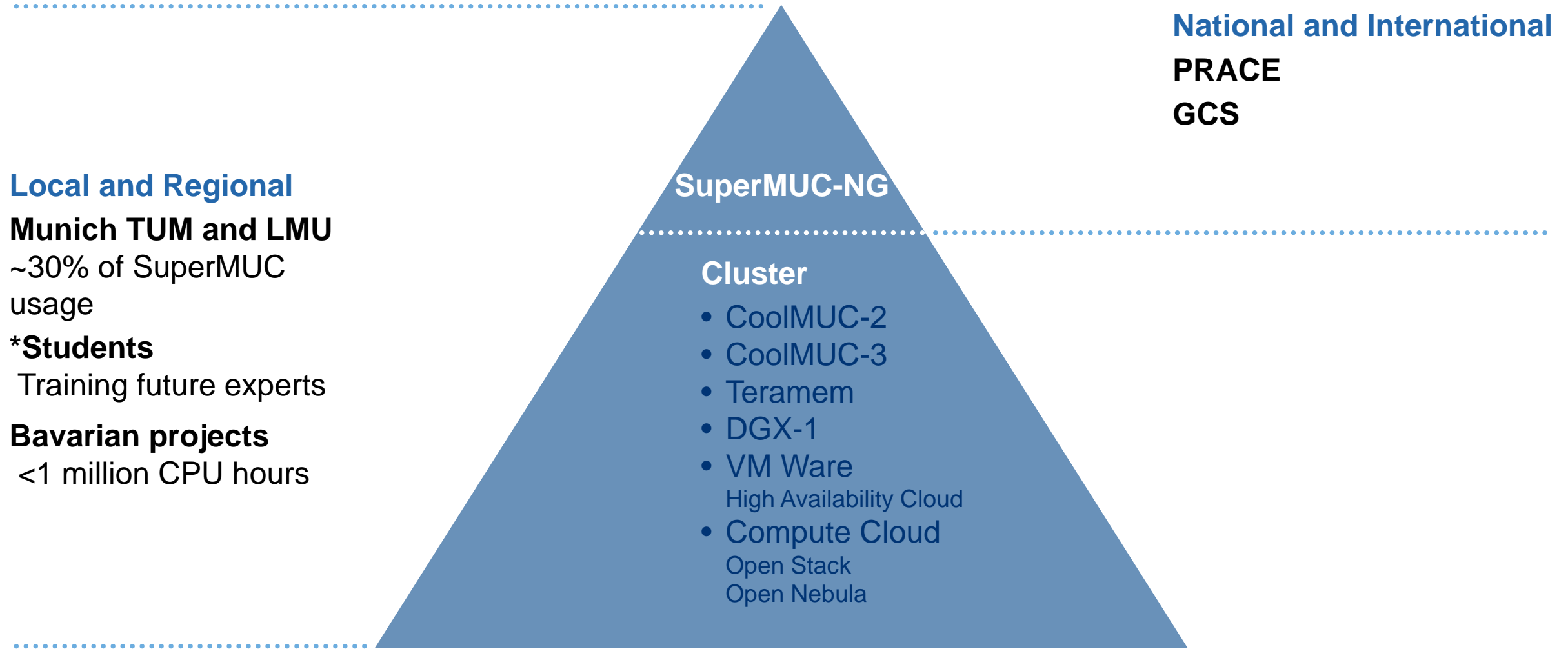




Leibniz Supercomputing Centre  
of the Bavarian Academy of Sciences and Humanities

# Running your HPC and AI projects on LRZ systems

23.7.2019 | Luigi Iapichino



# SuperMUC-NG (Next Generation)



## Specs

- Peak Performance: 26.7 Pflop/s
- 719 Tbyte main memory and
- 70 Pbyte disk storage
- 6,480 Lenovo ThinkSystem nodes with Intel Xeon processors (Skylake)
- 311,040 compute cores
- Intel Omni-Path interconnects
- Direct hot water cooled + Adsorption coolers (47 C)

## HPC + Cloud

- Usage of own and individual virtual machines (integrated cloud)
- Pre- and post-processing with user's individual software
- Integrated development, ability to use familiar software and tools
- Remote visualization and integration to V2C





