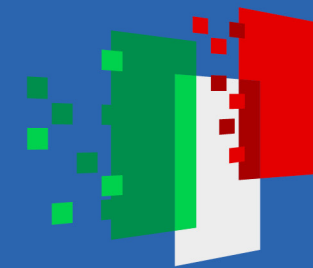




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# Introduction to the proposal writing session

Stefano Marchesi

(Università di Bologna, Dipartimento di Fisica e Astronomia, INAF-OAS Bologna)

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Financially supported from the European Union — Next Generation EU under the project IR0000012 - CTA+ (CUP C53C22000430006), announcement N.3264 on 28/12/2021: “Rafforzamento e creazione di IR nell’ambito del Piano Nazionale di Ripresa e Resilienza (PNRR)”

CTAO Summer School - Bertinoro (Italy)

June 15, 2025

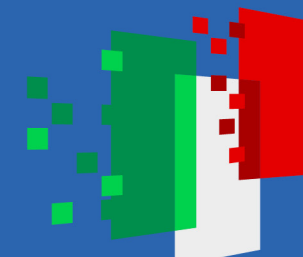




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# The job of the observational astronomer: From the idea to the data (and vice versa)

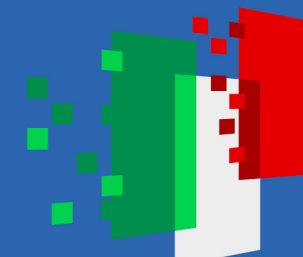
- As we know, astronomers can be divided in two broad categories: theoretical and experimental (which is, in our case, observational).
- Theorists: starting from existing data, new ideas are developed, trying to find new physical laws or making predictions about something that we cannot yet measure/observe.
- Observers: analysis of existing data; (try to) interpret them in the context built by theorists, confirming (or rejecting) theoretical hypotheses.
- There is therefore a continuous, lively dialogue between the two categories, and one does not exist without the other.



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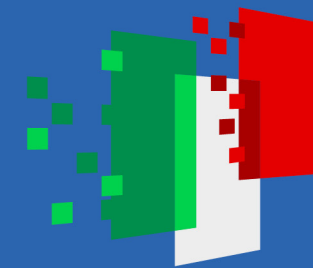
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- There is therefore a continuous, lively dialogue between the two categories, and one does not exist without the other.
- Here, we will focus on one important skill for observers: **write proposals to obtain new observations.**



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- Astrophysics, more than other branches of physics, follows good practices of data sharing and accessibility (the so-called Open Science Policies).
- Many observatories make their data available through public archives.

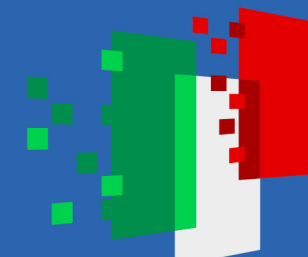




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- E.g.: HEASARC archive (<https://heasarc.gsfc.nasa.gov/cgi-bin/W3Browse/w3browse.pl>) of X-ray and Gamma-ray missions (all NASA ones, and many others).

## ☐ Most Requested Missions

- ☐ [Chandra](#) [**CXC**, **CSC**]
- ☐ [IXPE](#) [**MSFC**]
- ☐ [ROSAT](#)
- ☐ [WMAP](#)

- ☐ [Fermi](#)
- ☐ [MAXI](#) [**JAXA**]
- ☐ [RXTE](#)
- ☐ [XMM-Newton](#) [**XSA**]

- ☐ [HaloSat](#)
- ☐ [NICER](#)
- ☐ [Suzaku](#)

- ☐ [Hitomi](#)
- ☐ [NuSTAR](#) [**Caltech**]
- ☐ [Swift](#)

## ☐ Other X-Ray and EUV Missions

- ☐ [Ariel V](#)
- ☐ [Copernicus](#)
- ☐ [Ginga](#)
- ☐ [SAS 3](#)

- ☐ [ASCA](#)
- ☐ [Einstein](#)
- ☐ [HEAO 1](#)
- ☐ [SRG/eROSITA](#) [**MPE**]

