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Ministero
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Italiadomani

PIANO NAZIONALE
DI RIPRESA E RESILIENZA



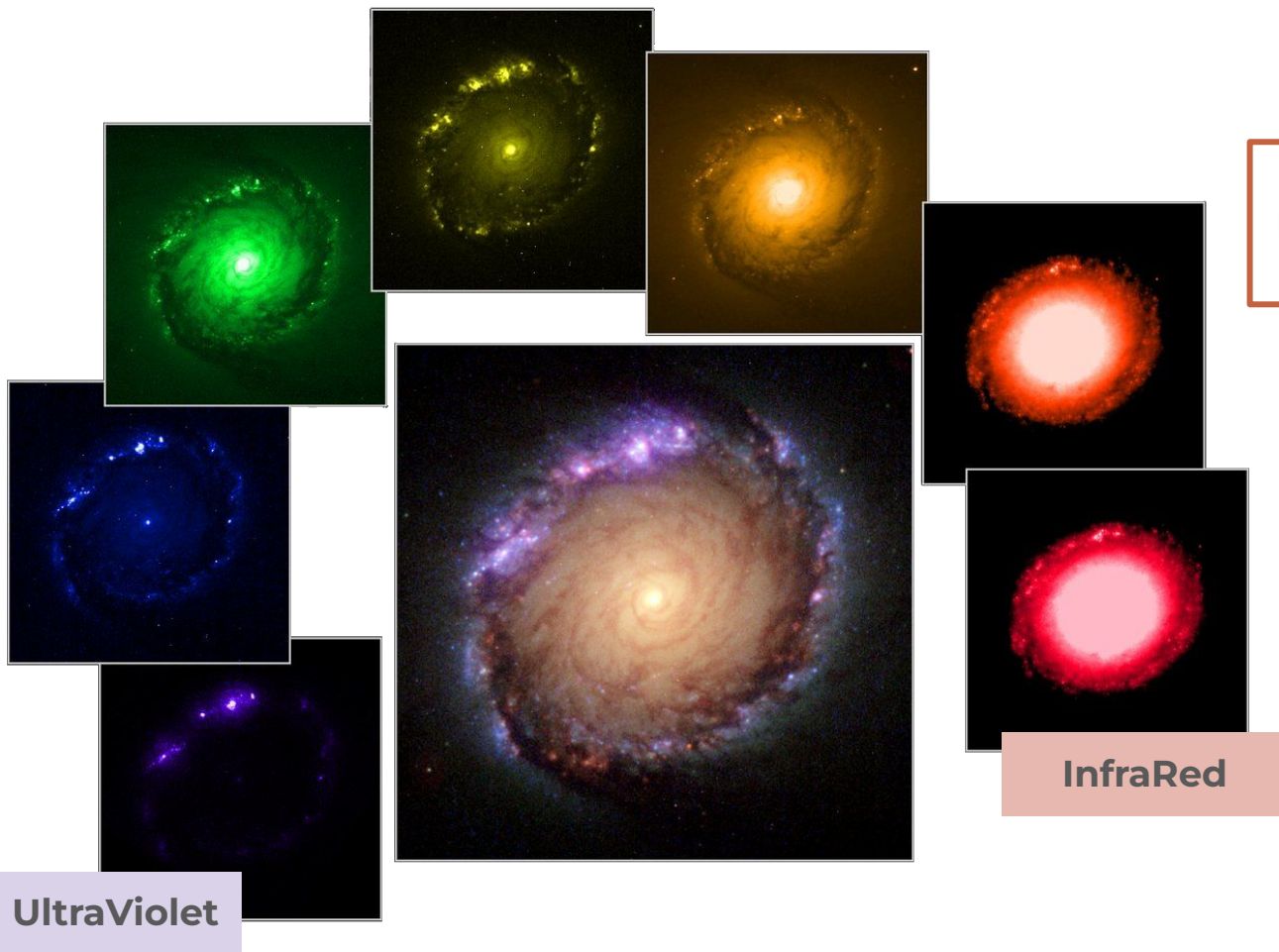
Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

GalaPy - once again (say bye!)