# SuperMUC-NG (Next Generation)



**#9**

in the world  
Overall performance (as of June 2019)



**#1**

in the world  
Data-intensive applications  
SSSP benchmark

**#5**

in the world  
Data-intensive applications  
BFS benchmark



**#1**

System in the EU



**HPCwire Award**  
for Energy Efficiency



200 research fields



**7.6 Billions**

Compute hours utilized



**5.6 Millions**

Computing jobs performed



**750**

Research projects supported



**1,995**

Researchers as users







# IT Service Provider



# Science Solution Enabler

# Application Mix – General Purpose, Broad Use



## Computational Fluid Dynamics

Optimisation of turbines/wings, noise reduction

---

## Fusion

Plasma in a future fusion reactor (ITER)

---

## Astrophysics

Origin and evolution of stars and galaxies

---

## Solid State Physics

Superconductivity, surface properties

---

## Geophysics

Earth quake scenarios

## Material Science

Semiconductors

---

## Chemistry

Catalytic reactions

---

## Medicine and Medical Engineering

Blood flow, aneurysms, air conditioning

---

## Biophysics

Properties of viruses, genome analysis

---

## Climate research

Currents in oceans

# What do the *first image of a black hole* and HPC have in common?

Image reduction:  
PBytes of data

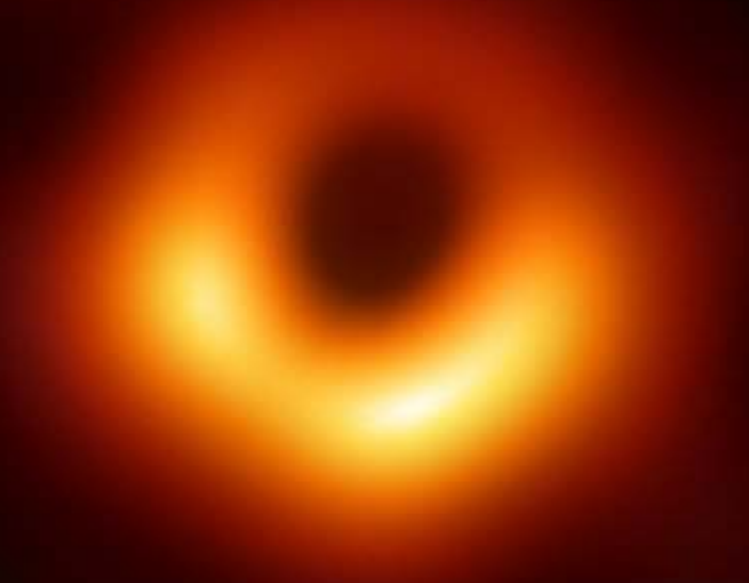
Theoretical modeling:  
comparison with  
simulations is necessary

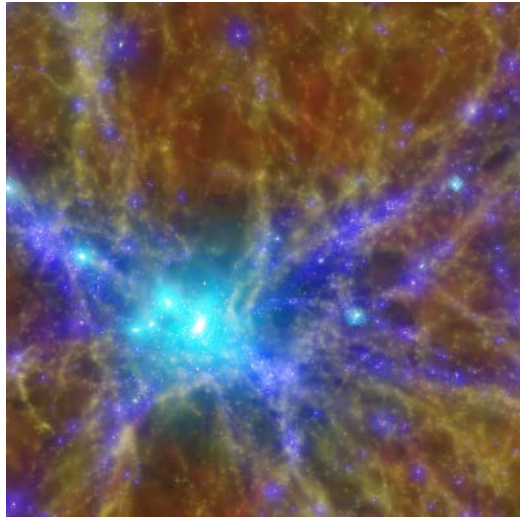
ECHO-3DHPC has been  
part of the comparison  
project of general relativity  
simulation codes (Porth et  
al. 2019, arXiv: 1904.04923)  
to validate the observational  
results

Both ECHO and BHAC  
(Black Hole Accretion Code;  
Porth et al.) have been  
optimized in collaboration  
with LRZ

