

The State of ChameleonCloud at NCAR

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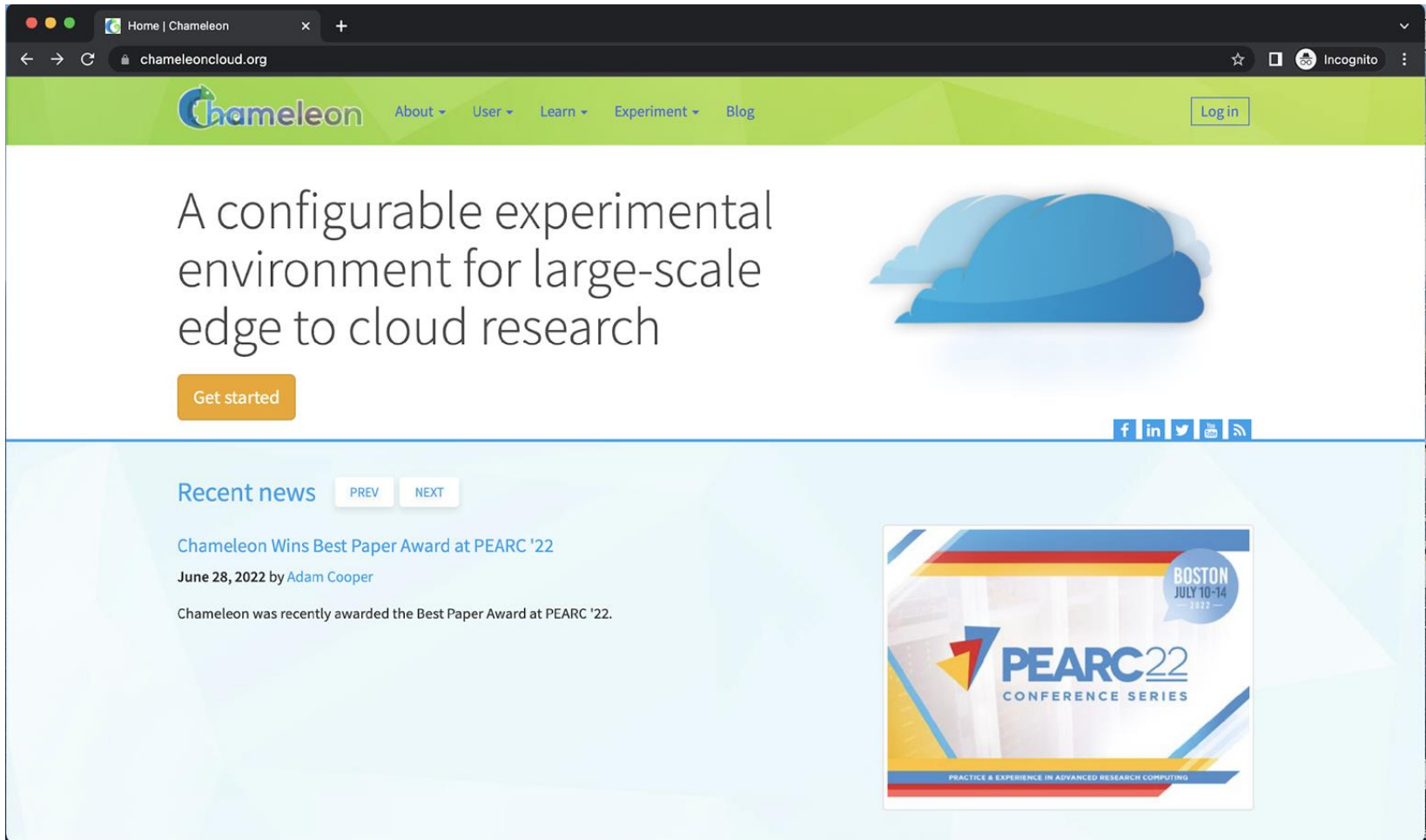


Thunder Nodes

- Thunder nodes consist of
 - Five nodes featuring Marvell's ThunderX2 Arm processors
 - Use the aarch64 instruction set
 - Four nodes have 256GB of memory
 - One node has 128GB of memory
 - A 100Gbe Cumulus-based interconnect
- Used to test the Arm processor as a candidate for a future NCAR supercomputer
 - All users were able to get their NCAR codes to run
 - Performance was good
- Infiniband NICs on the nodes as well, but they are not cabled to anything currently

