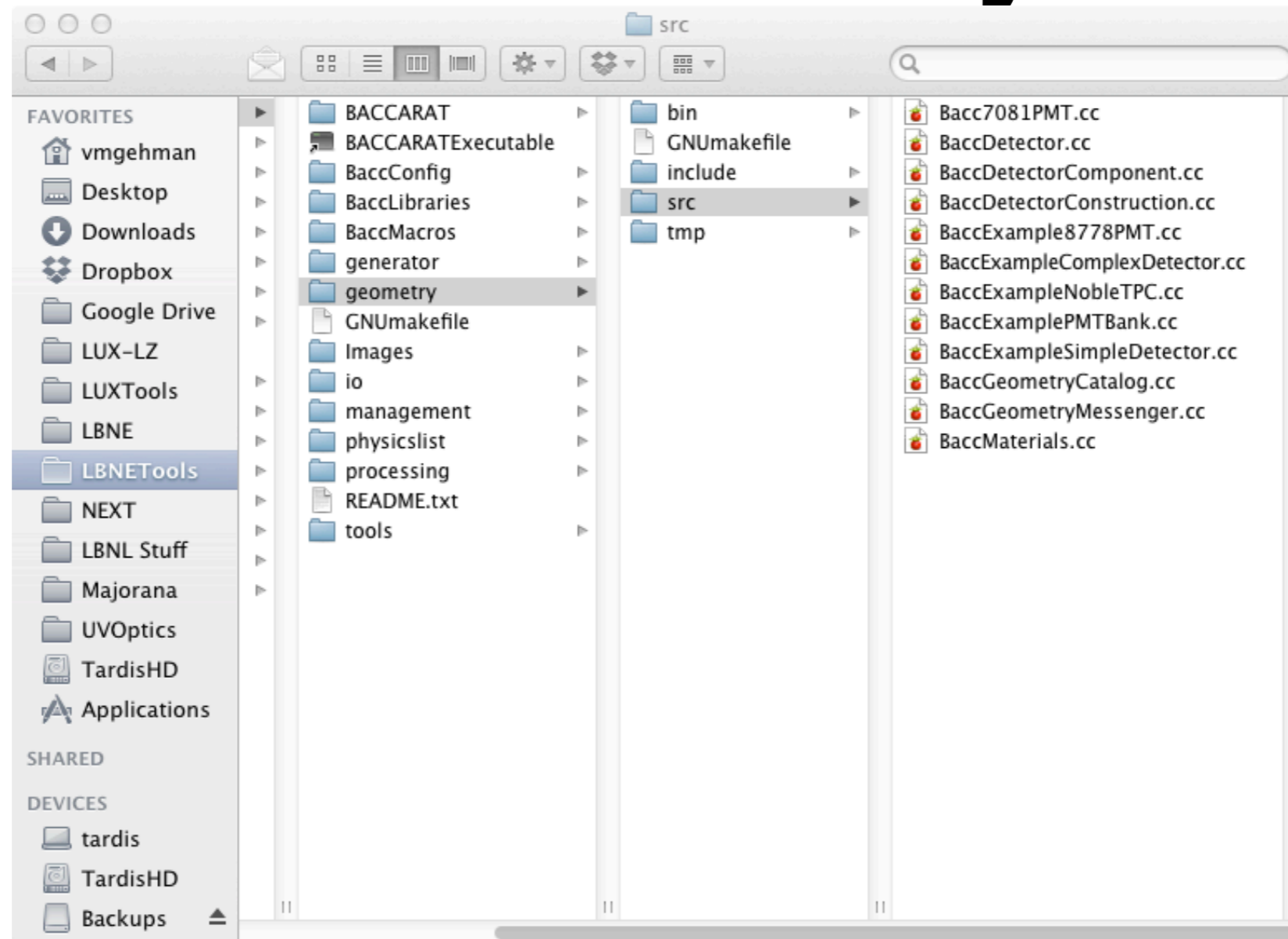
- What is BACCARAT and from whence did it arrive?
- What does it do and what dependencies does it have?
- How do I get BACCARAT?
- What is currently being done with BACCARAT?
- What are you going to do with this thing in the future?

