Finanziato dall'Unione europea
NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

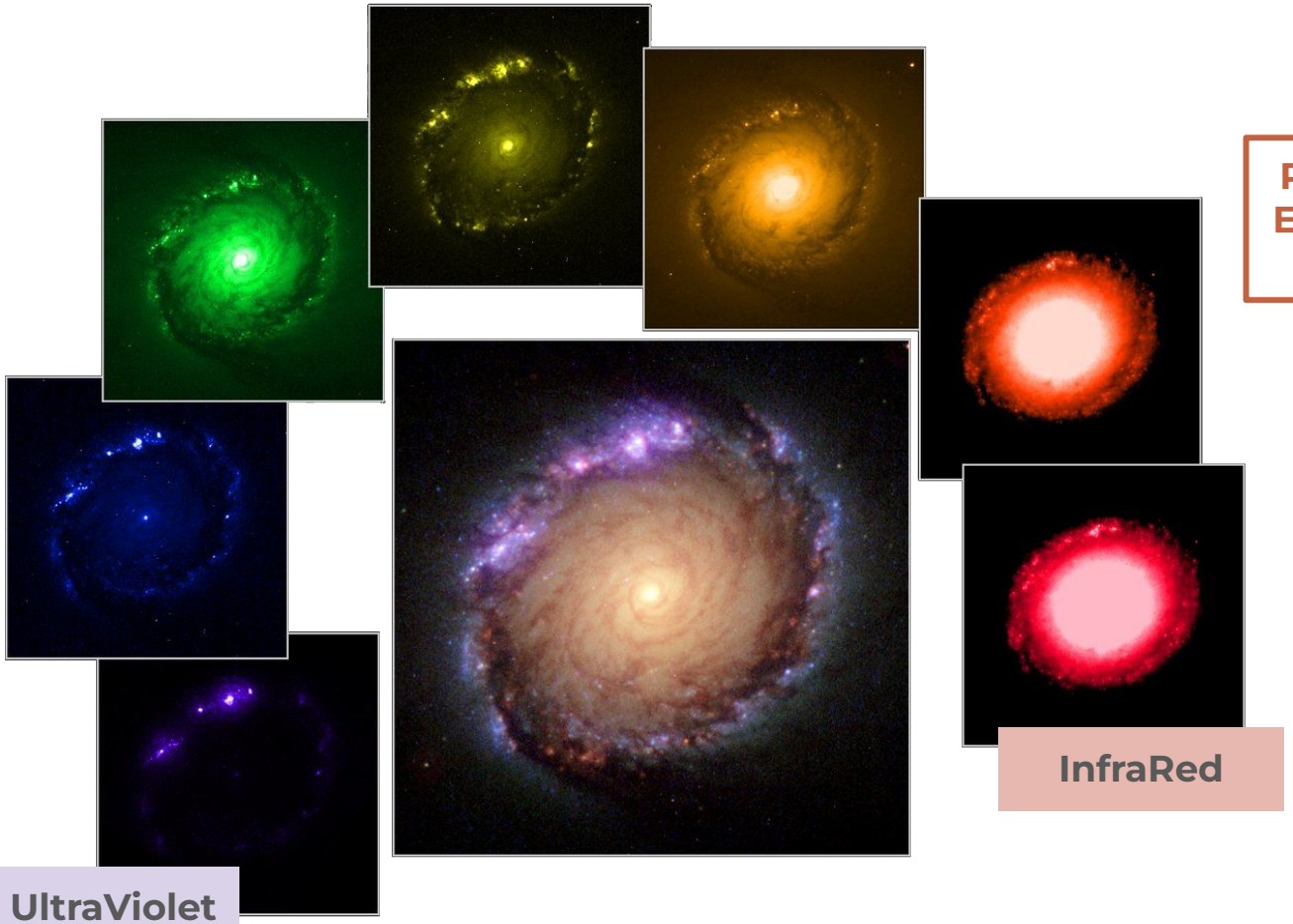
ICSC
Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