ChameleonCloud

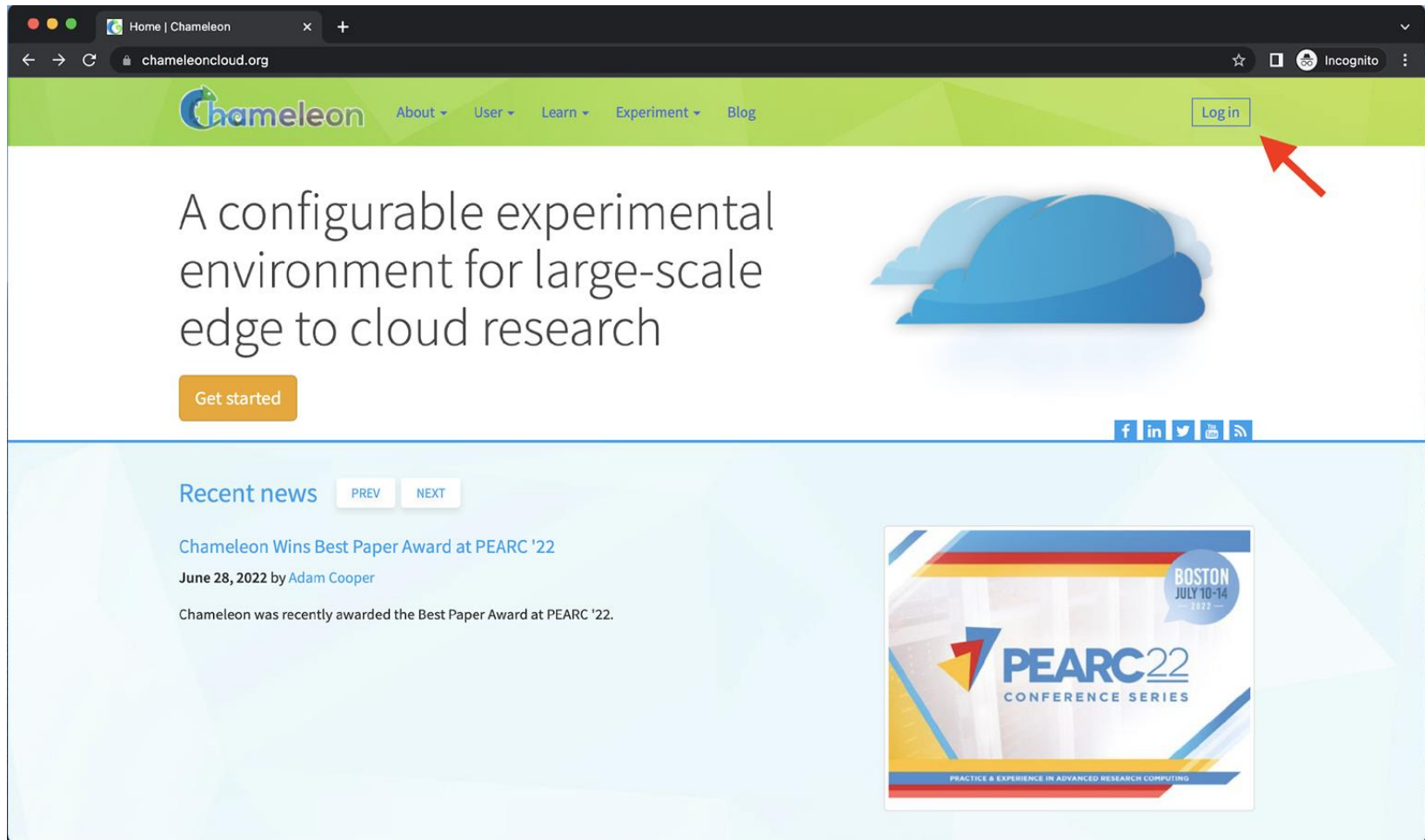
- <https://chameleoncloud.org>



The screenshot shows the homepage of ChameleonCloud. The browser address bar displays "chameleoncloud.org". The navigation menu includes "About", "User", "Learn", "Experiment", and "Blog", along with a "Login" button. The main heading reads "A configurable experimental environment for large-scale edge to cloud research". A blue cloud graphic is positioned to the right of the text. Below the heading is an orange "Get started" button. A social media bar contains icons for Facebook, LinkedIn, Twitter, YouTube, and RSS. The "Recent news" section features a "PREV" and "NEXT" button, followed by a news item: "Chameleon Wins Best Paper Award at PEARC '22" dated "June 28, 2022" by "Adam Cooper". The text below states: "Chameleon was recently awarded the Best Paper Award at PEARC '22." To the right of the news item is a promotional graphic for "PEARC22 CONFERENCE SERIES" in "BOSTON JULY 10-14 2022", with the tagline "PRACTICE & EXPERIENCE IN ADVANCED RESEARCH COMPUTING".

Creating an Account

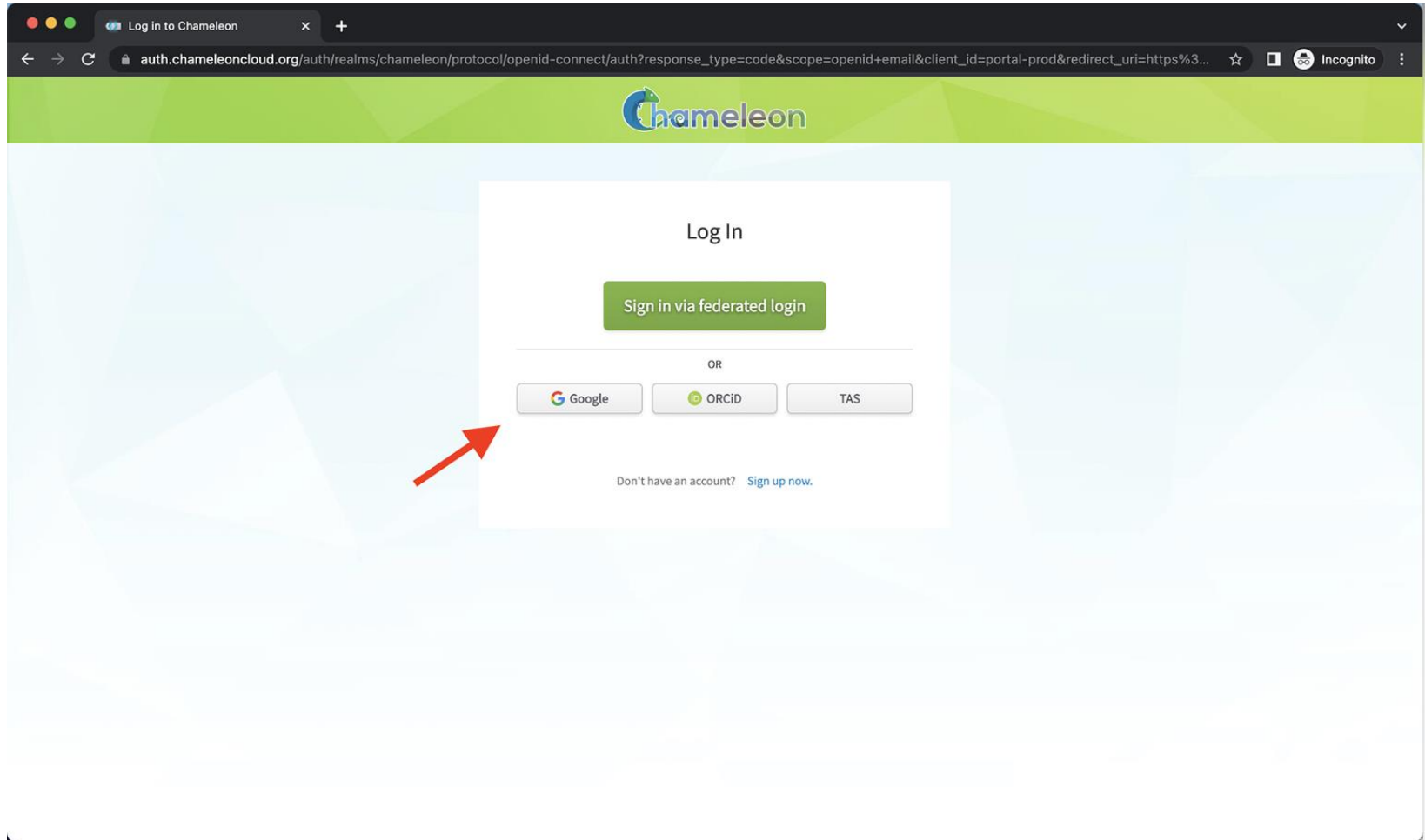
- Click “Log in”



The screenshot shows a web browser window with the URL chameleoncloud.org. The page features a green navigation bar with the Chameleon logo and menu items: About, User, Learn, Experiment, and Blog. A 'Log in' button is located in the top right corner of the navigation bar, highlighted by a red arrow. Below the navigation bar, the main content area displays the text 'A configurable experimental environment for large-scale edge to cloud research' next to a blue cloud graphic. An orange 'Get started' button is positioned below the text. A social media bar with icons for Facebook, LinkedIn, Twitter, YouTube, and RSS is located below the main content. The bottom section of the page is titled 'Recent news' and includes a 'PREV' and 'NEXT' button. The news item is titled 'Chameleon Wins Best Paper Award at PEARC '22' and is dated 'June 28, 2022 by Adam Cooper'. The text below the title reads 'Chameleon was recently awarded the Best Paper Award at PEARC '22.' To the right of the news item is a promotional graphic for the 'PEARC22 CONFERENCE SERIES' in Boston, July 10-14, 2022, with the tagline 'PRACTICE & EXPERIENCE IN ADVANCED RESEARCH COMPUTING'.

