Cloud Facility for Advancing Scientific Communities

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UCAR, Boulder, CO

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funded by the National Science Foundation
Award #ACI-1445604

Cloud Computing Terms ...simplified

- **Image:** a file on a disk. It will be booted to create an...
- **Instance**: a running virtual server; i.e. something you can log into.
- **Flavor**: the size of a running instance; i.e. #core, RAM, disk
- **Hypervisor**: the thing the instance runs on; something akin to a software defined hardware compute server.
- **Snapshot**: the process of taking an instance and turning it to an image.
- **State**: something worth remembering; i.e. the state of the system

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Cloud Computing Terms ...simplified (Cont.)

- **Object store**: a blob of bits; it has a starting address & a size. There may be metadata associated with the object. The data is consumed in a streaming manner.
- **Block store**: a software defined entity akin to an unformatted hardware disk drive.
- **Filesystem**: hierarchical in nature, directories & files, abilitiy to open, seek, read, write.
- **Persistent storage**: If you pull the plug, it will still exist when power is restored. Safe to store data or state here.
- **Ephemeral storage**: If you pull the plug, it no longer exists. (Don't put your data here!!!)

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What is Jetstream?

- **User-friendly**, widely accessible cloud environment
  - **User-selectable library** of preconfigured virtual machines
    - Interactive computing
    - Software maintained by domain specialist
    - No need for system administration skills
    - The “Atmosphere” side
  - **Programmable cyberinfrastructure**
    - Go beyond batch computing
    - Implement modern cloud computing techniques
    - Common modality for science gateways
    - The “API” side

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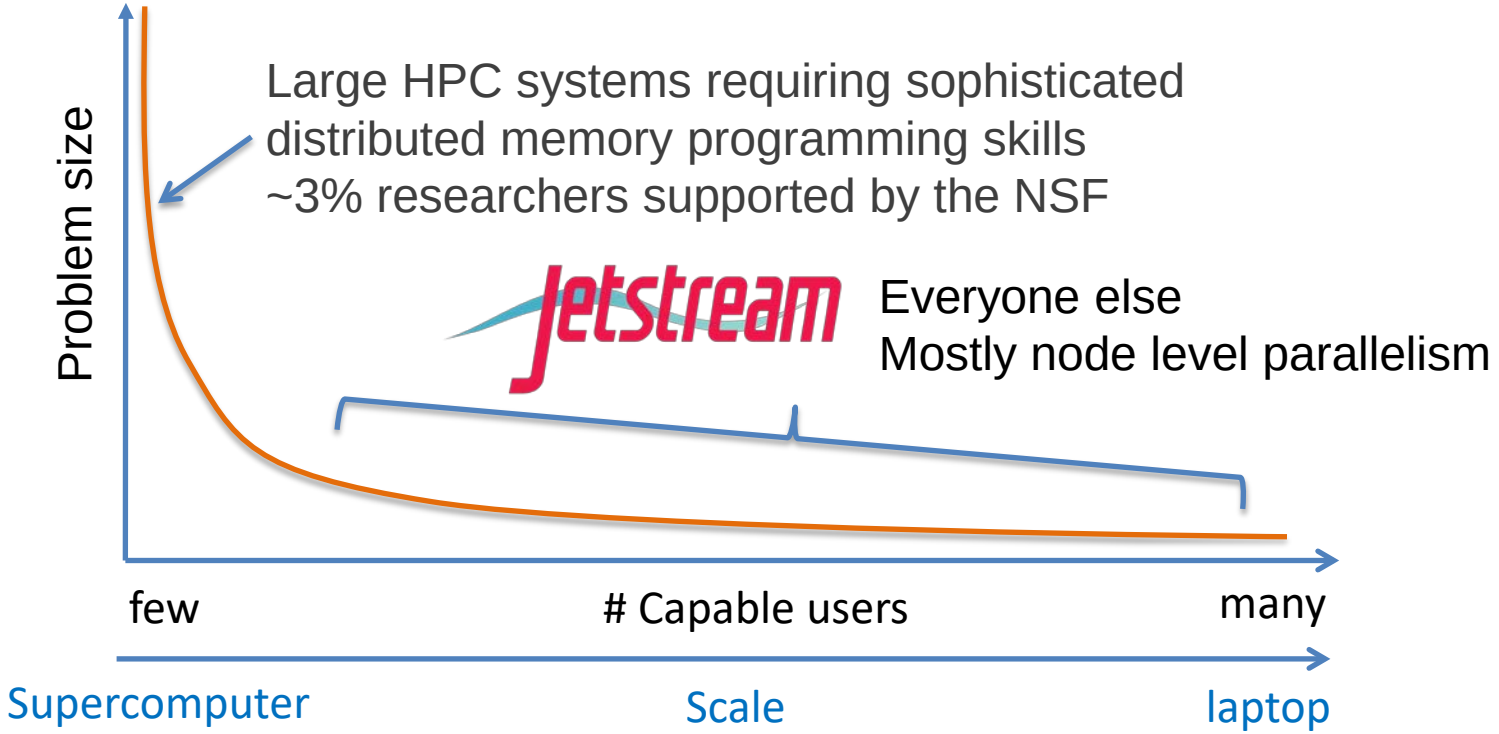
“Long tail” of the Science



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What is Jetstream? (Cont.)

- **Primary goal** is to **expand the user base** of NSF's e**X**treme **D**igital (**XD**) program resources beyond the current community of users.
- **Lowering the hurdle** to onboard to XSEDE resources
  - Desire to **ease** the **allocation request** process
  - **Easy-Button**; quick access but limited ability. (Beta)
- **Creating communities**
  - Domain developers **create, install, and maintain** the software
  - **Encourage collaboration** within the domains
  - **Operating system** level software is professionally **patched and maintained**
- **Repeatibility**: store & publish images via IU Scholarworks & create a DOI

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What is Jetstream? (Cont.)

- **Cloudy Technologies**: clouds are more the just virtual machines (VM)
  - **Old way**: robust (expensive) infrastructure, weak (cheap) software
    - You expect the hardware to not fail
    - State in maintained in volatile data structures
  - **Cloudy way**: commodity infrastructure, robust software
    - Expect & plan for infrastructure to fail
    - Put intelligence into the software to handle infrastructure failure
  - **Cows, not pets**:
    - pets have **state**, you name them, you get attached to them, you put forth great amount of care and effort
    - cows **do not** have **state**, you expect to have high turnover, you do not get attached to them, you give them numbers instead of names

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What is Jetstream? (cont)

- **Software layers**
  - **Atmosphere** web interface
    - library of images, genertic, domain specific
    - simplify VM administration
  - **OpenStack:** software tools for building and managing cloud computing platforms for public and private clouds.
  - **KVM** hypervisor: what the VMs run on
  - **Ceph**: storage platform that stores data on a single distributed computer cluster, and provides interfaces for **object**-, **block**- and *file-level* storage.
  - **Operating systems**: CentOS, Ubuntu, Windows?
  - **Applications**; e.g. software developed by the domain specialist, gateways, etc.

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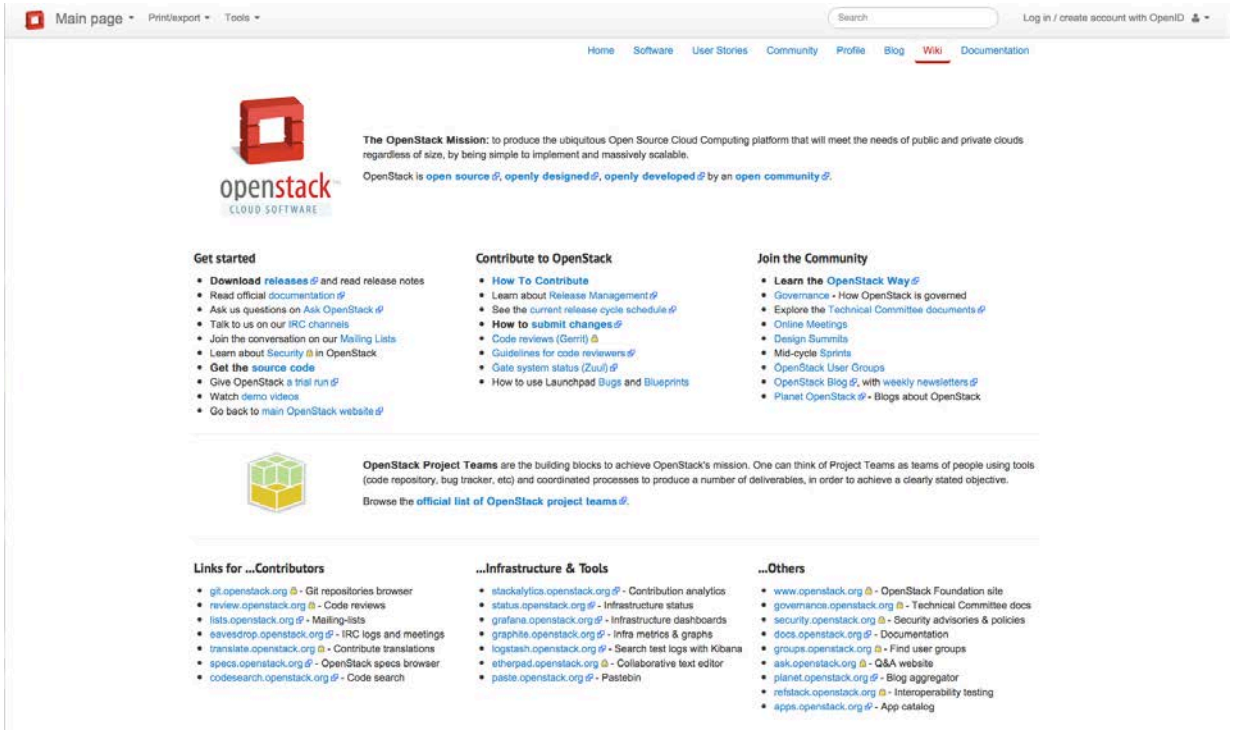
OpenStack Organization



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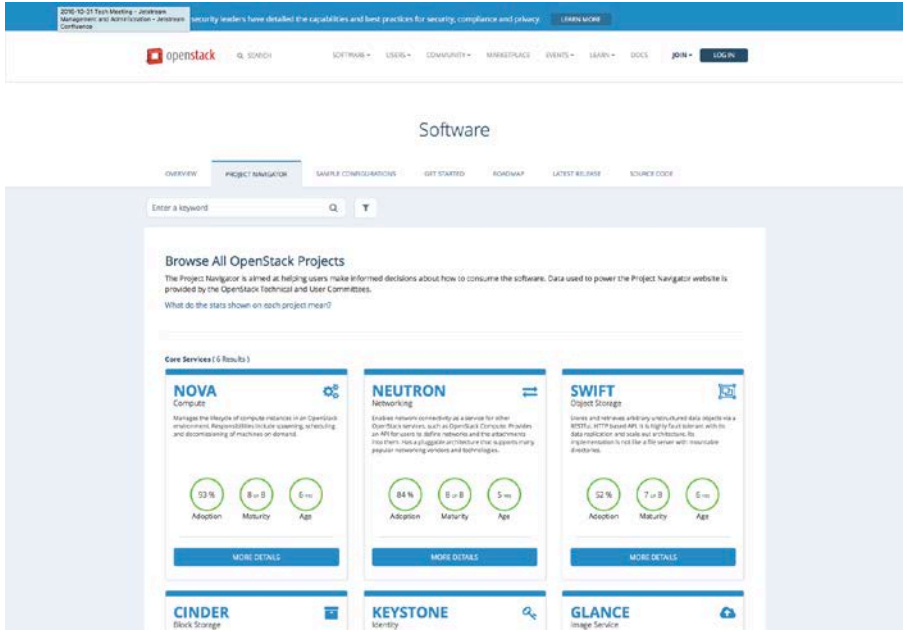
OpenStack : the Project Navigator



http://www.openstack.org/software/project-navigator/

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Openstack Projects ...the core services

