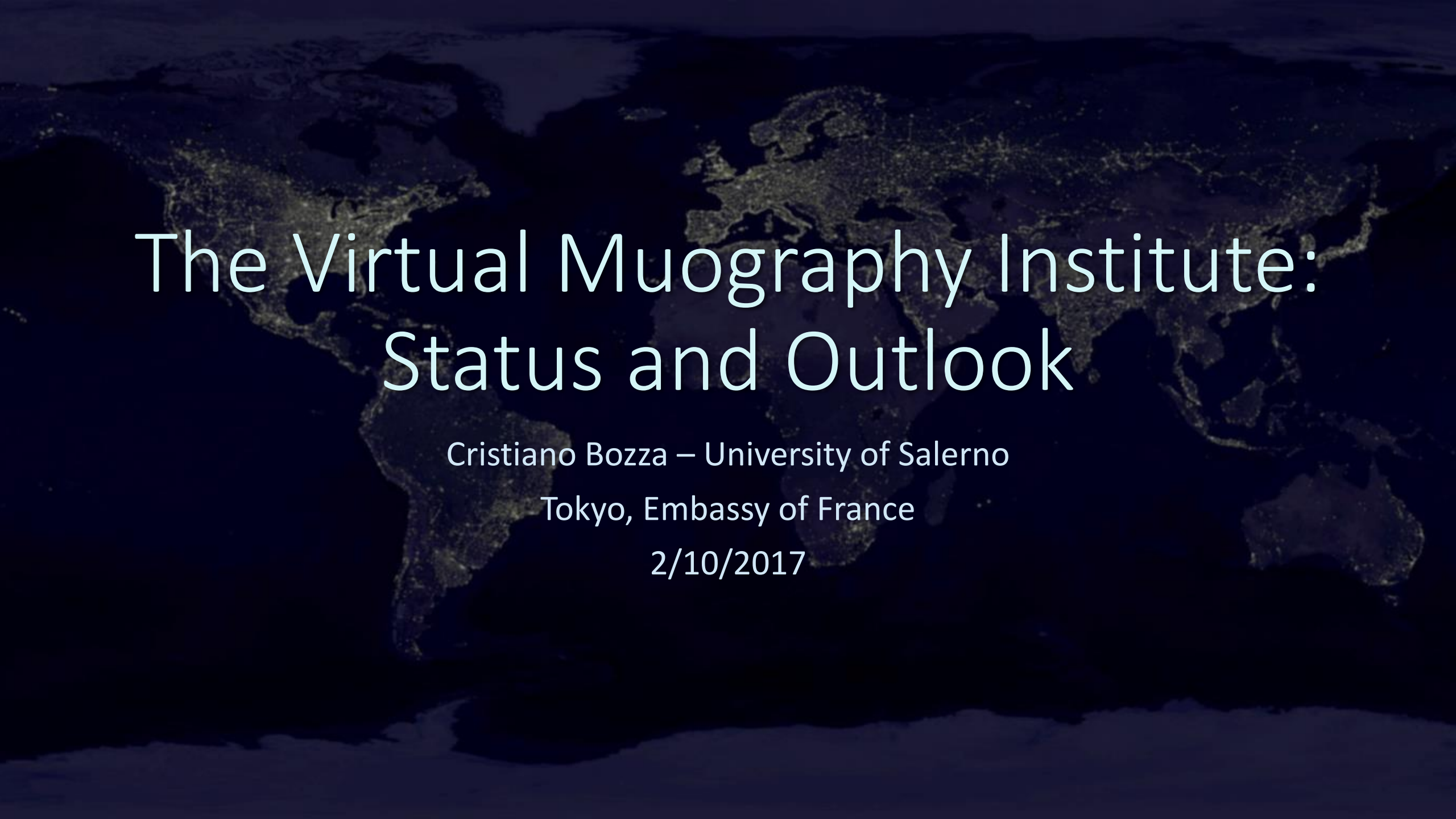


The Virtual Muography Institute: Status and Outlook

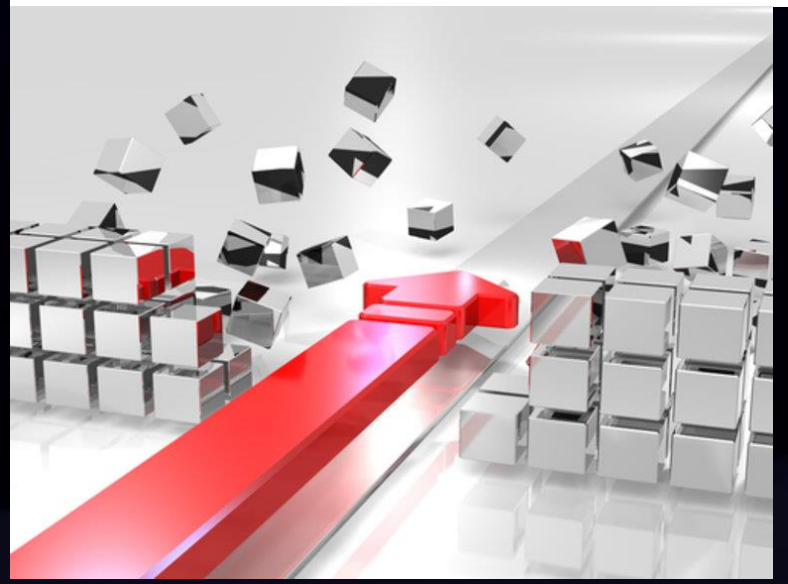
Cristiano Bozza – University of Salerno

Tokyo, Embassy of France

2/10/2017

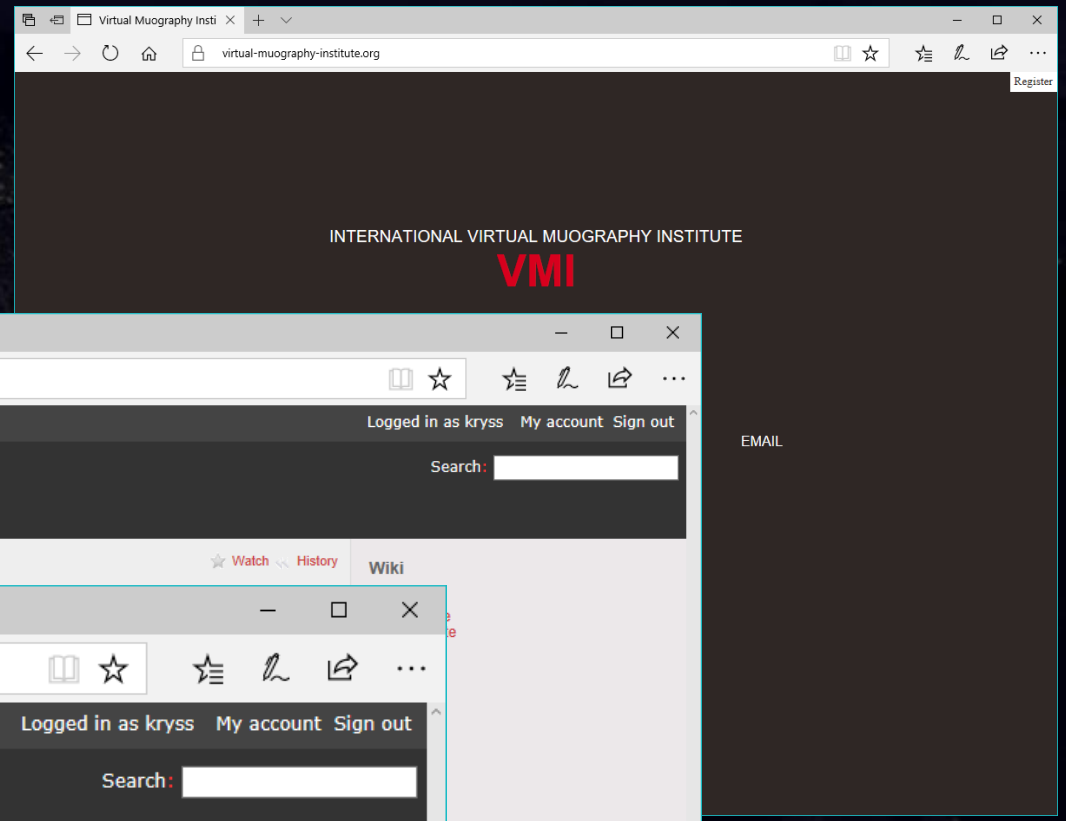
Motivations for a virtual institute

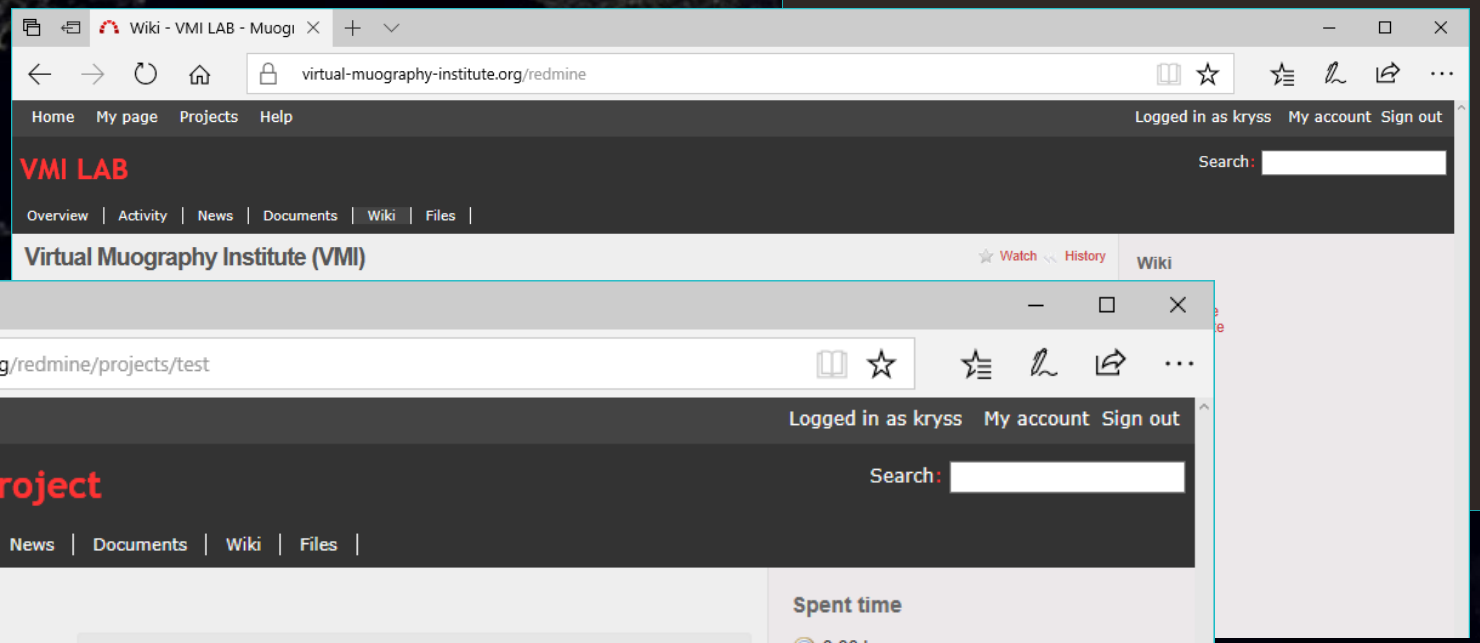