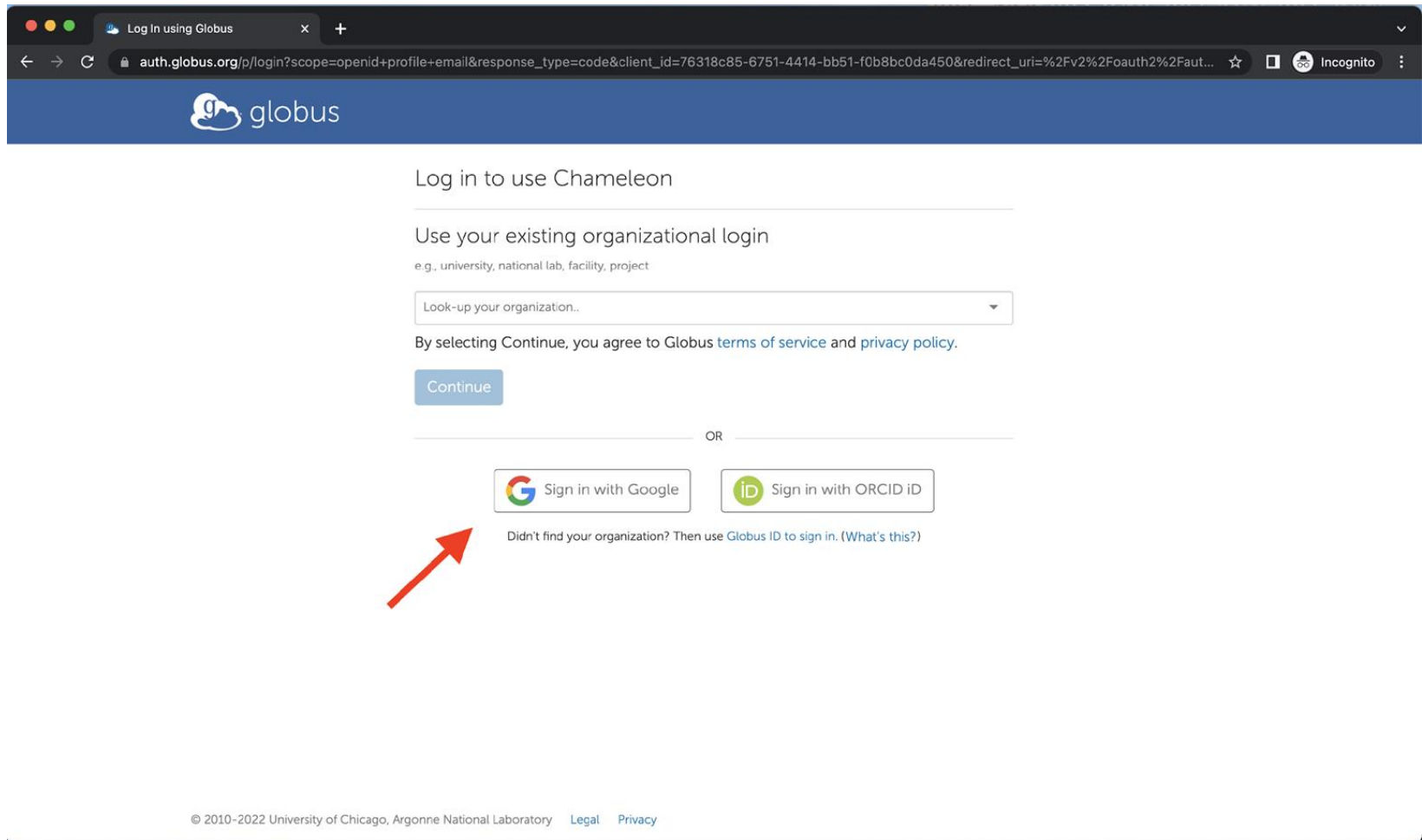
Creating an Account

- Login using your UCAR Google account



Creating an Account

- On the Globus screen, just choose “Google” again

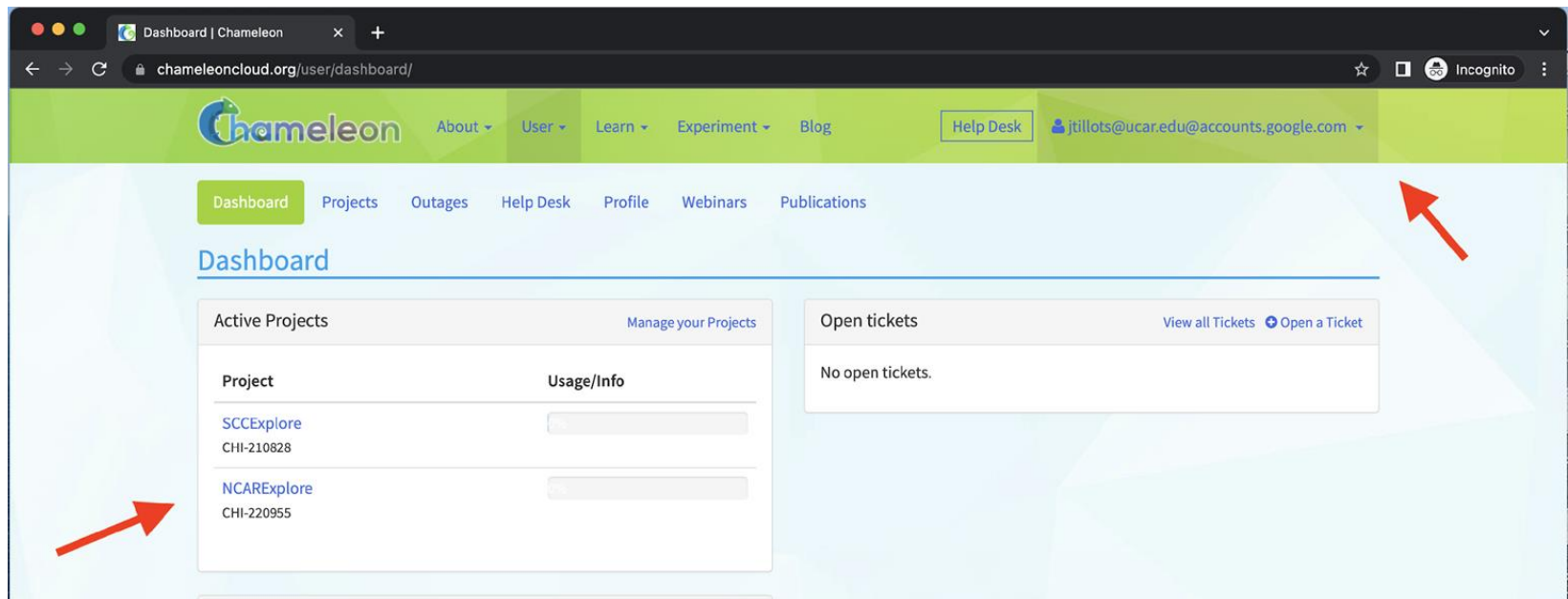


The screenshot shows a web browser window with the URL `auth.globus.org/p/login?scope=openid+profile+email&response_type=code&client_id=76318c85-6751-4414-bb51-f0b8bc0da450&redirect_uri=%2Fv2%2Foauth2%2Faut...`. The page title is "Log In using Globus". The main heading is "Log in to use Chameleon". Below this, it says "Use your existing organizational login" with examples: "e.g., university, national lab, facility, project". There is a search box labeled "Look-up your organization..". Below the search box, it says "By selecting Continue, you agree to Globus [terms of service](#) and [privacy policy](#)." There is a "Continue" button. Below this, it says "OR". There are two buttons: "Sign in with Google" and "Sign in with ORCID iD". A red arrow points to the "Sign in with Google" button. Below these buttons, it says "Didn't find your organization? Then use Globus ID to sign in. (What's this?)". At the bottom, there is a footer: "© 2010-2022 University of Chicago, Argonne National Laboratory [Legal](#) [Privacy](#)".

