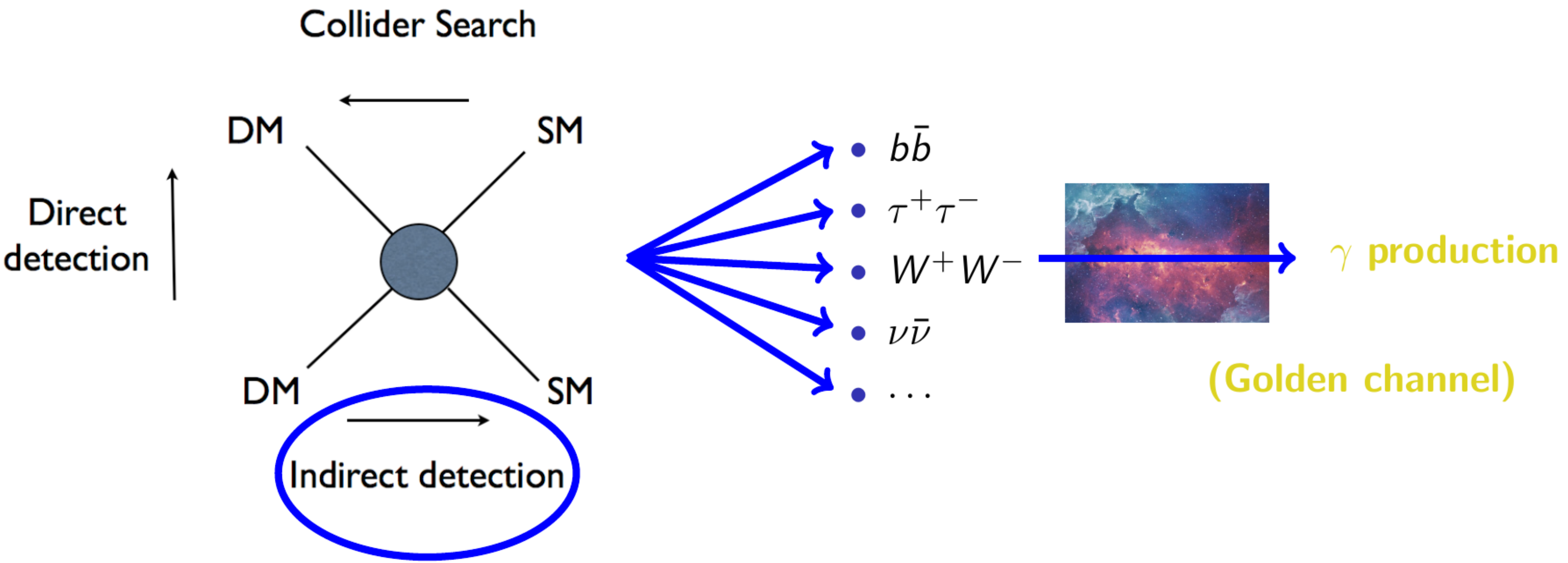
Multimessanger Astronomy with CTAO

Daniele Ambrosino
1° Meeting CTAO Napoli
07/04/2024

Master Thesis:

Dark Matter searches in the Large Magellanic Cloud with the Cherenkov Telescope Array



A **Python** package for **gamma-ray** astronomy

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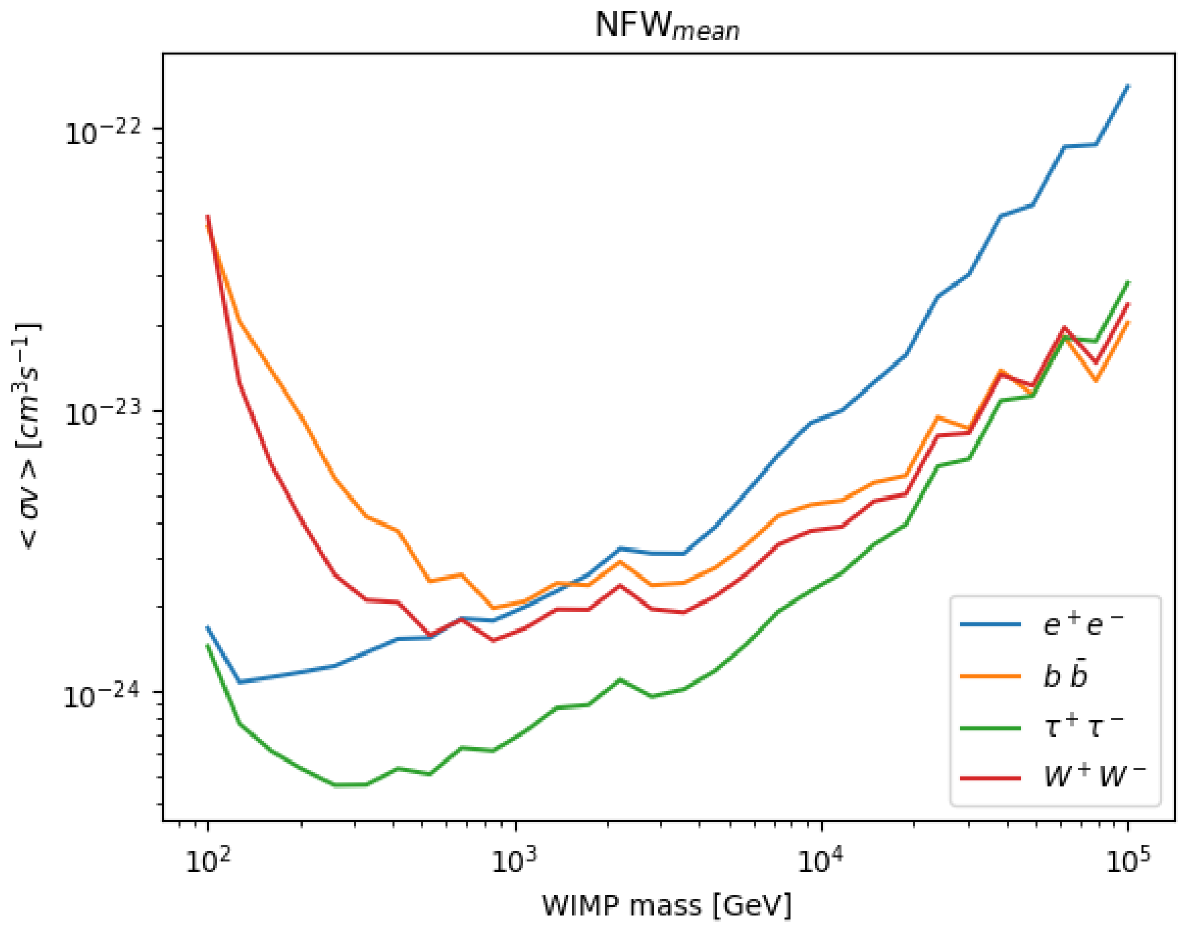

