
KubeCon
CloudNativeCon
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Fink on Kubernetes

Efficient management of massive alert streams for astronomical objects identification



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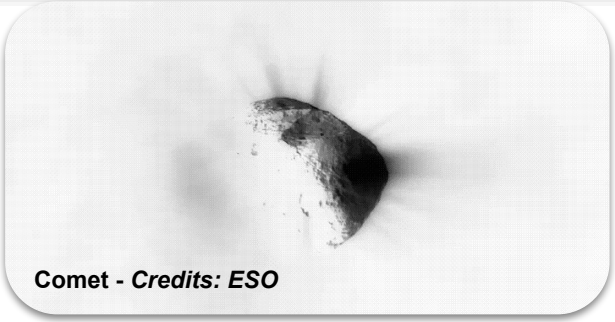
Fink: astronomy & computing

What are we doing?

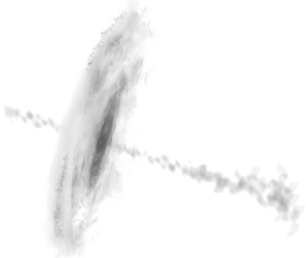
Tracking changes in the sky

- Solar system, galactic and extragalactic science

Fink is a broker, serving the scientific community by ingesting, classifying, filtering, and redistributing alerts from telescopes and surveys.

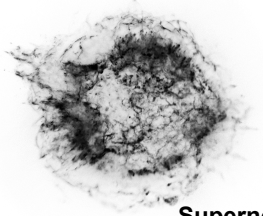


Comet - *Credits: ESO*





Active Galactic nucleus



Supernova



Tidal disruptive event

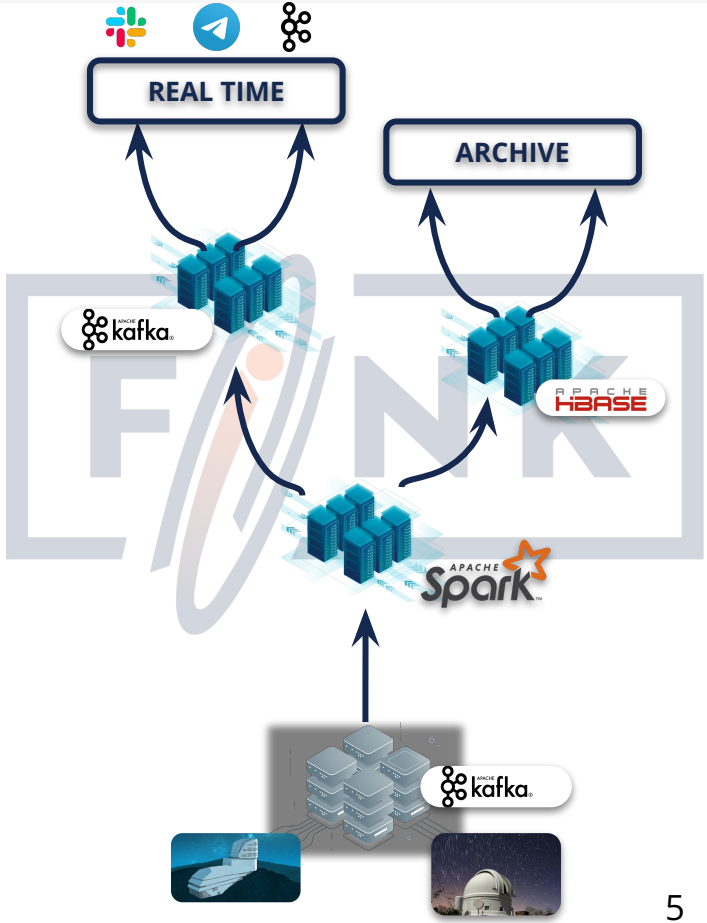
Current status

Services deployed on large academic OpenStack clouds

Operating 24/7, serving 100+ unique users per day: observatories, scientists & amateurs

- Real-time components (million+ event/night)
- Event database (~1B entries)

Community-driven: scientists bring building bricks to the project



Why using kubernetes?