GalaPy - we tried so hard and got so far

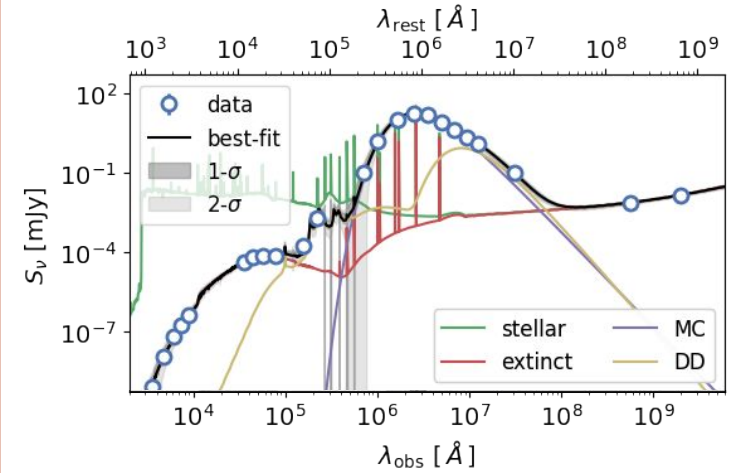
Ronconi, T.; Lapi, A.; + others

Spoke 3 III Technical Workshop, Perugia May 26-29, 2025

Scientific Rationale: Study Galaxies by Extracting (astro-)Physical Information from SED



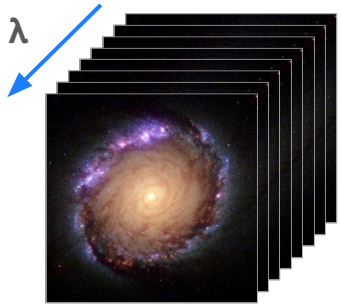
Physical Emission Model



Spectral Energy Distribution (SED)

→ **1 zettabyte** of data per year!

Methods: SED Fitting 101 and desiderata



Spectrum Observation ⊕ **Physical Emission Model** ⊕ **Parameter space sampling**

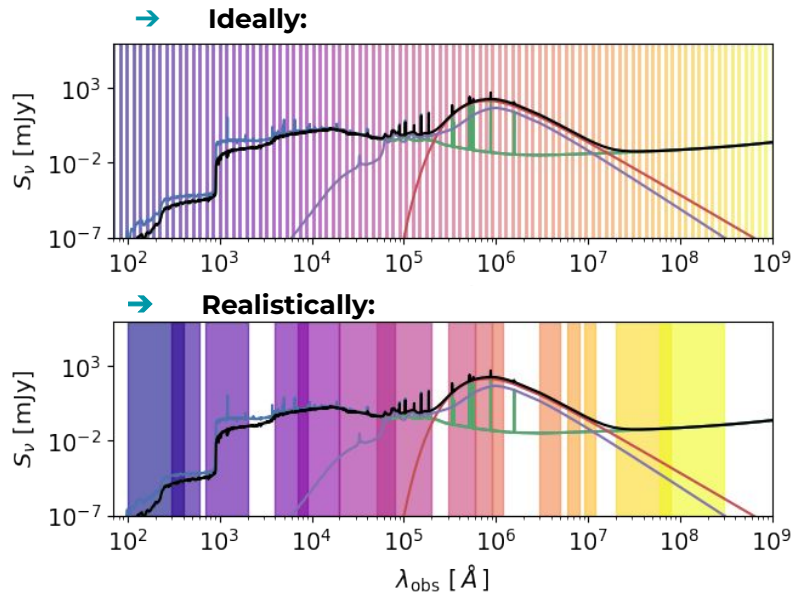
↑ parameterized

GalaPy

NOW **MCMC + Nested** sampling 1 source at a time (~10 minutes per source)