BACCARAT Overview

- BACCARAT (because it's a Monte Carlo! Right?) grew out of the simulation for the LUX dark matter experiment (we call it "LUXSim").
- It is essentially the guts of the LUX Monte Carlo with none of the LUX geometry information.
- This does NOT mean that it only works with two-phase xenon TPC's!
- LUXSim was designed with this in mind:
 - It is totally platform agnostic (Ubuntu, SL5, SL6, Debian, Mac OS, *etc.*)
 - Its output is a simple binary format that is happy talking to ROOT, MATLAB, or just about anything else
- LUXSim has already been used for a number of projects at Livermore: liquid argon detectors, Cherenkov counters, some NIF diagnostics.
- BACCARAT and LUXSim have also been endorsed by the AARM collaboration.



BACCARAT Directory Structure



- Should be no surprises for anyone used to writing Geant4 code...
- Users only need to edit code in the “geometry” directory to add their detector to the simulation (everything else: event generation, output, QA/QC, *etc.* done automatically).
- Several example detectors to help users get started.

Dependencies

- BACCARAT is *very* light on dependencies, and is as platform agnostic as we know how to make it.
- Dependency: Geant4.9.4 or Geant4.9.5 (either one)-- changes for getting Geant4.9.6 working should be minimal, and are in the works
- That's it. Everything else (including NEST) comes "batteries included"
- ROOT (version > 5.30) is nice to look at your results, but not necessary. Also a MATLAB reader that hasn't quite made it over from LUXSim yet.



BACCARAT Distribution

- Right now, it's just svn+ssh to the Mac Mini that lives in my office... So contact me if you would like to start playing with it.
- We are looking into different distribution strategies: probably go with svn, maybe a web downloadable tar ball.

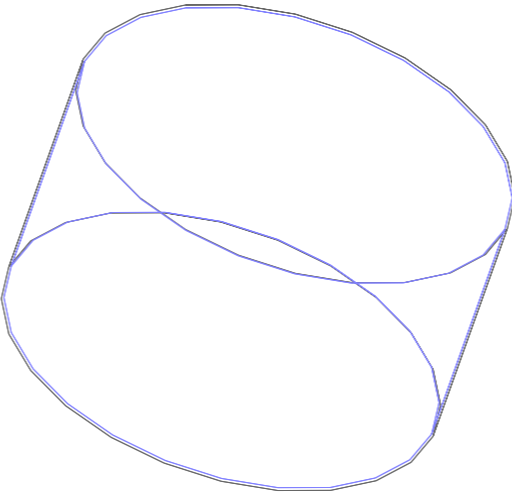
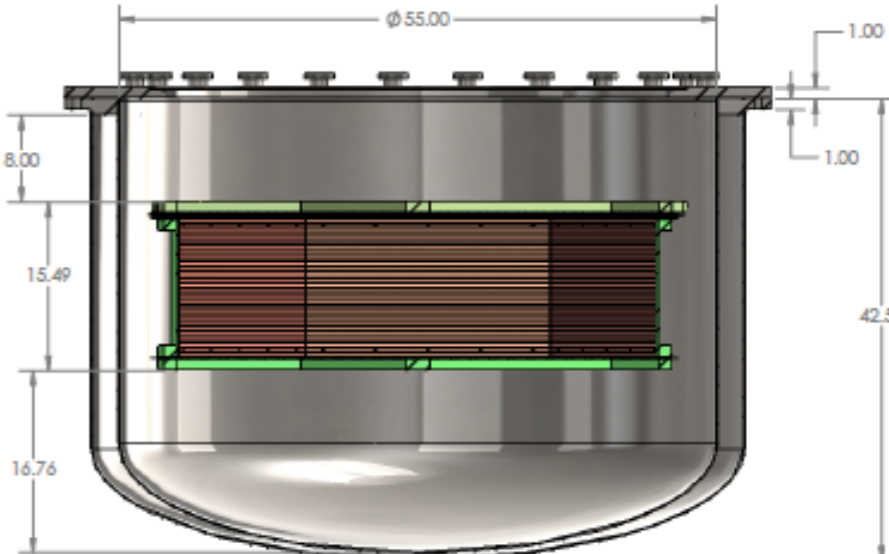


- Please let me know if you have a strong opinion about the right way to do this!