- Work together to speed up progress on muography
- Split problems, optimize solutions
- Boost discussion, help prepare common projects
- Break software barriers (different environments/formats)

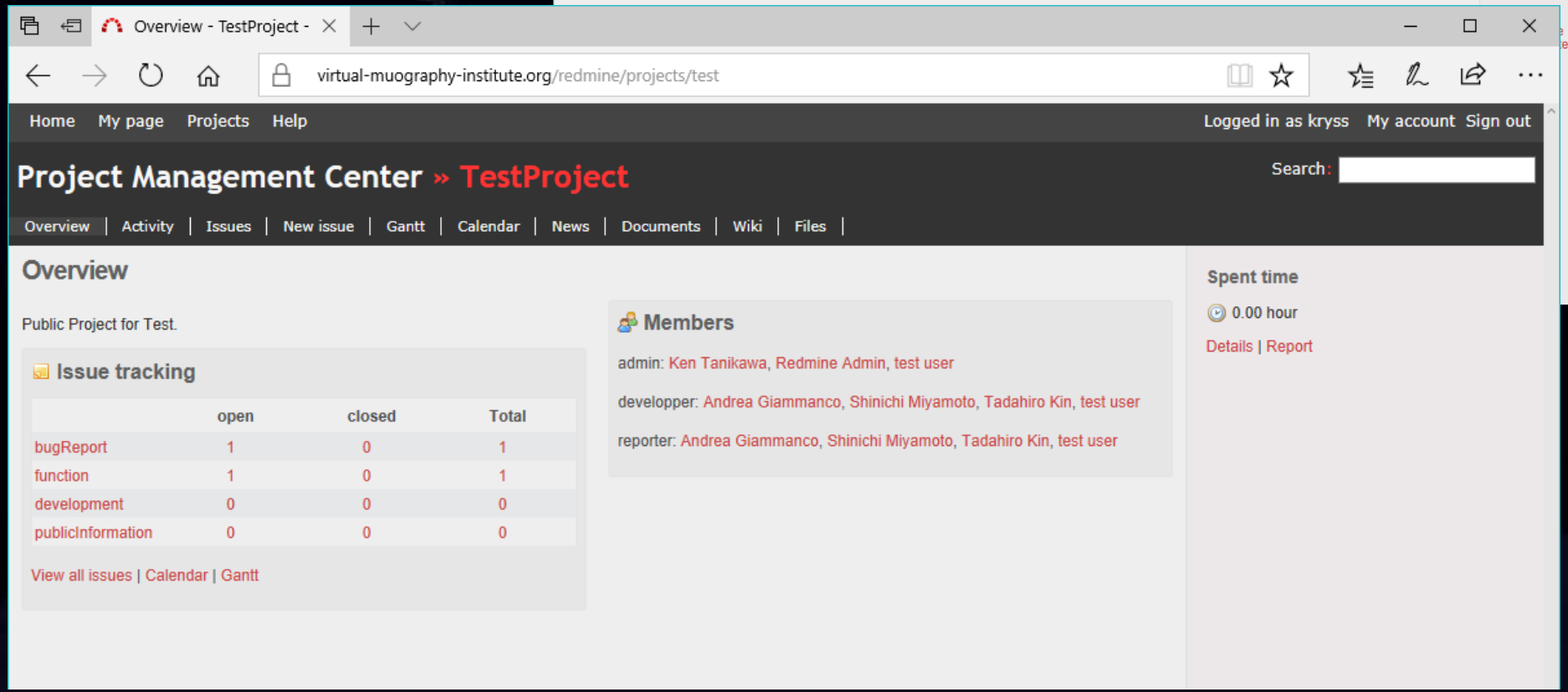


What can VMI do for you – 1/2

- Account (mail), News
- Wiki, Documents
- Project tracking (Redmine)