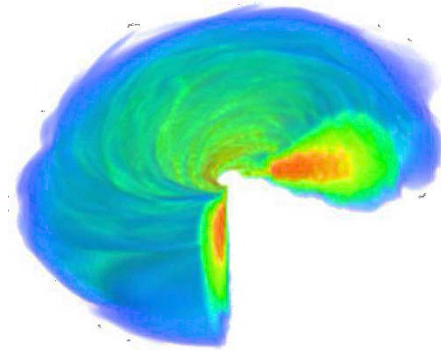
The use of both SuperMUC  
and Hazel Hen (HLRS  
Stuttgart) is acknowledged  
in the EHT papers

(credits: EHT Collaboration 2019)

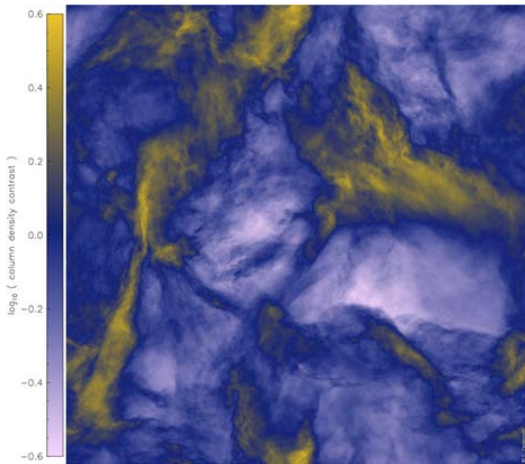




Dolag et al. (LMU)



Bugli et al. (CEA Saclay)



Federrath et al. (ANU / ITA)

**Lab members:** L. Iapichino, S. Cielo, S. Hachinger, V. Jančauskas, M. Martone

**High-level support** (also GCS, PRACE): code modernisation on SuperMUC and SuperMUC-NG.

*Highlights:*

- Intel Parallel Computing Center @ LRZ/TUM
- Magneticum simulation suite (Dolag)
- The world's largest turbulence simulation (Federrath & Klessen)
- Numerical simulations for the Event Horizon Telescope (Bugli; Porth)

# AstroLab: new steps as HPC evolves



## Supporting cutting-edge research

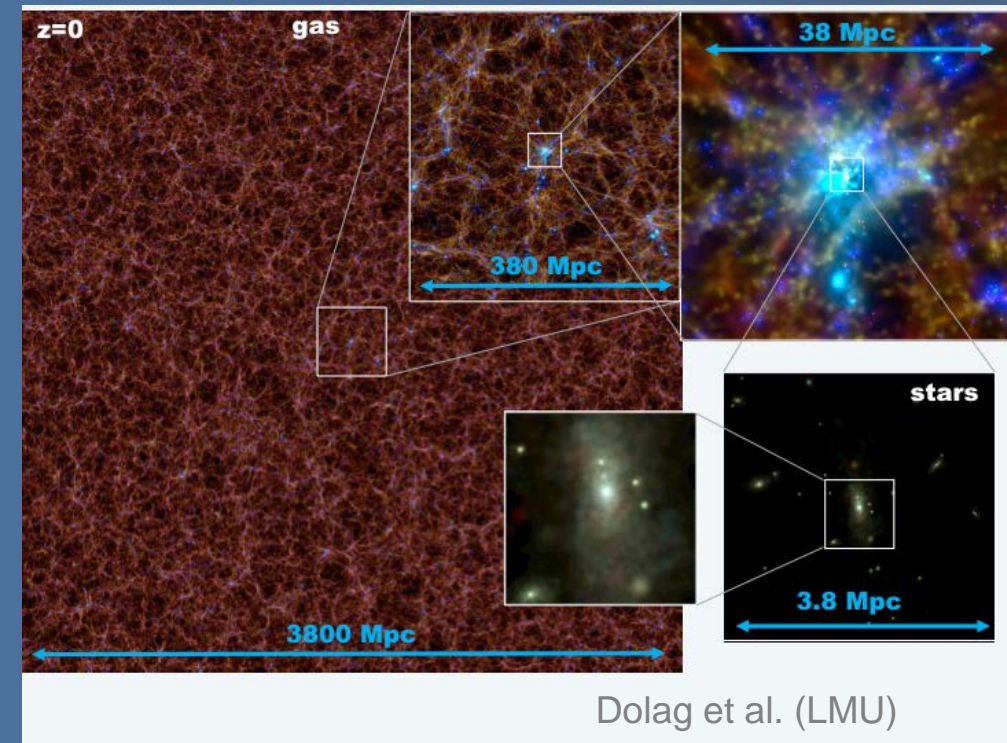
- Runs at machine scale (Gadget, Arepo, GReX, FLASH)
- New solutions for optimization: semantic patching