Service	Name	Adoption	Maturity	Age
Identity	Keystone	96%	7/8	5 yrs
Images	Glance	95%	6/8	7 yrs
Block device	Cinder	88%	7/8	5 yrs
Networking	Neutron	93%	7/8	5 yrs
Compute	Nova	95%	8/8	7 yrs
Object device	Swift	52%	7/8	7 yrs

https://www.openstack.org/software/project-navigator/

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Openstack Projects ...some other services

Service	Name	Adoption	Maturity	Age
Dashboard	Horizon	87%	6/8	5 yrs
Telemetry	Ceilometer	55%	1/8	4 yrs
Orchestration	Heat	67%	6/8	4 yrs
Containers	Magnum	11%	2/8	2 yrs
Map/Reduce	Sahara	10%	3/8	3 yrs

https://www.openstack.org/software/project-navigator/

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Openstack Projects ...some other services

Service	Name	Adoption	Maturity	Age
Shared Filesystems	Manila	14%	5/8	3 yrs
Workflow	Mistral	5%	1/7	1 yr
Load Balancing as a Service	Octavia	>0%	1/7	1 yr

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Production Cloud Hardware (per site)

Hardware	Number	Specifications	Function (IU)
Dell PowerEdge M630 blades	320	2X Intel E5-2680v3 "Haswell" 24 cores @ 2.5 GHz 128 GB RAM 2 TB local disk	Compute hosts OpenStack services
Dell PowerEdge R630 1U server	7	2X Intel E5-2680v3 "Haswell" 24 cores @ 2.5 GHz 128 GB RAM 2 TB local disk	Cluster management, High Availability, Databases, RabbitMQ
Dell PowerEdge R730xd 2U servers	20	2X Intel E5-2680v3 "Haswell" 24 cores @ 2.5 GHz 64 GB RAM 48 TB storage for Ceph pool	~1 PB Ceph storage
Dell S6000-ON network switches	9	32+2 40 Gb/s ports	Top of Rack & Spine 2 to 1 Fat Tree topology

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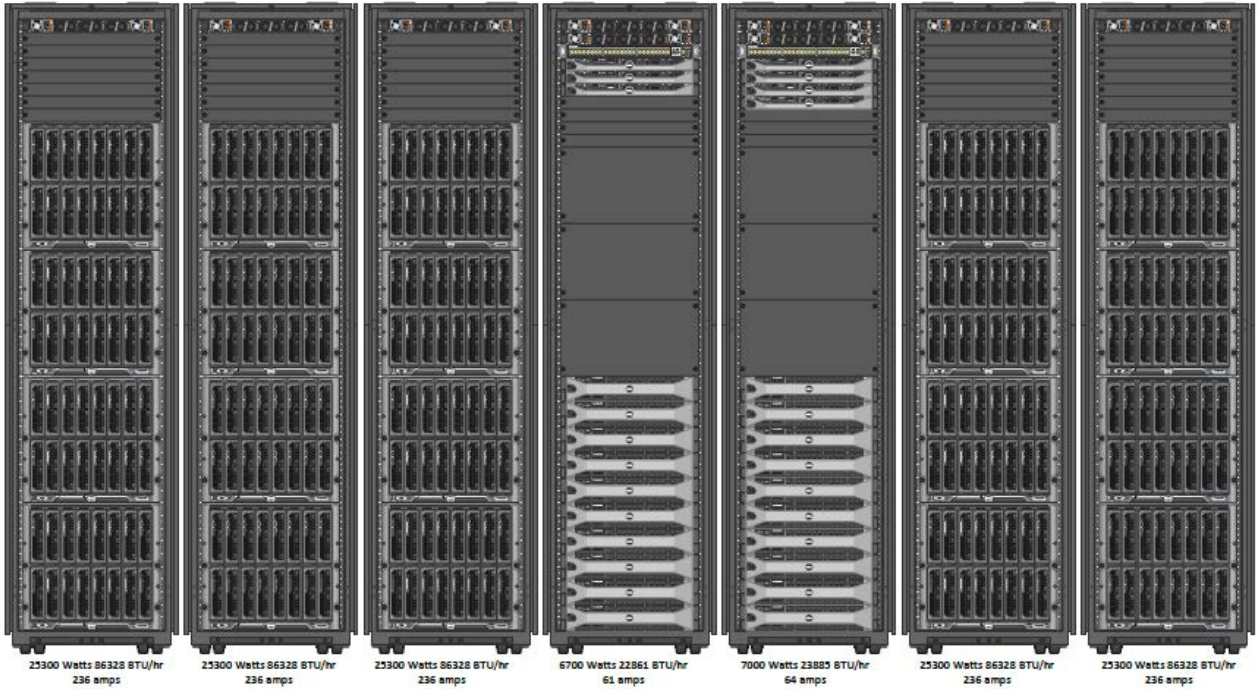
Jetstream Production Hardware



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Just for fun: Happy Cluster – Mad Cluster

ChilledDoor Rack Cooling System by motivair

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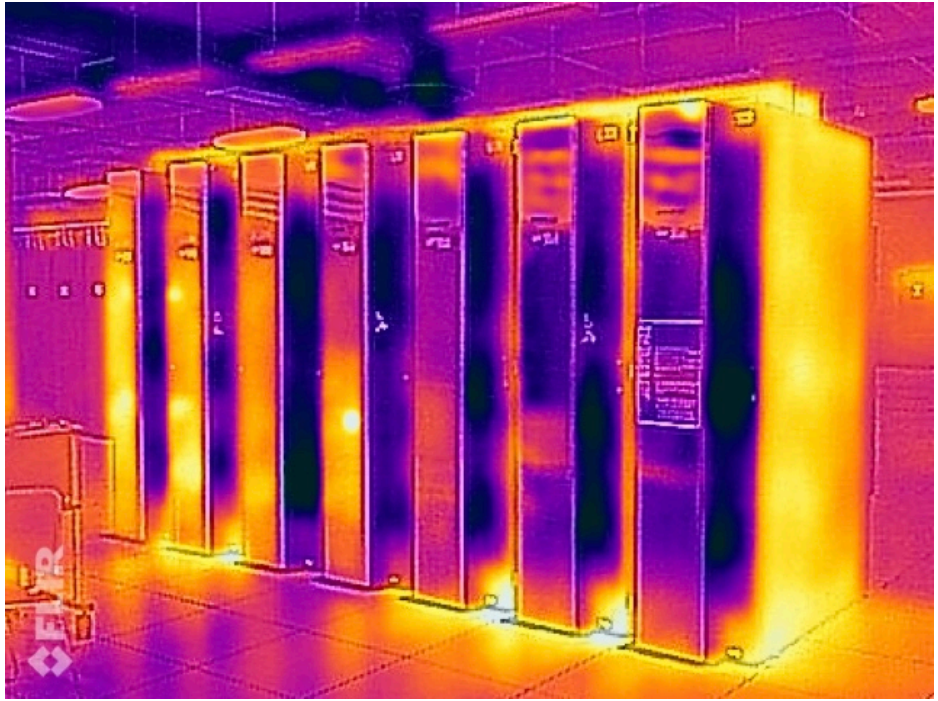
Infrared image of Jetstream



ChilledDoor Rack Cooling System by motivair

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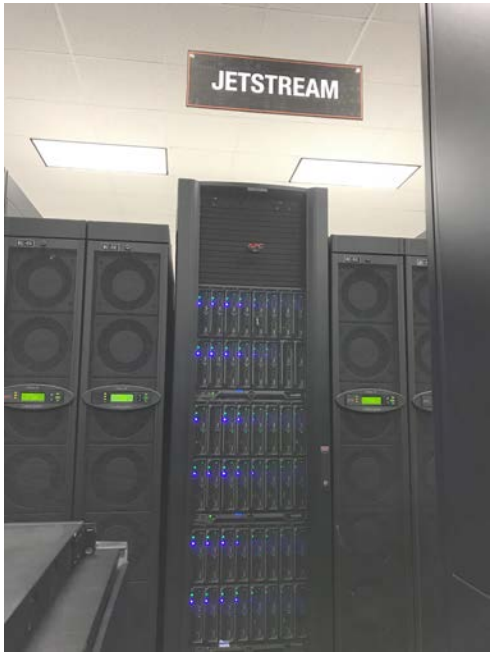
Jetstream - TACC

APC InRow RC cooling units



- Placing in-row moves source of cooling closer to the heat load which helps to eliminate hot/cold air mixing.
- Hot air is ingested at the rear and cold air is expelled at the.
- Rack inlet monitoring provides controlled server inlet temperatures.

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IUB Data Center

Inside the Research Pod

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IU Data Center

https://dcops.iu.edu

https://www.youtube.com/watch?v=zdHvnt3D7Tc&feature=share

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HPCC results : VM vs BareMetal Comparison

Benchmark	VM/ BareMetal	Units	What's tested
HPL	97%	FLOPS	floating point execution rate for solving a system of linear equations
DGEMM	98%	FLOPS	floating point execution rate for double precision real matrix-matrix multiplication
Bandwidth	88%	B/s	bytes/unit_time it takes to transmit a 2MB message from one node to another
Latency	97%	s	time required to send an 8-byte message from one node to another

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HPCC results : VM vs BareMetal Comparison (Cont.)

Benchmark	VM/ BareMetal	Units	What's tested
Random	80%	up/s	rate of random updates of memory
Stream	77%	B/s	sustained memory bandwidth
MPI-FFT	67%	FLOPS	floating point rate of execution of double precision complex one-dimensional Discrete Fourier Tranform
Ptrans	64%	B/s	rate of transfer for large arrays of data from multiprocessor's memory

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VM Instance Sizes (Flavors)

Instance Type	vCPUs	RAM(GB)	Storage(GB)	Instances/Node
Tiny	1	2	8	46
Small	2	4	20	23
Medium	6	16	60	7
Large	10	30	120/60*	4
X-Large	22	60	240/60*	2
XX-Large	44	120	480/60*	1

Node config: dual Intel E-2680v3 “Haswell”, 24 physical cores/node @ 2.5 GHz, 128 GB RAM, dual 1 TB local disks.