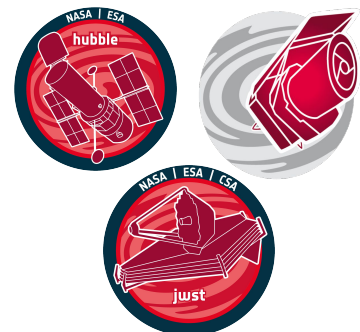
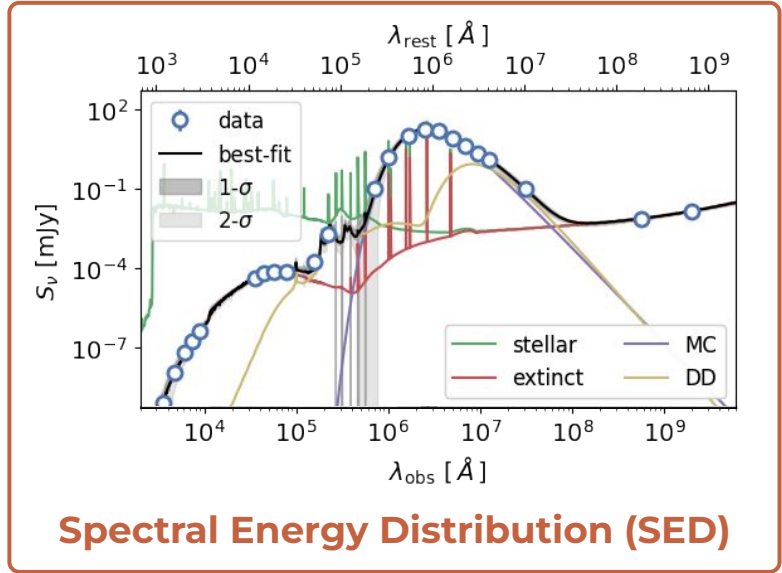
Ronconi, T.; Lapi, A.; + others

Spoke 3 II Technical Workshop, Bologna Dec 17 -19, 2024

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

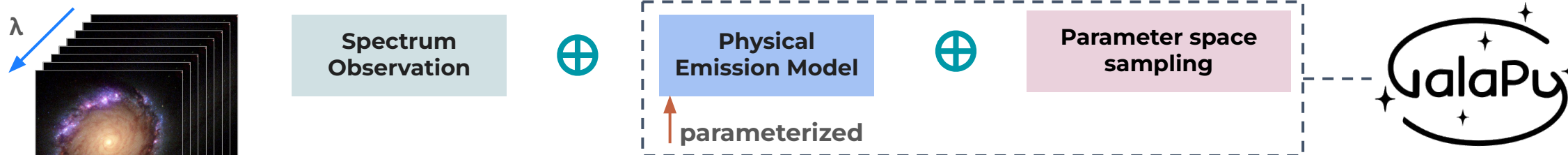


Physical Emission Model



→ 1 zettabyte of data per year!