## Machine learning and HPC

- AI at scale on SuperMUC-NG

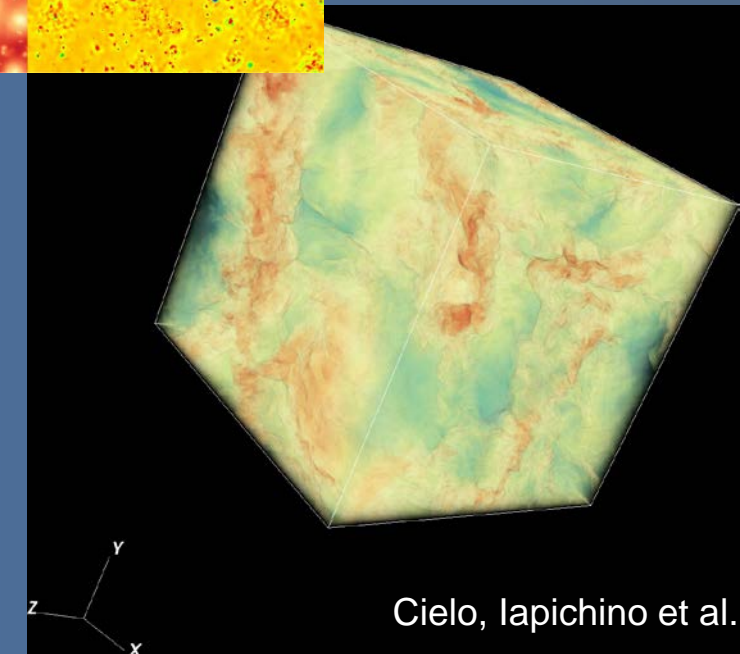
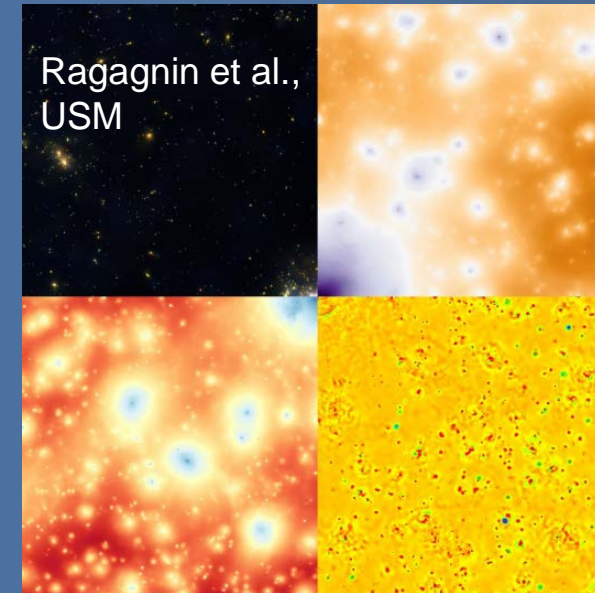
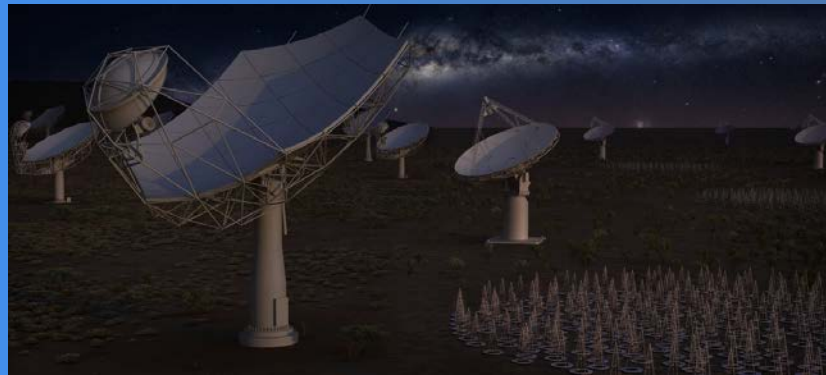
## Community building (in collaboration with Intel):