The long run is difficult

- Number of maintainers is low → deployment and operations should be made easy
- From 0 to million of events per night → auto-scaling
- Domain experts are the crucial agents for scientific discoveries, but low computer skills → high-level abstractions
- Large ecosystem of dependencies, often incompatible → microservices
- Interplay between the computing model & user software → Infrastructure should adapt to specific user needs
- From development to production → end-to-end testing is necessary: code & infrastructure

Harnessing the power of Kubernetes

Empowering academic cloud

Beyond improving Fink capabilities, the **objective is to develop skills to operate large Academic On-Premise clouds** (e.g. Paris Saclay University cloud)

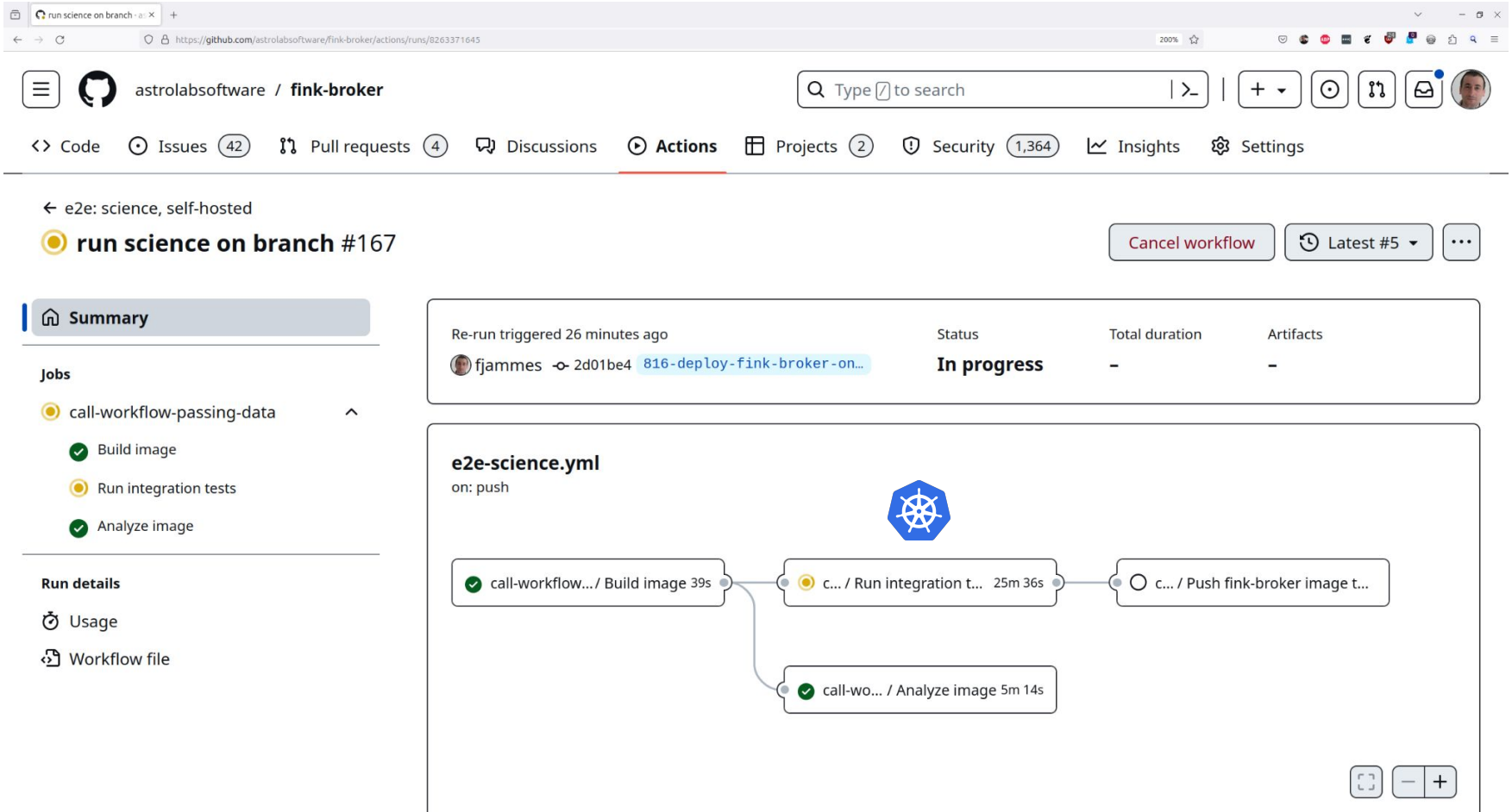
The experience gained with Fink benefits other communities in return, e.g. available with Kubernetes 

