EBL/ALP/IGMF/LIV call – 2016-11-07

Indico:
https://www.cta-observatory.org/indico/conferenceDisplay.py?confId=1225

Participants (in random order):
Jonathan Biteau, Manuel Meyer, Bohdan Hnatyk, Rafael Alves Batista, Roman Gnatyk, Elisa Prandini, Paolo Goldoni, Stefan Wagner, Paolo Da Vela, Tarek Hassan, Abelardo Moralejo, Pankaj Kushwaha, Vitor de Souza, Tomislav Terzic, Malcolm Fairbairn, Antonio Stamerra

Latest News / Updates (M. Meyer)
https://cta.cta-observatory.org/indico/materialDisplay.py?contribId=1&materialId=slides&confId=1225

. As a starter, we will work with IRFs optimized for sensitivity, as they should be readily available for the baseline and threshold arrays. Ultimately, we would like to work with IRFs optimized for energy and angular (IGMF) resolution, but we realize this might not fit our schedule.

. The next PHYS meeting (mid Feb. - mid. March) sets a deadline for our first results to be presented there. The January call should be the time to discuss actively these first results, with a deadline for completion of this first step by the end of January. Detailed goals are shown in Manuel's slides.

. More manpower would appreciated for the ALPs and IGMF sub-tasks (could be simply running the code, checking the outputs, etc)

3D Simulation of electromagnetic cascades (R. Alves Batista)
https://cta.cta-observatory.org/indico/materialDisplay.py?contribId=7&materialId=slides&confId=1225

. Description of GRPropa: a 3D code focusing on, among others, the propagation of electromagnetic cascades within IGMFs. This is an alternative to the simpler Elmag, enabling e.g. the study of misaligned jets.

. All relevant processes for the IGMF are implemented in a modular manner (C++ code with python binding). Relevant geometries, observer centered or source centered, are implemented, the latter being possibly more efficient for our purpose.

. Good consistency with model from Neronov & Semikoz (2009) for a specific set of parameters. A more advanced cross check with Elmag is envisioned.

Questions:

. Abelardo: interesting tool for 3D simulations, but do we need such a complete software for ALPs, EBL, LIV?
→ Rafael: the code is pretty fast if the IGMF is not included, as it becomes 1D, so it might be useful.

//Post meeting note by Manuel & Jonathan: this might be an interesting tool to get an independent cross check for table generations over the parameter space we want to probe, for sure for the IGMF,

but maybe also for the other effects.

. Manuel: could you further explain the differences between geometries (slide 4)? How does the effect of the opening angle compares with previous studies?
→ Rafael: the small sphere observer enables the tracking of all events, but if one considers many sources, the method is not computationally efficient. On the contrary, the large sphere observer method, where a single source in the center and the observer at the edge, is computationally efficient because all particles reaching the sphere are collected and one can then derive the expectations for any point on the sphere, an finally convert the arrival directions into the observer frame. The opening angle effect has been compared with previous results in a publication and it seems to be working quite well.

. Manuel: Which source properties are included as of now, in particular concerning the intrinsic spectrum? For the IGMF analysis, we will need to jointly fit the intrinsic and IGMF parameters, we will need to rerun simulations each time, can a re-weighting be done, e.g. based on optical depth?
→ Rafael: the example in slide 5 merely presents a monochromatic spectrum, but any spectrum can be readily implemented, if not already done. A re-weighting would indeed be the best way to go, based e.g. on a very hard intrinsic spectrum to have statistics at all energies.

. Jonathan: Suggests a uniformization of the outputs of ELMag and GRPropa, enabling study of systematics when running the simulations and analysis.
→ Rafael: will discuss that with Manuel.

Round table discussions for next steps (M. Meyer)
https://cta.cta-observatory.org/indico/materialDisplay.py?contribId=6&materialId=slides&confId=1225

. First plan for simulations:
- use the observations planned within the AGN KSP (see https://docs.google.com/)
- assume intrinsic spectra based on current observations by Fermi-LAT and IACTs (simple parametrizations for now)
- assume one reference EBL model to be determined
- simulate one spectrum for each observation set with ctools/gammapy (Asimov datasets instead of running many simulations for each observation)

. First plan for analysis
- check exoticas (LIV/ALPs) against the null hypothesis of only EBL absorption, by means of a likelihood ratio test. The likelihood will be evaluated for each point of the parameter space where we evaluate the exoticas models (go for a tabulated approach)
- the IGMF specificity is that the effect of the intrinsic parameters can not be factorized. Go for a re-weighting approach, effectively enabling the tabulation of the model. The question of the morphological fit is raised again.

Questions / comments:

. Manuel: How do we interface this with ctools and gammapy?
→ Interfacing with ctools is envisioned within CTAtools (see D. Sanchez's https://github.com/davidsanchez/CTAtools)
→ For gammapy, Pankaj is interested. Other people have signed up on the to-do list table: need a confirmation of what is planned there.

. Abelardo: When doing the analysis, will we assume that we already know the spectral shape?

→ Jonathan: suggests not to, work in agnostic manner, and establish a statistically reliable method to select the best-fit intrinsic model.
→ Abelardo/Jonathan: more realistic models (SSC, EC, hadronic) might also be tested as input and then fit with simple parametrizations. This would be done later on, once we are confident about the tools we have developed. It would be good way to assess the deviations/systematics induced by our assumptions on the intrinsic spectra.
→ Some work needs to be planned for this item, e.g. using two advanced models for one source.

. Manuel: we should start defining a grid over which storing the models and generate the corresponding tables. Anyone interested in looking into generating models for:
.. EBL?
→ We are almost already there for usual models. Manuel, Alberto, and David expressed interest in compiling the info for current models
→ Elisa: Franceschini is finalizing a new EBL model that we could include when the paper is out on the arXiv.
.. LIV?
→ Malcolm - Vitor - Jonathan: interested → interactions to come through the Cta-phys-gpropa-liv list
//Note post meeting: John E. Ward & Leyre Nogues also expressed interest in this topic but could not attend the November call. They will certainly have inputs on this too.
.. IGMF?
→ Rafael: work a little more on GRPropa, finalization expected for January
→ Manuel will work with Elmag, which is almost ready to go at this stafe
.. ALPs?
→ Manpower need to run/check the code

. Jonathan: The conveners of the EGAL and DMEP groups raised the question of the metrics that we need to provide to the collaboration by February. Which simple metrics would best characterize our needs for the science? Simulations might prove very useful to progress on that question. We should think by next call about the criteria that seem most relevant (e.g. number of AGNs detectable (5sigma) in 20h of observations, number of AGNs with 3sigma above an optical depth of 2 in 20h, etc)
→ Tarek: What is the difference between such a metric and saying that we want the best possible reconstruction quality of specific spectral / morphological features?
→ Jonathan: The collaboration expects an easy to compute number quantifying the gain/loss in terms of the physics dealt by this task force.