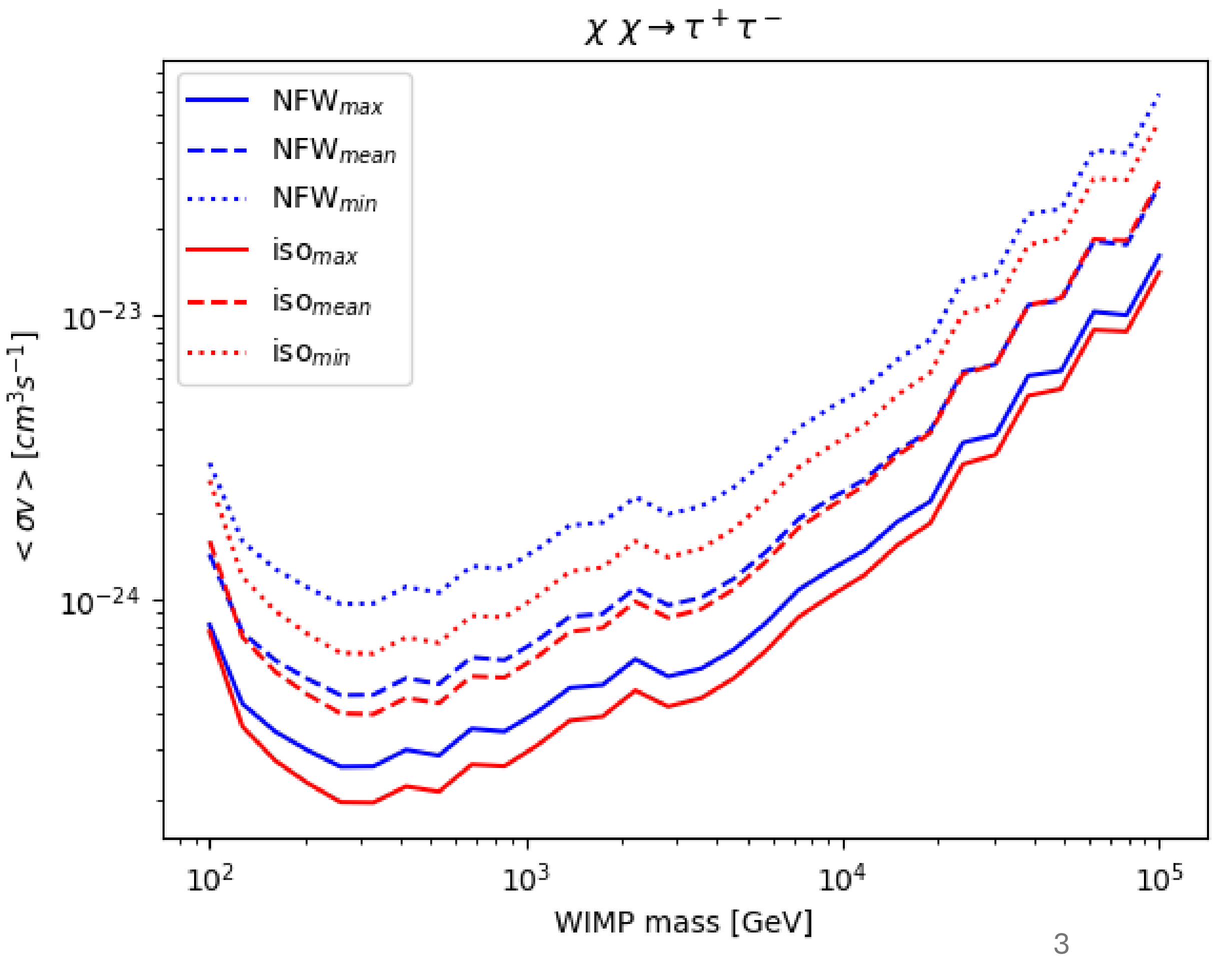

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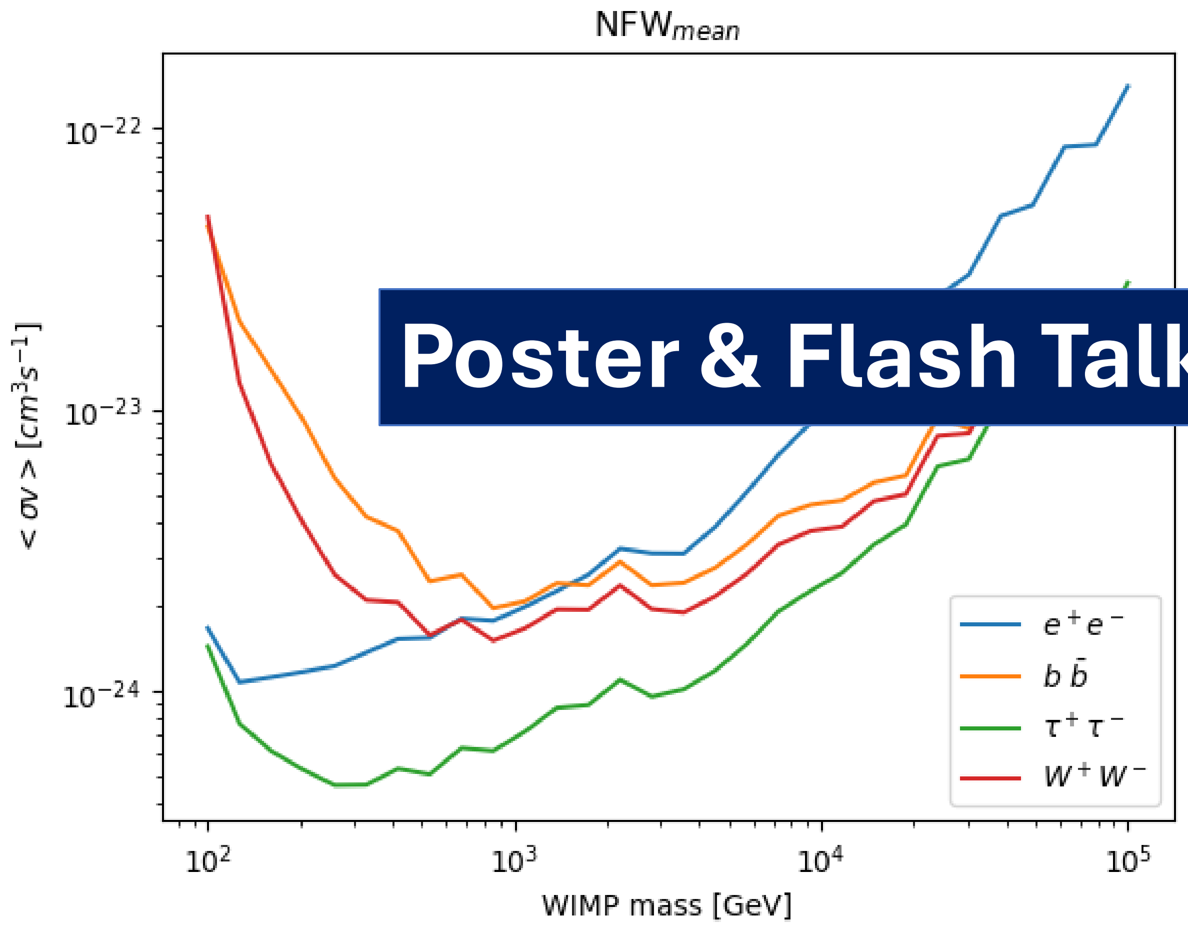