* Effective 29-Mar-2017

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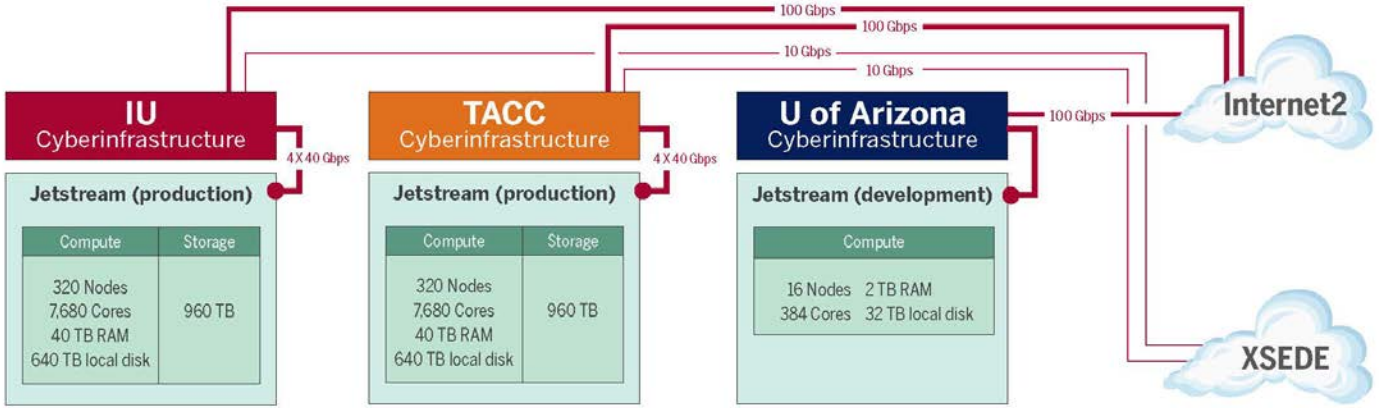
Jetstream Systems



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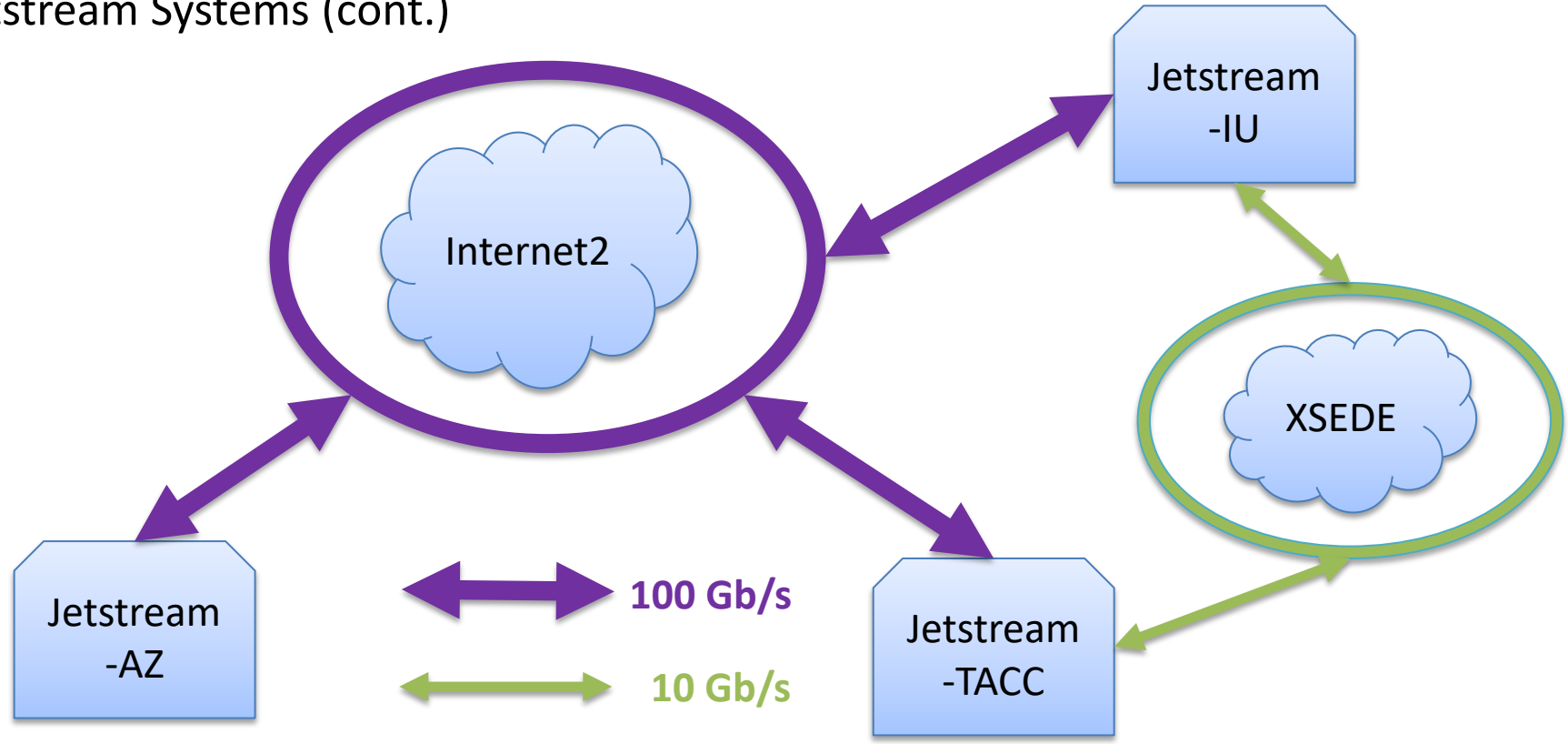
Jetstream Systems (cont.)



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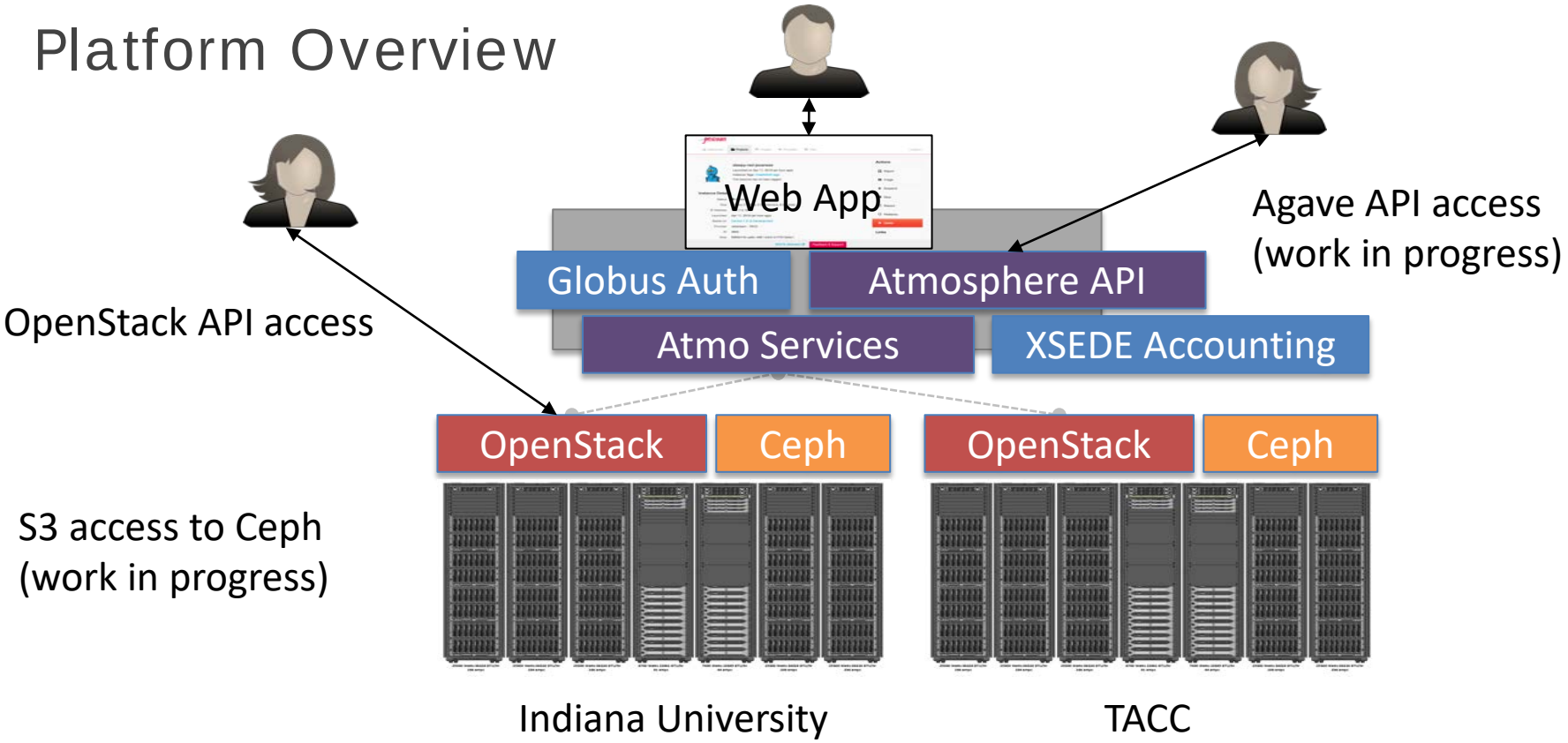
Platform Overview