- HPC code optimization workshop
- Tutorials at the ESO conference “AI in Astronomy”

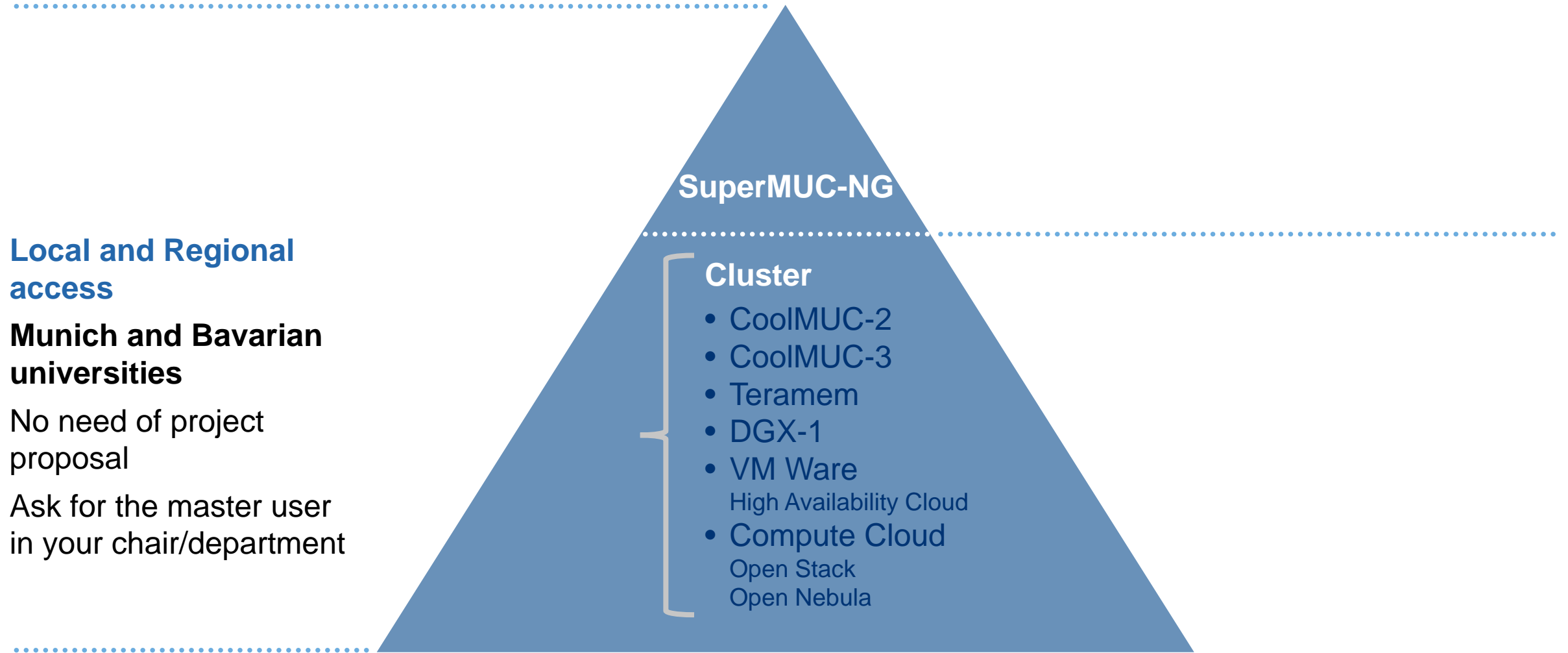


## AstroLab and data science

- Magneticum Web Portal: access and analysis of simulations from browser
- Software-defined visualization: volume rendering of 10's TB on SuperMUC-NG
- Collaboration with Astro-NFDI (National Research Data Infrastructure)
- Engagement in the German SKA and LSST communities