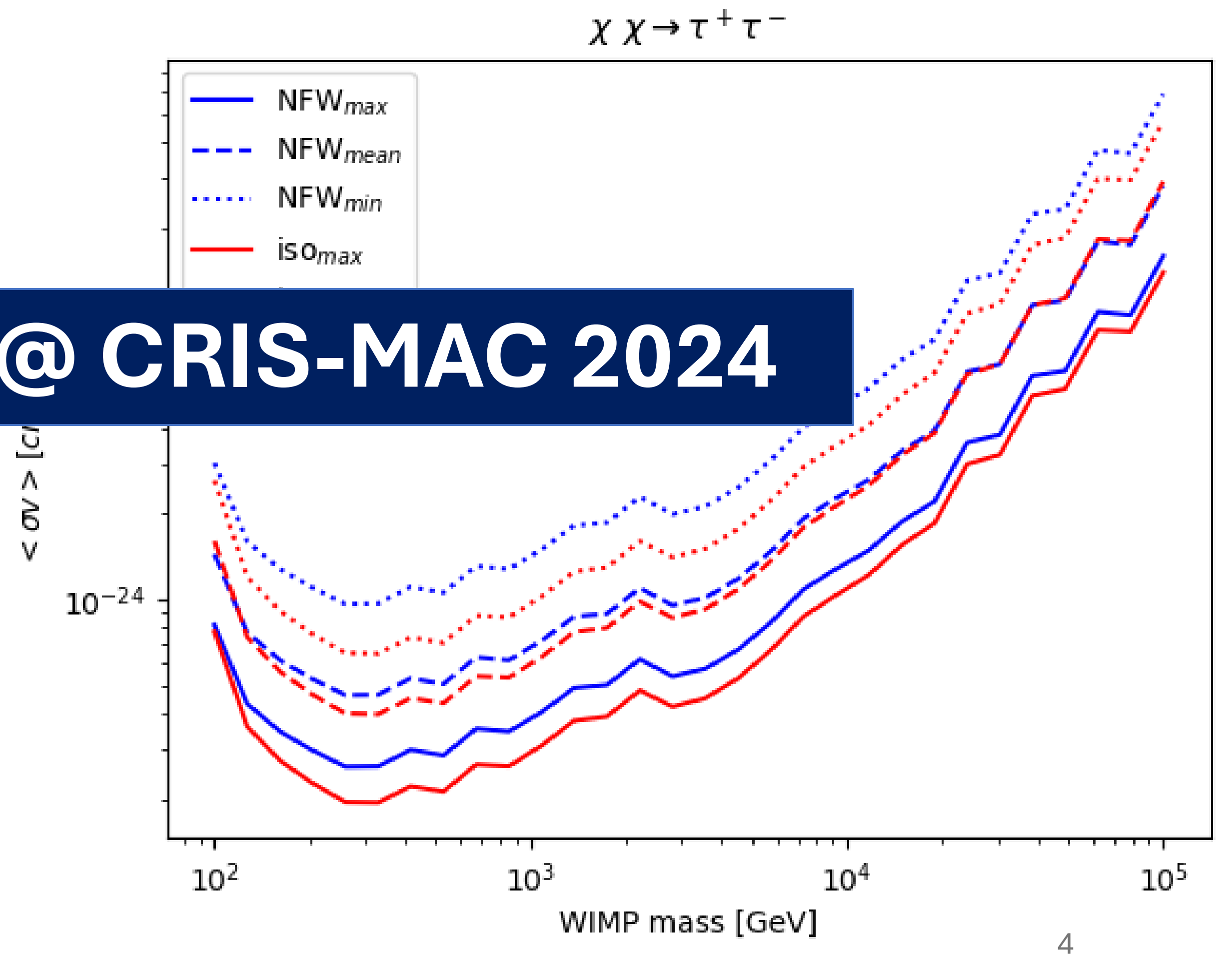

Poster & Flash Talk @ CRIS-MAC 2024

Corsi @

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A Python package for gamma-ray astronomy

Corso	Docente	Ore
Low Energy Astroparticle Physics - Theory (Neutrino Physics)	E. Lisi	15
Low Energy Astroparticle Physics - Theory (Dark Matter)	F. D'Eramo	15
Low Energy Astroparticle Physics - Experiments (Double Beta Decay)	L. Pagnanini	15
Low Energy Astroparticle Physics - Experiments (Dark Matter Searches)	E. Baracchini	15
High energy Astropartcile Physics - Theory	C. Evoli	30
High energy Astropartcile Physics - Experiments	I. De Mitri	30
Gravitation and Cosmology - Theory (Gravitation)	A. Maselli	15
Gravitation and Cosmology - Theory (Cosmology)	S. Matarrese	15
Gravitation and Cosmology - Experiment (GW Detection)	J. Harms	15
Gravitation and Cosmology - Experiment (GW Astrophysics)	M. Branchesi	15
Statisticl Methods in Astroparticle Physics	G. Benato	30

Dalle lezioni di Marica Branchesi

A&A 678, A126 (2023)
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Astronomy & Astrophysics

Pre-merger alert to detect prompt emission in very-high-energy gamma-rays from binary neutron star mergers: *Einstein* Telescope and Cherenkov Telescope Array synergy

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ABSTRACT

The current generation of very-high-energy gamma-ray (VHE; $E > 30$ GeV) detectors (MAGIC and H.E.S.S.) have recently demonstrated the ability to detect the afterglow emission of gamma-ray bursts (GRBs). However, the GRB prompt emission, typically observed in the 10 keV–10 MeV band, is still undetected at higher energies. Here, we investigate the perspectives of multi-messenger observations to detect the earliest VHE emission from short GRBs. Considering binary neutron star mergers as progenitors of short GRBs, we evaluate the joint detection efficiency of the Cherenkov Telescope Array (CTA) observing in synergy with the third generation of gravitational-wave detectors, such as the *Einstein* Telescope (ET) and Cosmic Explorer (CE). In particular, we evaluate the expected capabilities to detect and localize gravitational-wave events in the inspiral phase and to provide an early warning alert able to drive the VHE search. We compute the amount of possible joint detections by considering several observational strategies, and demonstrate that the sensitivity of CTA make the detection of the VHE emission possible even if it is several orders fainter than that observed at 10 keV–10 MeV. We discuss the results in terms of possible scenarios of the production of VHE photons from binary neutron star mergers.