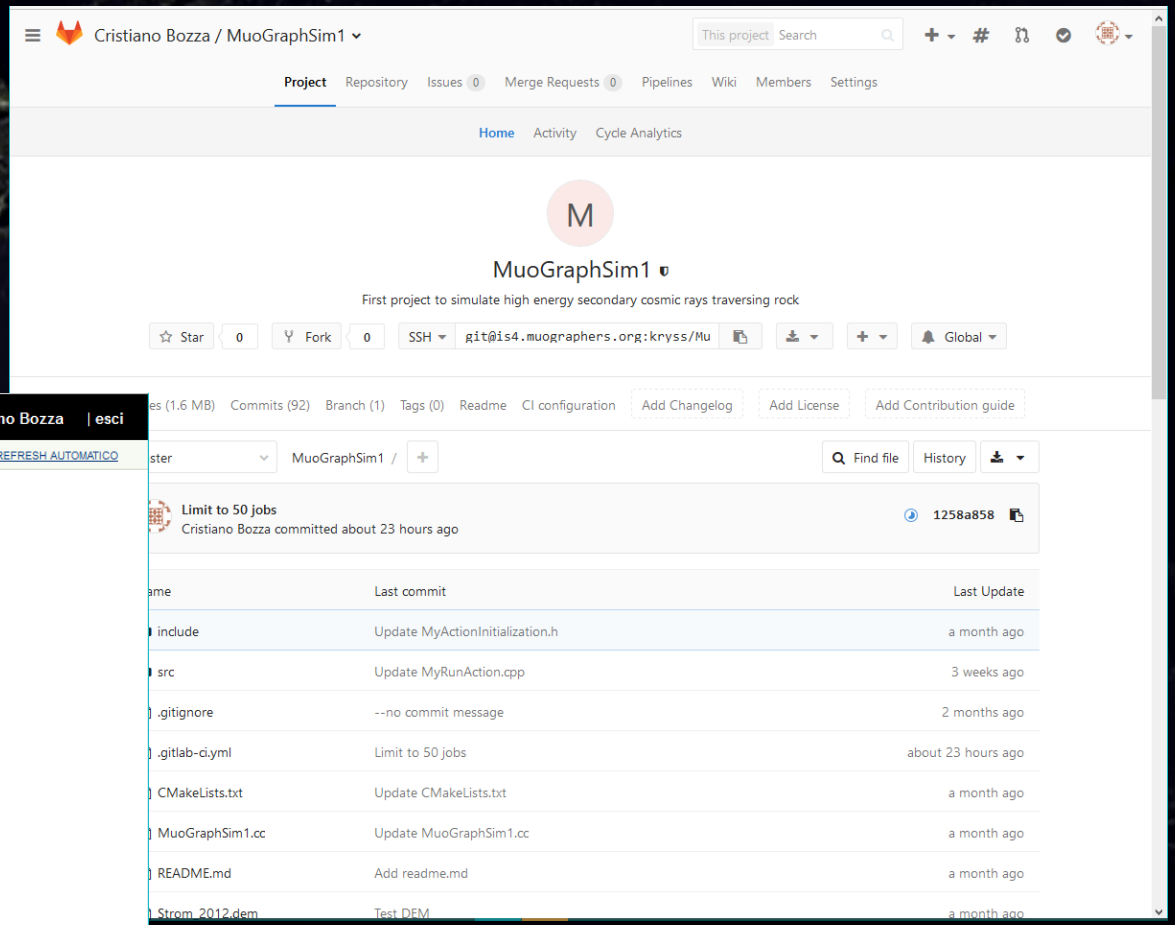


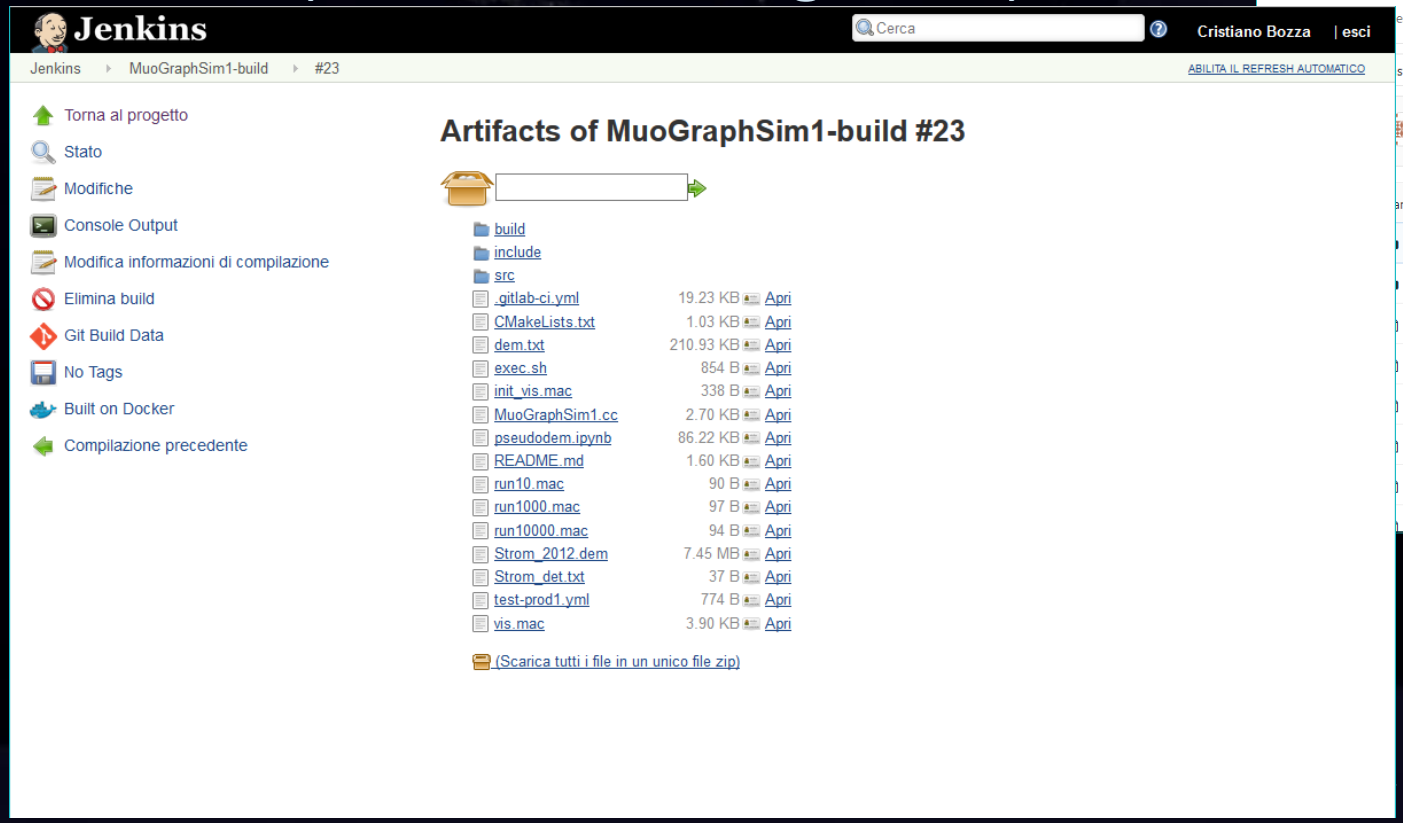




What can VMI do for you – 2/2

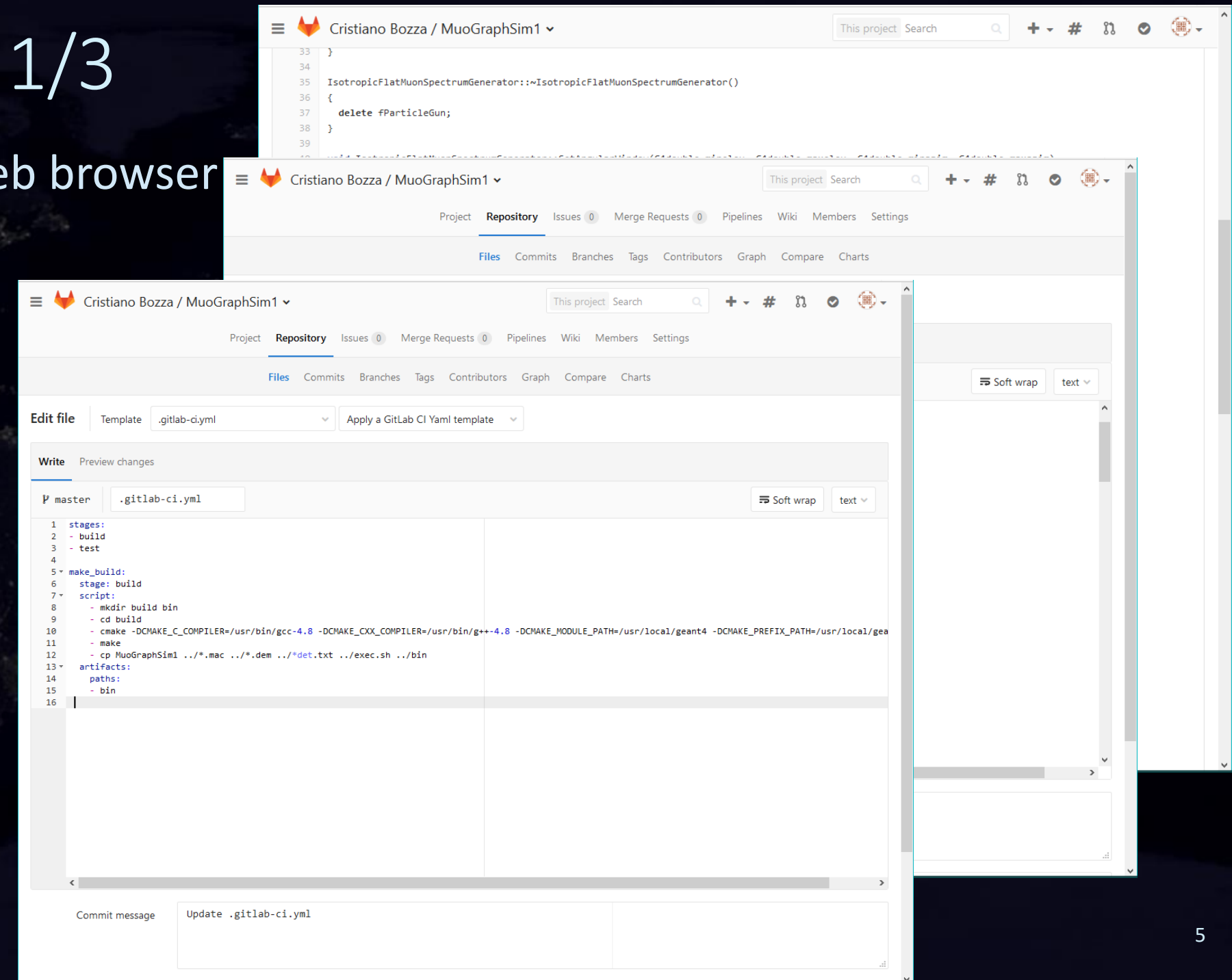
- Geant4 installed
- Gitlab (software management + build/test/run pipelines)
- Jenkins (continuous integration)