Methods: SED Fitting 101 and desiderata



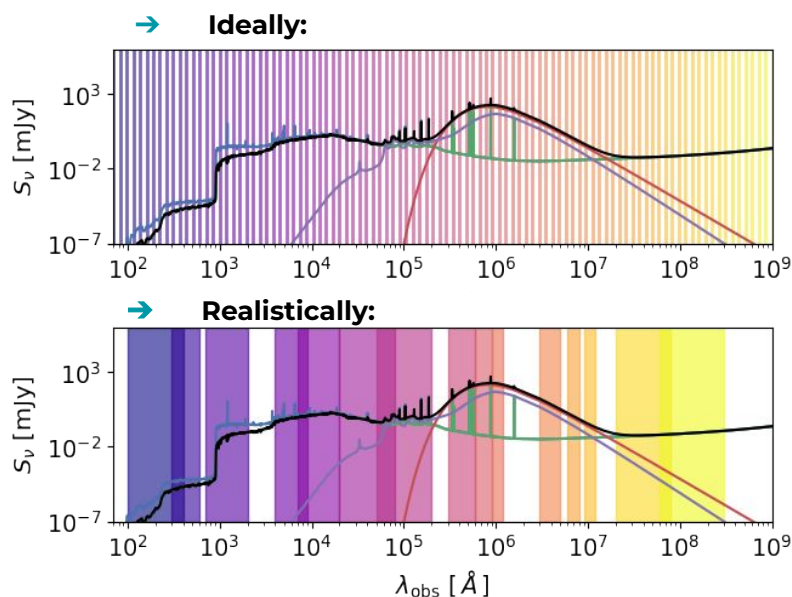
NOW

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

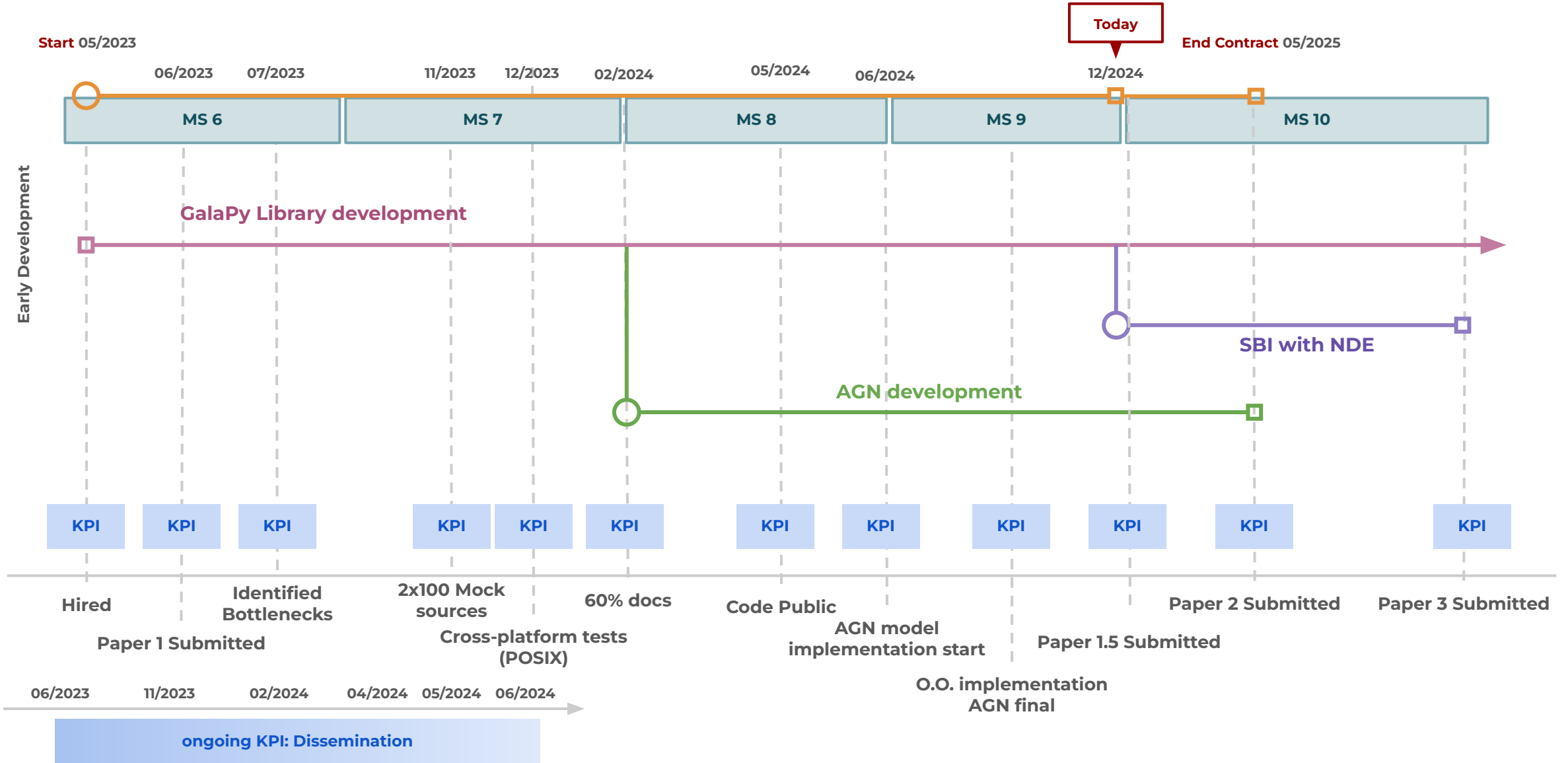
FUTURE

(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](#))