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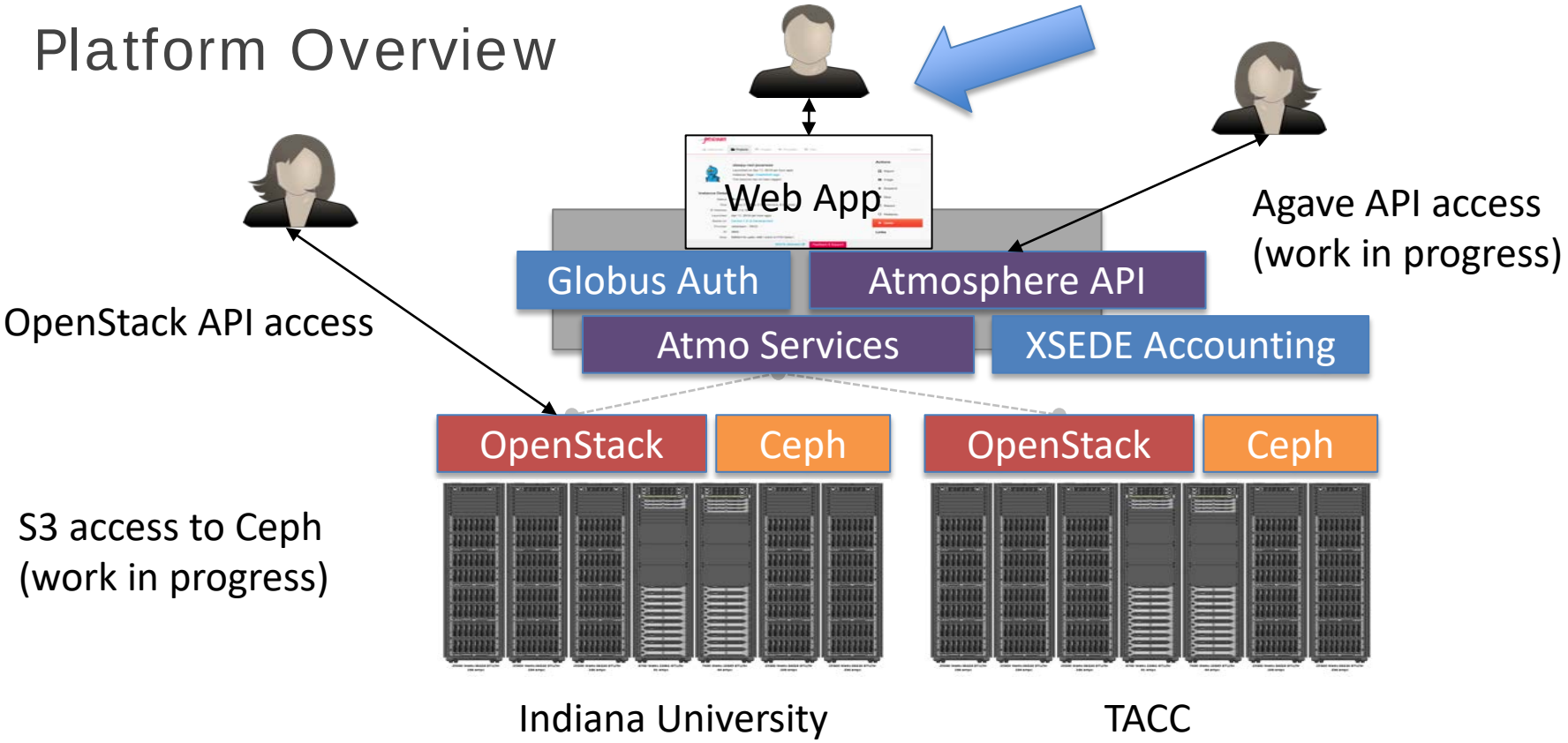

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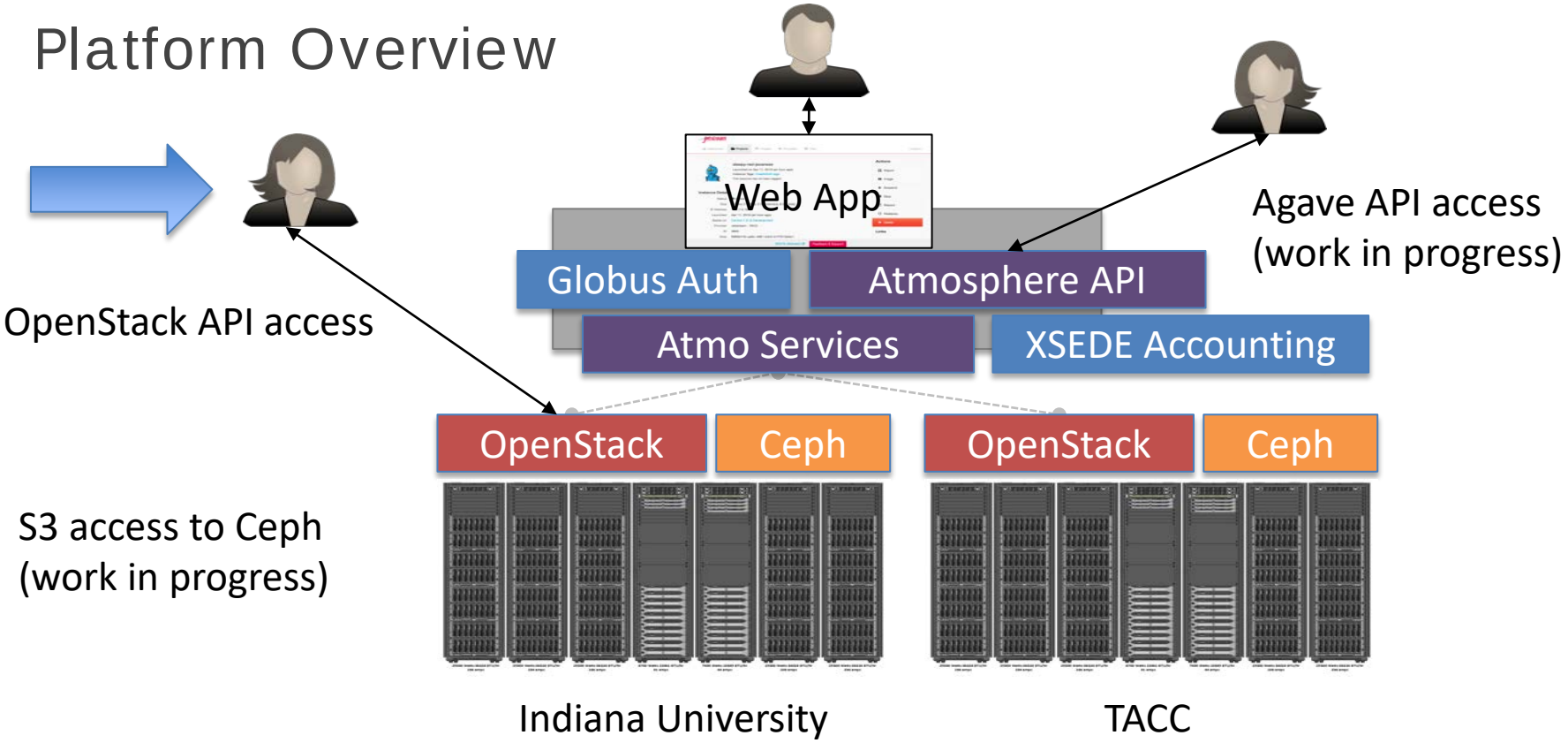

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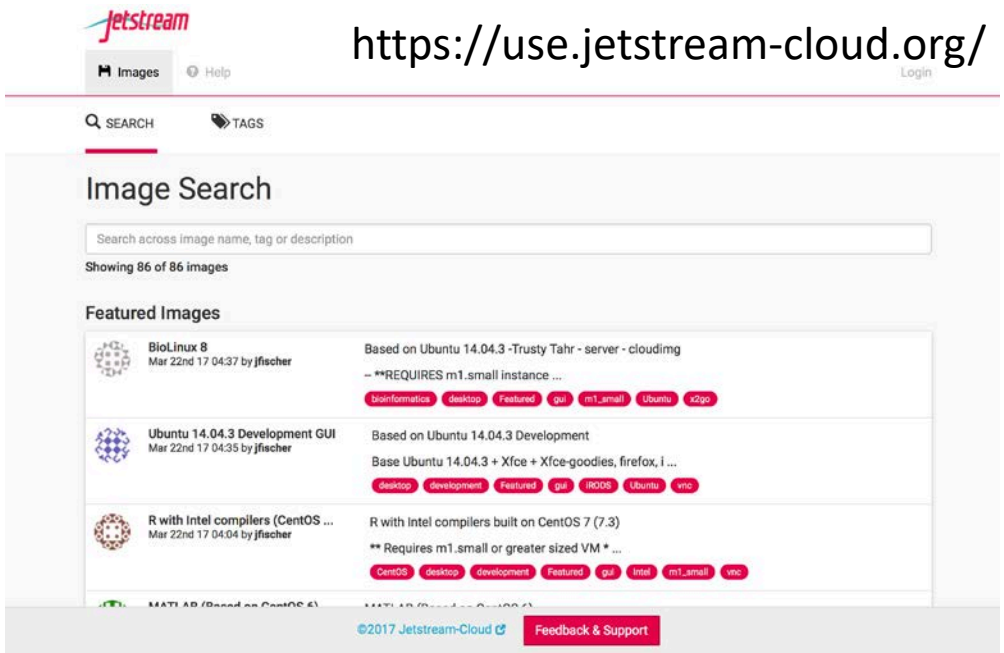
Jetstream's Atmosphere Interface



https://use.jetstream-cloud.org/

- No login required at this point
- You will be able to peruse the image library
- Based upon the work of the CyVerse team of Univ of AZ
- See cyverse.org for further details concerning the Atmosphere interface

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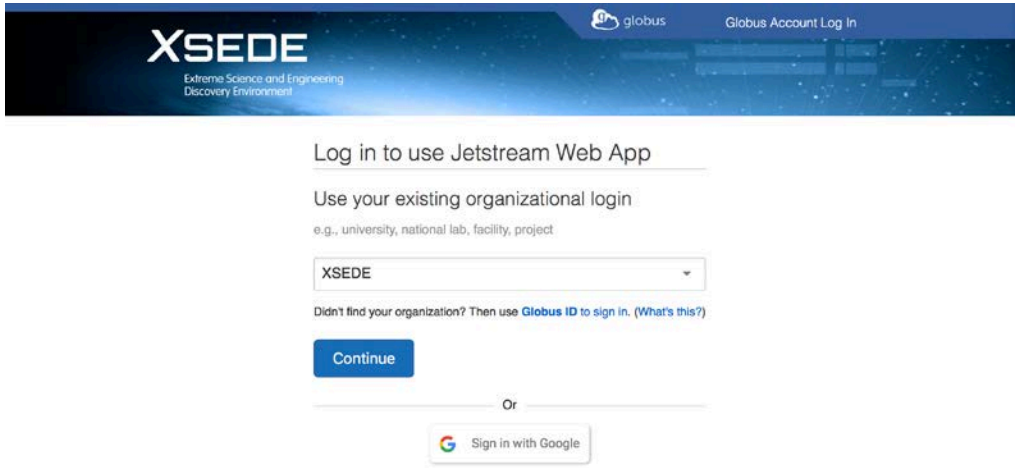
Jetstream's Atmosphere Interface

Pick identity provider

Globus Auth under the hood



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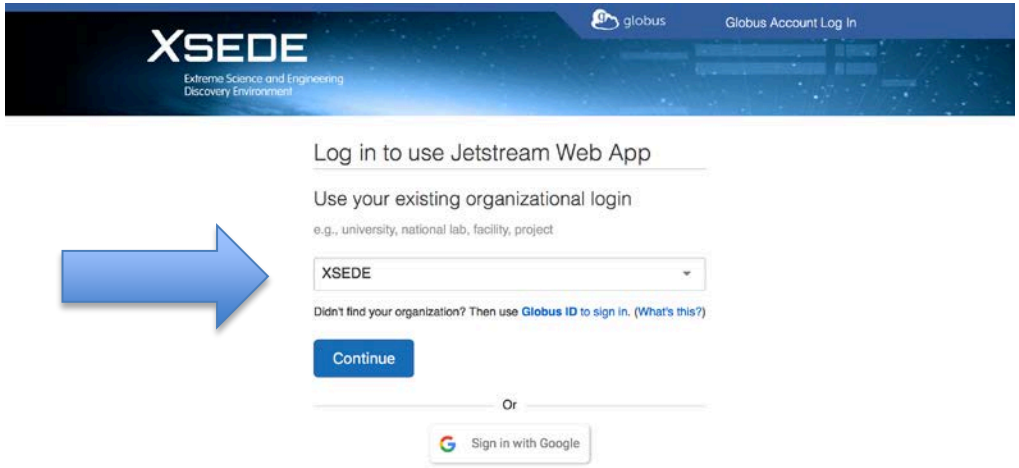
Globus Auth under the hood



