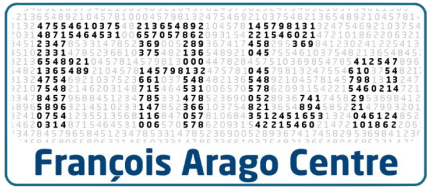


EPFL

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

MMODA multi-messenger data analysis platform

Denys Savchenko[1]

Andrii Neronov[1,2], Volodymyr Savchenko[2,3], Carlo Ferrigno[3], Gabriele Barni[3], Mohamed Meharga[3], Oleg Kalashev[2]

1. *Astroparticule et Cosmologie, CNRS & Université Paris Cité*
2. *EPFL Laboratoire d'astrophysique*
3. *Observatoire Astronomique de l'Université de Genève*

Multi-Messenger Astronomy

Exploding field!

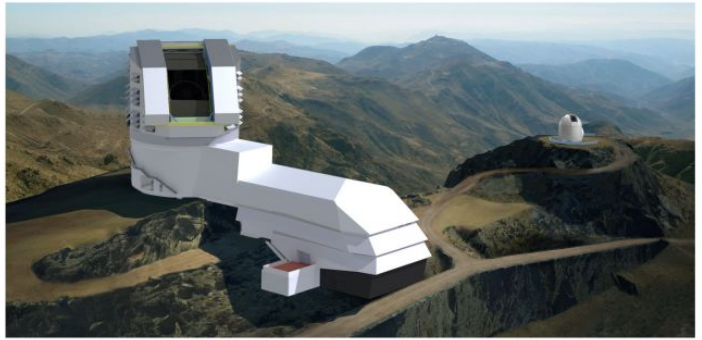
Last decade key **new observables** were discovered, and conventional telescopes dramatically upgraded to match.

Number of alerts and **volume of data** we deal with **increased by couple orders of magnitude in the last years**, and several nearly-ready telescopes promise another comparable increase

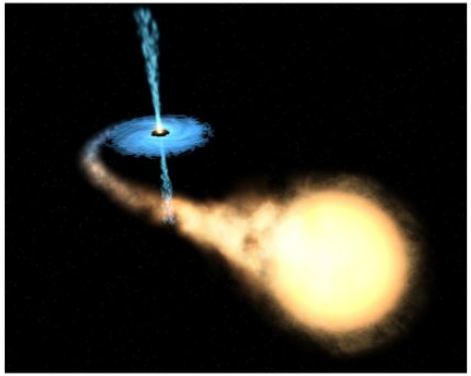
"Just" a star

Radio

Visible

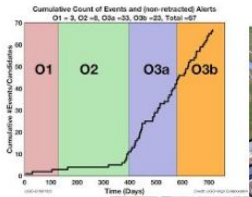


Star and black hole



Two neutron stars

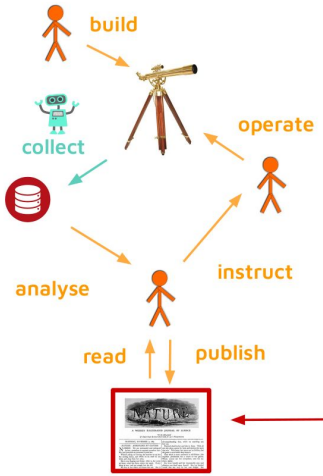
Gravity

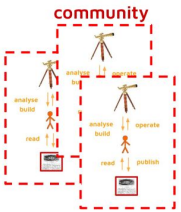


Evolution of astronomy

Mostly-human Astronomy

- Reaction to sky: **slow**
- Reaction to papers: **slow**
- Trials (p-hacking): **uncontrolled**
- Publishing: **slow**
- Scalability: **bad**
- Creativity: **high**
- Communication: **nuanced but imprecise and slow**

