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Italiadomani

PIANO NAZIONALE
DI RIPRESA E RESILIENZA



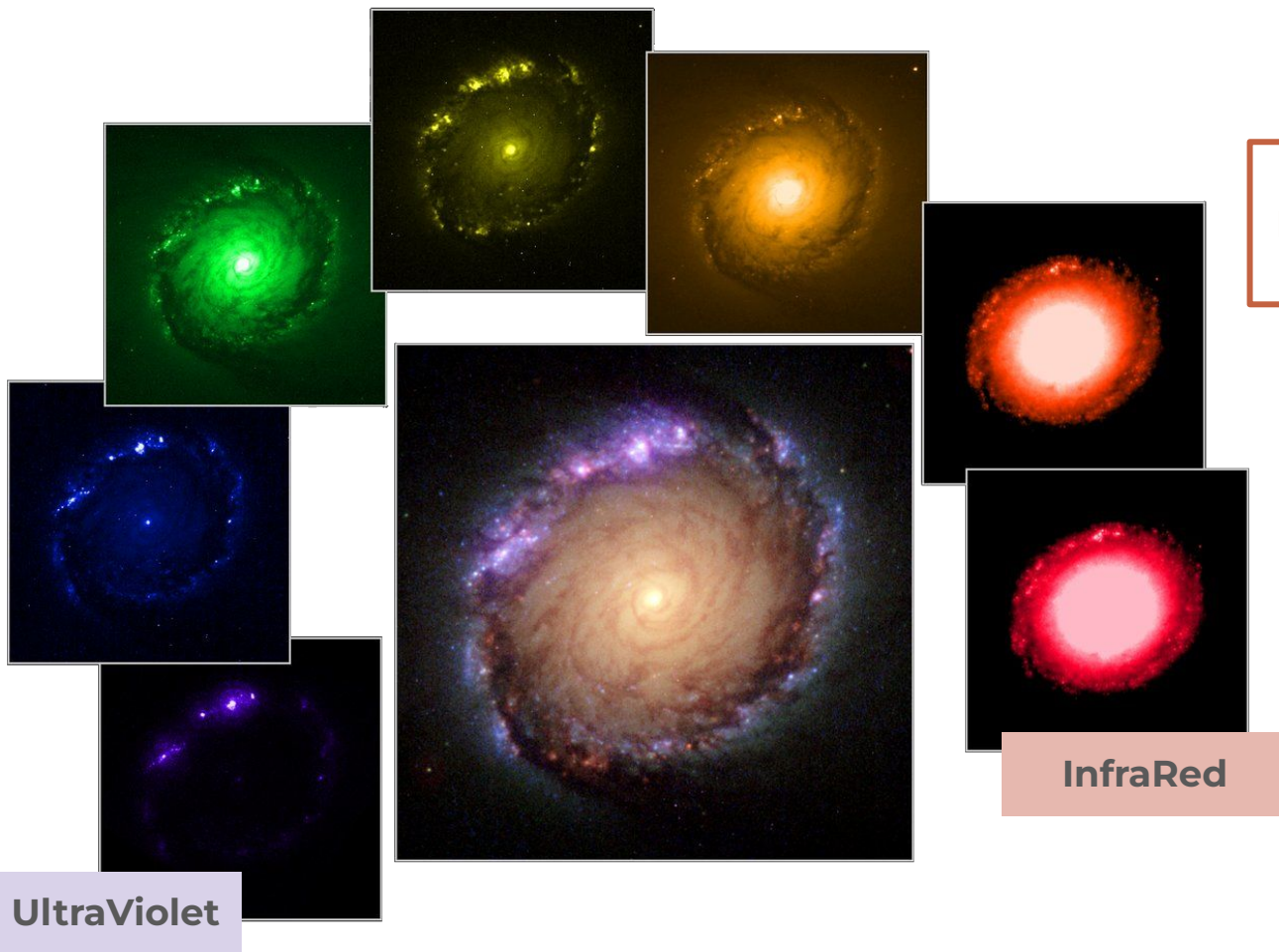
Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