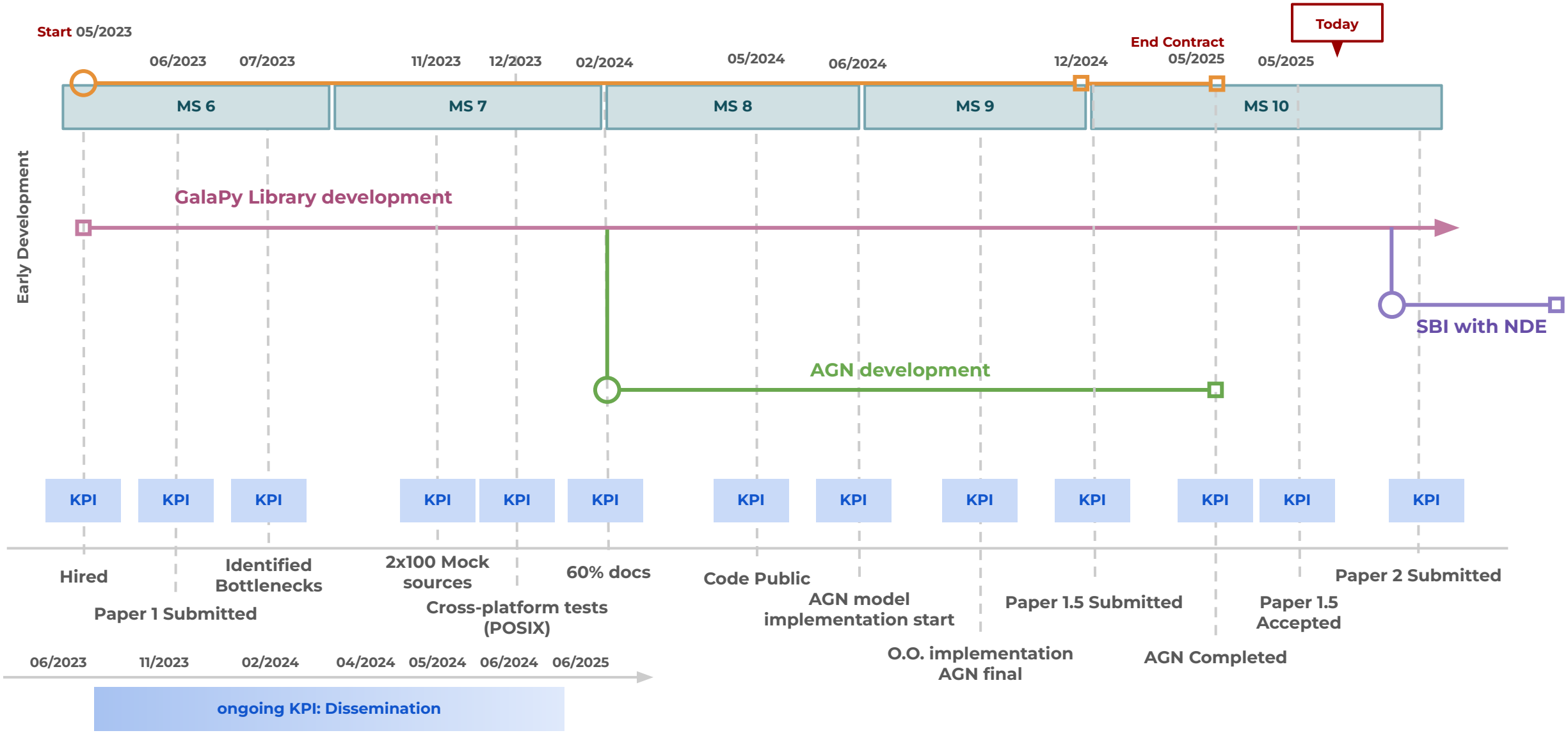
FUTURE (virtually) On-the-fly **posteriors** to handle up-coming data-fluxes from surveys

Main difficulty



- **Optimisation strategies/parallelisation**
  Hybrid implementation approach: C++/Python
  new parallelization strategy in development

- **Simulation Based Inference**
  with **Neural Density Estimators**
  - **SBI package** (Tejero-Cantero et al., 2020)
  - **PyDELFI** (Alsing et al., 2019)


Start 05/2023
Today
End Contract 05/2025
06/2023
07/2023
11/2023
12/2023
02/2024
05/2024
06/2024
12/2024
05/2025
MS 6
MS 7
MS 8
MS 9
MS 10
Early Development
GalaPy Library development
SBI with NDE
AGN development
KPI
Hired
Paper 1 Submitted
Identified Bottlenecks
2x100 Mock sources
Cross-platform tests (POSIX)
60% docs
Code Public
AGN model implementation start
O.O. implementation AGN final
Paper 1.5 Submitted
AGN Completed
Paper 1.5 Accepted
Paper 2 Submitted
06/2023
11/2023
02/2024
04/2024
05/2024
06/2024
06/2025
ongoing KPI: Dissemination