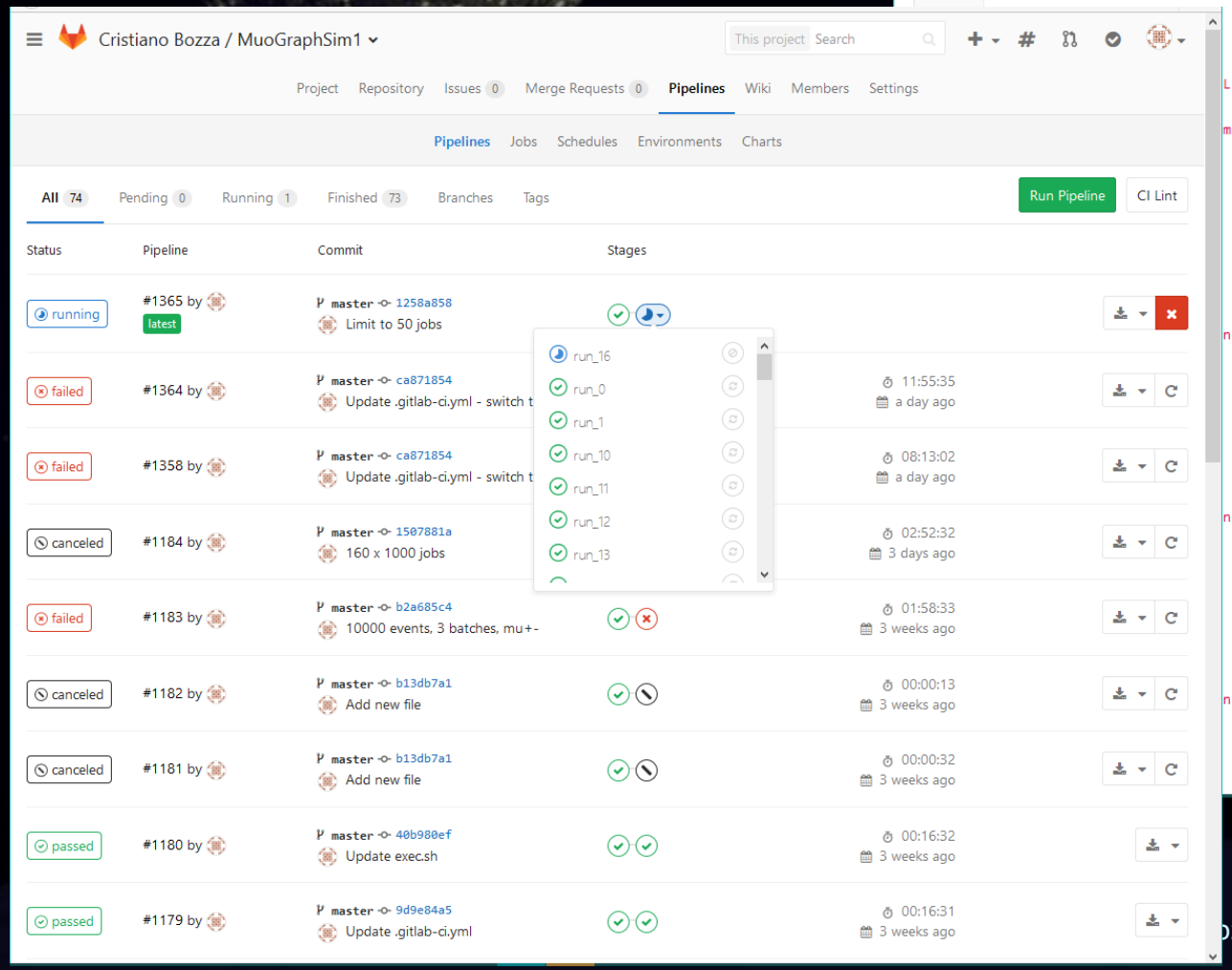
Gitlab at VMI – 1/3

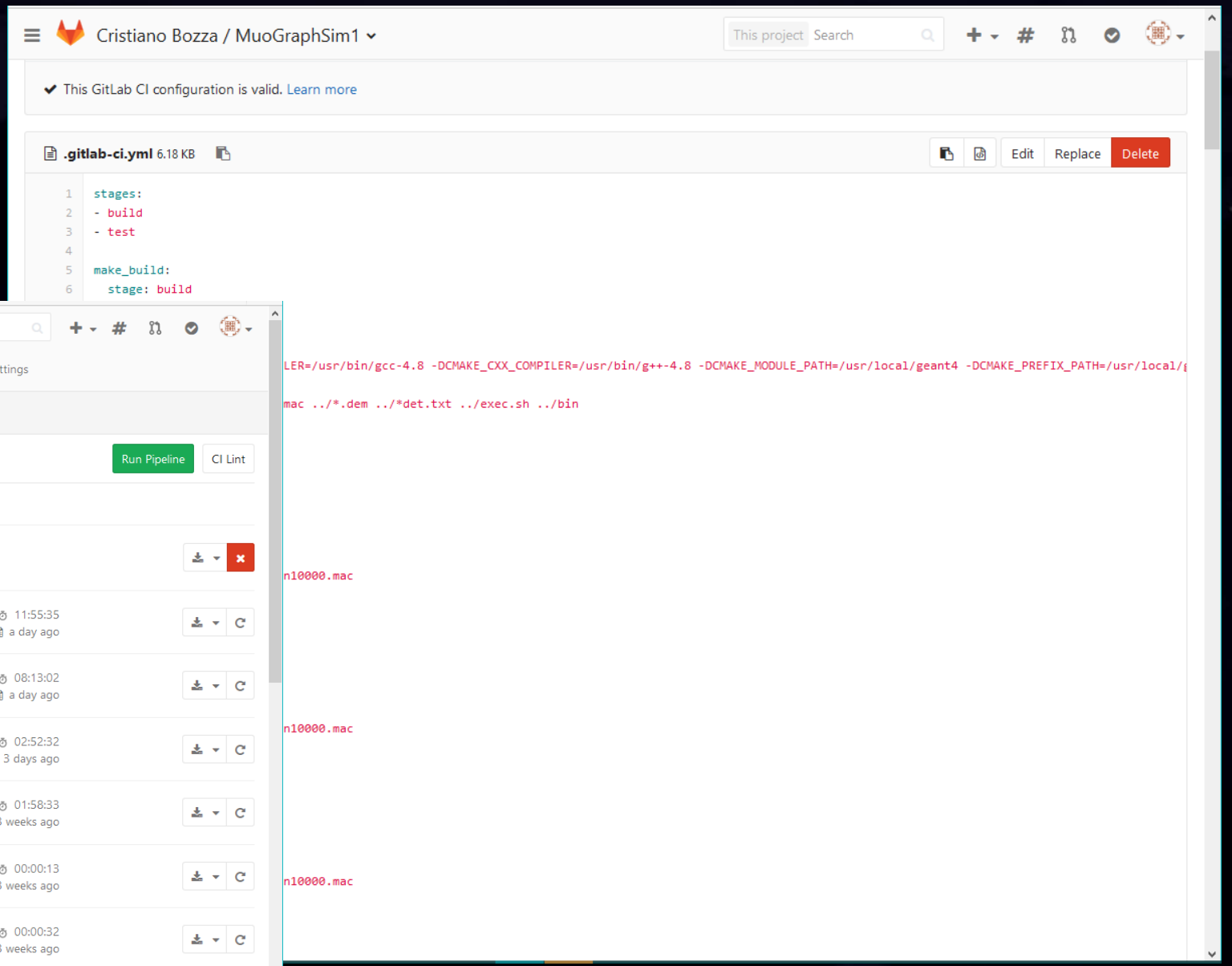
- View source files in web browser
- Edit «in place» or use local «git» to manage software evolution