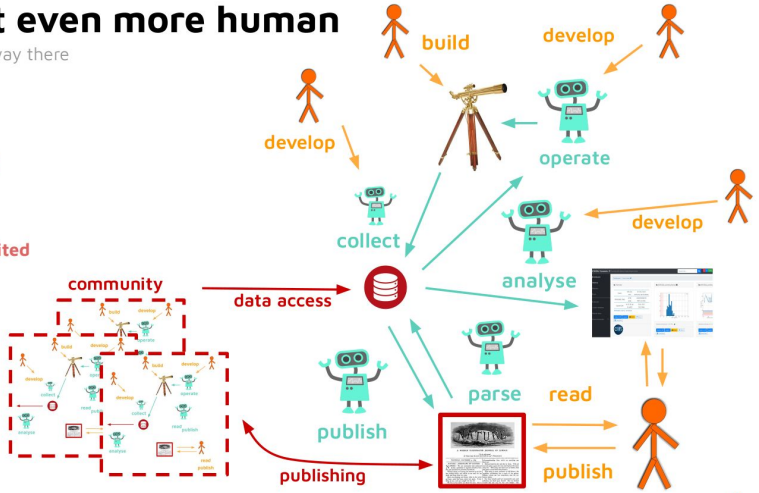




More robot, but even more human

"Ideal" picture: most reality halfway there

- Reaction to sky: **fast**
- Reaction to papers: **fast**
- Trials (p-hacking): **controlled**
- Publishing: **fast**
- Scaling: **good**
- Creativity: **low**
- Communication: **precise, limited**