# How to access the LRZ systems





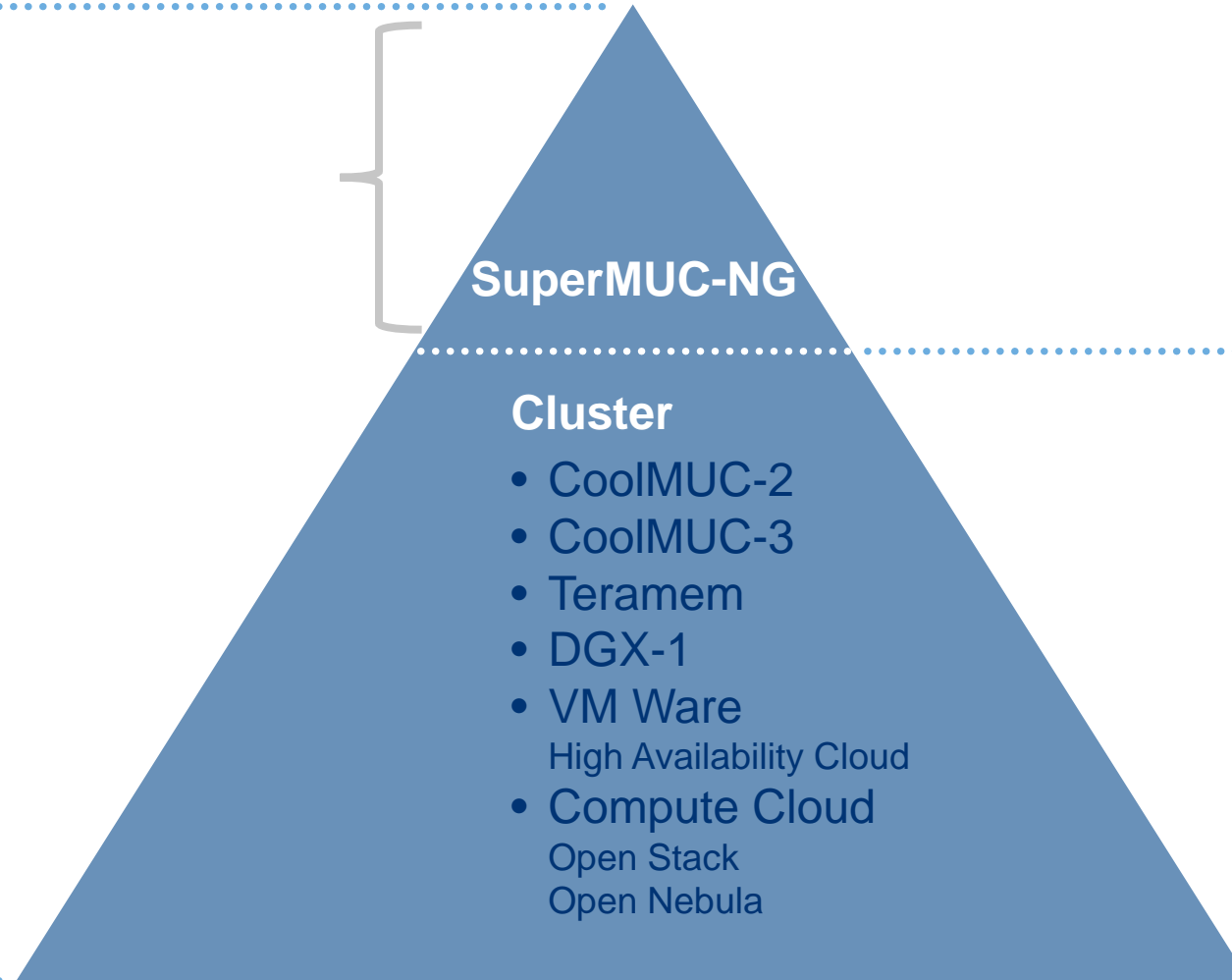
# How to access the LRZ systems

## National access

**Projects with PI from a German institution**

Need to submit a project proposal (running call)