Key words. astroparticle physics – gravitational waves – methods: observational – relativistic processes – binaries: general – gamma rays: general

Corsi @ GSSI

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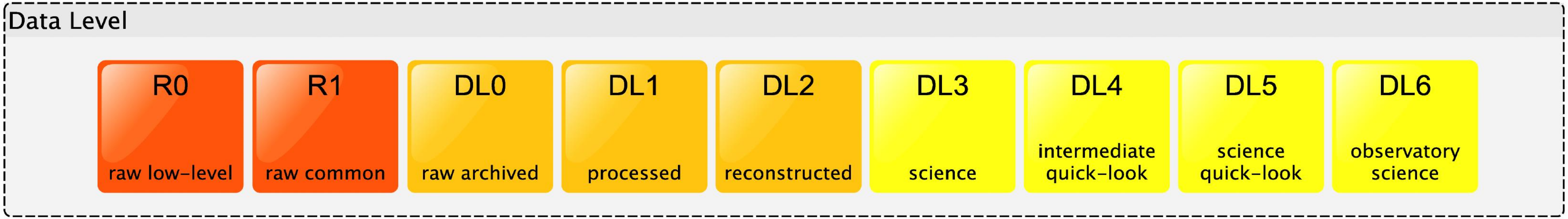
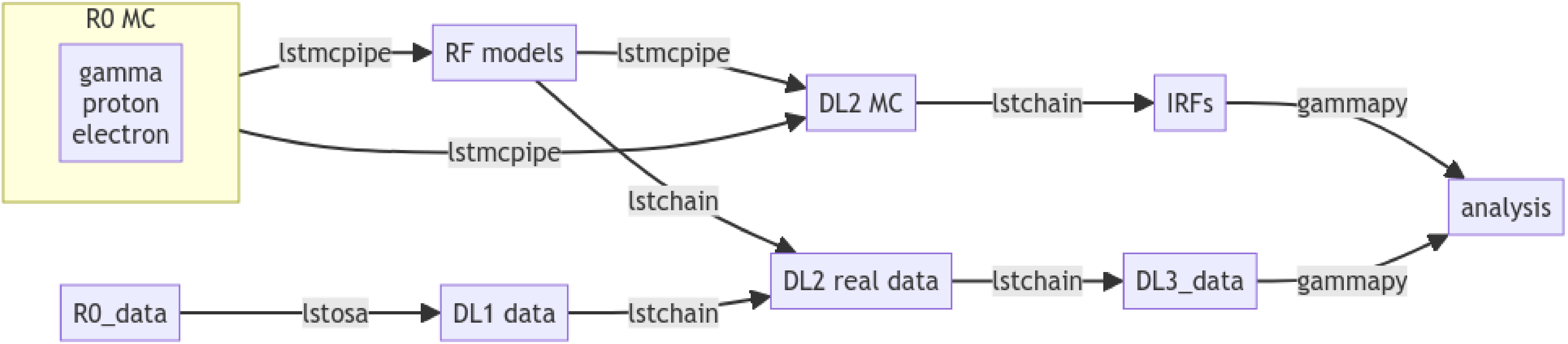
Gravitation and Cosmology - Experiment (GW Astrophysics)	M. Branchesi	15
Statistical Methods in Astroparticle Physics	G. Benato	30

Corsi @

Corso	Docente	Ore
Gravitation, relativity and Black Holes	M. De laurentis	6-8
Physics and Evolution of Supermassive Black Holes	D. De Cicco & M. Paolillo	6-8
Gravitational waves and Gamma-Ray Bursts	T. Di Girolamo	6-8