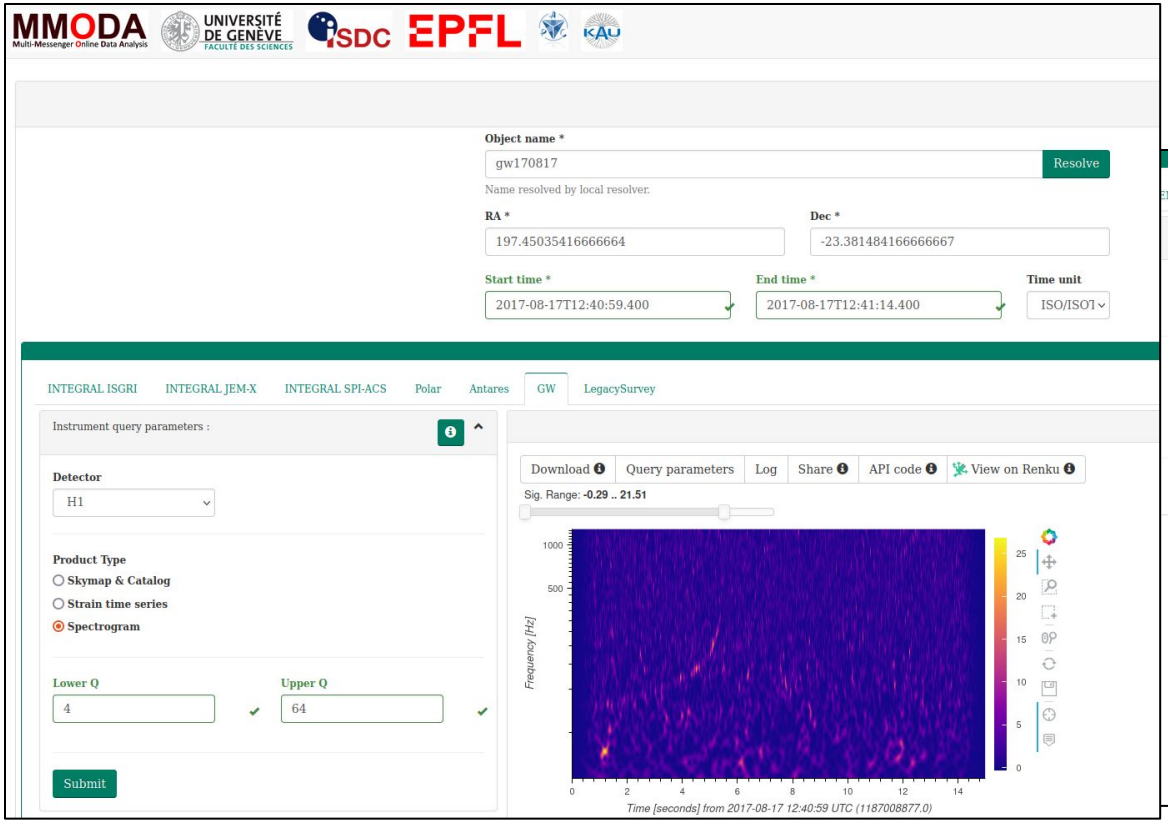


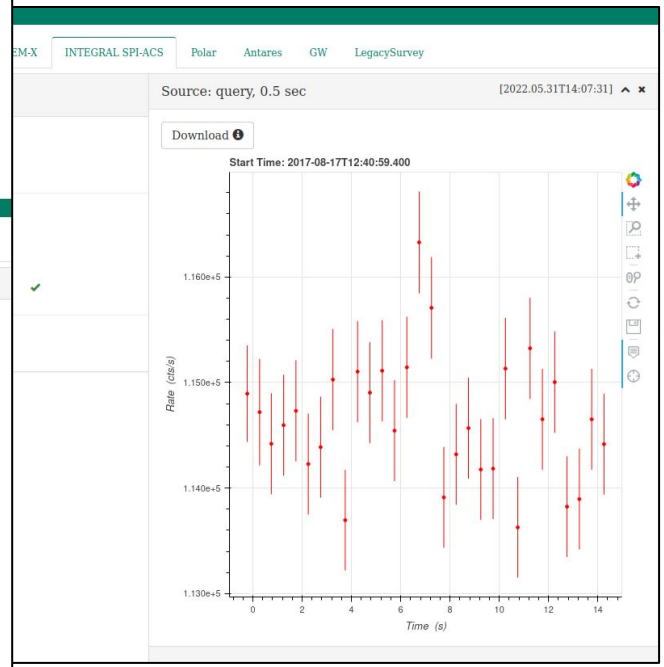
- **Making smart robots is hard**: always lacking **developers who are also research scientists.**
- If all is automated, **scientists have hard time seeing what's going on**, since **they do not speak robot**
- Robots are **fast**, but **lack creative reaction** in **new situations**.

Human reaction and processing **is slow**, even if it's within even one person. But people are **smart**

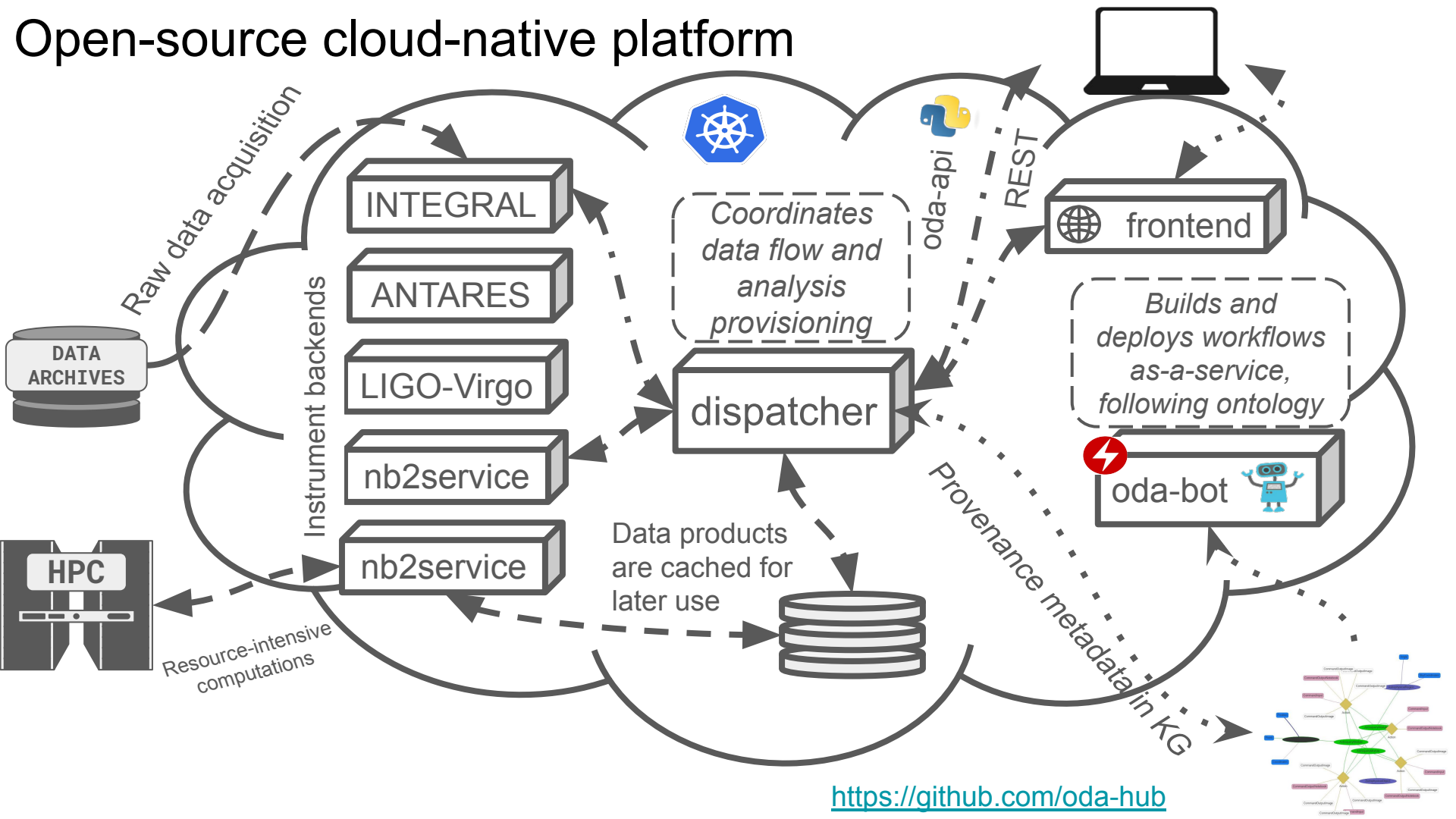
MMODA: a tool for exploring, transforming MM data