- The first time you login, you'll have to accept the EULA

Accessing CHI@NCAR

- Creates an account called {username}@ucar.edu@accounts.google.com
- NCAR has an NCARExplore project
- Email hpcrd@ucar.edu to get added to the project



The screenshot shows the Chameleon dashboard interface. The browser address bar displays "chameleoncloud.org/user/dashboard/". The navigation bar includes the Chameleon logo, menu items (About, User, Learn, Experiment, Blog), a Help Desk button, and a user profile dropdown for "jtillots@ucar.edu@accounts.google.com". Below the navigation bar, a secondary menu contains "Dashboard" (highlighted), "Projects", "Outages", "Help Desk", "Profile", "Webinars", and "Publications". The main content area is titled "Dashboard" and features two primary sections: "Active Projects" and "Open tickets".

Active Projects (Manage your Projects)

Project	Usage/Info
SCCExplore CHI-210828	<input type="text"/>
NCARExplore CHI-220955	<input type="text"/>

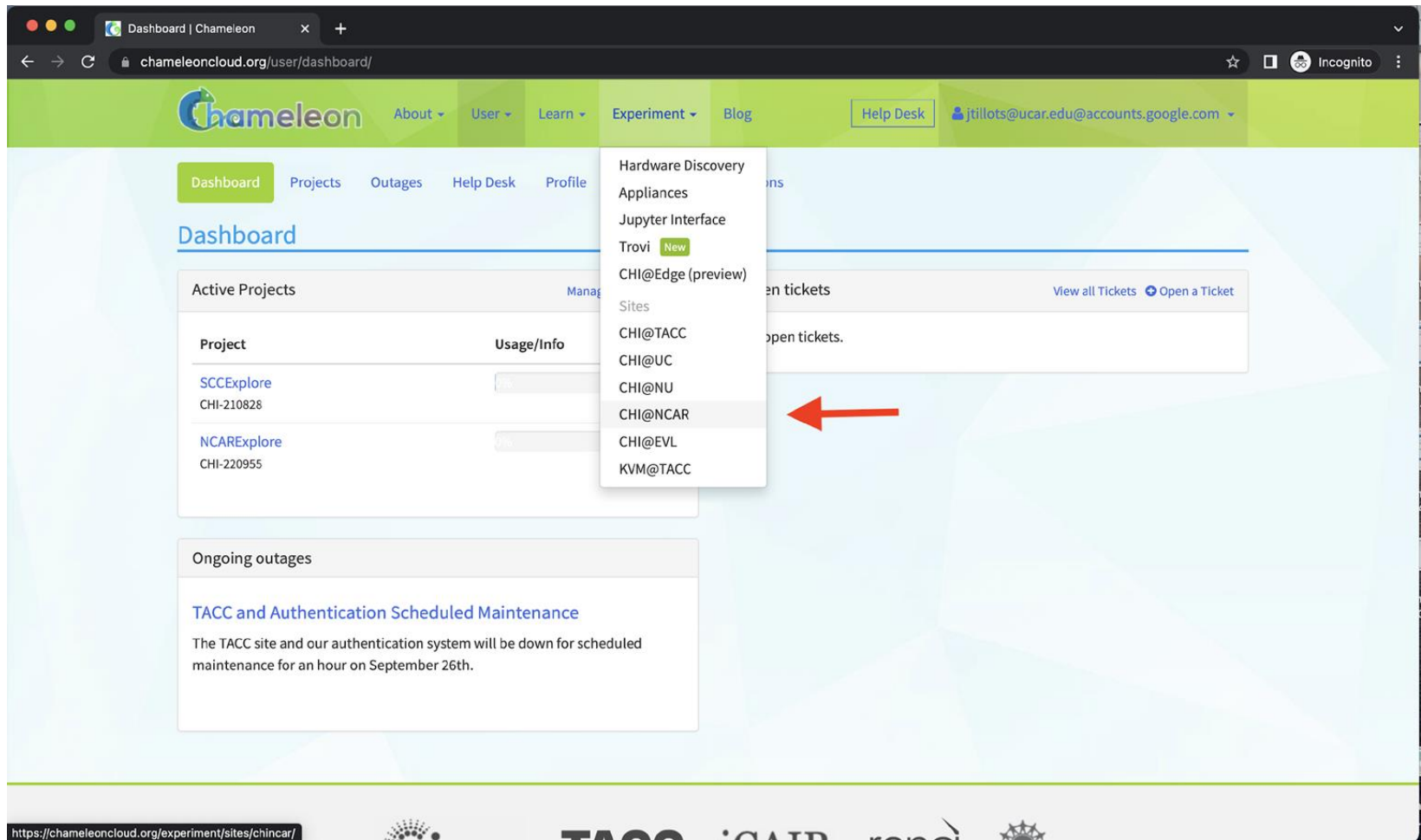
Open tickets (View all Tickets + Open a Ticket)

No open tickets.

Two red arrows are present: one points to the "NCARExplore" project entry in the Active Projects table, and the other points to the user profile dropdown menu in the top right navigation bar.

Accessing CHI@NCAR

- Once you've been added to the project, you can go to the CHI@NCAR site either by choosing "CHI@NCAR" under "Experiment" or just by going to <https://chi.hpc.ucar.edu/>



The screenshot shows the Chameleon Cloud dashboard interface. The top navigation bar includes the Chameleon logo, links for 'About', 'User', 'Learn', 'Experiment', and 'Blog', a 'Help Desk' button, and a user profile dropdown for 'jtilots@ucar.edu@accounts.google.com'. Below the navigation bar, there are tabs for 'Dashboard', 'Projects', 'Outages', 'Help Desk', and 'Profile'. The main content area features a 'Dashboard' section with a table of 'Active Projects' and a 'Help Desk' section with 'Open tickets'. A dropdown menu is open under the 'Experiment' tab, listing various sites: 'Hardware Discovery', 'Appliances', 'Jupyter Interface', 'Trove', 'CHI@Edge (preview)', 'Sites', 'CHI@TACC', 'CHI@UC', 'CHI@NU', 'CHI@NCAR', 'CHI@EVL', and 'KVM@TACC'. A red arrow points to the 'CHI@NCAR' option in the dropdown menu. The 'Active Projects' table has the following data:

Project	Usage/Info
SCCExplore CHI-210828	
NCAREExplore CHI-220955	

The 'Ongoing outages' section contains the following text:

TACC and Authentication Scheduled Maintenance
The TACC site and our authentication system will be down for scheduled maintenance for an hour on September 26th.

The footer of the page shows the URL <https://chameleoncloud.org/experiment/sites/chincar/> and logos for TACC, NCAR, and other institutions.