- Define build and test procedures



Gitlab at VMI – 2/3

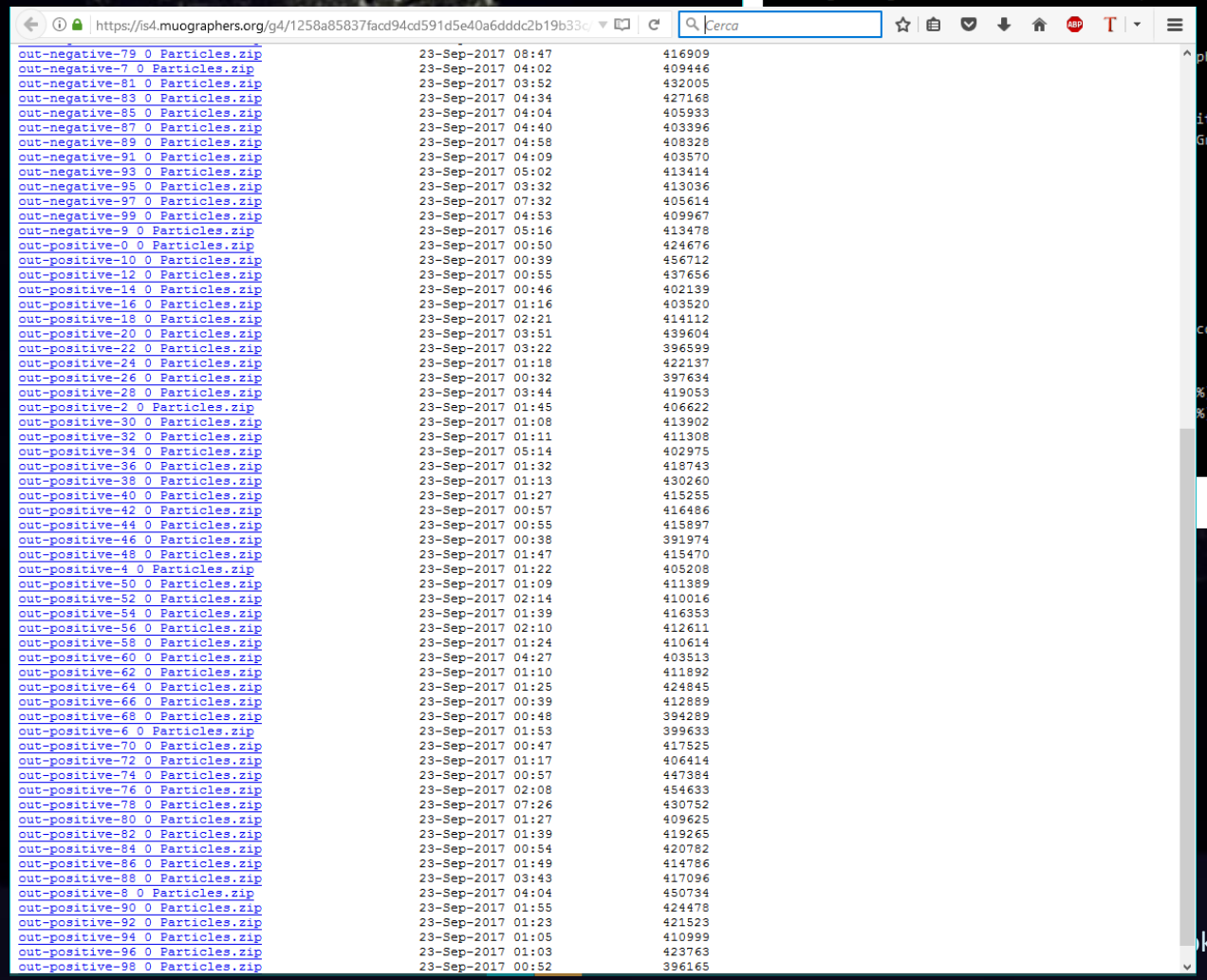
- Run tests or use the feature to launch data production