https://mmoda.io





Open-source cloud-native platform



https://github.com/oda-hub

Development space: help scientists make robots

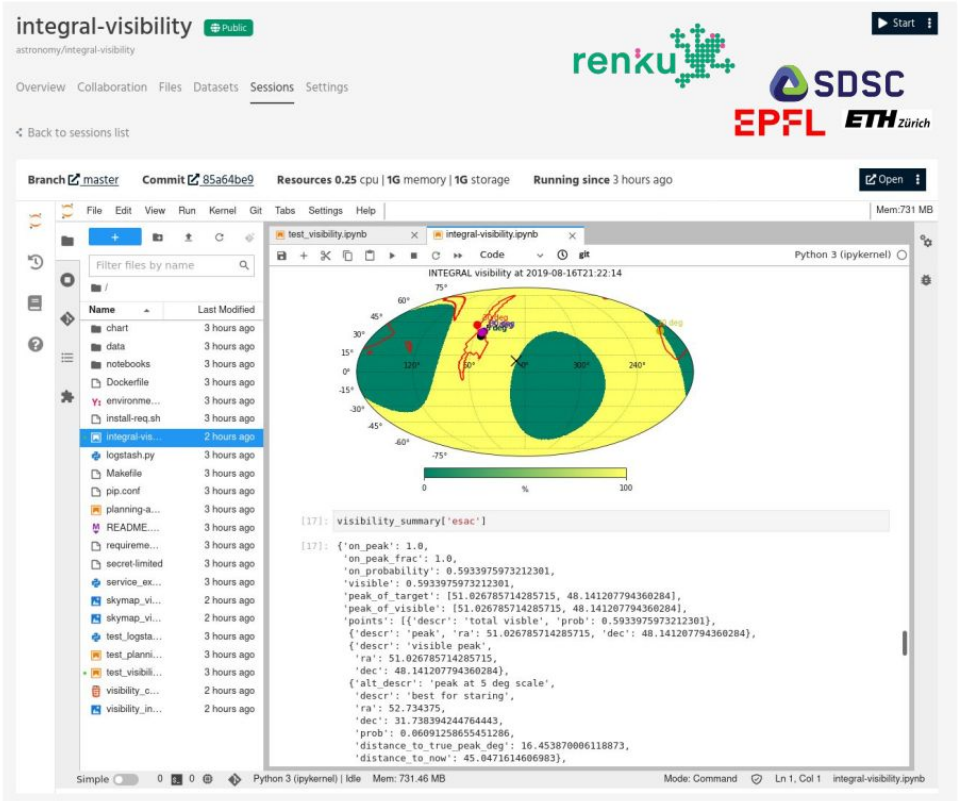
There are much **more scientists who can make a Jupyter notebook than write organized code.**