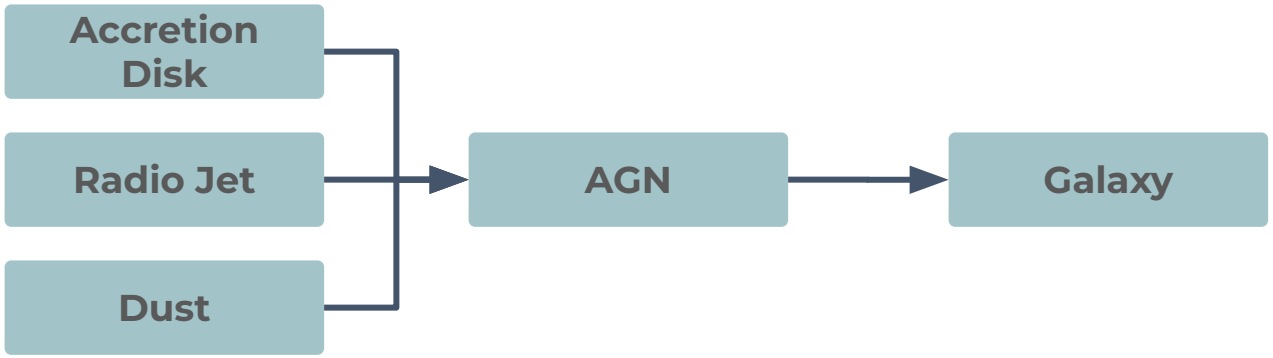
Accomplished Work:

Implementation of AGN completed!

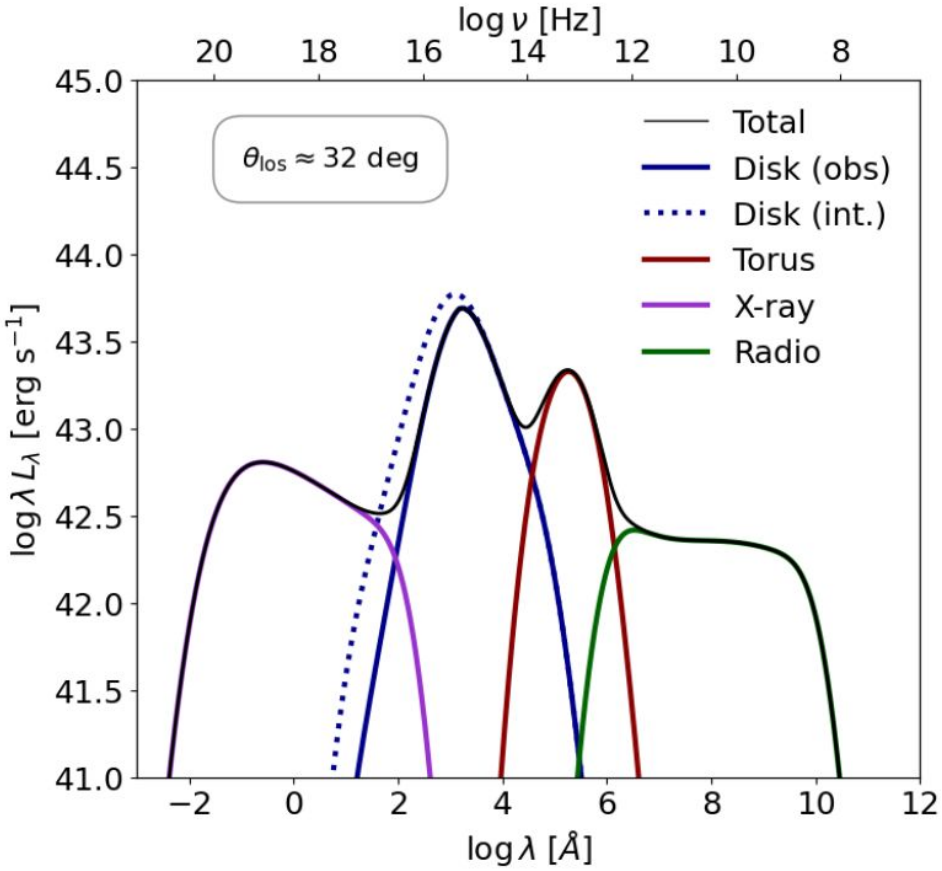
KPI solid **implementation strategy**:

- Disk Obj. + Torus Obj. + Corona Obj. = AGN Obj.