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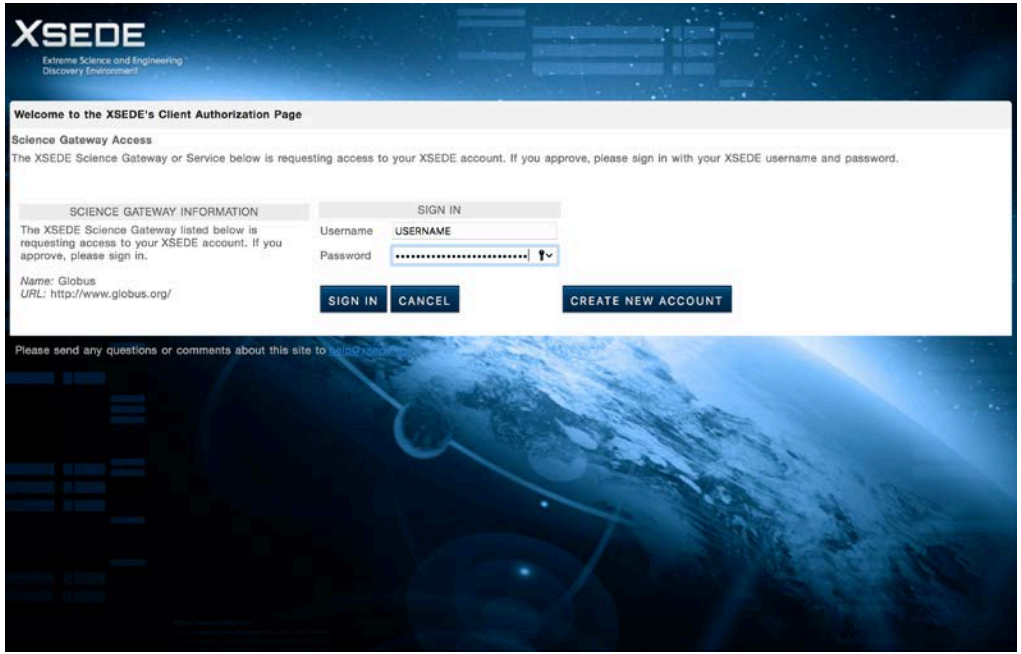
Jetstream's Atmosphere Interface

Authenticate with the chosen identity provider



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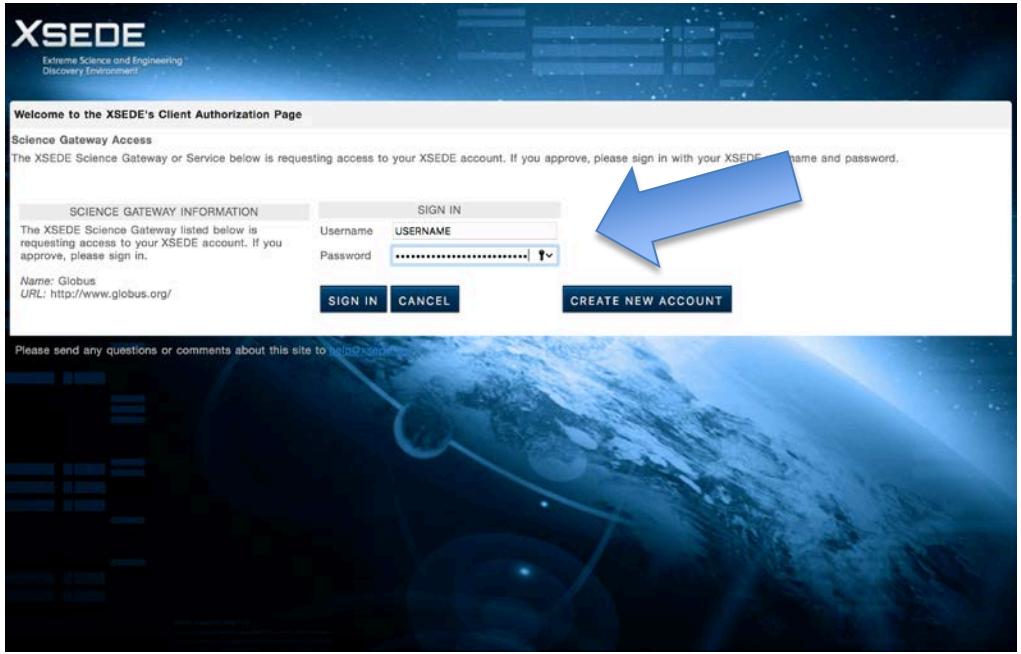

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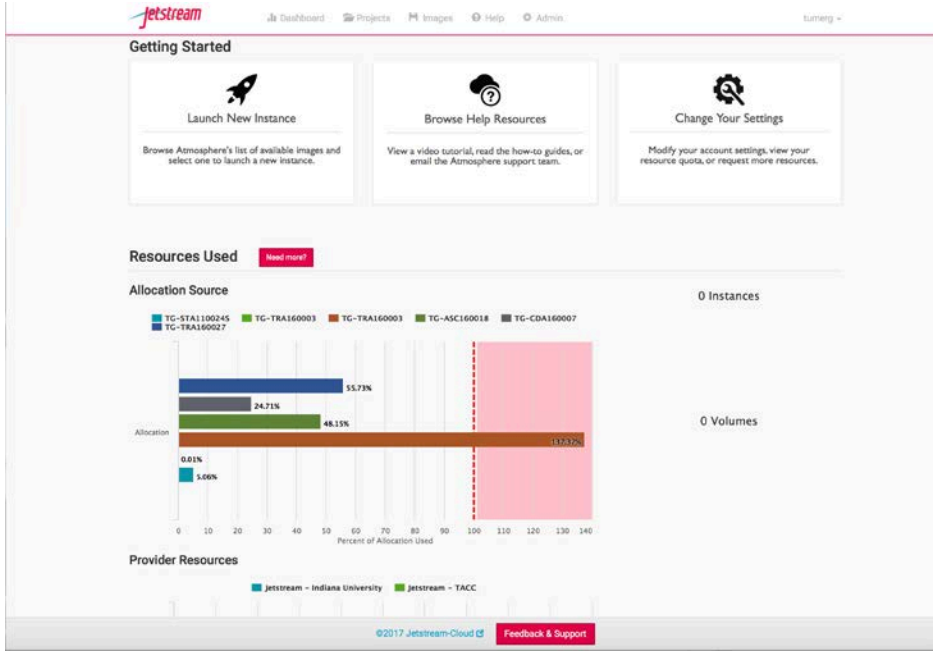
Jetstream's Atmosphere Interface

user's home dashboard



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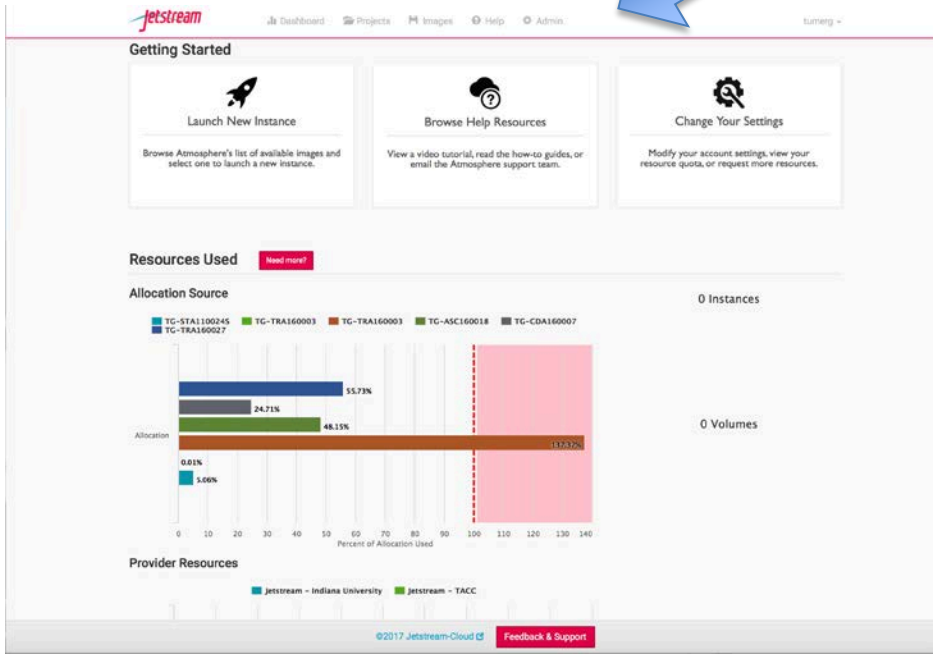

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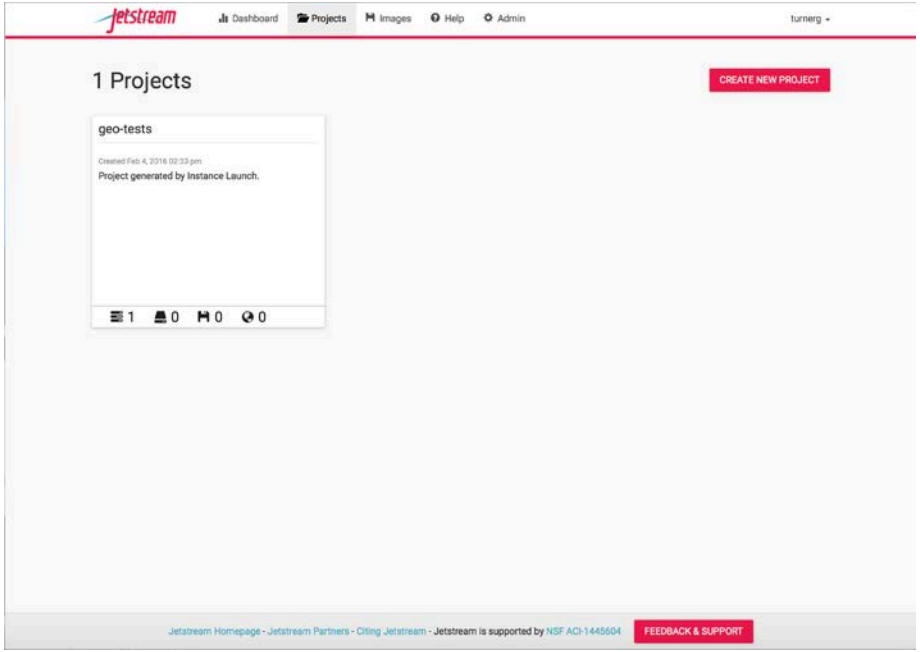
Jetstream's Atmosphere Interface

user's project dashboard



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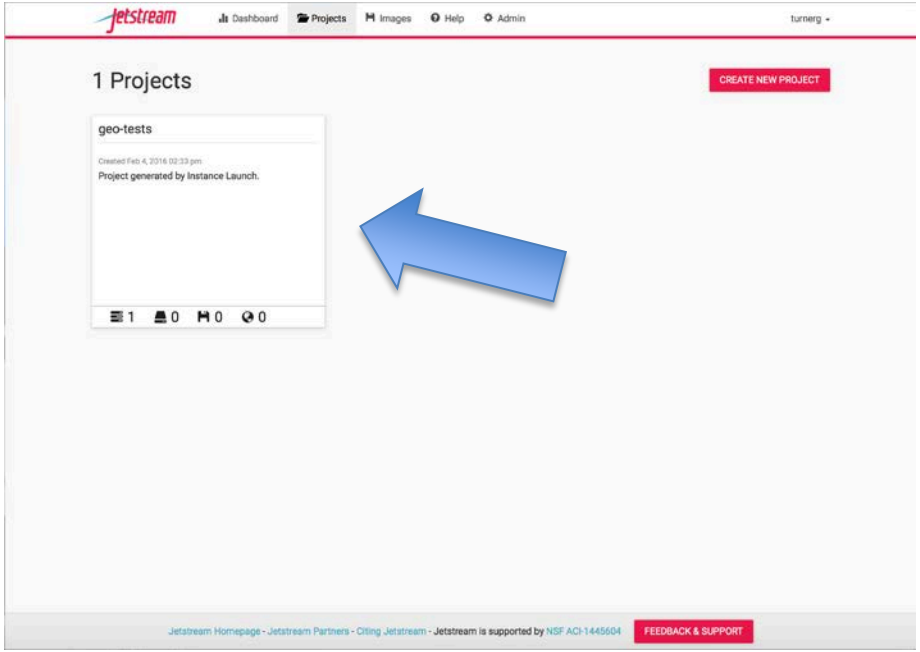