Leasing Nodes

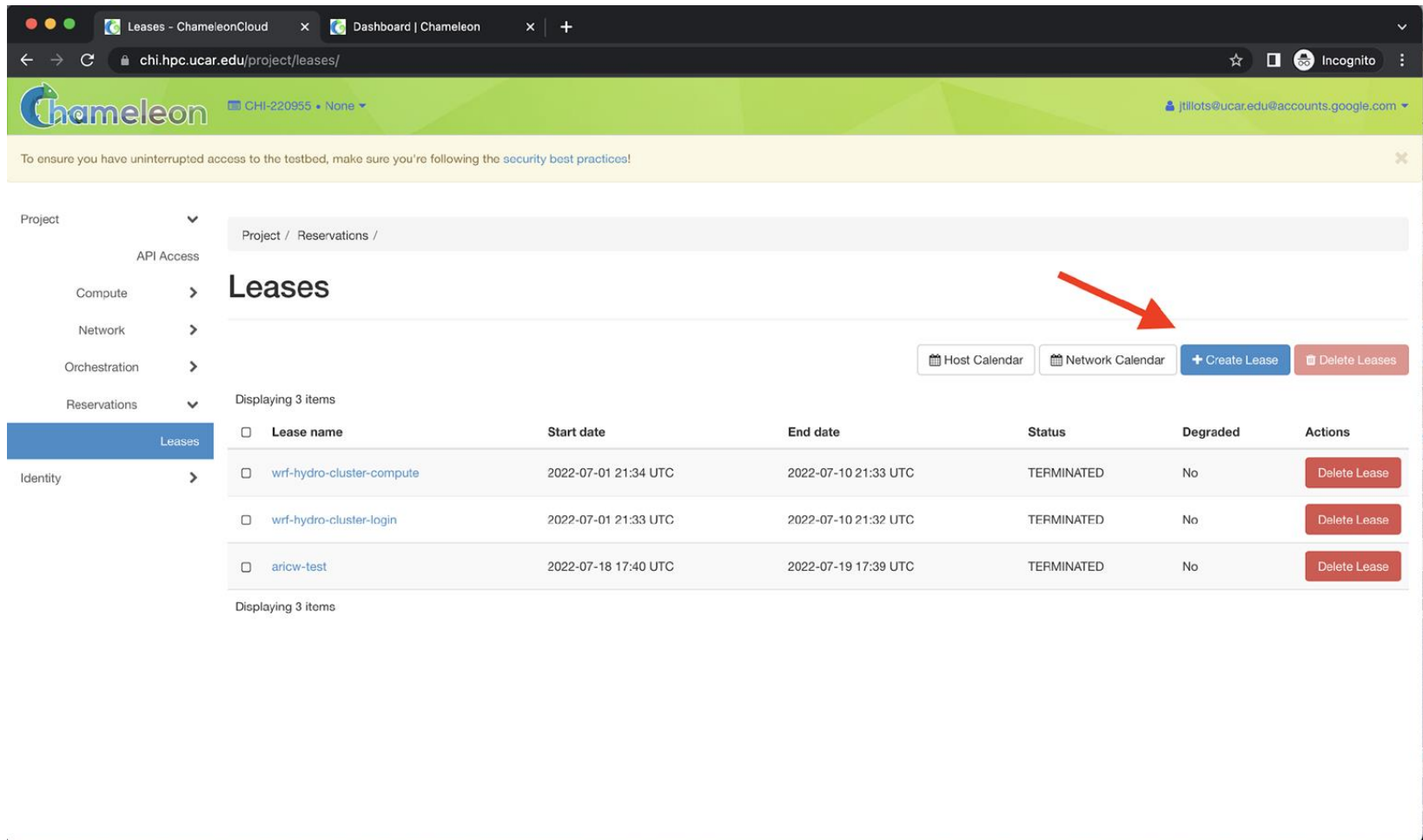
- Lease nodes by choosing “Leases” under “Reservations”

The screenshot shows a web browser window with the URL `chi.hpc.ucar.edu/project/`. The page title is "Overview" and the breadcrumb is "Project / Compute / Overview". The left sidebar shows a navigation menu with "Leases" selected under "Reservations". The main content area displays a "Limit Summary" for "Compute" with a gauge showing "Used 0 (No Limit)". Below this, there are six resource usage gauges: "Floating IPs" (Allocated 0 of 50), "Security Groups" (Used 1 of 10), "Security Group Rules" (Used 4 of 100), "Networks" (Used 0 of 100), "Ports" (Used 0 (No Limit)), and "Routers" (Used 0 of 10). A red arrow points to the "Leases" gauge. At the bottom, there is a "Usage Summary" section with a text input field for selecting a time period to query usage.

<https://chi.hpc.ucar.edu/project/leases/> Select a period of time to query its usage:
The data should be in YYYY-MM-DD format

Leasing Nodes

- Create a new lease by clicking on “Create Lease”



The screenshot shows the Chameleon Cloud interface. The browser address bar displays `chi.hpc.ucar.edu/project/leases/`. The page title is "Leases" under the "Reservations" section. A red arrow points to the "+ Create Lease" button in the top right corner of the main content area. Below the button are two calendar buttons: "Host Calendar" and "Network Calendar".

Displaying 3 items

<input type="checkbox"/>	Lease name	Start date	End date	Status	Degraded	Actions
<input type="checkbox"/>	wrf-hydro-cluster-compute	2022-07-01 21:34 UTC	2022-07-10 21:33 UTC	TERMINATED	No	Delete Lease
<input type="checkbox"/>	wrf-hydro-cluster-login	2022-07-01 21:33 UTC	2022-07-10 21:32 UTC	TERMINATED	No	Delete Lease
<input type="checkbox"/>	aricw-test	2022-07-18 17:40 UTC	2022-07-19 17:39 UTC	TERMINATED	No	Delete Lease

Displaying 3 items

Creating Leases

- Enter a Lease Name
- Enter the Start Date and Time (default: today and now)
- Enter the Lease Length in days (default: 1)
- Enter a specific End Time (default: current time)
- Click “Next”

Create Lease ✕

General * Hosts Networks

Lease Name *

Start Date ?

Start Time ?

Lease Length (days) ?

Ends ?

End Time ?

