Physics software deployed using Spack

Marc Paterno
August 20, 2020

What is CosmoSIS for?

- CosmoSIS is a modular Markov Chain Monte Carlo (MCMC) parameter estimation system.
- The *modularity* lies in the user's ability to insert Python, Fortran, C, or C++ *modules* into the likelihood calculation.
- Its primary task is to use observed data to constrain the values of parameters in physical models, with an emphasis on cosmological models.
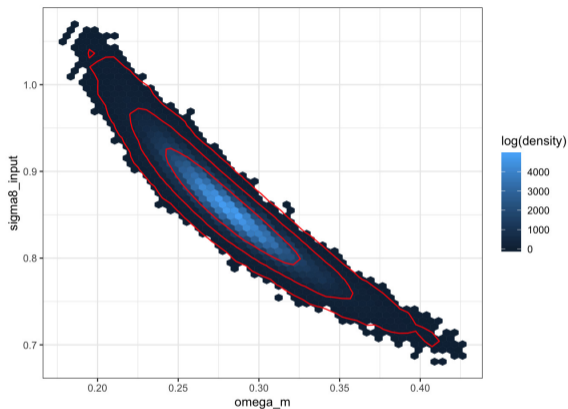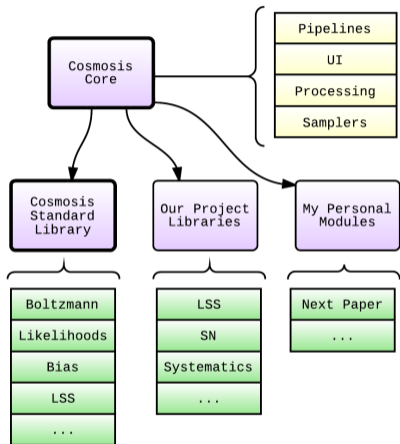

Figure 1: An example 2-d posterior density.

🌐 Fermilab

The structure of CosmoSIS

- CosmoSIS programs are composed of code from multiple sources.
  - The CosmoSIS core contains samplers and supporting code to make *pipelines* run.
  - The CosmoSIS Standard Library and project libraries contribute *modules*.
- The *spack-dev* team has built CosmoSIS, the CSL, and all the supporting libraries we need into CVMFS.
- We can build our analysis code on any machine that mounts CVMFS, and compile our project libraries.
  - The result is a ~20 MB tarball to deliver to a grid node for running.

🐝 **Fermilab**

Galaxy cluster analysis
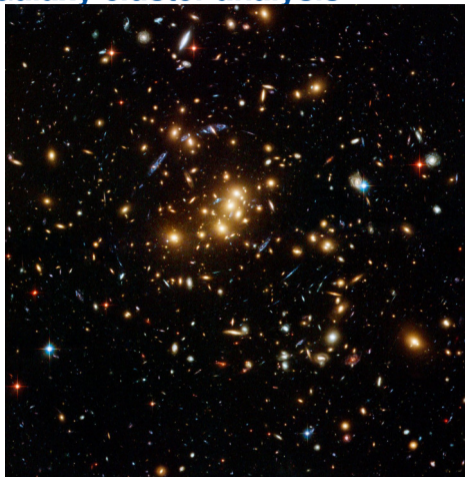
- Analysis technique: predict the number and distribution of galaxy clusters in the universe from fundamental cosmology.
- Previous analyses like this have used simple approximations for many astrophysical effects.
- This analysis is using well-motivated mathematical models for many effects.
- Effects to be modeled include:
  - Halo mass function
  - Critical Density
  - Survey area
  - Volume Element
 - Various scaling relations
  - Miscentering
  - . . .

🐝 **Fermilab**

How we build our code

- Our project has C++ and Python code
  - Our C++ code is built using `CMake`.
  - Supporting Python code is installed in a *virtual environment*
- We build using compilers, Python, and other critical libraries supplied in CVMFS.
- CosmoSIS has recently moved from using UPS for setup to using spack:
  - old: `setup -B cosmosis-ups <version>`
  - new: `spack load -r cosmosis <version>`
- As an aside: creating an updated CosmoSIS package using spack requires far less expertise than does updating the `cosmosis_ups` package.

🐝 **Fermilab**

Science results (almost)
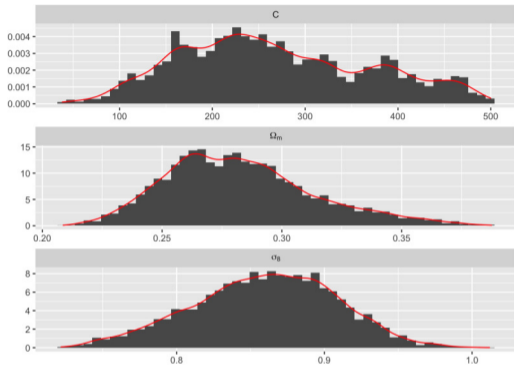
* We are now concentrating on tuning up our software, using available grid resources.
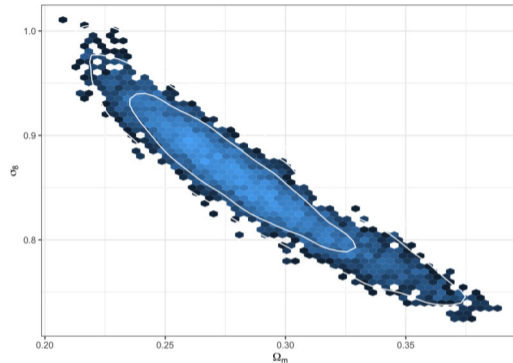
* Many thanks to the *spack-dev* team who converted our use of UPS infrastructure to use of Spack and CVMFS.

🐦 Fermilab