- ☐ [BBXRT/Astro-1](#)
- ☐ [EUVE](#) [**MAST**]
- ☐ [Kvant](#)
- ☐ [Uhuru](#)

- ☐ [BeppoSAX](#)
- ☐ [EXOSAT](#)
- ☐ [OSO8](#)
- ☐ [Vela 5B](#)

## ☐ Other Gamma-Ray Missions

- ☐ [AGILE](#) [**ASDC**]
- ☐ [HETE-2](#)
- ☐ [RHESSI](#)

- ☐ [CALET](#) [**JAXA**]
- ☐ [INTEGRAL](#) [**ISDA**, **ISDC**]

- ☐ [CGRO](#)
- ☐ [SAS 2](#)

- ☐ [COS B](#)
- ☐ [Gamma-Ray Bursts](#)

## ☐ Missions and Facilities

- ☐ [AKARI \(IR\)](#) [**Project**]
- ☐ [FAUST/Atlas-1 \(UV\)](#)
- ☐ [Herschel \(IR-submm\)](#) [**ESA**]
- ☐ [ISO \(IR\)](#) [**IDA**]
- ☐ [Planck \(submm-radio\)](#) [**ESA**, **IRSA**]
- ☐ [UIT/Astro-1 \(UV\)](#) [**MAST**]

- ☐ [ANS \(UV\)](#)
- ☐ [FUSE \(UV\)](#) [**MAST**]
- ☐ [HST \(UV-NearIR\)](#) [**MAST**]
- ☐ [IUE \(UV\)](#) [**MAST**]
- ☐ [SDSS \(Opt\)](#) [**Project**]
- ☐ [WISE \(IR\)](#) [**IRSA**]
- ☐ [COBE \(IR/sub-mm\)](#) [**LAMBDA**]
- ☐ [GALEX \(UV\)](#) [**MAST**]
- ☐ [IceCube \(Neutrino\)](#) [**Project**]
- ☐ [LPF](#) [**ESA**]
- ☐ [Spitzer \(IR\)](#) [**SSC**]

- ☐ [CoRoT \(Opt\)](#) [**CNES**]
- ☐ [Ground-Based \(Opt-Radio\)](#)
- ☐ [IRAS \(IR\)](#)
- ☐ [MSX \(UV-IR\)](#)
- ☐ [TD1 \(UV\)](#)

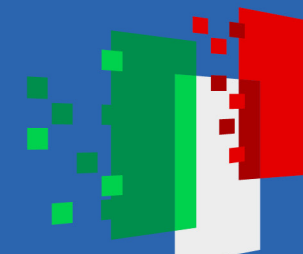




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- Gaia Archive (<https://gea.esac.esa.int/archive/>): “astrometry, photometry, and spectroscopy of nearly 2000 million stars in the Milky Way as well as significant samples of extragalactic and solar system objects”



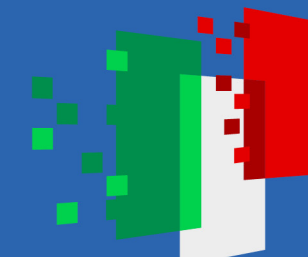




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## The job of the observational astronomer: CTAO and an Open Access approach for the VHE science

- Astrophysics, more than other branches of physics, follows good practices of data sharing and accessibility (the so-called Open Science Policies).
- This is less true when moving to the Very High Energy Astrophysics field, but one of the commitments of CTAO is to be the first Open Access VHE Observatory, as mentioned in the CTA White Paper.

Together, the northern and southern CTAO arrays will constitute the CTAO, which will be the first ground-based gamma-ray observatory open to the world-wide astronomical and particle physics communities as a resource for data from unique high-energy astronomical observations. The CTAO will be operated as an open, proposal-driven observatory for the first time in very high-energy astronomy. This is expected to significantly boost the scientific output of the CTAO by engaging a much wider research community.