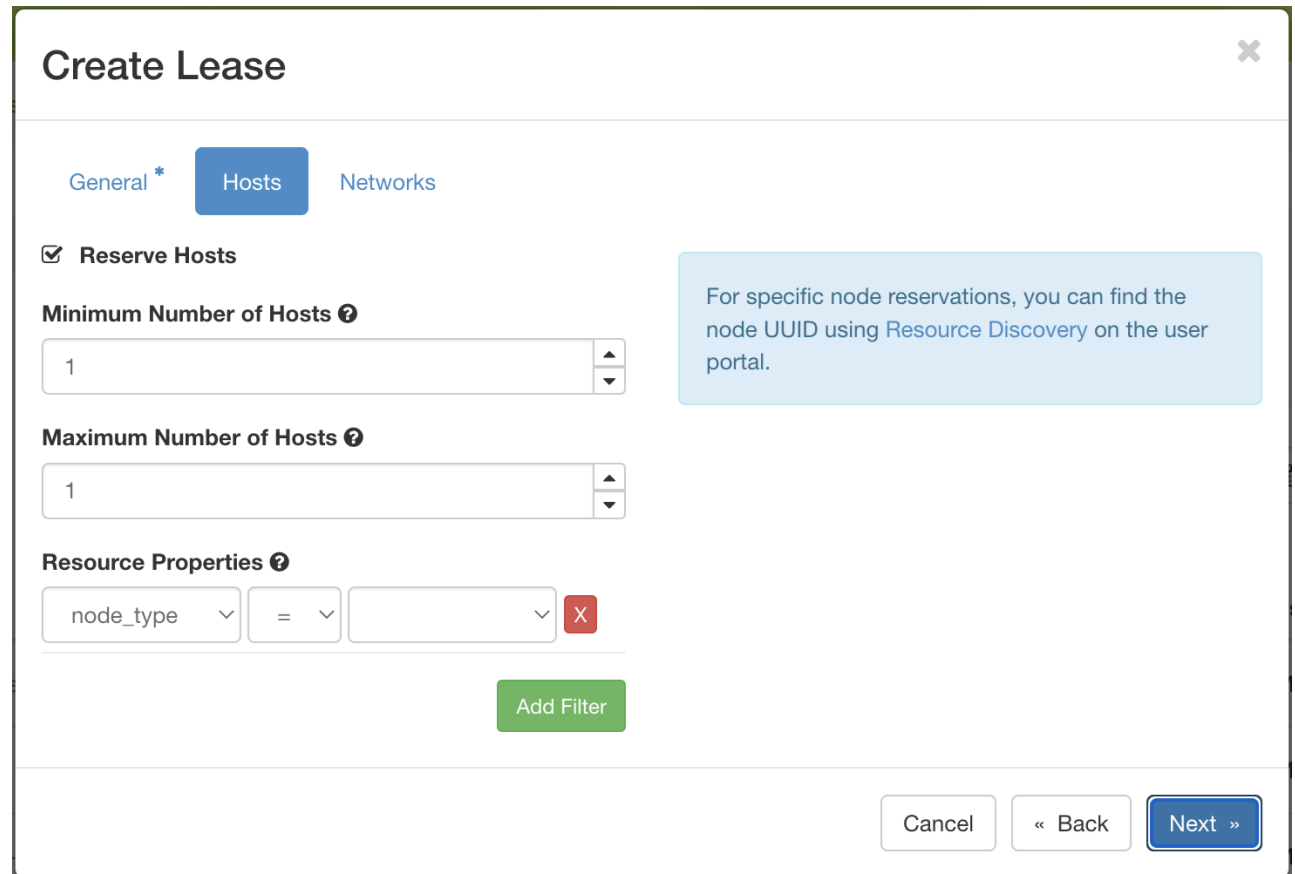
Your timezone is currently configured as **UTC**. If you need to update your timezone please go to your [User Settings](#).

Please be courteous to other users of the testbed and make sure your lease represents a responsible use of Chameleon resources and complies with our [best practices](#). Chameleon operators reserve the right to terminate leases judged to be abusive.

For leases shorter than 24 hours, use a lease length of zero days.

Creating Leases

- Check the “Reserve Hosts” box to reserve a host
- Select Min and Max Number of Hosts (default: 1 and 1)
- We only have one type of Resource Properties for Hosts, so ignore that
- Click “Next”



Create Lease ✕

General * **Hosts** Networks

Reserve Hosts

Minimum Number of Hosts ⓘ

1

Maximum Number of Hosts ⓘ

1

Resource Properties ⓘ

node_type = ✕

[Add Filter](#)

For specific node reservations, you can find the node UUID using [Resource Discovery](#) on the user portal.

Cancel « Back **Next »**

Creating Leases

- We only no tenant networking yet, so don't select "Reserve Network"
- Check the "Reserve Floating IPs" box and select the Number of Floating IP Addresses Needed. You'll need at least one.
- Click "Create"

Create Lease

General * Hosts **Networks**

Reserve Network

Network Name ?

Network Description ?

Resource Properties ?

physical_network = physnet1 X

Add Filter

Reserve Floating IPs

Number of Floating IP Addresses Needed ?

Network name is required when reserving a network.

Floating IP addresses are used to connect to an instance over the internet. There is typically no need to reserve more than one per-project for a given site. If there are no floating IPs available, try taking an ad-hoc IP (no reservation required). [Learn more.](#)

Cancel « Back **Create**

Launching Instances

- Once your lease is “ACTIVE”, you can launch an instance
- Select “Instances” under “Compute”

The screenshot shows the Chameleon Cloud interface. The left sidebar has a 'Compute' menu with 'Instances' selected. The main content area is titled 'Leases' and displays a table of leases. The first lease, 'Sept19Test', is in an 'ACTIVE' state. A red arrow points to the 'Instances' menu item, and another red arrow points to the 'ACTIVE' status in the table.

Project / Reservations /

Leases

Displaying 4 items

Host Calendar Network Calendar + Create Lease Delete Leases

<input type="checkbox"/>	Lease name	Start date	End date	Status	Degraded	Actions
<input type="checkbox"/>	Sept19Test	2022-09-20 00:20 UTC	2022-09-21 00:19 UTC	ACTIVE	No	Update Lease
<input type="checkbox"/>	wrf-hydro-cluster-compute	2022-07-01 21:34 UTC	2022-07-10 21:33 UTC	TERMINATED	No	Delete Lease
<input type="checkbox"/>	wrf-hydro-cluster-login	2022-07-01 21:33 UTC	2022-07-10 21:32 UTC	TERMINATED	No	Delete Lease
<input type="checkbox"/>	aricw-test	2022-07-18 17:40 UTC	2022-07-19 17:39 UTC	TERMINATED	No	Delete Lease

Displaying 4 items

https://chi.hpc.ucar.edu/project/instances/

Launching Instances

- Click on “Launch Instance”

The screenshot shows the Chameleon Cloud web interface. The browser address bar displays `chi.hpc.ucar.edu/project/instances/`. The page header includes the Chameleon logo, the project name `CHI-220955`, and the user `jillots@ucar.edu@accounts.google.com`. A navigation sidebar on the left lists various options: Project, API Access, Compute, Overview, Instances (highlighted), Images, Key Pairs, Server Groups, Network, Orchestration, Reservations, and Identity. The main content area is titled `Instances` and contains a search bar with `Instance ID =` and a `Filter` button. A red arrow points to the `Launch Instance` button. Below the search bar is a table with columns: `Instance Name`, `Image Name`, `IP Address`, `Flavor`, `Key Pair`, `Status`, `Availability Zone`, `Task`, `Power State`, `Age`, and `Actions`. The table currently displays `No items to display.`

Launching Instances

- Under the “Details” section:
 - Enter Instance Name
 - Select the lease reservation we made from the previous steps
 - Enter the Count which is the number of instances to start

Launch Instance

Please provide the initial hostname for the instance, the availability zone where it will be deployed, and the instance count. Increase the Count to create multiple instances with the same settings.

Project Name	<input type="text" value="CHI-220955"/>	Total Instances (No Limit)
Instance Name *	<input type="text" value="Sept19Instance"/>	0 Current Usage
Description	<input type="text"/>	1 Added
Reservation *	<input type="text" value="Sept19Test (00a02c4c-7d13-4901-8a58-68c6b6f9556a)"/>	
Count *	<input type="text" value="1"/>	

Launching Instances

- Under the "Source" section:
 - click the button labelled with an "up arrow" to select the standard Chameleon Cloud Ubuntu 20.04 ARM64 image

Launch Instance

Instance source is the template used to create an instance. You can use an image, a snapshot of an instance (image snapshot), a volume or a volume snapshot (if enabled). You can also choose to use persistent storage by creating a new volume.

Select Boot Source

Image

Allocated

Displaying 0 items

Name	Updated	Size	Format	Visibility
Select an item from Available items below				

Displaying 0 items

Available ²

Select one

Click here for filters or full text search.