Each component is a python object:

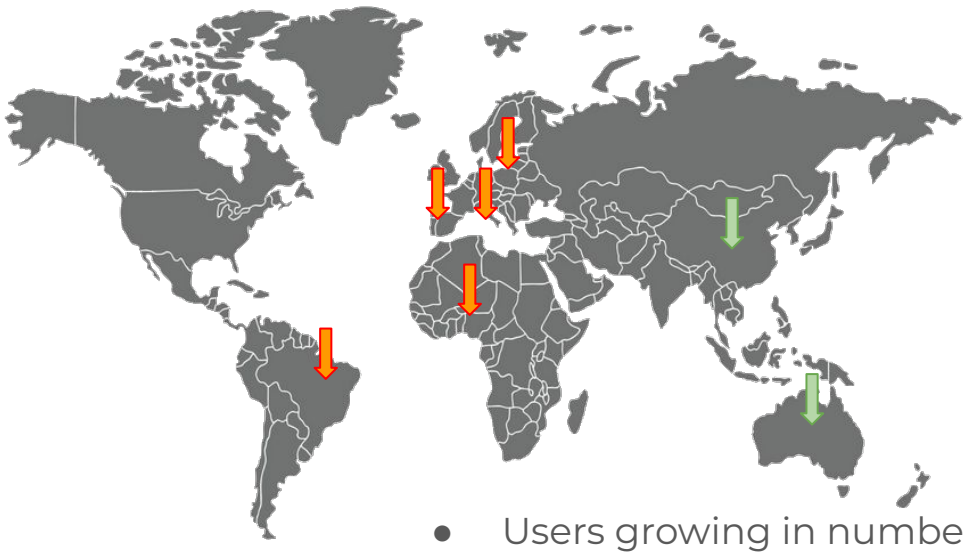


KPI completed optimized emission calculator



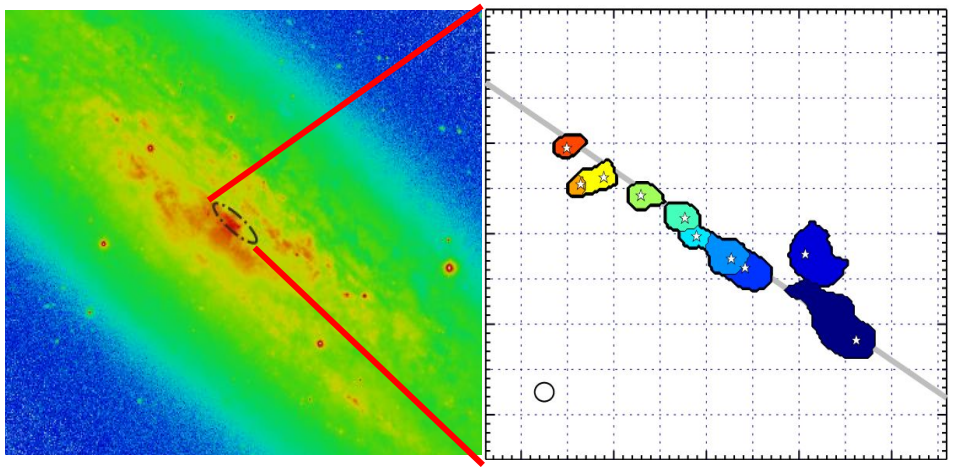
Accomplished Work:

KPI Interaction with the **community**



- Users growing in number

KPI **paper 1.5 accepted**



- S-PLUS collaboration
- Sao Paulo Univ. Brazil

Final steps:

- current percentage completeness: **~80%**
- [end of April] final **AGN implementation completed** (alpha-testing on-going)

  (+ paper TBD, probably late 2025)
- [end of March] new **parallelization strategy** implemented
- [end of August] **evidence based model selection** implemented
- final percentage completeness: **~99%-ish**
  - **SBI with NDE** will not be completed **but it was a bonus anyways**: no paper 3