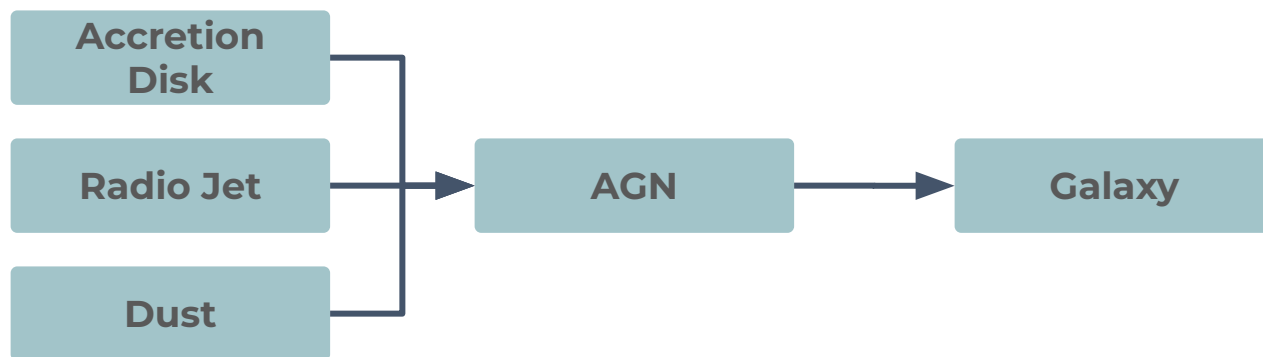


Accomplished Work:

Implementation of AGN on-going

- KPI** solid **implementation strategy**:
- Disk Obj. + Torus Obj. + Corona Obj. = AGN Obj.

Each component is a python object:

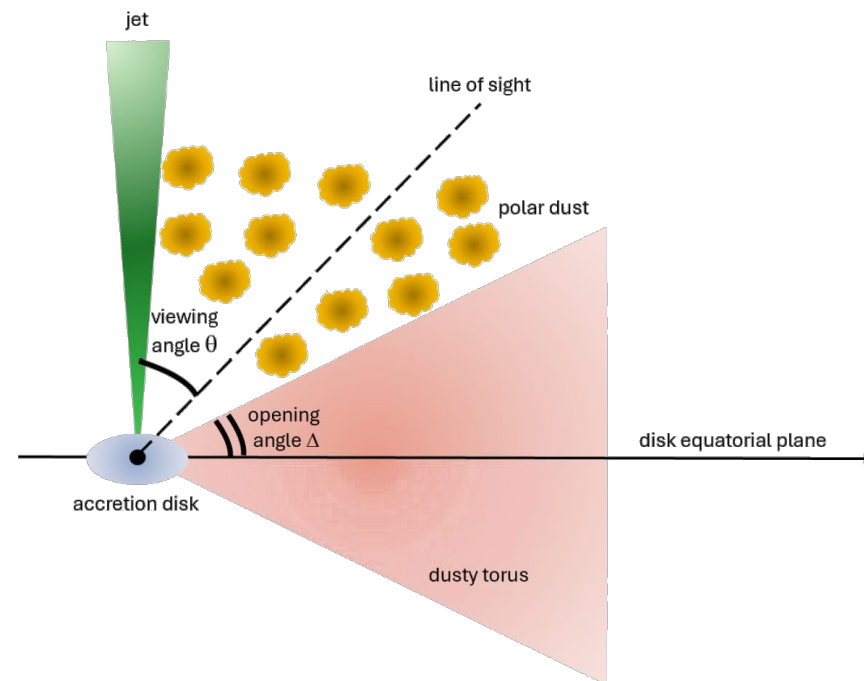


- KPI** optimized performances (algebra + vectorization + parallel):
- likelihood computation **~0.25 host galaxy**

$$(\lambda L_\lambda)_{\text{iso}}^{\text{AD}} \propto \begin{cases} \lambda^{\alpha_{\text{low}}^{\text{AD}}} & \lambda_{\text{low}}^{\text{AD}} \lesssim \lambda \lesssim \lambda_{\text{mid}}^{\text{AD}} \\ \lambda^{\alpha_{\text{mid}}^{\text{AD}}} & \lambda_{\text{mid}}^{\text{AD}} \lesssim \lambda \lesssim \lambda_{\text{int}}^{\text{AD}} \\ \lambda^{\alpha_{\text{int}}^{\text{AD}} + \delta_{\text{int}}^{\text{AD}}} & \lambda_{\text{int}}^{\text{AD}} \lesssim \lambda \lesssim \lambda_{\text{high}}^{\text{AD}} \\ \lambda^{\alpha_{\text{high}}^{\text{AD}}} & \lambda \gtrsim \lambda_{\text{high}}^{\text{AD}} \end{cases}$$