Displaying 2 items

Name	Updated	Size	Format	Visibility
> CC-Ubuntu20.04-ARM64	7/29/22 8:16 PM	1.27 GB	RAW	Public
> test	6/6/22 10:33 PM	1.30 GB	QCOW2	Shared

Displaying 2 items

Cancel < Back Next > Launch Instance

Launching Instances

Launch Instance

Instance source is the template used to create an instance. You can use an image, a snapshot of an instance (image snapshot), a volume or a volume snapshot (if enabled). You can also choose to use persistent storage by creating a new volume.

Select Boot Source

Image

Allocated

Displaying 1 item

Name	Updated	Size	Format	Visibility
> CC-Ubuntu20.04-ARM64	7/29/22 8:16 PM	1.27 GB	RAW	Public

Displaying 1 item

Available 1 Select one

Click here for filters or full text search.

Displaying 1 item

Name	Updated	Size	Format	Visibility
> test	6/6/22 10:33 PM	1.30 GB	QCOW2	Shared

Displaying 1 item

Launching Instances

- Under the “Key Pair” section
 - Upload a public key pair for logging into you instance later
 - You can click on “Create Key Pair” to have the CHI@NCAR site generate a new key pair for using with CHI@NCAR
 - You can click on “Import Key Pair” to import a pubic key
 - If you have already uploaded a public key to CHI@NCAR, it will already be selected in the “Allocated” section

Launch Instance

Details
Source
Flavor
Networks
Network Ports
Security Groups
Key Pair
Configuration
Server Groups
Scheduler Hints
Metadata

A key pair allows you to SSH into your newly created instance. You may select an existing key pair, import a key pair, or generate a new key pair.

Allocated
Displaying 1 item

Name	Type
Jenett-CISL	ssh

Displaying 1 item

Available 0 Select one

Click here for filters or full text search.

Displaying 0 items

Name	Type
No items to display.	

Displaying 0 items

Set admin password

Launching Instances

- Once you have filled in all the sections, click “Launch Instance”

Launch Instance ✕ ?

Details

A key pair allows you to SSH into your newly created instance. You may select an existing key pair, import a key pair, or generate a new key pair.

Source + Create Key Pair ⬇ Import Key Pair

Flavor

Networks

Network Ports

Security Groups

Key Pair

Configuration

Server Groups

Scheduler Hints

Metadata

Allocated

Displaying 1 item

Name	Type
▶ Jenett-CISL	ssh ⬇

Displaying 1 item

Available 0 Select one

✕

Displaying 0 items

Name	Type
No items to display.	

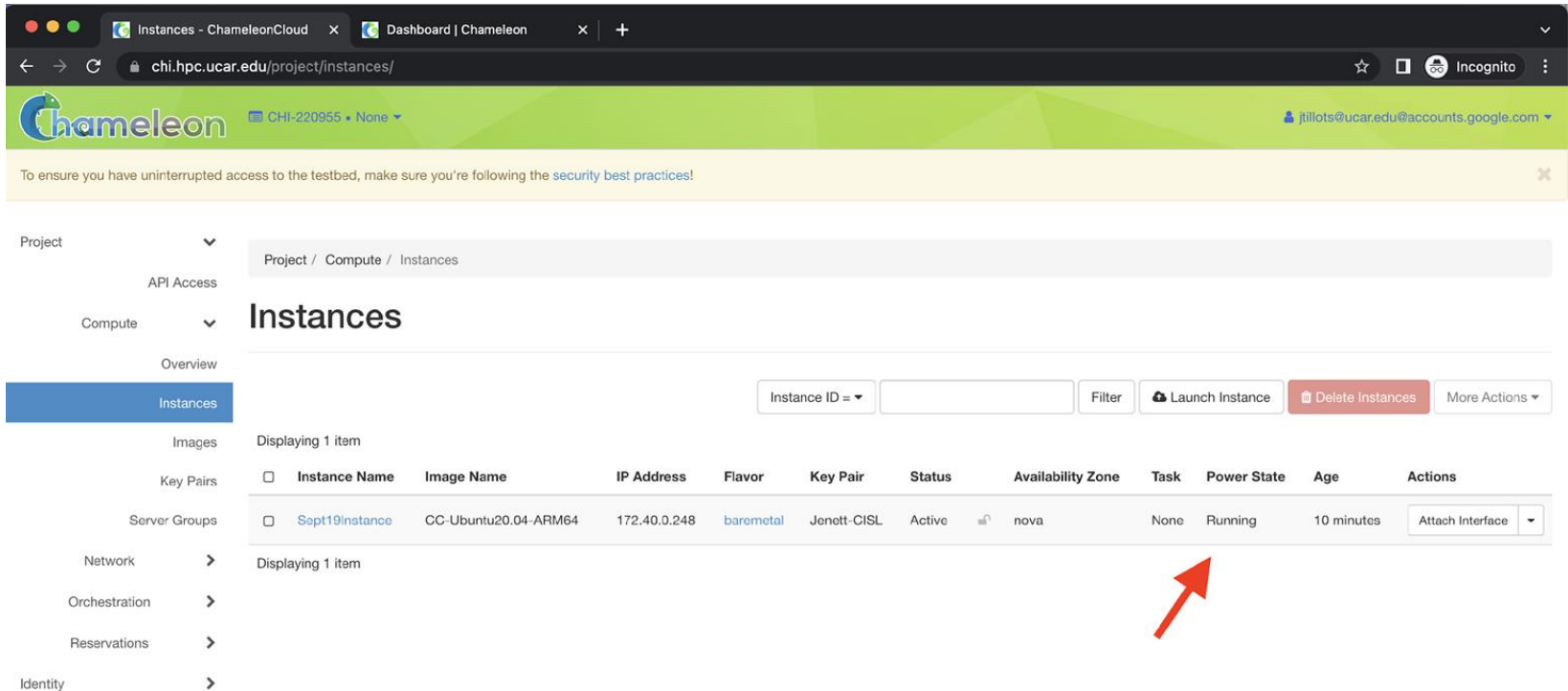
Displaying 0 items

Set admin password

✕ Cancel < Back Next > 🔑 Launch Instance

Launching Instances

- It'll take about 10 minutes for the image to be written to the hard drive and your instance to be “Running”



