LISA Astrophysics Working Group

Co-Chairs:

Shane Larson, Lucio Mayer,

Gijs Nelemans, Marta Volonteri

Goal: engage the broad astrophysics community, provide entry point to LISA Consortium (for associate and full members)

Tasks

- Explain nature of membership in LISA Consortium to interested scientists. For Full membership explain necessity to find connection with science objectives of WP7 and WP8 (or envision/propose new WP)

- Advertise the consortium and WG membership

- Promote research on LISA astrophysics

Relevant WPs

WP 7: Multi-messenger, multi-band

WP	Description
7.1	Exploration of multi-messenger science with
7.2	Joint analysis methods/tools for EM and GW
7.3	Identification of VBs from EM catalogues
7.4	Multi-band GW analysis
7.5	Establish partnerships and MOUs etc
7.6	Define data/communication protocols
7.7	Technical outreach and communication

*   Interaction with cosmology/fundamental physics WGs

WP 8: Interpretation, key-science projects

WP	Description
8.1	analysis of joint GW+EM observations of GBs (including VBs)
8.2	population studies of GW-only GBs
8.3	studies of seed black holes and BH formation mechanisms
8.4	studies of SMBHBs and connection to galaxy clustering
8.5	analysis of joint EM+GW SMBHB events
8.6	analysis of EMRI population
8.7	tests of GR* and the nature of compact objects
8.8	analysis of IMBHBs and IMRIs
8.9	studies of SOBH populations
8.1	estimation of cosmological parameters*
8.11	characterisation of backgrounds*
8.12	analysis of detected unmodelled events*

Themes

Identification of four "themes" as aggregation points for diverse sub-communities

1. Binaries of stellar remnants and the Galaxy

2. Massive and supermassive black holes (origin, binary evolution, their connection with cosmic structure formation)

3. EMRIs and IMRIs

4. Multi-messenger astrophysics (EM counterparts, and more broadly interplay with upcoming observational efforts in EM domain)

Status

- ~350 members, mostly from Europe and Americas

- Wide variety of expertise and career stage

- Interactions with the cosmology WG
  - cosmological effects on massive black hole evolution (eg role of dark matter distribution in galaxies, primordial black holes etc..)
  - Non-gaussianity and other non-standard power spectrum features in relation to BH seed formation mechanisms
  - EM counterparts and measurement of cosmological parameters

- Interactions with the Fundamental Physics WG and other WG (eg Waveforms) to be developed

1st AstroWG Workshop
IAP Paris, Dec. 12-14. 2018

- 120 registrants (maxed out the venue capacity)
- Distribution of talks among main themes:

  - Binaries of stellar remnants and the Galaxy: 15%
  - Massive and supermassive black holes: 37%
  - EMRIs and IMRIs: 21%
  - Multi-messenger astrophysics: 21%
  - Other: 6%

1st AstroWG Workshop: Aims

()Help to characterise the background, key scientific interests, goals, and tools at disposal, of the community that identifies itself with AstroWG

What is that we really care about in this diverse group?

Where is the common ground, and how to best exploit diversity of expertise and interests?

What the main scientific goals for the next 10+ years that match the existing LISA Work Packages and their projects?

Are there scientific questions/areas of high relevance to LISA in the astro domain that are not identified with existing LISA Work Packages?

What tools do we need to achieve community goals, and how can AstroWG help to acquire then if not yet available?

How could the AstroWG best serve the community and communicate to it by operating as an interface to the the LISA Consortium?

() Foster new interactions and collaborations among the different sub-fields in the community *with LISA applications in mind*

()Eventually conceive new WPs or place the existing ones better in focus through such new collaborations

Wish List (for this meeting)

()Trigger lively and engaging Discussion sessions which help to place in better focus a number of challenges:

-    what is the best approach to make progress in a given area/ project inside WP over the next 15+ years?

-    what useful predictions can be made for LISA and/or how we can best use the LISA data stream to infer key phenomena and qualifying properties associated with target GW sources?

-    what are the major sources of error/uncertainty we need to cope with for interpreting the LISA datastream (eg think about the complexity in reverse-engineering the merger rate of black holes)?

-   what tools, existing or to be developed, should we consider in order to best exploit the information that will be contained in the LISA datastream? (eg what about *machine learning tools?*)

()Think about thematic connections and new collaborations with other WGs, and develop/make more concrete those that have been already proposed

()Come up with one or more "flagship projects" that are relevant to LISA WPs but possibly add value eg by being trasversal to projects already listed in WPs ?

Flagship projects can be really long-term endeavours (we have time!) but should be geared towards producing deliverables that can be measured/inferred with the LISA data stream
Potentially useful also to train the AstroWG community to work as such and demonstrate need of new tools/foster their development

Operational level of AstroWG
(open to suggestions)

()Communication

- Workshops (at least 1 per year)
- Focused meeting of sub-groups (topical/project-oriented)
- Mailing list
- Slack/Mattermost channels?

()Tools

- LISA simulators
- Links to repositories of public simulation codes/simulation datasets/analysis software (huge variety and unawareness given diverse community, hence potential high benefit of common platform). First task:identify what is useful/relevant to deploy

()Servicing collaborative projects

- Provide community-wide tools (see above)
- Repository hub for collaborative software spawned by collaborative projects (eg git)
- Help to organise collaborative workpaces to facilitate collaborative project (wikis, slack, see Communication item)

Future actions

- Evaluate if current members cover the required expertise

- Reach out to experts in under-represented fields of research

- Create tangible interactions with Cosmo (and possibly FP) WG