Current BACCARAT Work

- BACCARAT works now! That means:
 - it builds and runs,
 - it is set up so that adding a new detector only requires you to add/edit code to/in the “geometry” directory
 - the goal is for the BACCARAT developers to provide everything else: physics lists, infrastructure, *etc.*
- We are tidying up the last of the infrastructure and documentation now.
- Also adding a last few example detectors: currently have a two-phase TPC. Single-phase scintillation detector and single-phase (liquid) TPC coming soon.

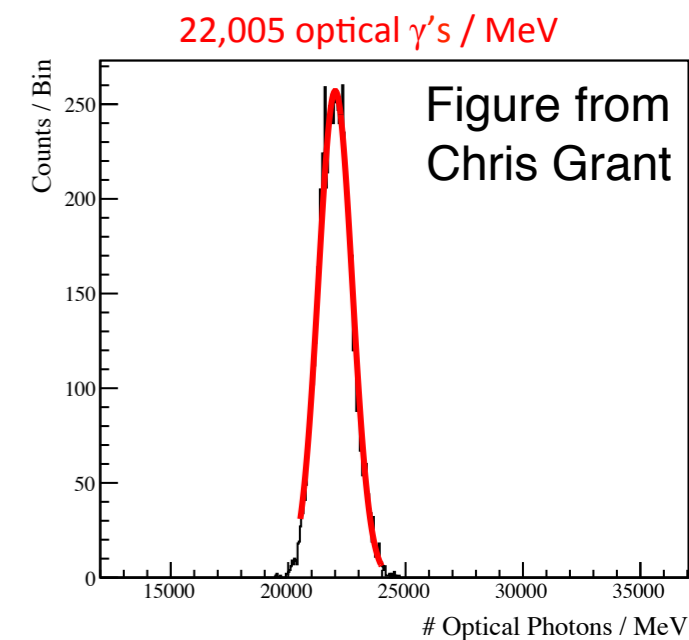
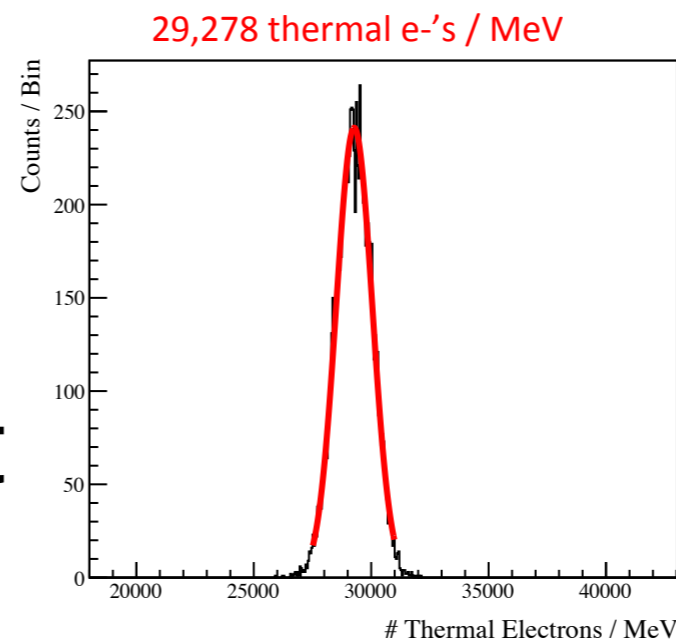
BACCARAT in CAPTAIN

- BACCARAT has been adopted by the CAPTAIN collaboration.
- Have a very simple CAPTAIN geometry. 
- More sophisticated one being worked on by the collaboration (this is NOT part of the general BACCARAT distribution). 
- Initial simulations with simple geometry done (by Chris Grant) to look at the partitioning of the charge and light signal (native, graceful integration with NEST *really* helped here!).

BACCARAT in CAPTAIN

- Started with isotropic emission of 10 MeV electrons at the center of the simplified geometry
- Count the total number of photons and ionization electrons

- Work function defined as minimum energy to produce charge or light (for Ar, $W = 19.5 \text{ eV}$)