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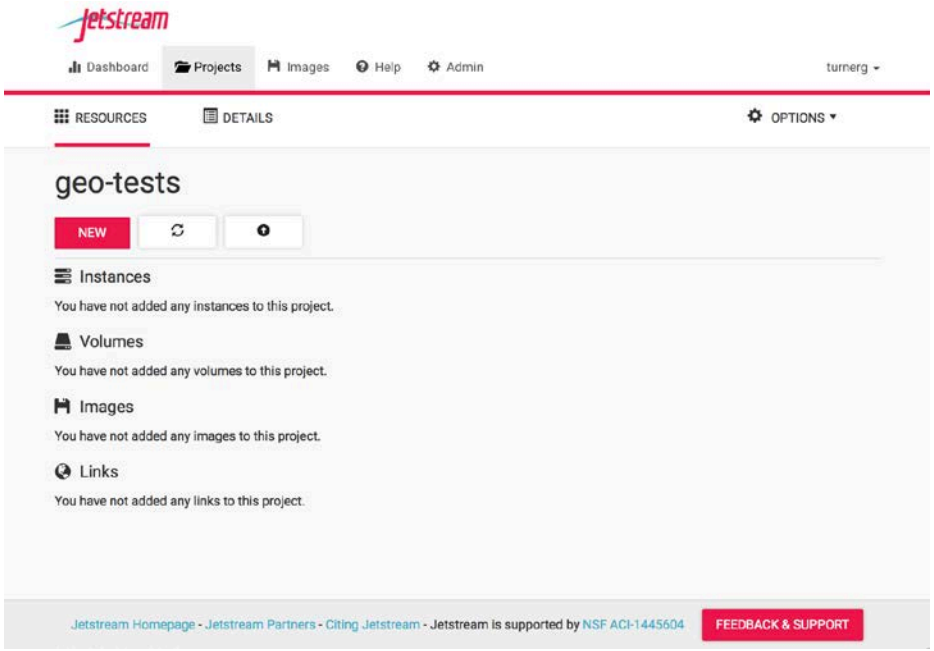
user's project details



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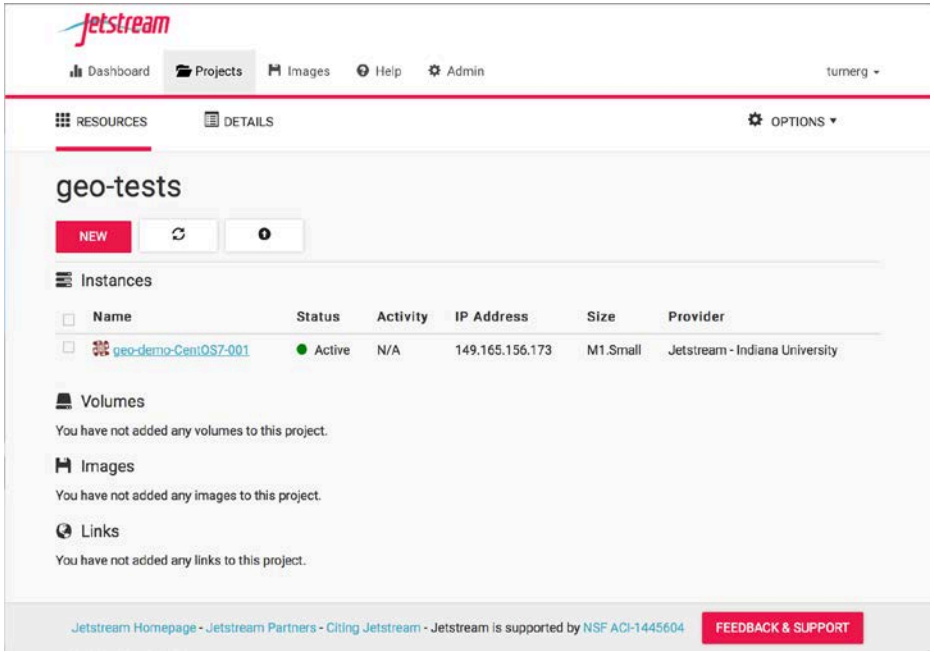
Jetstream's Atmosphere Interface

Instance ready for use



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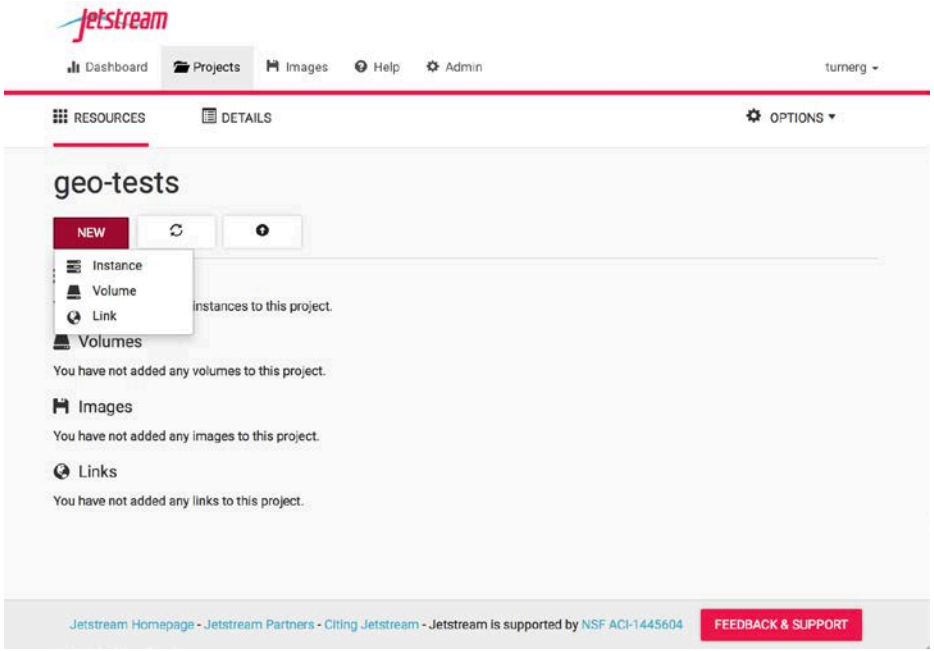
starting an instance



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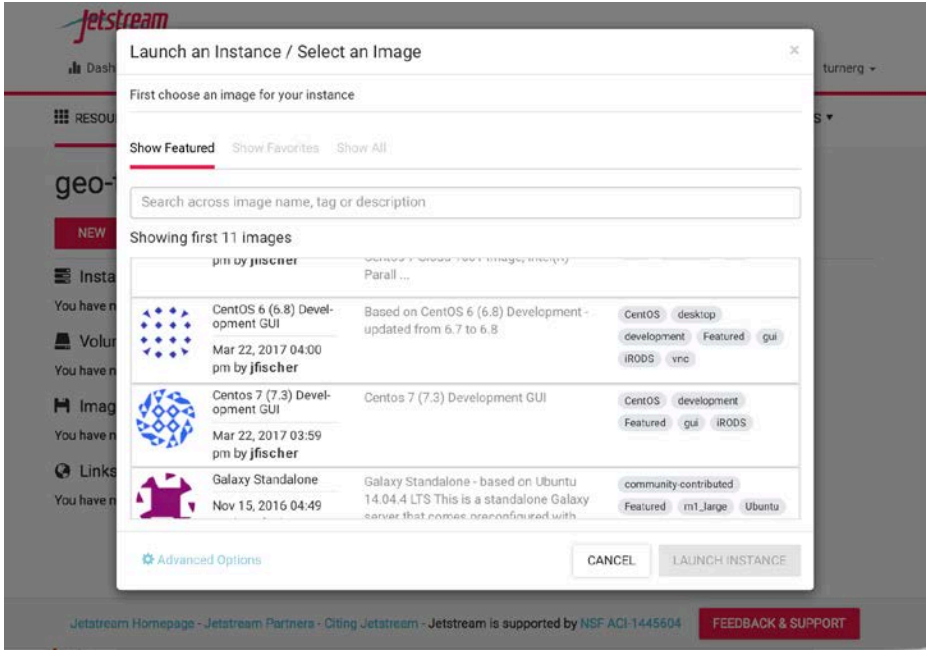
Jetstream's Atmosphere Interface

pick an image from library



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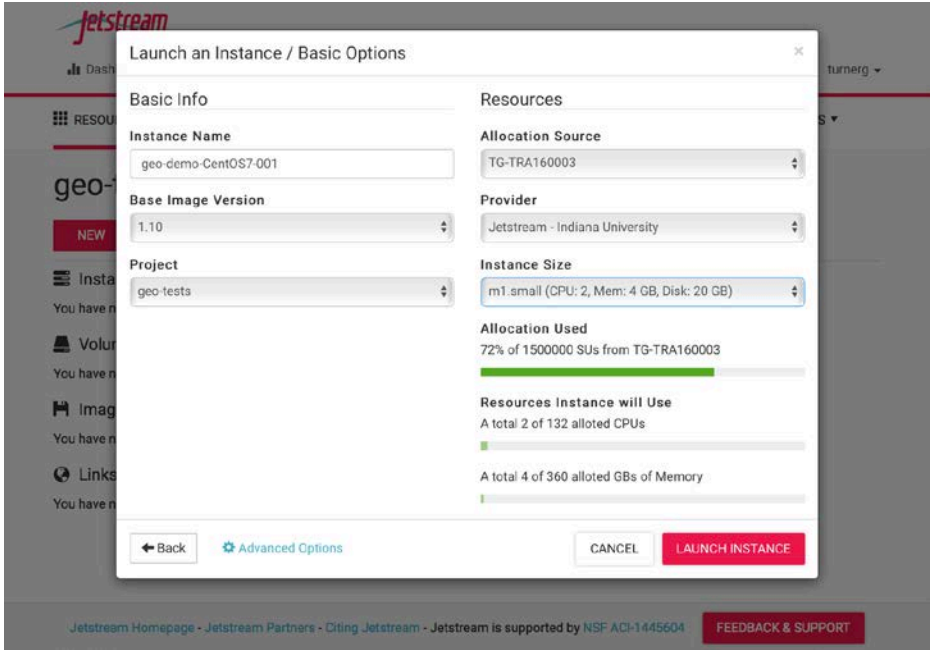
Instance's details; e.g. name, flavor, allocation, etc.