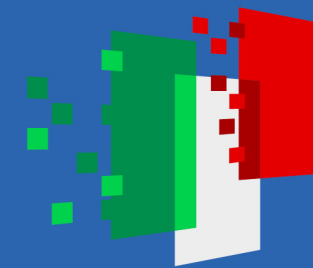
Additionally, the CTAO will feed its data into a virtual observatory, which will allow scientists to probe multiple data centres seamlessly and transparently, provide analysis and visualization tools and give other observatories a standard framework for publishing and delivering services using their data.



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## When archives are not enough Time to write a proposal

- While archives are becoming increasingly rich of sources and data to analyze (and indeed data storage and preservation is one important topic of discussion for current and future facilities!), it is nonetheless possible that no observation in the archives allows us to fully address the scientific question we have in mind.
- The next step is thus to wait for a Call for Proposals (CfP) from our telescope or observatory of choice, and try to convince the evaluation panel that our case is the most compelling (or at least among the most).

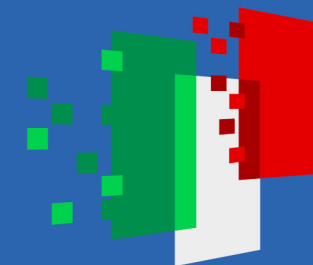




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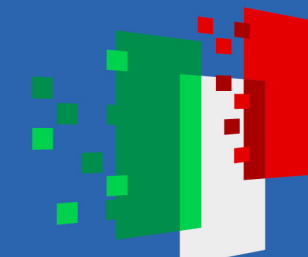
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- Proposals will then be evaluated (not actually submitted) and comments will be provided.



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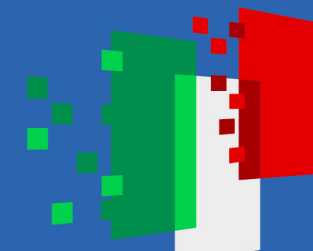
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- Proposal writing sessions will take both here and in La Palma (see program on School webpage).
- We ask you that by then you have already organized yourselves in **groups of three/four people per group**.
- Each group should also have at least a general idea of the type of proposal they wish to write, and of the **target(s) they would like to observe**.
- During the proposal writing sessions, tutors will be available to address your doubts and provide suggestions.

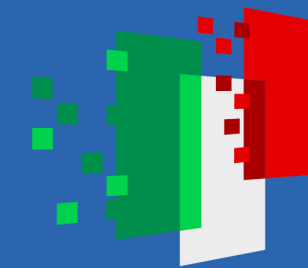




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# Writing a proposal: scientific justification

- Scientific justification provides a (brief, but effective) summary of the current state of research in the field related to your proposed observation. By reading the scientific rationale the person in charge for the evaluation should:
  1. Get a general understanding of the topic and of the open questions.
  2. Within this framework, be convinced that the proposed observation would represent a significant step forward in our understanding of the phenomenon (for example by confirming or rejecting at a certain significance level a theoretical prediction, or by complementing already existing observations providing details that would otherwise be missed...)
- Plots are key in helping you drive home your main points, in terms of both existing information and expected outcome.

## 1. Scientific justification for the proposal:

TEXT IN GRAY GIVES DETAILED EXPLANATIONS OF WHAT SHOULD BE GIVEN IN EACH SECTION, AND HAS TO BE REMOVED BEFORE SUBMISSION (see lines 44-46 in the tex file).

Scientific Justification of the proposal: THREE pages maximum are allowed, with the proposal text in pages 1 and 2 and references and figures in page 3.

### NOTES:

- The Scientific Justification should be self-contained and not refer to previous proposals.
- Describe clearly and in a manner that can be understood also by a non-specialist in your field the general scientific background and main goals of the proposal.
- Explain clearly how the proposed observations will contribute significantly in advancing our understanding of the corresponding project scientific goal(s).
- Key references to the literature should be properly cited here and listed in page 3.
- Describe how the data reduction and scientific analysis will be done, and document that the team possesses the required expertise.

...