- On-demand Kubernetes / Apache Spark clusters
- On-demand self-hosted GitHub Action runners
- Training on cloud technologies for students & staff

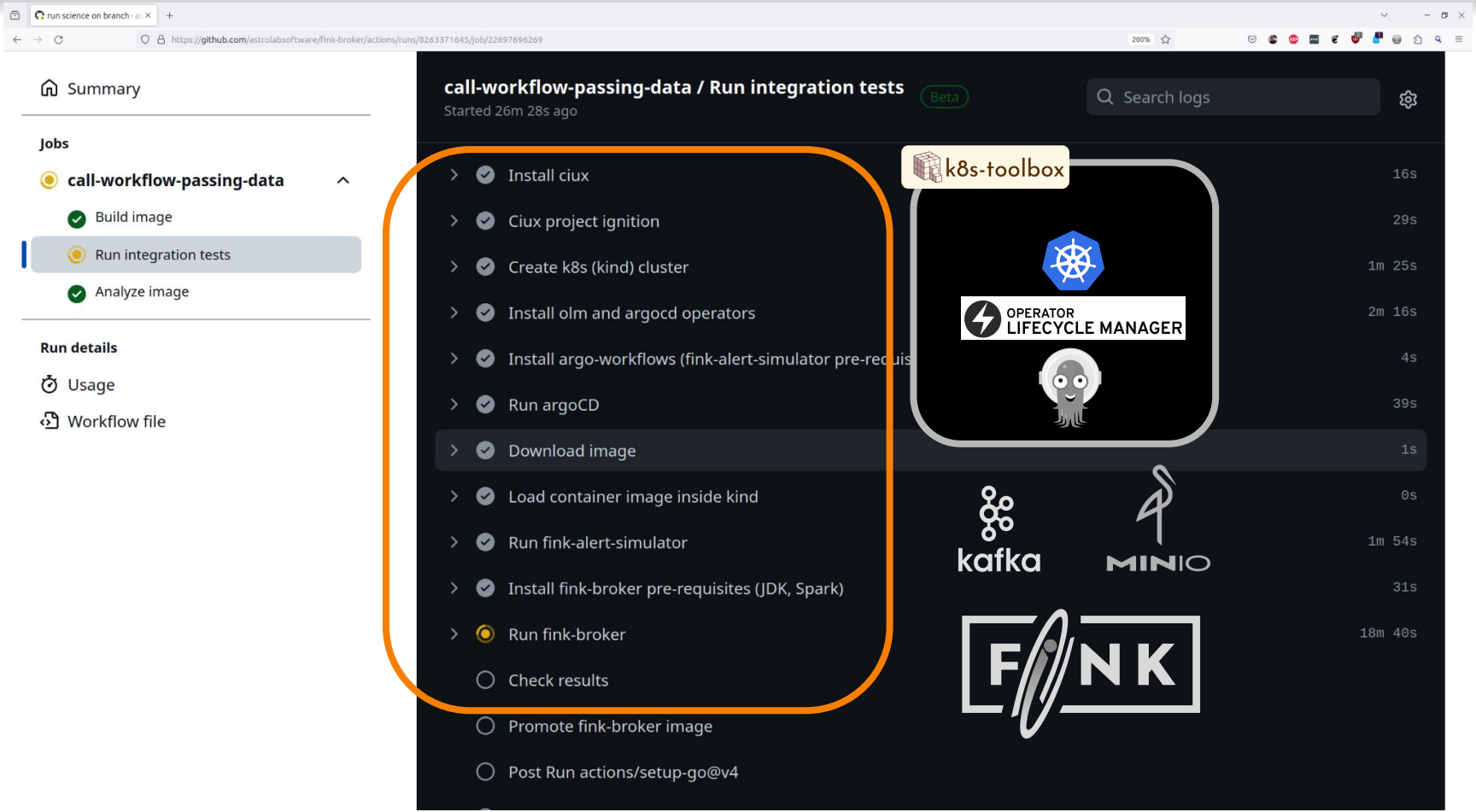
A scalable self-hosted CI

“Let’s turn those big static CI/CD pipelines into lightweight, easy to create, easy to run pipelines”

Validation the full production platform



CI replicates production deployment and execution



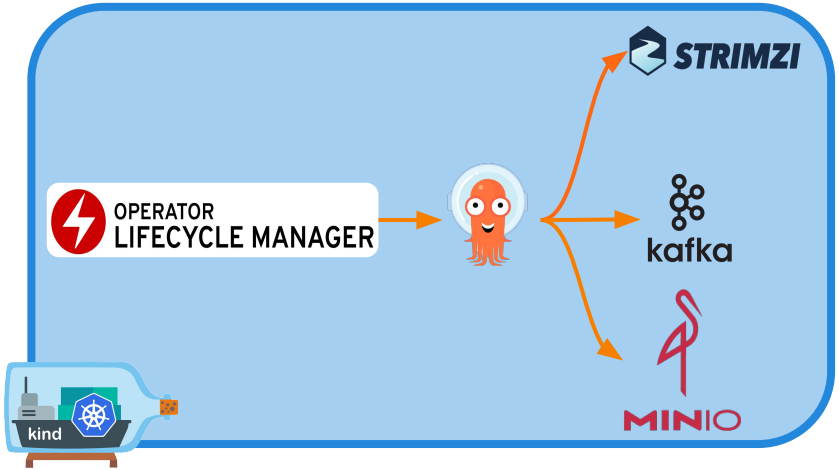
Setup the Fink pre-requisites in CI with Gitops

k8s-toolbox

https://github.com/k8s-school/ktbx

- Easy Kubernetes Installation on Linux
- One-line installations for OLM, ArgoCD, Argo Workflow
- Instant access to k8s sysadmin tools

→ Simulate Kafka servers and S3 storage for telescopes in seconds




```
# 3 nodes k8s cluster with Calico CNI
ktbx create -c

# Install components
ktbx install kubectl
ktbx install olm
ktbx install argocd
ktbx install argowf
```

Spark startup script is not GitOps friendly



https://github.com/astrolabsoftware/finkctl

- CLI for `fink-broker` on k8s
- Written in Go
- Full control on Apache Spark, with a configuration file