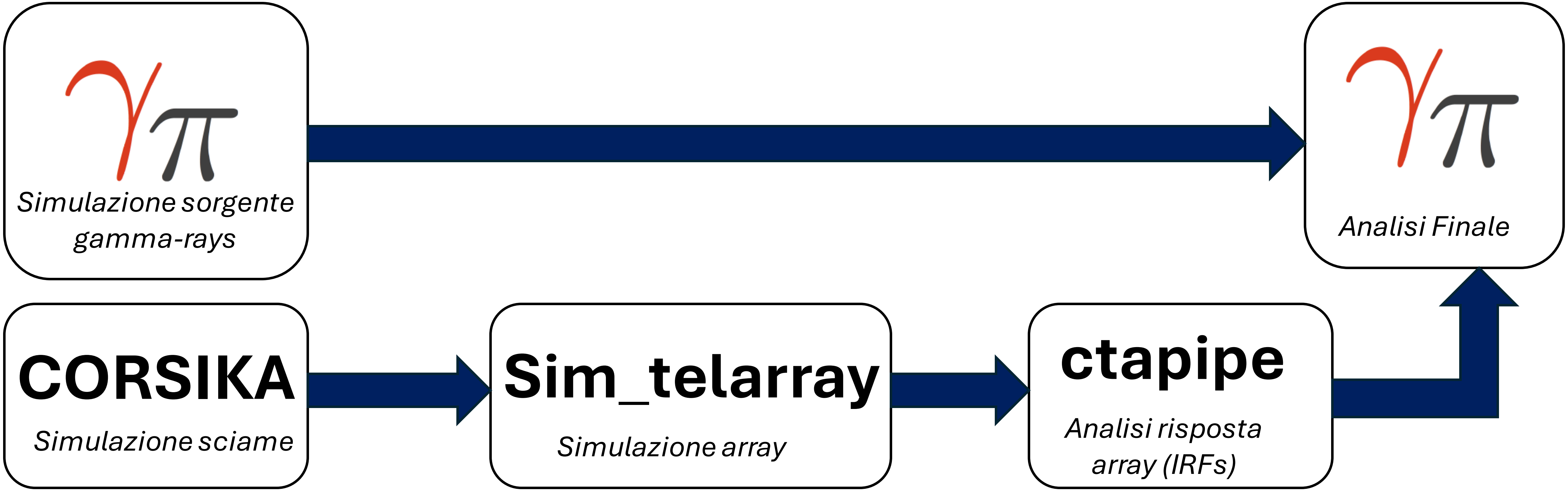
2nd LST Analysis School



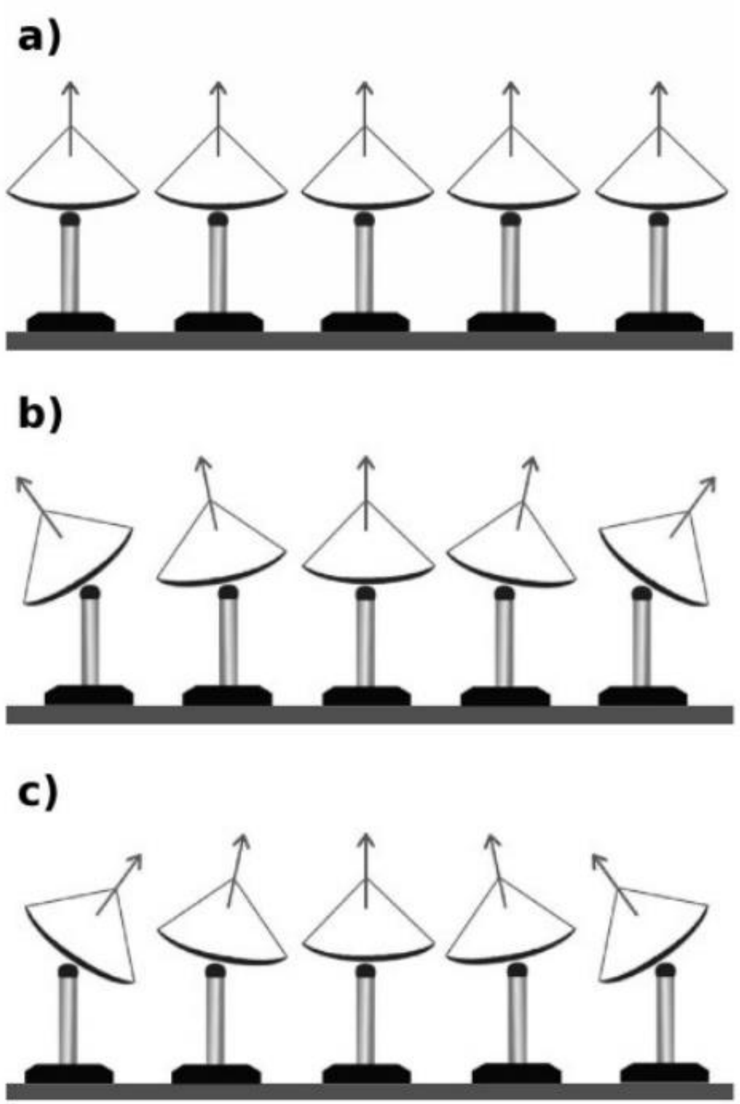