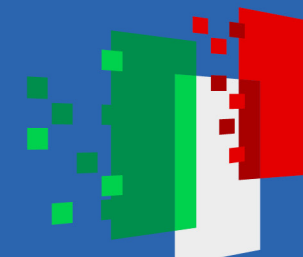




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## Writing a proposal: previous observations

- This section allows one to elaborate a bit more in detail on what is already known on the proposed target (note that this section is thus more specific than the Scientific Justification, since in the SJ one should give a more comprehensive review of the topic of interest).
- It is likely that the source of interest has already been studied with multiple facilities at different wavelengths: this is the time to mention it, while underlining how the proposed observations would complement the already available data.
- Figures from already published papers on the source can (and should) also be included.

### 2. Past observations related to this project (if any).

**List any past observations of the proposed source(s) performed with MAGIC or LST**

Please provide information about previous MAGIC (MAGIC-only or joint proposal) and LST (LST-only or joint proposal) observations. Give approximate number of hours taken, and the scientific output that these data provided (publications in peer-reviewed journals, presentations in international conferences, PhD theses etc). Note that the need of new observations of previously observed sources should be justified in section 1.

...

**List the past observations of the proposed source(s) performed with other Cherenkov telescopes**

Publicly known (papers or conference contributions) information about observations of the proposed sources with other Cherenkov telescopes (H.E.S.S., VERITAS, ...) should be summarized here. If available, give approximate number of hours reported.

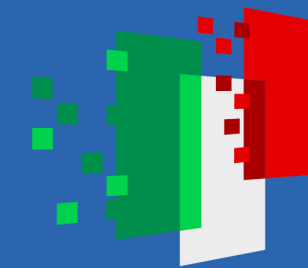




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# Writing a proposal: technical justification

## 3. Technical description of the MAGIC and/or LST-1 observations:

Describe how the observations will be performed, so the feasibility of the project becomes clear. Describe (in this or the next section) also the S/N ratio calculations you have used to justify the number of hours you request (no correction for expected weather conditions should be applied).

- This is the Section where your overall exposure time request (and more in general the observing strategy) should be justified.
- In practice, Feasibility tools like those that will be presented by Dr David Green will give you the numbers that you need to include in this section.
- Plots to support the claim might be helpful as well (e.g., simulated spectrum with exposure equal to the requested one).
- You will learn more about this later in the week, but the take home message here is the following: one needs first to quantify what they need to achieve a scientific meaningful result (e.g., detection at NNN sigma; spectral parameters constrained with NNN accuracy); then, they should tools to convert these numbers in an exposure time (which should be reasonable: if your goal can be achieved with 500 hours of LST-1 time, it might be the best idea ever, but it will be extremely difficult to convince the panel to give you the time).

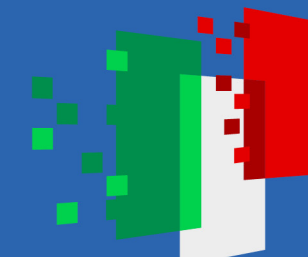




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# Writing a proposal: publications plans

## 7. Plans for publication(s) with the data requested from this proposal.

Please discuss what to do in case of firm detection, partial detection, non-detection of the main goal of the proposal (source, spectral feature, extension, ...).

...

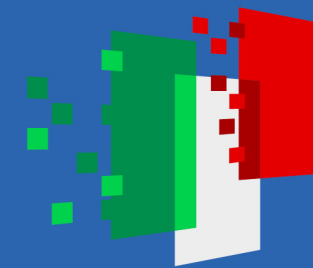
- Explain (once again briefly) how the LST-1 data you are proposing for will be instrumental to address the scientific goals presented in the Scientific Justification.
- This is a good section to briefly report on the outcome of simulations, if they were performed to get an understanding on how the proposed observations would look like (more on this in a moment).
- One final sentence can contain some estimate on the expected timeline, from data analysis to publication.