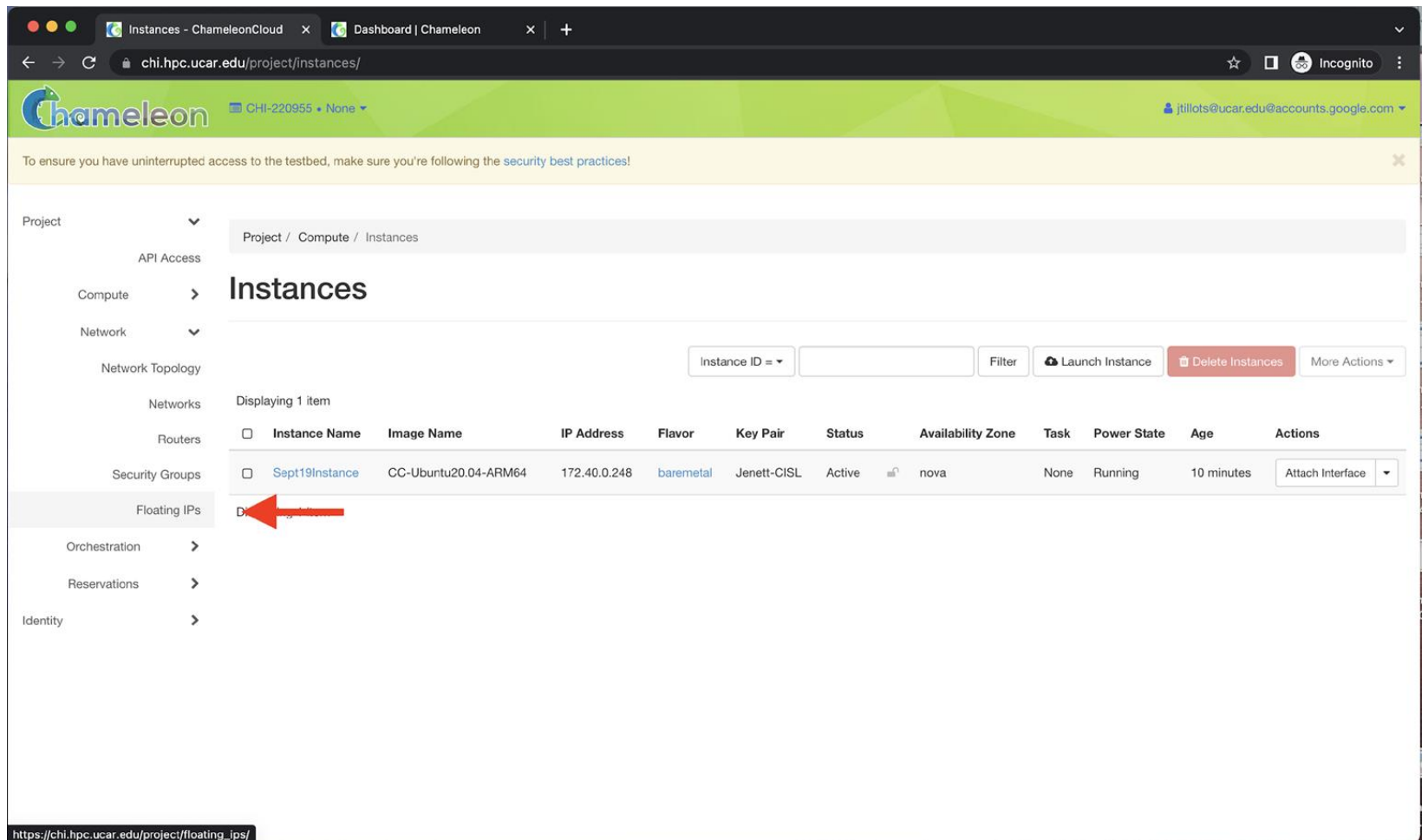
The screenshot shows the Chameleon Cloud web interface. The browser address bar displays `chi.hpc.ucar.edu/project/instances/`. The page title is "Instances". A sidebar on the left contains navigation links for Project, API Access, Compute, Overview, Instances (highlighted), Images, Key Pairs, Server Groups, Network, Orchestration, Reservations, and Identity. The main content area shows a table of instances with the following data:

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
<input type="checkbox"/> Sept19Instance	CC-Ubuntu20.04-ARM64	172.40.0.248	baremetal	Jenott-CISL	Active	nova	None	Running	10 minutes	<input type="button" value="Attach Interface"/>

A red arrow points to the "Running" power state in the table.

Accessing Instances

- Once your instance is running you can attach your Floating IP
- Select “Floating IPs” under “Network”



The screenshot shows the Chameleon Cloud dashboard. The left sidebar contains a navigation menu with the following items: Project, API Access, Compute, Network, Network Topology, Networks, Routers, Security Groups, Floating IPs, Orchestration, Reservations, and Identity. The 'Instances' page is active, displaying a table with one instance: 'Sept19Instance' with IP address 172.40.0.248. A red arrow points to the 'Floating IPs' link in the sidebar.

Project / Compute / Instances

Instances

instance ID = Filter More Actions ▾

Displaying 1 item

<input type="checkbox"/>	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
<input type="checkbox"/>	Sept19Instance	CC-Ubuntu20.04-ARM64	172.40.0.248	baremetal	Jenett-CISL	Active	nova	None	Running	10 minutes	Attach Interface ▾

[Floating IPs](#)

https://chi.hpc.ucar.edu/project/floating_ips/

Accessing Instances

- Your Floating IP will be listed under “IP Address”
- Select your instance as the “Port to be associated”
- Click on “Associate”

Manage Floating IP Associations ✕

IP Address *


128.117.250.24 ▼ +

Select the IP address you wish to associate with the selected instance or port.

Port to be associated *

Sept19Instance: 172.40.0.248 ▼

Cancel Associate



Accessing Instances

- Wait for your Floating IP association to be “Active”

The screenshot shows the Chameleon Cloud interface for managing Floating IPs. The page title is "Floating IPs" and the breadcrumb is "Project / Network / Floating IPs". The left sidebar shows the navigation menu with "Floating IPs" selected. The main content area displays a table with one floating IP association. The status of this association is "Active", which is highlighted by a red arrow.

IP Address	Description	Mapped Fixed IP Address	Pool	Status	Actions
128.117.250.24		Sept19Instance 172.40.0.248	public	Active	Disassociate

Accessing Instances

- You can now “ssh” to your instance using the “cc” account and your Floating IP

```
jtillots — cc@sept19instance: ~ — ssh cc@128.117.250.24 — 95x40
cisl-pierz:~ jtillots$ ssh cc@128.117.250.24
The authenticity of host '128.117.250.24 (128.117.250.24)' can't be established.
ECDSA key fingerprint is SHA256:rcTr0ceFpG6HwuVE3fL5jysb0hzN2lXkVOXp+FXa3nc.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '128.117.250.24' (ECDSA) to the list of known hosts.
Welcome to Ubuntu 20.04.3 LTS (GNU/Linux 5.4.0-91-generic aarch64)

* Documentation:  https://help.ubuntu.com
* Management:    https://landscape.canonical.com
* Support:       https://ubuntu.com/advantage

System information as of Tue Sep 20 00:51:51 UTC 2022

System load:  0.13          Processes:           2337
Usage of /:   0.2% of 1.71TB Users logged in:    1
Memory usage: 1%          IPv4 address for eno2: 172.40.0.248
Swap usage:   0%          IPv4 address for enp145s0f1: 10.18.250.76
Temperature: 48.3 C

* Super-optimized for small spaces – read how we shrank the memory
  footprint of MicroK8s to make it the smallest full K8s around.

https://ubuntu.com/blog/microk8s-memory-optimisation

222 updates can be applied immediately.
164 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

The list of available updates is more than a week old.
To check for new updates run: sudo apt update
New release '22.04.1 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Tue Sep 20 00:51:23 2022 from 75.70.96.198
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

cc@sept19instance:~$
```

Future Work

- Setup tenant network
 - There is a physical, high speed network connected to a Cumulus switch
 - Currently works, but is getting IP addresses from a central NCAR DHCP server
 - Need to create VLAN create/destroy scripts and setup a DHCP server inside CHI@NCAR
- RoCE over the Internet
 - Working on getting a Layer 2 connection/RDMA to machines at other Chameleon sites
- Specialized images
 - Have a JBOD for storing images that needs setup
 - Create some specialized images for NCAR users

Questions?