  → Transition to Apache Spark operator for further progression toward full GitOps?




```
# Create a bucket
finkctl --endpoint=localhost:9000 s3 \
makebucket

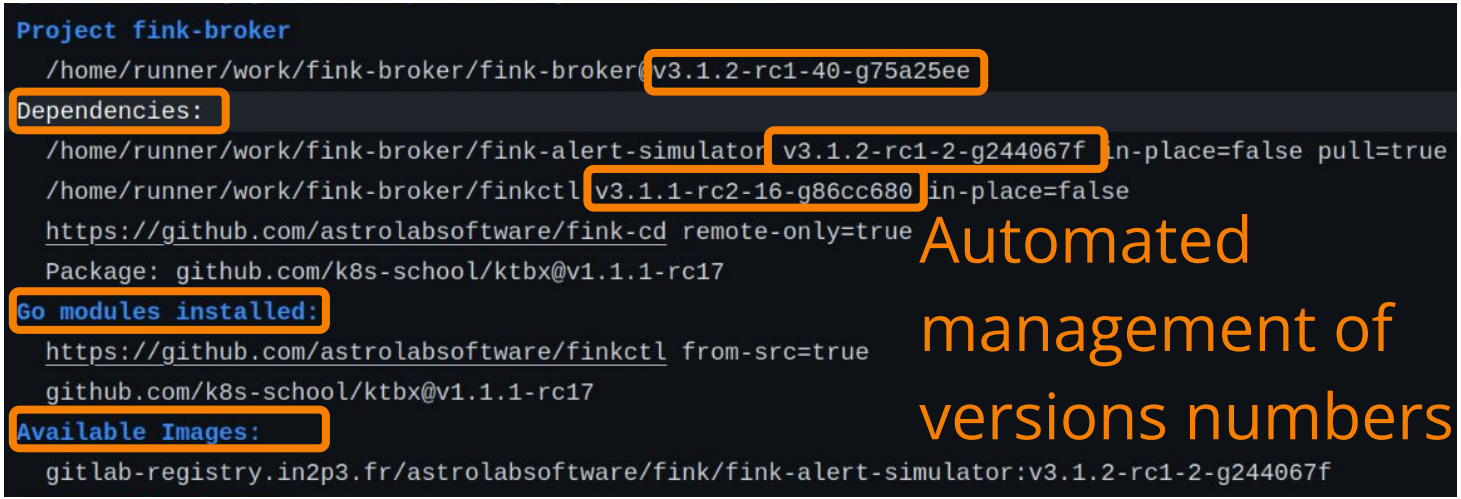
# Launch a task with a given image
finkctl run $task --image $IMAGE

# Wait for the results
while ! finkctl wait tasks; do
   ...
done
```

Ciux : automated build/e2e tests pre-requisites checks

https://github.com/k8s-school/ciux

- avoids rebuilding fink image in CI if no code changed
- deploys all microservices, including those under development, necessary for the fink stack e2e testing



Insights on self-hosted runner for GHA

Essential for testing Fink with its production environment

- Runs on a k8s cluster, each CI job runs in a pod
- Based on ARC which is stable in recent versions
- Considering VCluster as an alternative to Kind

While powerful, CI still requires significant maintenance ;-(
but it saves a lot of time when deploying production!

K8s-based Self-Hosted Runner Advantages

- Scalability: Easily scale resources to match workload demands
- Interactive Debugging: access from workstation in 2 lines:

```
user@workstation:~$ export KUBECONFIG=$HOME/.kube/self-hosted-ci_kubeconfig
user@workstation:~$ kubectl exec -it -n arc-runners arc-runners-cllkn-runner-jzgr9 -- bash
Defaulted container "runner" out of: runner, dind, init-dind-externals (init)
runner@arc-runners-cllkn-runner-jzgr9:~$ kubectl get pods
NAME                                          READY   STATUS    RESTARTS   AGE
distribute-py-10fc7d8e41697017-driver         1/1     Running   0          21m
distribute-sims-20200101-7766b68e416b3f78-exec-10   1/1     Running   0          18m
distribute-sims-20200101-7766b68e416b3f78-exec-9    1/1     Running   0          18m
raw2science-py-721c198e41696faa-driver        0/1     Error     0          21m
stream2raw-py-d247da8e41697082-driver         1/1     Running   0          21m
stream2raw-sims-ee7de18e416b4246-exec-10      1/1     Running   0          18m
stream2raw-sims-ee7de18e416b4246-exec-9       1/1     Running   0          18m
```

Easy interactive access to GHA self-hosted runner

Interactive troubleshooting:

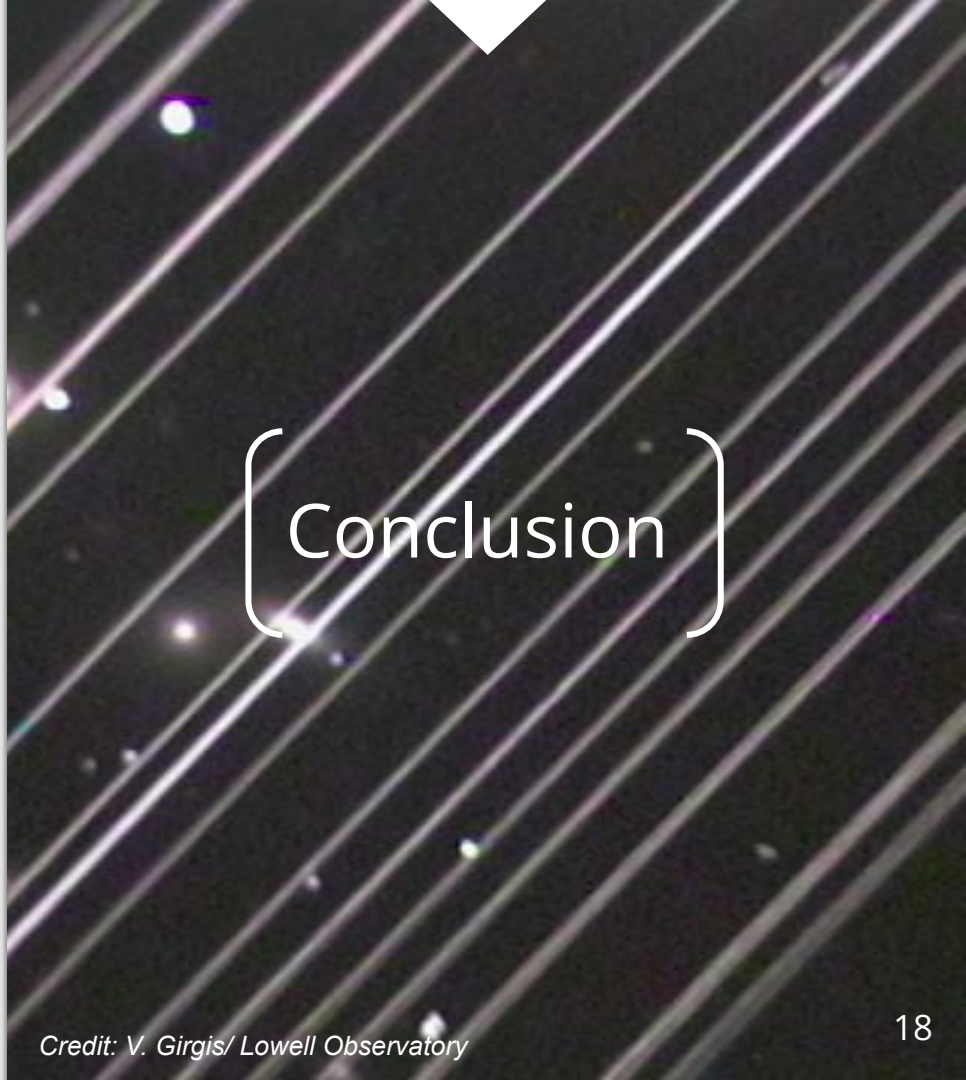
```
runner@arc-runners-cllkn-runner-jzgr9:~$ kubectl logs raw2science-py-721c198e41696faa-driver
24/03/15 09:23:26 INFO main (raw2science.py line 88): Applying quality cuts
Traceback (most recent call last):
  File "/home/fink/fink-broker/bin/raw2science.py", line 147, in <module>
    main()
  File "/home/fink/fink-broker/bin/raw2science.py", line 93, in main
    df = apply_science_modules(df, args.noscience)
  File "/home/fink/fink-broker/fink_broker/science.py", line 225, in apply_science_modules
    df = xmatch_cds(df)
NameError: name 'xmatch_cds' is not defined
24/03/15 09:23:27 WARN ExecutorPodsWatchSnapshotSource: Kubernetes client has been closed.
```

Save time by avoiding the need to reinstall the entire `fink-broker` stack and up-to-date microservices.

Regular GitHub Actions (GHA) runners lack interactive access and scalability.

Conclusion

1. Fink is set to run until 2035 (at least!)
2. Hundreds of users watching the sky
3. Full deployment on k8s ongoing, fine-tuning in progress
4. Opportunity to learn better how to operate academic on-premise clouds



Credit: V. Girgis/ Lowell Observatory

Q&A

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