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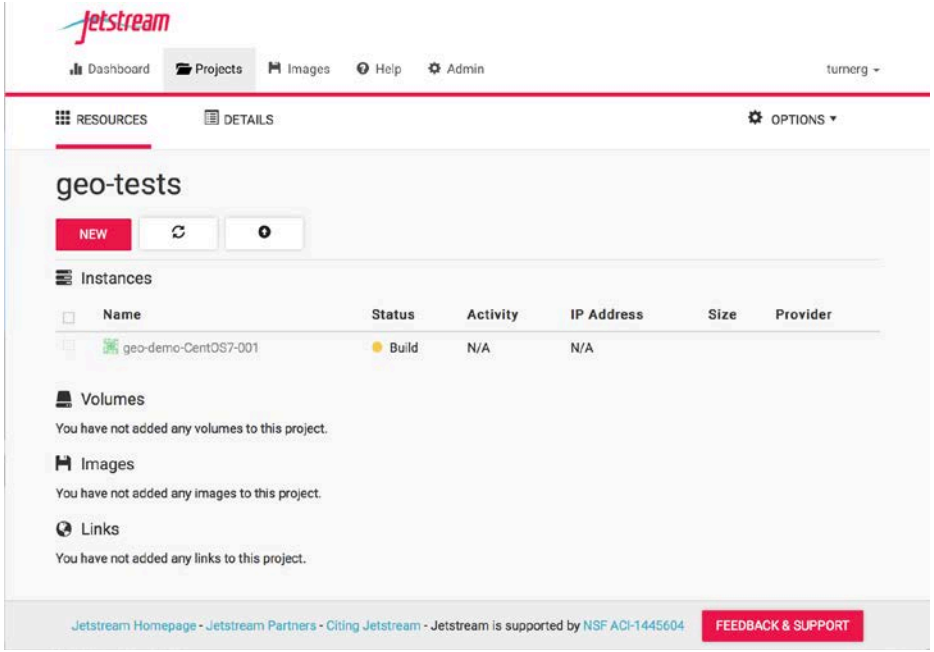
Jetstream's Atmosphere Interface

Instance is building



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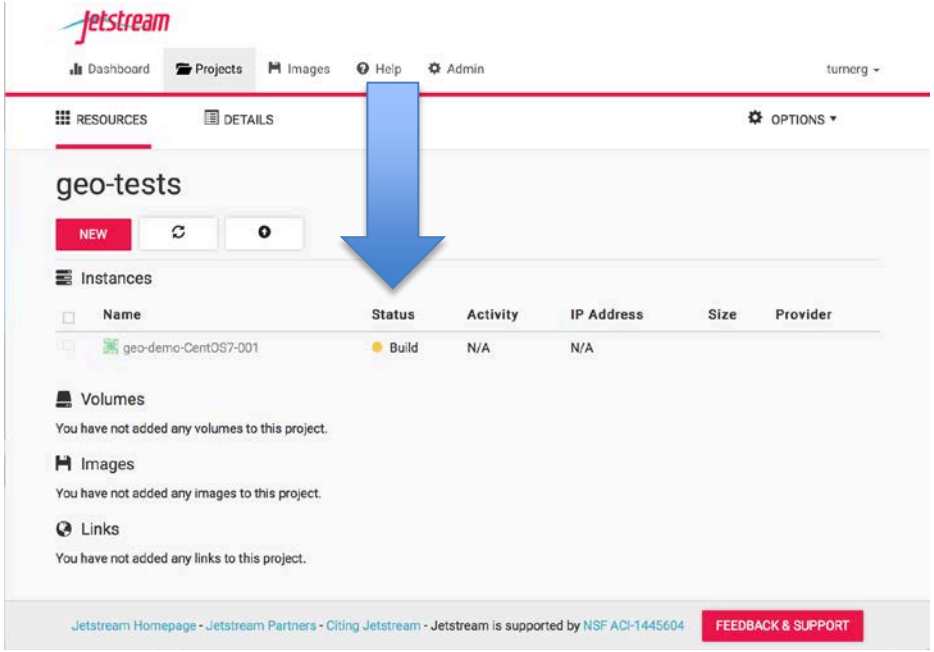
Jetstream's Atmosphere Interface

Instance is building



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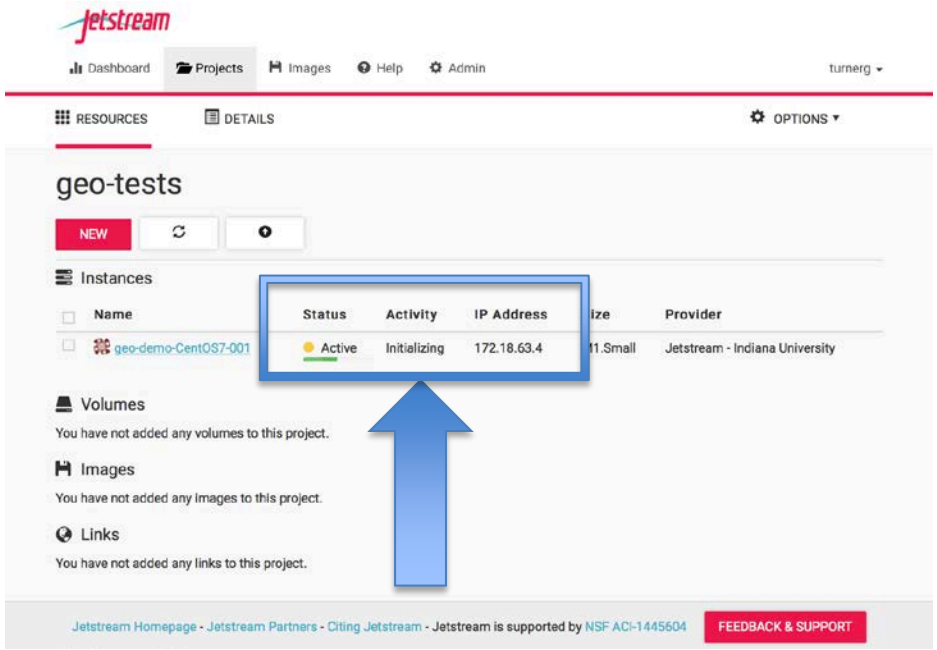
Jetstream's Atmosphere Interface

…still building



Atmosphere is doing the hard part (systems administration) of virtualized computing

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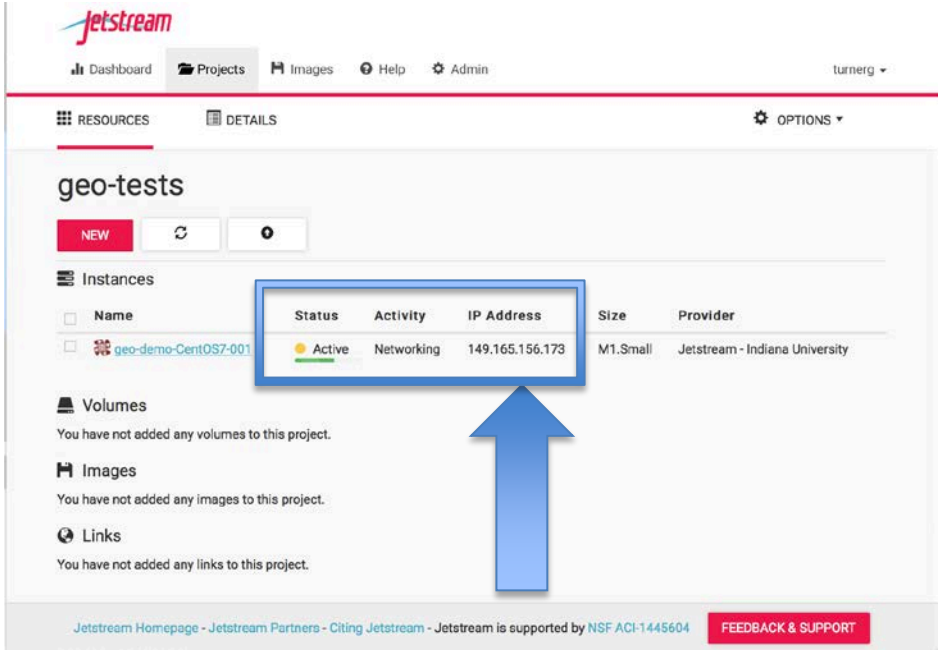
Jetstream's Atmosphere Interface

…still building



Atmosphere is doing the hard part (systems administration) of virtualized computing; e.g. building the network, routers, & virtual switches

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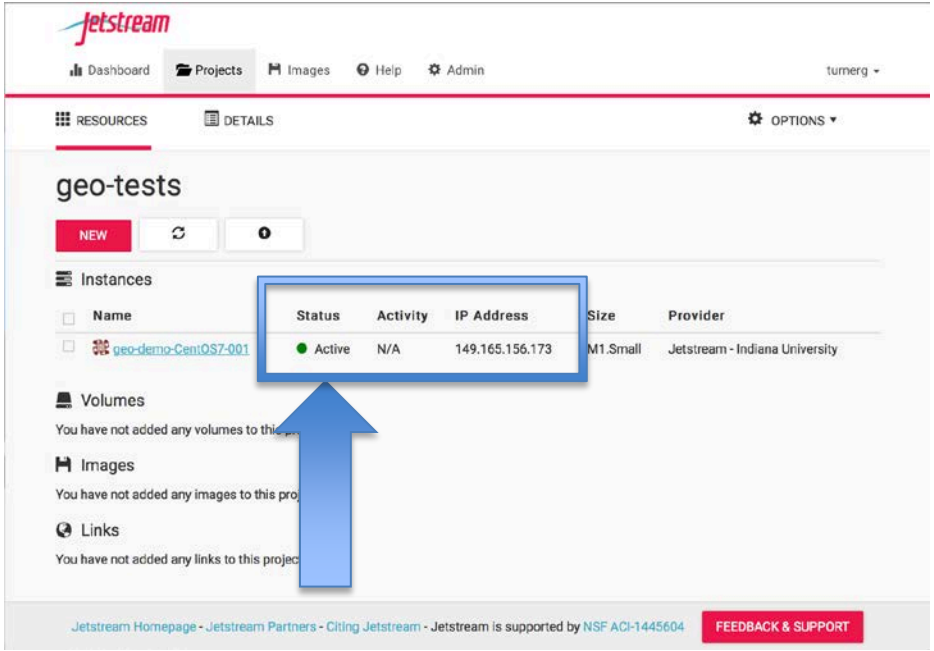
Jetstream's Atmosphere Interface