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# Dual Anonymous Peer Review (DAPR): the increasingly common standard in proposal writing

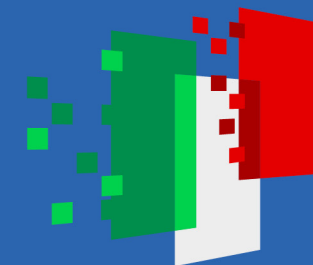
- In the last ~10 years, the vast majority of observatories and facilities have switched to a Dual Anonymous Peer Review (DAPR) system.
- Dual Anonymous: the person that writes the proposal does not know who's judging it (same as for papers) AND the panel in charge of the evaluation do not know who wrote the proposal.
- Goal: removing biases (explicit or implicit) and focus on the validity of the science.
- Evidence shows this as effective (e.g., in NASA Archival Data Analysis Proposals the number of proposals granted to women PI is increased; similar trends are observed in favor of early career PIs...)



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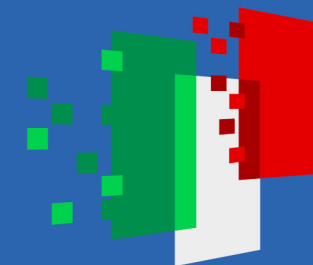




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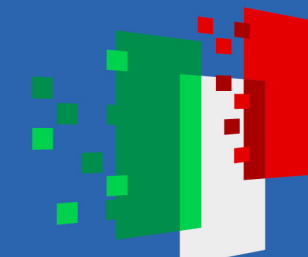
Proposers are required to write the Scientific/Technical/Management (i.e., science justification) section of the proposal in an anonymized format, i.e., in a manner that does not explicitly identify the names of the team members or their institutions. Some specific points follow:



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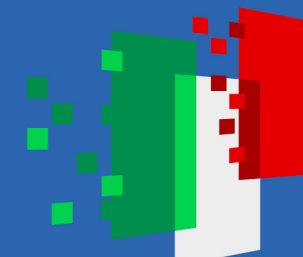
- 1 Do not claim ownership of past work, e.g., "my previously funded work..." or "Our prior analysis demonstrates that..."
- 2 Do not include the names of the personnel associated with the proposal or their organizational affiliations. This includes but is not limited to, page headers, footers, diagrams, figures, watermarks, or PDF bookmarks. This does not include references to past work, which should be included whenever relevant (see below).
- 3 Do not associate personnel with named teams or collaborations, e.g., "the PI is a member of the EAGLE collaboration."



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## An example (from the Hubble Space Telescope DAPR webpage)

Over the last five years, we have used infrared photometry from 2MASS to compile a census of nearby ultracool M and L dwarfs (Cruz et al, 2003; 2006). We have identified 87 L dwarfs in 80 systems with nominal distances less than 20 parsecs from the Sun. This is the first true L dwarf census a large-scale, volume-limited sample. Most distances are based on spectroscopic parallaxes, accurate to 20%, which is adequate for present purposes. Fifty systems already have high-resolution imaging, including our Cycle 9 and 13 snapshot programs, #8581 and #10143; nine are in binary or multiple systems, including six new discoveries. We propose to target the remaining sources via the current proposal.

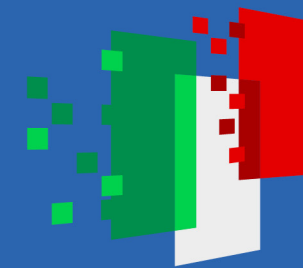




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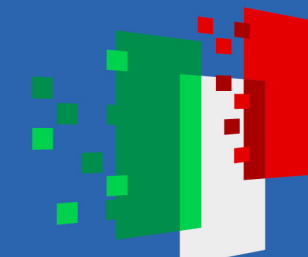
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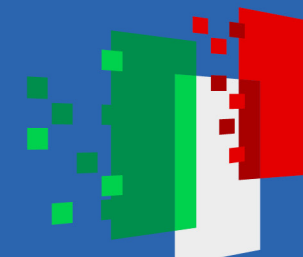




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## Summary

- Writing proposals is a key skill for astronomers.
- During this School you will work in groups to write a mock MAGIC-LST 1 proposal on a topic of your choice.
- The proposals will then be evaluated by a panel, and feedback will be provided.
- Before the proposal writing sessions, you will learn to estimate how much time is needed to fulfil your scientific requirements.
- Use today to divide yourselves in groups, and to think about a scientific case you deem interesting!