GalaPy - Bayesian SED fitting

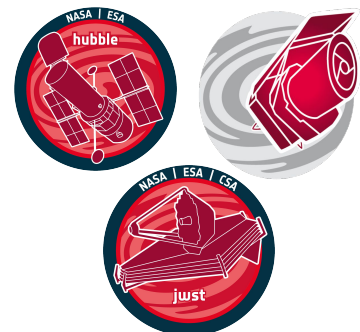
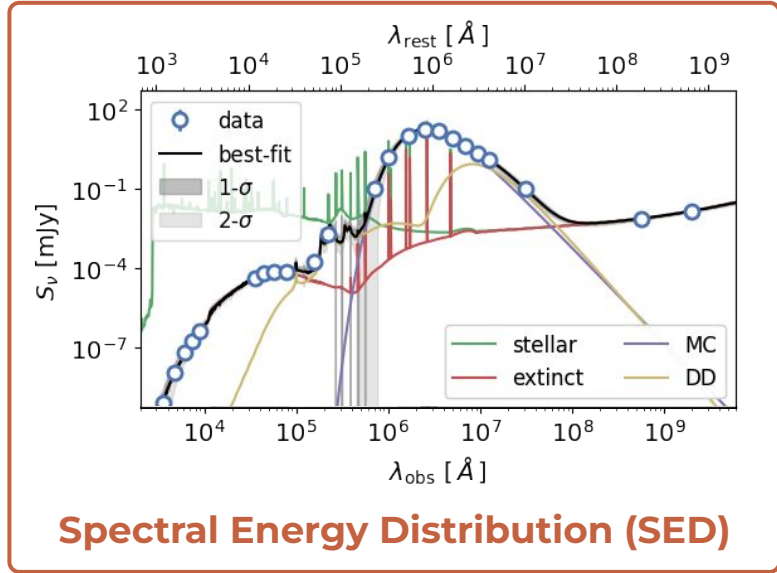
Tommaso Ronconi, Andrea Lapi, Martina Torsello and others

Spoke 3 Technical Workshop, Trieste October 9 / 11, 2023

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



Physical Emission Model



→ 1 zettabyte of data per year!

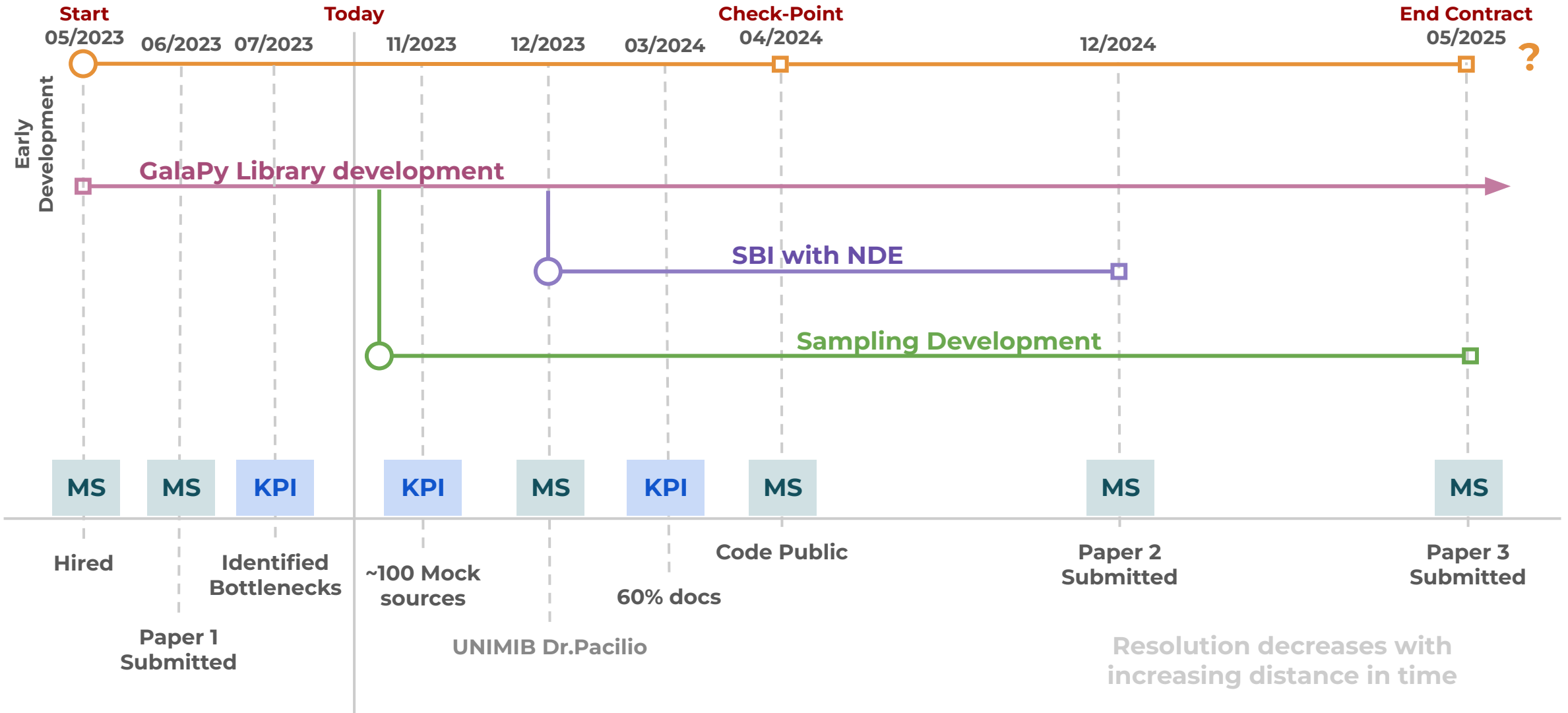
Technical Objectives, Methodologies and Solutions