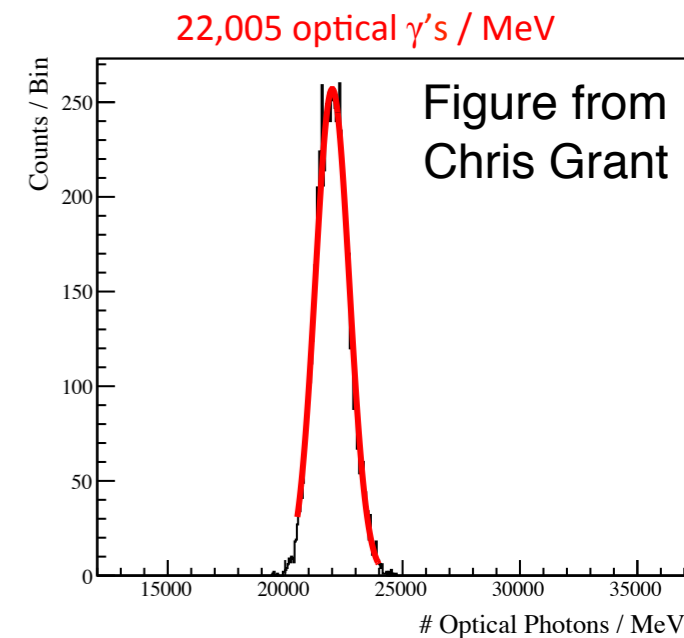
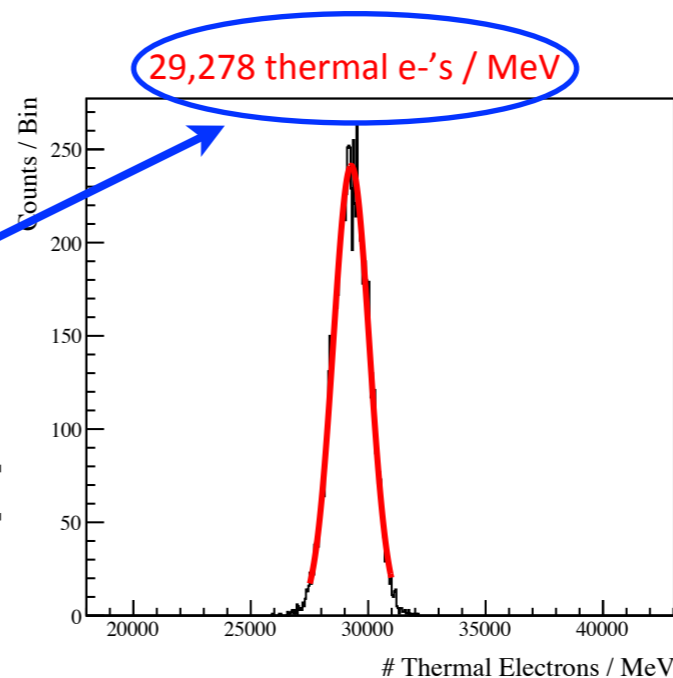
- Total quanta: $N_q = N_{e^-} + N_\gamma = \frac{E_{dep}}{W} = \frac{51000 \text{ quanta}}{\text{MeV}}$
- From ICARUS data: 29.3 ionization electrons per keV

BACCARAT in CAPTAIN

- Started with isotropic emission of 10 MeV electrons at the center of the simplified geometry
- Count the total number of photons and ionization electrons

- Work function defined as minimum energy to produce a photoelectron (for Ar, $W = 19.5 \text{ eV}$)

Hey, look at that!



- Total quanta: $N_q = N_{e^-} + N_\gamma = \frac{E_{dep}}{W} = \frac{51000 \text{ quanta}}{\text{MeV}}$

- From ICARUS data: 29.3 ionization electrons per keV

BACCARAT in the Future

- Finish our official roll out!
 - Getting last few example geometries built
 - Need to finalize documentation and hosting
 - Iron out any licensing/legal disclaimer issues
- Continue to cross check argon response model with data from LAr experiments (ICARUS has lots of detector performance publications!)
- Optimize layout of photon detection system in CAPTAIN
- Build up LBNE FD geometry

Conclusions

- BACCARAT has a very mature infrastructure, and is getting traction throughout a number of communities
- We are just starting our efforts on LBNE, but we should be able to make a lot of progress quickly
- This is **NOT** intended to replace LArSoft!
 - There is currently no reconstruction in BACCARAT
 - Our intent is to provide a tool that allows people the ability to quickly and easily sweep through some detector design space with minimal overhead so that it is easier to make smart design choices that will feed into full reconstruction in LArSoft and construction of prototype and production detectors.

Thank you for your attention...
Any questions?