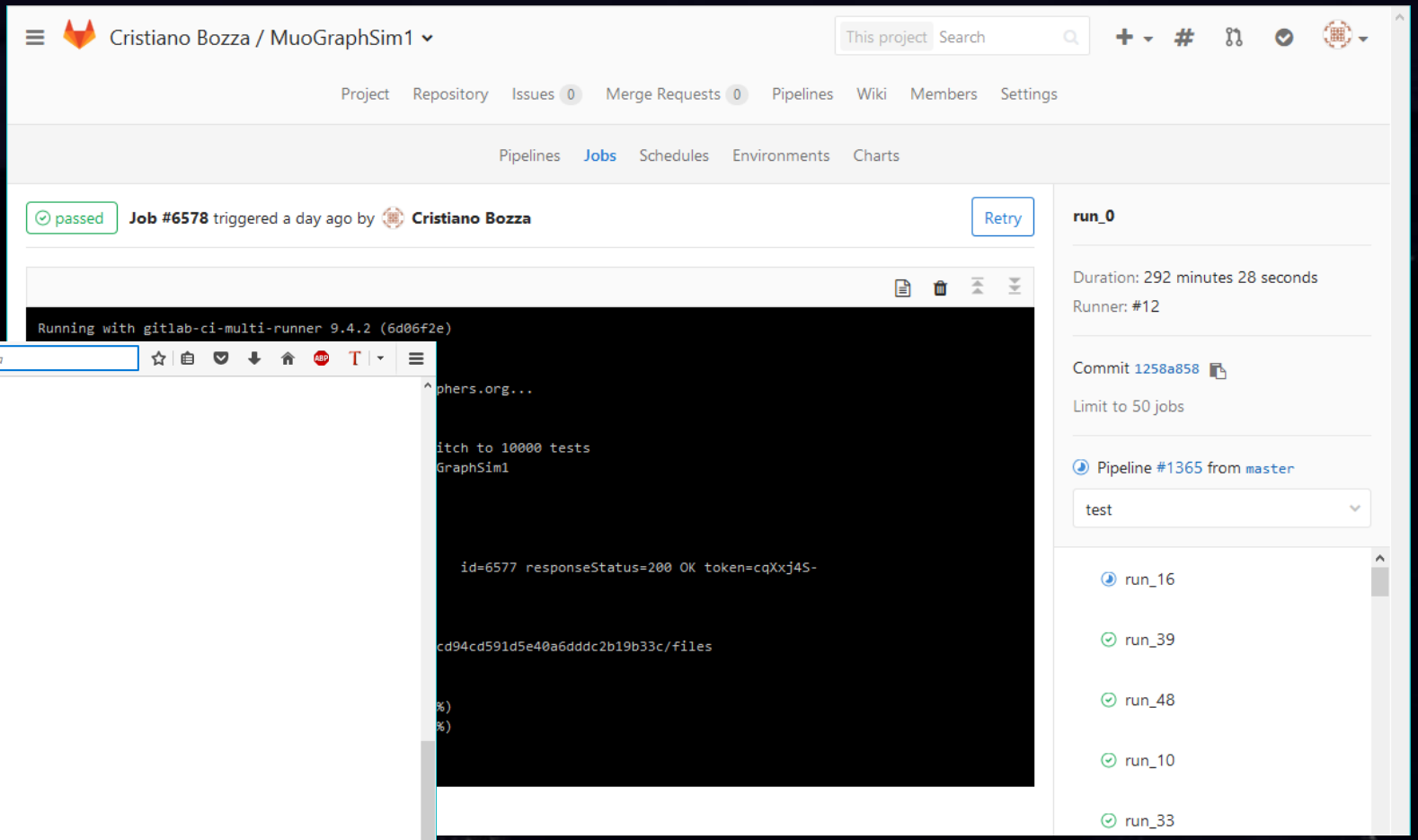




Gitlab at VMI – 3/3

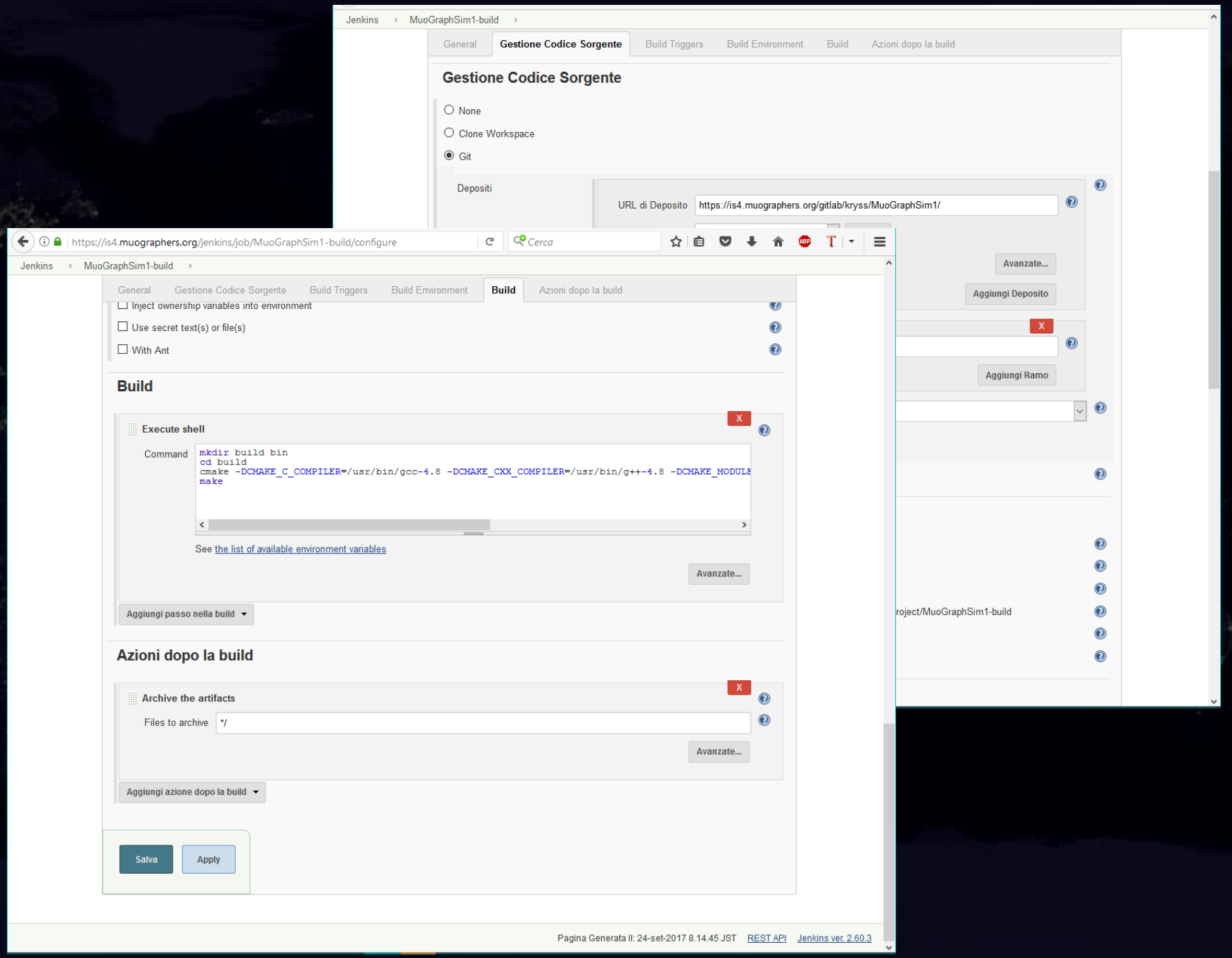
- Pick results of simulations as zip files via HTTP





Jenkins at VMI

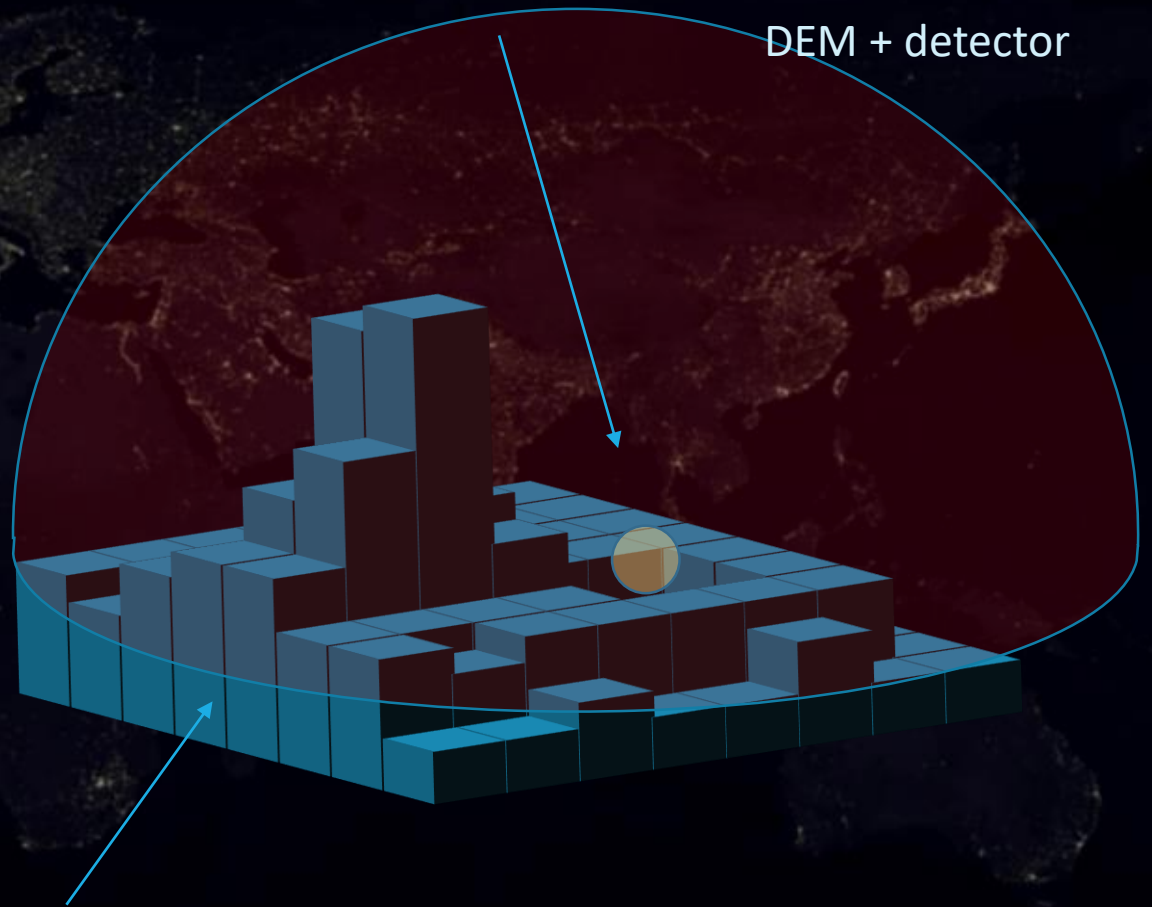
- Integrated with git
- Custom shell scripts can be called
- Save artifacts (including possible data files) after build



MuoGraphSim1 at VMI

- First Geant4 program at VMI