Scientific and technical review



# How to access the LRZ systems

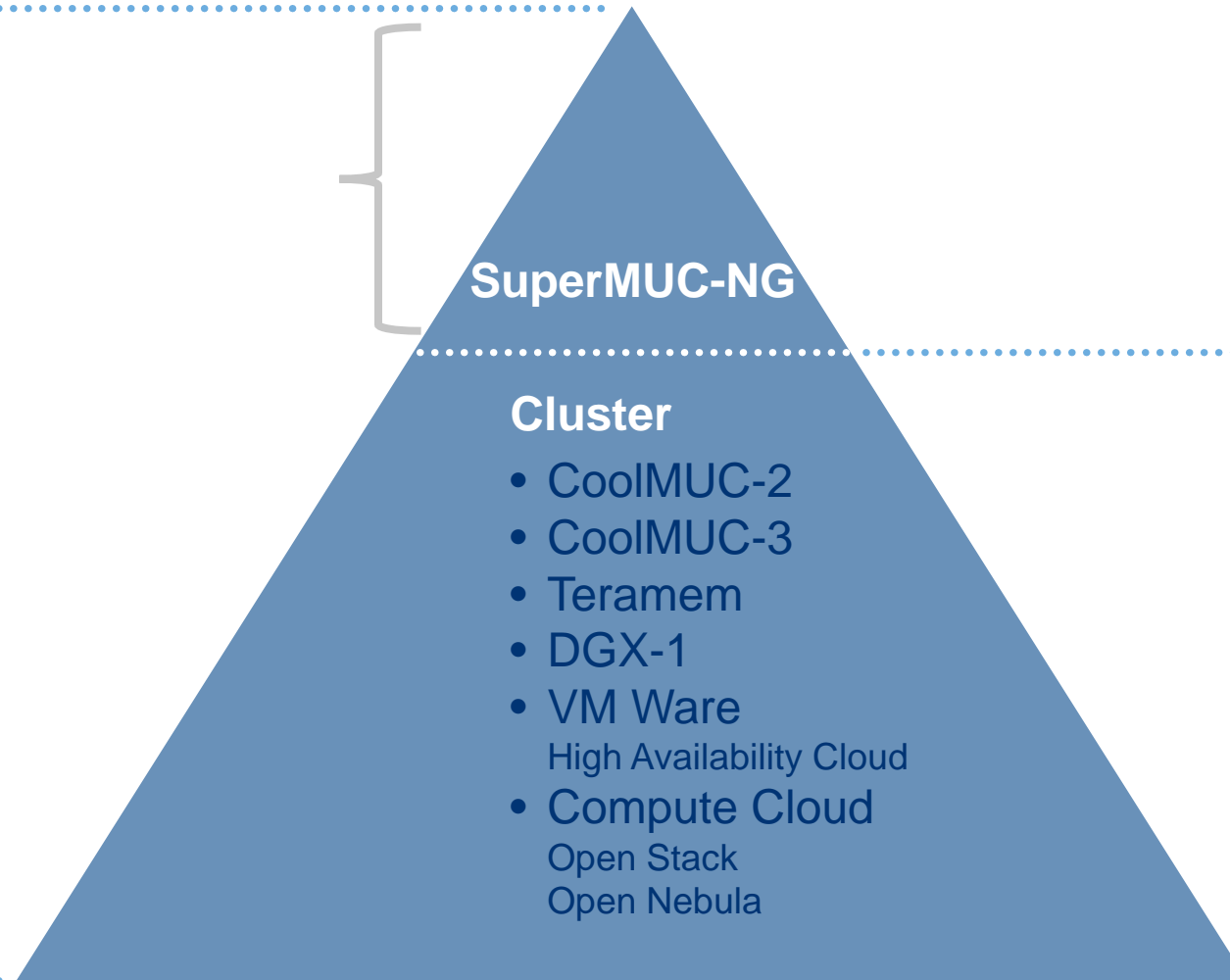
## National access

### GCS Large Scale Projects (PI from a German institution)

More than 30 millions CPU-h: submit a project proposal to GCS

Two calls a year (next deadline in August)

Scientific and technical review



# How to access the LRZ systems

## European access

### PRACE Projects

Need to submit a project proposal via PRACE

Scientific and technical review

Possibility of applying for dedicated support