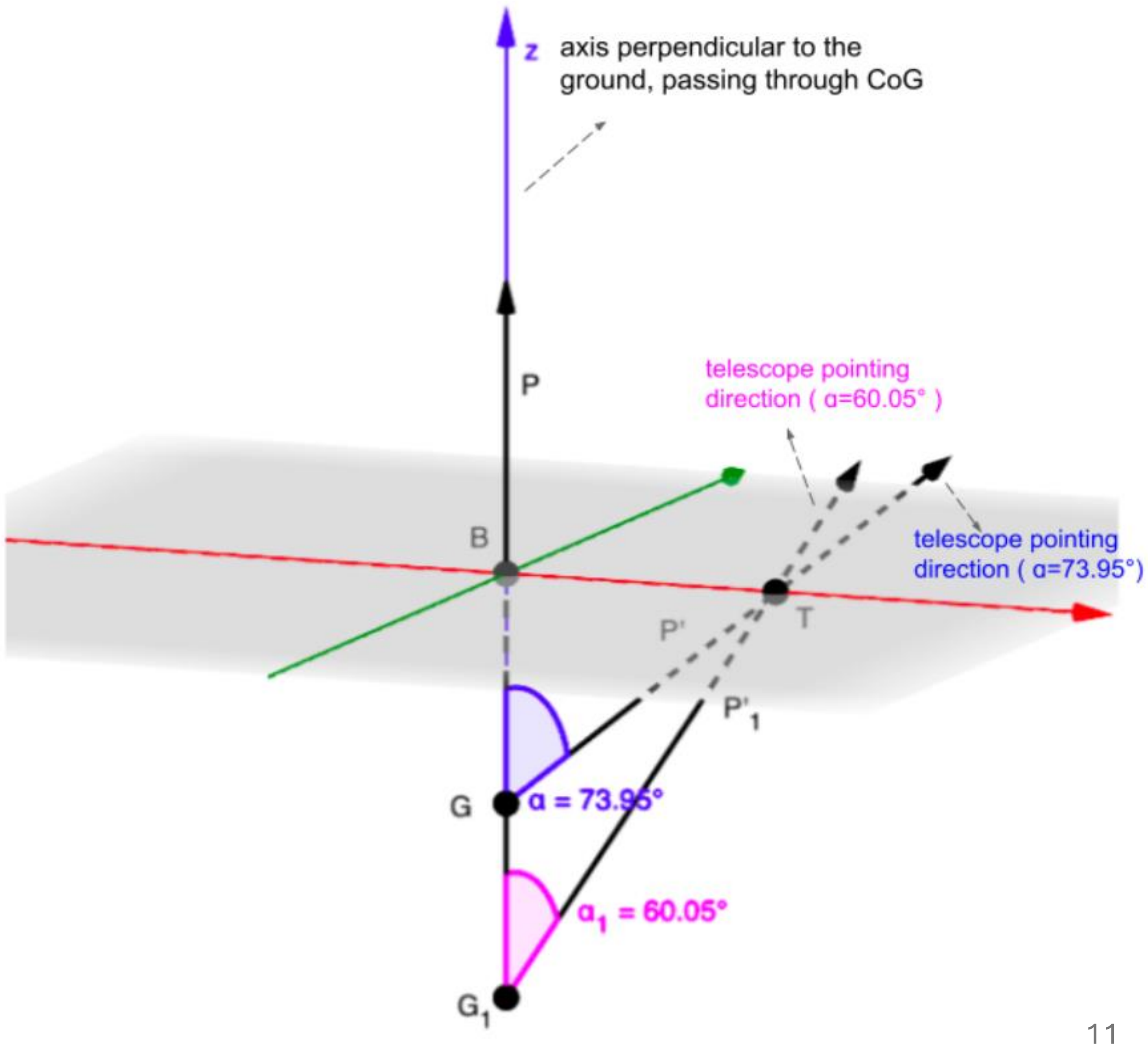
Fonte:https://cta-observatory.github.io/lstmcpipe/lstmcpipe_user_doc.html