- Simple but flexible
- Decouple cosmic ray simulation from passage through rock and instrument acceptance
- Output files document incoming muon as well as all particles at the detector surface with a proper range (1 m)
- Easy to apply weights to rescale to cosmic ray models

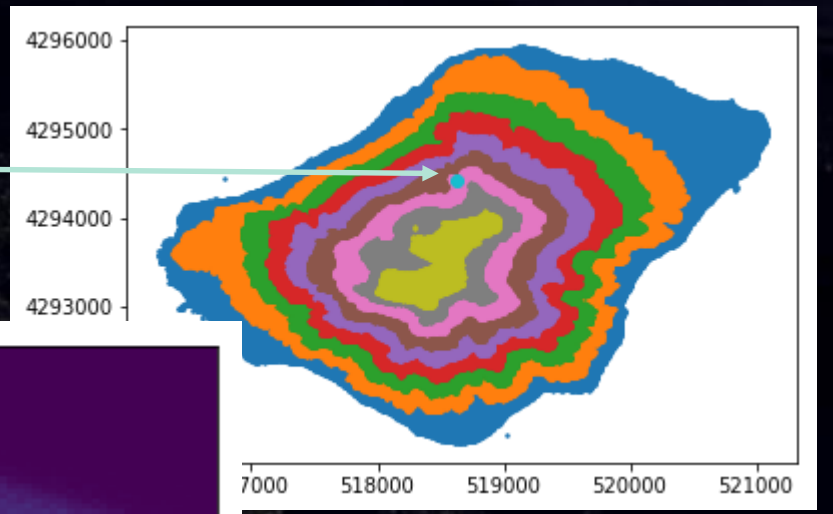
DEM: rectangular mesh (free step and size)
Detector: 10m radius sphere, efficiency = 1