- **Bayesian sampling** at the cost of template-fitting (or better if possible?)
 - Fit large catalogues contemporary
 - Currently 10s of minutes, desiderata \lesssim 1 minute

- **Parallelisation scheme**
 - we are currently bound in parallelisation through Python
 - as is the speed-up reaches a plateau at a factor x4.5: need to **re-think the strategy**
- **Sampling strategy**
 - currently: MCMC and Dynamic NestedWe have to investigate on alternatives:
 - Hierarchical Bayesian
 - Hamiltonian
 - Pre-Conditioned Monte-Carlo

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

- **Simulation Based Inference**
Train neural network models of the posterior distribution with given input-data
 - **SBI package** ([Tejero-Cantero et al., 2020](#))
 - **PyDELFI** ([Alsing et al., 2019](#))Main difficulties:
 - Combining data from different experiments
 - Generating the training data

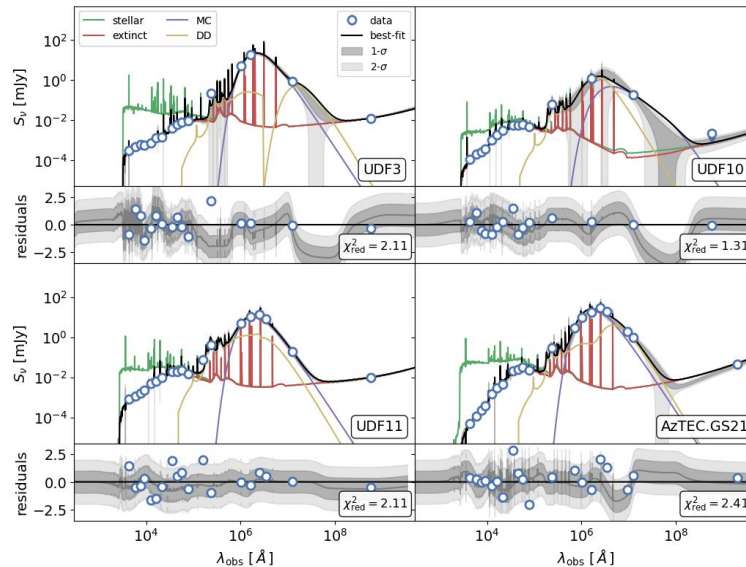


Accomplished Work, Results

MS

Paper 1 Submitted
presentation of the code and application to real and simulated photometric data

- **High-redshift dusty star-forming**
 - interesting for GFE studies
 - lot of candidates from JWST



- **Lensed + upper limits**
Data from [Giulietti et al., 2022](#)
- **Early type galaxies**
 - no ISM/dust only stellar contribution
 - consistency of the SFH model

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Identified Bottlenecks

Serial implementation is working with minimal memory consumption and efficiently

- **Sampling**
- **Parallelization**

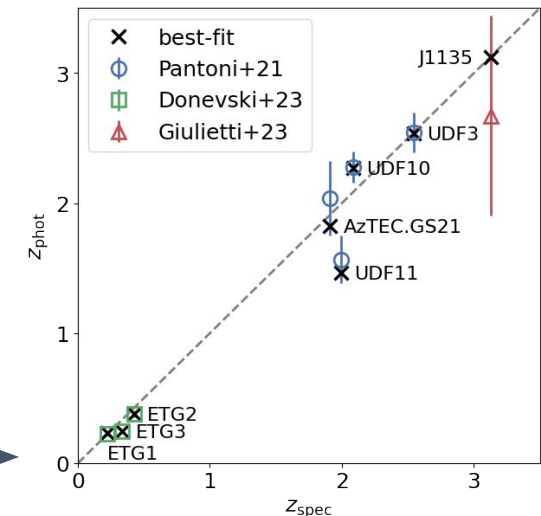
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~100 Mock sources

We need to generate and analyse in a realistic framework the possible sources while validating the tool over the parameter space.

- 100 with spectroscopic redshift W.I.P. 60%
- 100 derivation of photometric redshift



but **Photometric Redshift estimation works**

Next Steps and Expected Results (by next checkpoint: April 2024)

- **November 2023:**

2x100 Mock sources generated & analysed for validation purposes

- 100 with spectroscopic redshift (W.I.P)
- 100 also deriving photometric redshift

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- **December 2023:**

Start collaboration with University of Milano Bicocca

- feasibility of **Simulation Based Inference** with Neural Density Estimators

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- **March 2024:**

Documentation complete up to **60-80%**

- Complete Tutorials
- Scientific context description
- API documentation *incomplete is fine*

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- **April 2024:**

Library public

- GitHub, Python Package Index
- ReadTheDocs for online documentation

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