Instance ready for use



…and in the end, all you need to do is log in and start doing science & engineering

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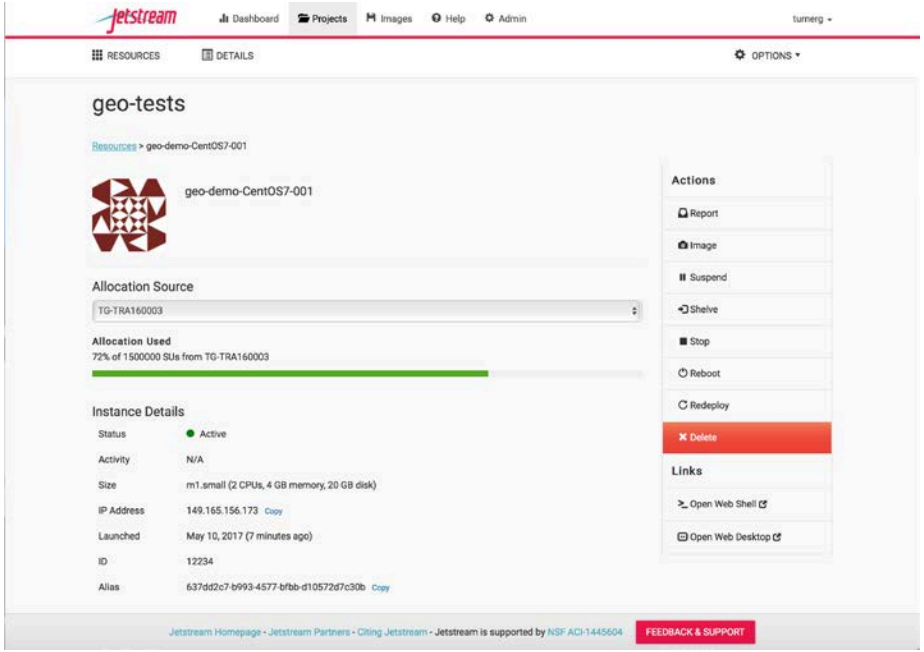
Jetstream's Atmosphere Interface

User's instance dashboard

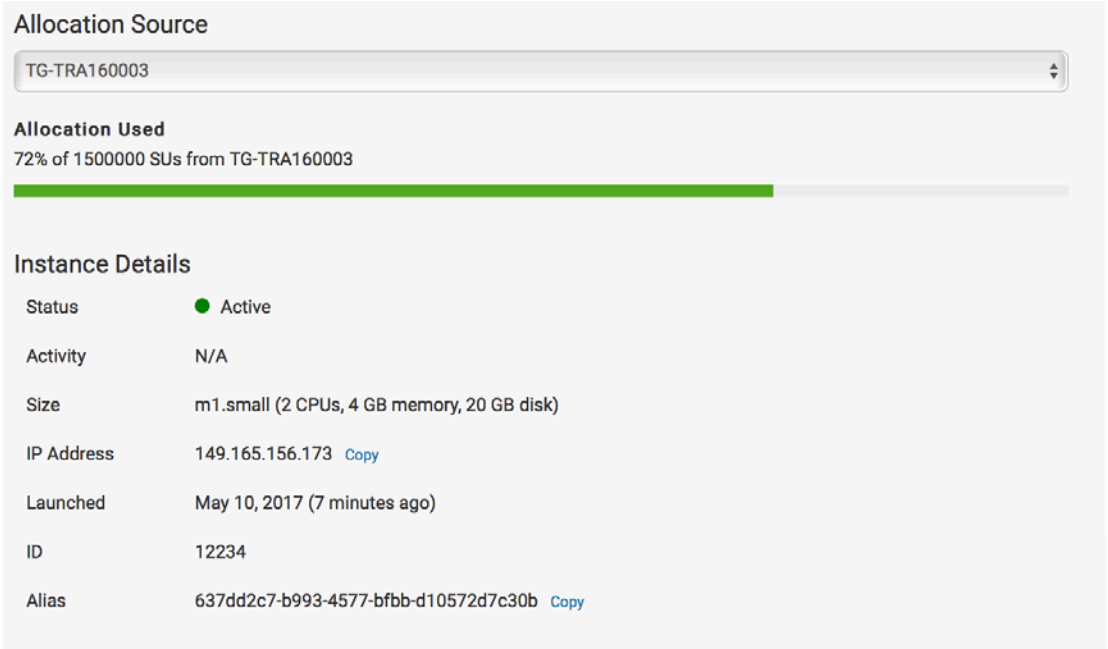


Jetstream
http://jetstream-cloud.org/

funded by the National Science Foundation
Award #ACI-1445604

Jetstream's Atmosphere Interface

User's instance dashboard
Instance's details



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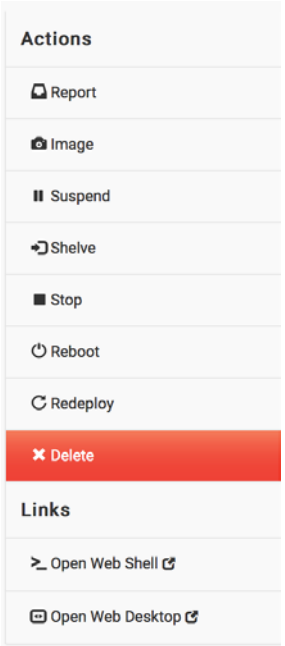
Jetstream's Atmosphere Interface

User's instance dashboard
Action requests



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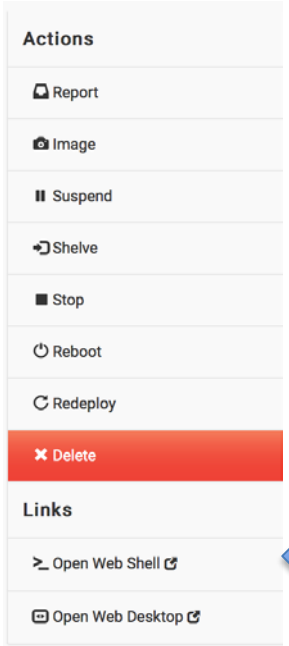
Jetstream's Atmosphere Interface

User's instance dashboard
Action requests



Open Web Shell

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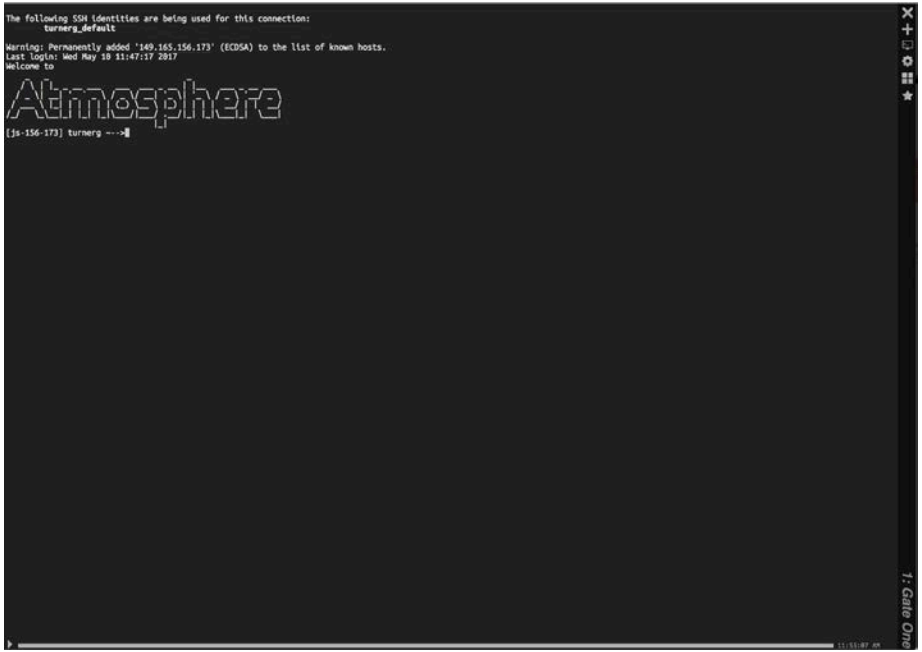
Jetstream's Atmosphere Interface

Web Shell access to instance
External ssh access also available



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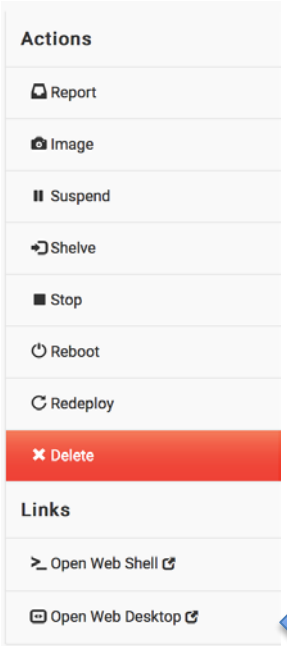
Jetstream's Atmosphere Interface

User's instance dashboard
Action requests



Open Web Desktop

Jetstream
http://jetstream-cloud.org/

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Jetstream's Atmosphere Interface

Web desktop access to instance
VNC access also available

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API Access to Jetstream

- What was **unexpected**
  - **Demand** for **programmable cyberinfrastructure**
  - Great platform for learning system administration skills
  - Great platform for **teaching & learning cloudy technologies**
- **Command line clients**
- **Horizon dashboard** very popular; but, incomplete
- **Programmatic control**; python is popular
- **Slack channel** for collaboration API users of Jetstream

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How do we onboard users onto Jetstream?

- An **XSEDE User Portal (XUP) account** is required. They are free! Get one at https://portal.xsede.org
- **Work with your XSEDE Campus Champion.**
- Submit an **allocations request**
  - Read the Allocations Overview - https://portal.xsede.org/allocations-overview
  - Writeup an allocation request – ***start with a Startup or Education request*** - https://portal.xsede.org/successful-requests
- **Easy Button**: instant access to small, limited instances while the allocation request is processed and the user is vetted.

Jetstream
http://jetstream-cloud.org/

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Jetstream Information Sources

- Twitter: @jetstream-cloud
- Jetstream's web interface: https://use.jetstream-cloud.org/
- XSEDE User Portal account is required to actually login: https://portal.xsede.org
- Jetstream Home page: http://jetstream-cloud.org/
- Jetstream's Public Wiki: https://iujetstream.atlassian.net/wiki/display/JWT/Jetstream+Public+Wiki

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Jetstream Information Sources (Cont.)

- Paper describing Jetstream Jetstream: A self-provisioned, scalable scince and engineering cloud environment
- Configuration management: https://github.com/jetstream-cloud/Jetstream-Salt-States

- **For questions, comments, etc. of any manner, help@xsede.org**
  - Put Jetstream in the Subject line for proper routing.

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Jetstream Partners

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UNIVERSITY

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Questions?

Project website: http://jetstream-cloud.org/
Project email: jethelp@iu.edu
Direct email: turnerg@iu.edu

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