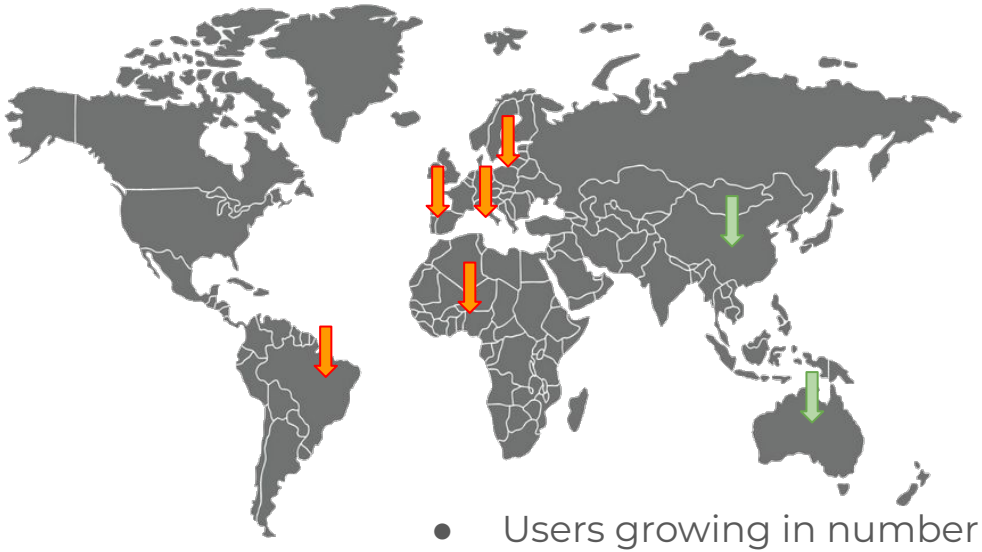


```
# compute emission
self._emission = (
    numpy.exp(
        self.coeff[:,numpy.newaxis] +
        self.expnt[:,numpy.newaxis] *
        self.llgrid
    ) * self.weight
).sum(axis=0)
```

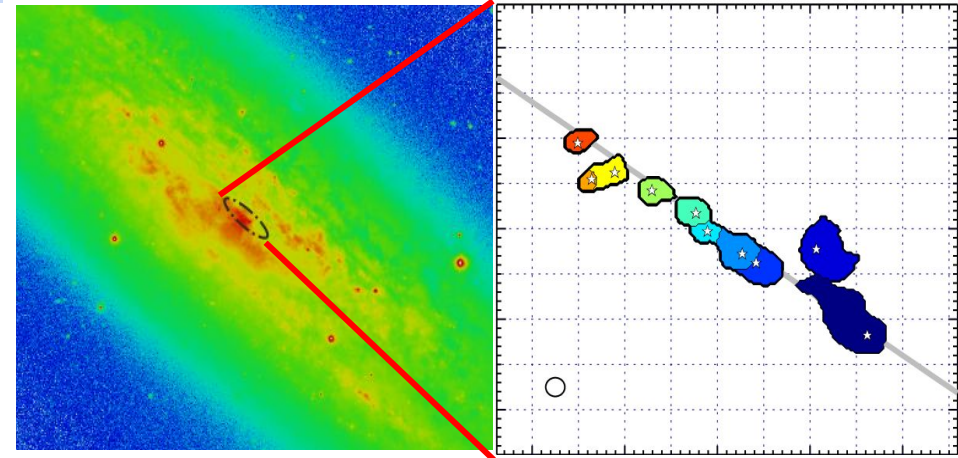


Accomplished Work:

KPI Interaction with the **community**



KPI Library adapted for **resolved sub-galaxy scale**



- **paper 1.5** likely submitted by end of M9
- S-PLUS collaboration
- Sao Paulo Univ. Brazil

KPI BONUS Free Lunch! **x4 speed up** on Apple M3

Final steps:

- current percentage completeness: **~60%**
- [end of February] final **AGN implementation and deployment**
(+ paper TBD, probably late 2025)
- [end of March] new **parallelization strategy** implemented
- [end of April] **evidence based model selection** implemented
- final percentage completeness: **~70%**
 - **SBI with NDE** will not be completed by the end of my contract: no paper 3