JupyterHub(s), Google-collab, ESA DataLabs, Renku

- **Continuous integration and testing**
- Supports in **publishing of data and code** (e.g. in zenodo)
- Support in **annotation** for scientists and robots reuse with ontology terms

Developing and integrating metadata in a **Knowledge Graph**

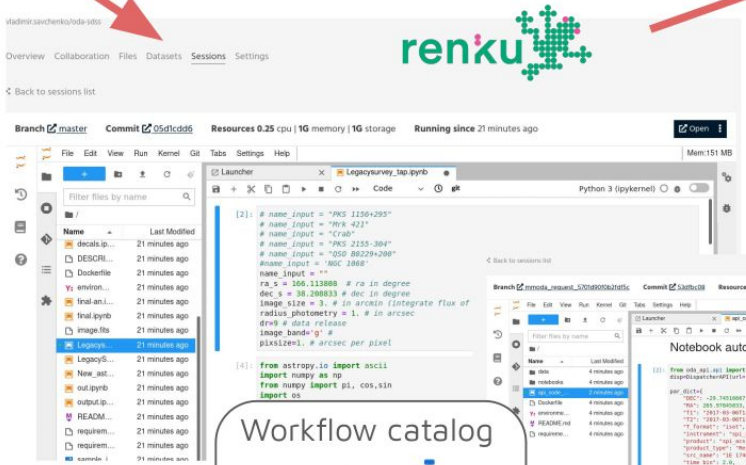
This process creates a collection of notebooks and other workflows, but they are only really accessible interactively one-by-one

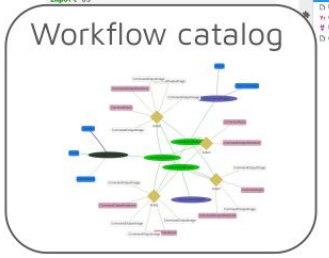


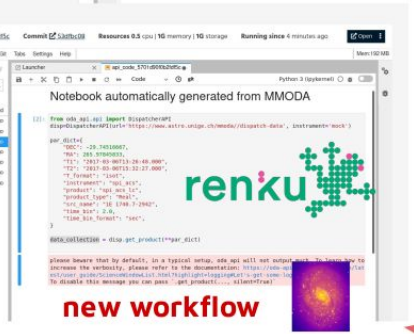
Feedback loop for crowd-sourcing workflow catalog

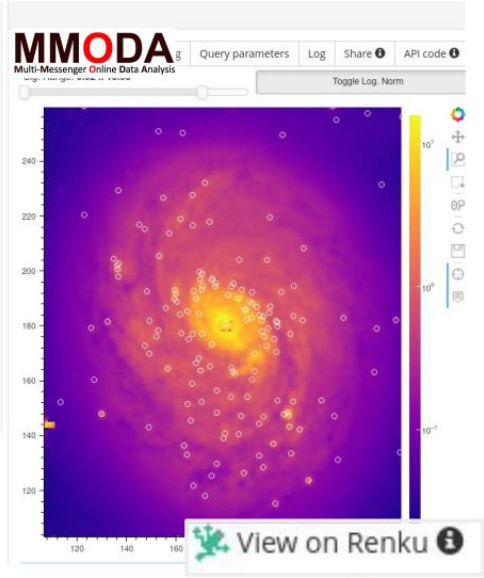
Scientist develops data reduction with deep scientific expertise

Publishing renku workflow as discoverable and executable asset









Automated workflow testing, benchmarking, reaction to space events, etc

Scientist creates new workflow leveraging the existing one

Résumé

- L'astronomie multimessagere traite des grands volumes de données et nécessite une automatisation intelligente pour réagir rapidement et assurer la réutilisation et la reproductibilité.
- Nous développons la plateforme open-source, native du cloud, pour l'analyse de données multimessagers en ligne – MMODA.
- Nous établissons un écosystème centré autour de la plateforme MMODA, qui permet la création de flux de travail FAIR via le crowdsourcing.

Merci pour votre attention !

Plus de détails sur le poster

It's time for questions