CTAO Simulation Workflow



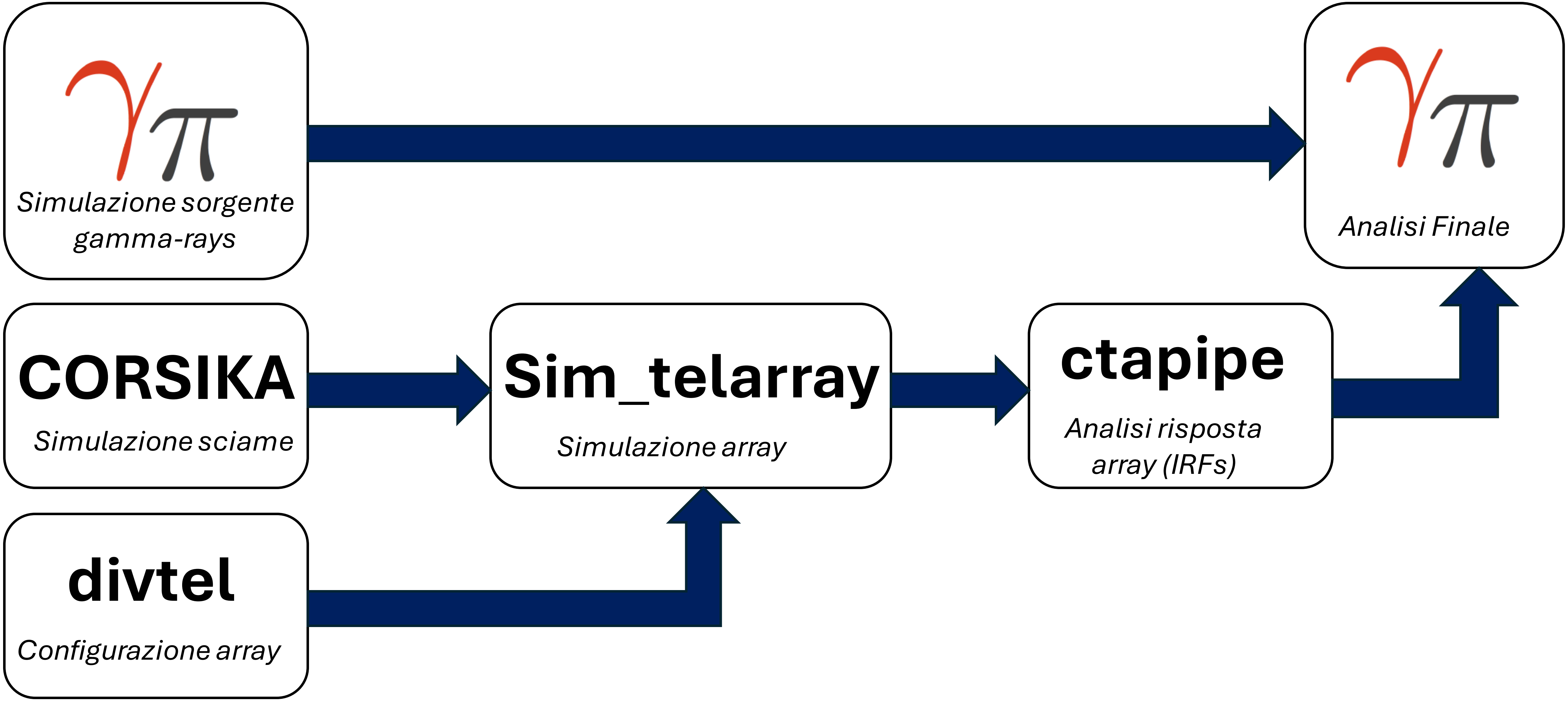
Divergent Pointing



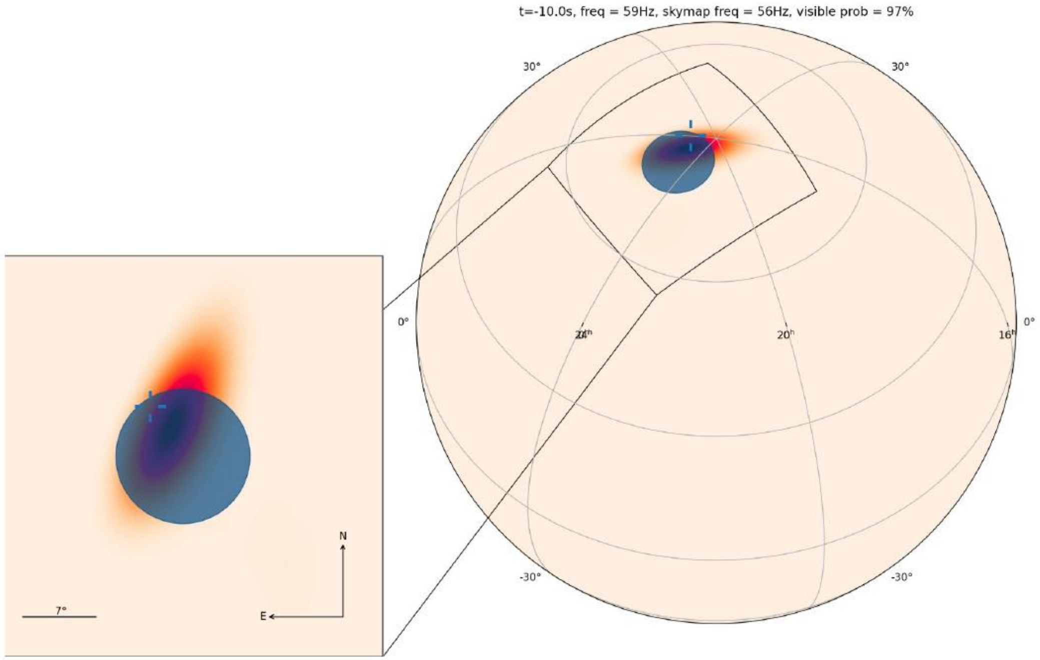


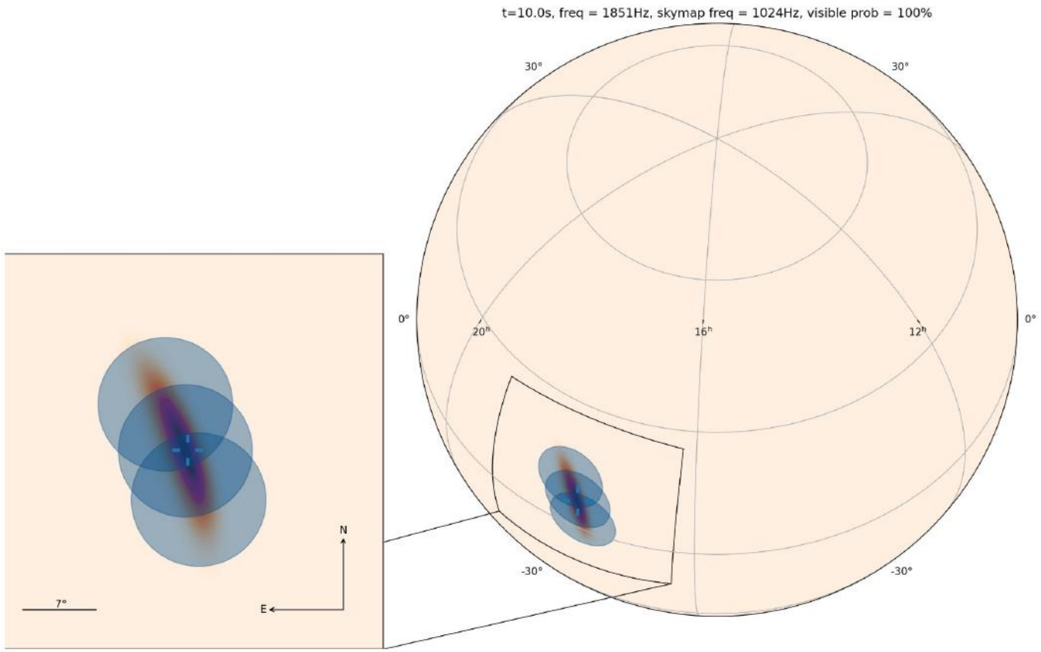
Fonte: Tesi dottorato I. Burelli

CTAO Simulation Workflow



Using gravitational wave early warning to pre-point neutron star mergers





Fonte: Jacopo Tissino talk @ CTAO Science Symposium

Using gravitational wave early warning to pre-point neutron star mergers

GWFISH

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Full length article

GWFISH: A simulation software to evaluate parameter-estimation capabilities of gravitational-wave detector networks

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ABSTRACT

An important step in the planning of future gravitational-wave (GW) detectors and of the networks they will form is the estimation of their detection and parameter-estimation capabilities, which is the basis of science-case studies. Several future GW detectors have been proposed or are under development, which might also operate and observe in parallel. These detectors include terrestrial, lunar, and space-borne detectors. In this paper, we present GWFISH,[1] a new software to simulate GW detector networks and to calculate measurement uncertainties based on the Fisher-matrix approximation. GWFISH models the impact of detector motion on PE and makes it possible to analyze multiband scenarios, i.e., observation of a GW signal by different detectors in different frequency bands. We showcase a few examples for the Einstein Telescope (ET) including the sky-localization of binary neutron stars, and ET's capability to measure the polarization of GWs.