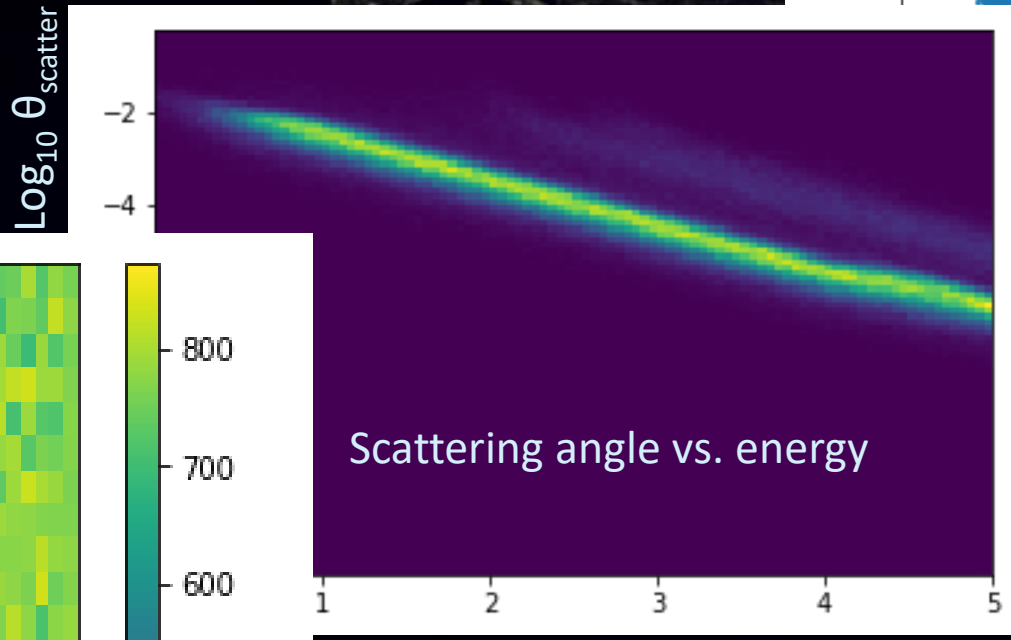


MuoGraphSim1 at VMI

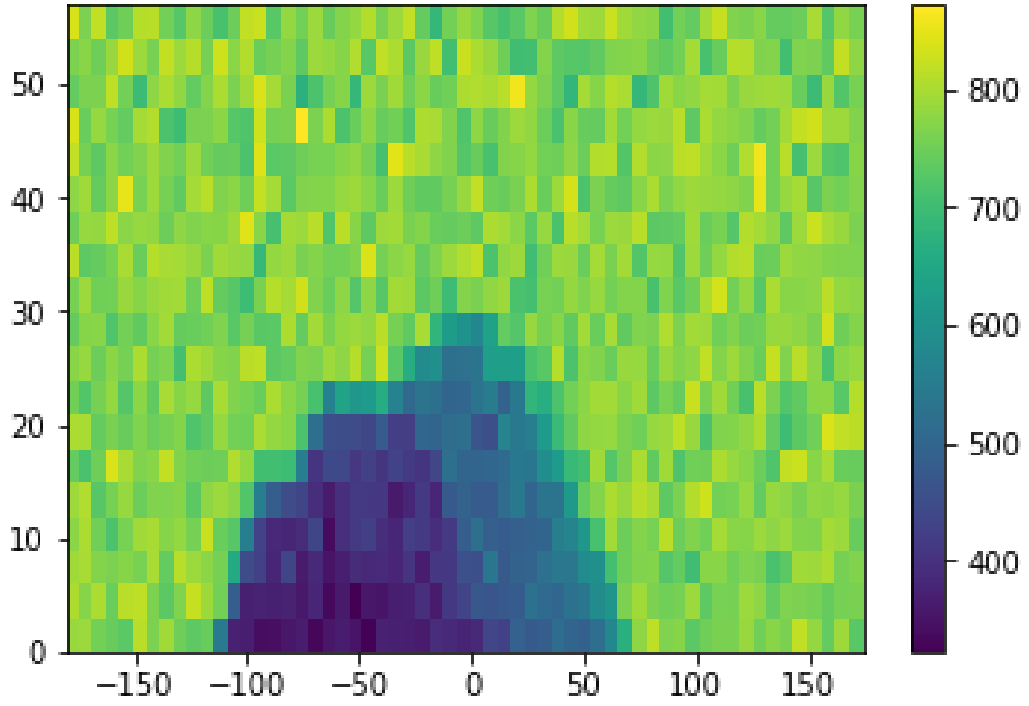
- Example of application to Stromboli
- 1,5 Mtracks
- 5 hour running

Stromboli
DEM 2012
Detector
X,Y in m





Scattering angle vs. energy



Muons crossing rock
(Log-flat isotropic spectrum)

Cloud Hardware at VMI

- CPU: 2×14 cores = 28 real cores, 56 hyperthreaded
- Memory: 64 GiB, possible upgrade to 192 GiB
- Storage: 6 TB

- Upgrades available depending on usage!

Simulation of secondary cosmic rays – 1/2

- Install CORSIKA or COSMOS at VMI
- Use ready-made CORELib production by KM3NeT for ASTERICS (www.asterics2020.eu), currently distributed through a server in Salerno
- 1% «no Cherenkov» pilot production → 550 GB

High energy model	Low energy model	Option	
		TAULEP	CHARM
QGSJET01	GHEISHA		X
QGSJET01	GHEISHA	X	
QGSJETII-04	GHEISHA	X	
EPOS LHC	GHEISHA	X	

Energy range (GeV)	Number of events
200-1000	10^7
10^3-10^4	10^7
10^4-10^5	10^6
10^5-10^6	10^5
10^6-10^7	10^4
10^7-10^8	10^3
10^8-10^9	10^2

Simulation of secondary cosmic rays – 2/2

Status of CORELib

- Proton-induced showers:
  - HE models : QGSJET01 with CHARM, QGSJET01 with TAULEP, QGSJET-II with TAULEP, EPOSLHC with TAULEP
  - LE model : GHEISHA
  - about 21M Evts per HE model
  - 7 energy bins (2×10^2GeV-10^3GeV+equally logarithmically spaced from 1TeV to 10^9GeV)
  - power-law spectrum with -2 spectral index
  - zenith angle from 0 to 89 degrees
- Nuclei-induced showers:
  - HE model : QGSJET01 with CHARM, QGSJET01 with TAULEP, QGSJET-II with TAULEP, EPOS-LHC with TAULEP
  - LE model : GHEISHA
  - about 21M Evts per HE model
  - 7 energy bins (2×10^2GeV-10^3GeV+equally logarithmically spaced from 1TeV to 10^9GeV)
  - Power-law spectrum with -2 spectral index
  - zenith angle from 0 to 89 degrees

Conclusions

- VMI is moving its first steps
- Very interesting opportunity for real, tight cooperation
- Geant4 cloud already set up and running
- Possible interaction with other projects
- Capabilities will grow with user demand, so don’t hesitate to ask!