GW Cosmology @ L2IT

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People and topics

- **Nicola Tamanini** (DR)
  - Coordination of LVK and LISA cosmology WGs
  - Dark and bright siren analyses and forecasts (LVK/3G/LISA)
  - Tests of beyond-LCDM models
  - Studies of peculiar velocities effects and systematics

- **Sylvain Marsat** (CR)
  - Pipeline development and review

- **Danny Laghi** (PD)
  - Dark and bright siren analyses and forecasts (LVK/3G/LISA)
  - Pipeline development and review
  - CosmoLISA main developer

- **Martina Toscani** (PD)
  - Lensing and population analyses

+ **Rémi Delpech**, **Niccolò Muttoni**, …

Ongoing projects

- Cosmological forecasts (3G) with dark sirens (cross correlations with galaxy catalogs with cosmoLISA)
- Joint cosmological forecasts (O4/O5/3G) with SNIa + bright standard sirens
- Cosmological forecasts with LISA bright sirens (MBHBs)
- Cosmological forecasts with LISA dark + bright sirens (EMRIs + MBHBs)
- Studies of peculiar velocities effects and systematics (aberration, acceleration, environmental effects, …)

*cosmological inference made with cosmoLISA

Status of cosmoLISA

Objectives

- Bayesian inference of cosmological parameters with LISA (and 3G detectors)
- **Statistical method** (cross-matching with galaxy catalog) or assuming **EM counterpart**
- Sources: EMRIs, MBHB, …
- Maintainers: Walter Del Pozzo, Danny Laghi
- The code is **public**: https://github.com/wdpozzo/cosmolisa

Data

d_L (from GW)

z (from galaxy catalogs or direct observation)

Inference

$p(\{H_0, \Omega_m, \dots\} \,|\, \text{Data, Model})$

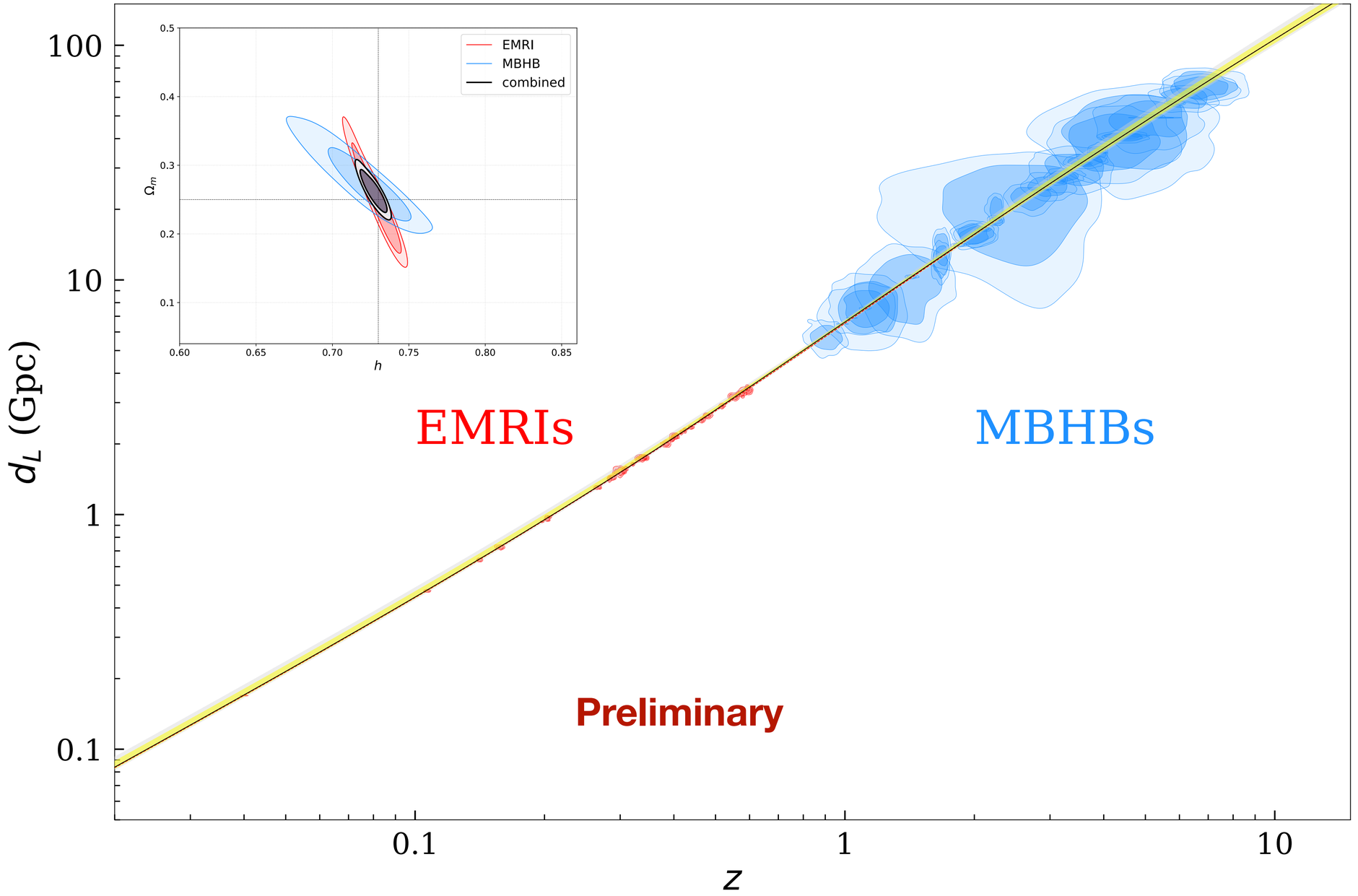
Tools implemented

- Modules written in **cython** (likelihood, libraries from LALCosmology) to speed up the inference
- **Nested sampling** algorithm (CPNest) optimised for multithreading

Levels of approximation

- GW likelihood in the high-SNR approximation
- Selection effects & joint inference of cosmo + source population parameters (to be implemented)

Status of cosmoLISA



Future plans

- Contribute to review of O4 cosmological pipelines and analyses
- Contribute to O4 cosmological analyses, operations and paper writing
- Study of beyond LCDM effects and development of pipelines
- Systematic comparison between LVK pipelines and cosmoLISA
- Provide reliable forecasts for O5+