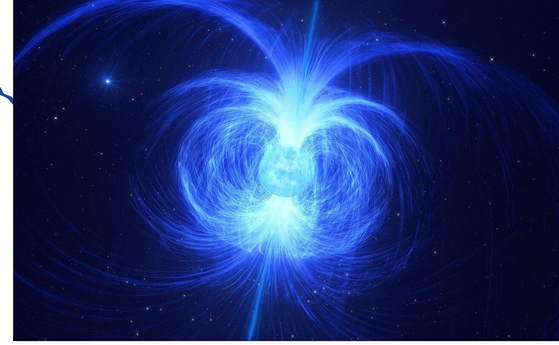


Gamma Ray Bursts

Reference people

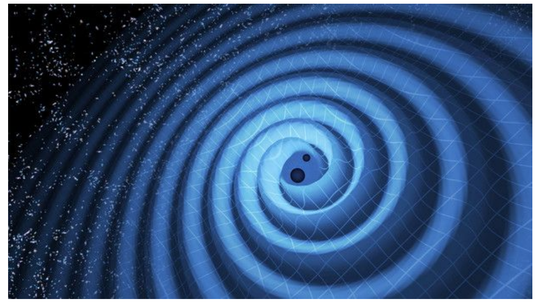
DIFA: Marcella Brusa, Cristian Vignali

OAS: Andrea Rossi, Eliana Palazzi, Giulia Stratta, Elisabetta Maiorano, Daniela Vergani, Lorenzo Amati

INFN: Simone Dall'Osso

Chance to get involved in international collaborations for the follow-up of GRB and Gravitational wave sources

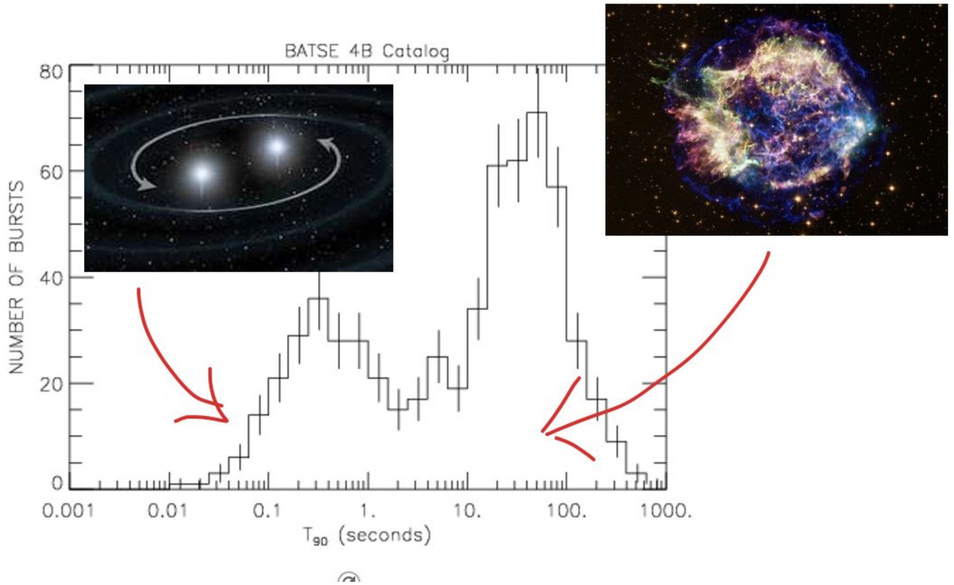
STARGATE – GRAWITA – ENGRAVE



GRB: progenitors ?

- **Long GRB:** generated by the core-collapse of massive stars

- **Short GRB:** generated by compact binary coalescences (CBC) as NS-NS or NS-BH → *gravitational wave sources!*



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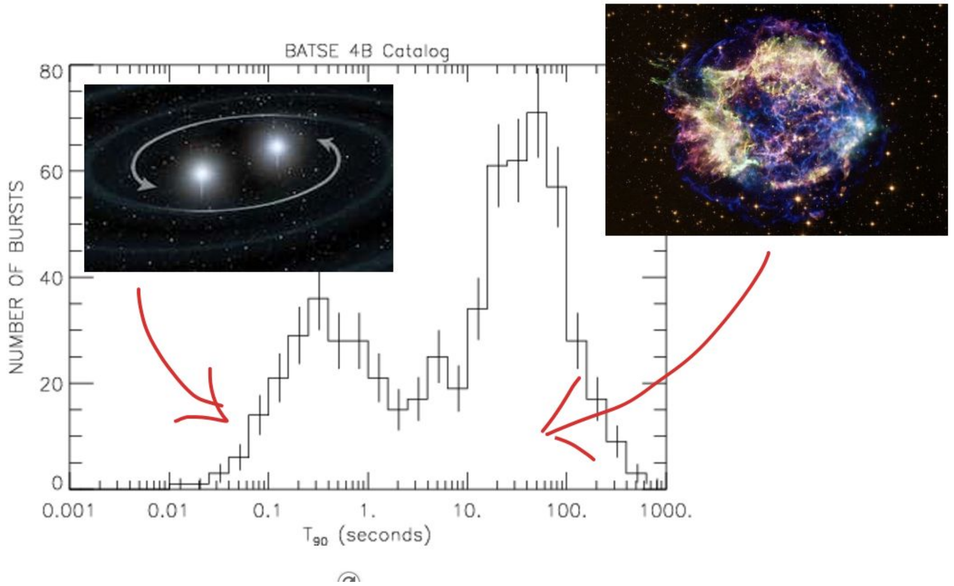
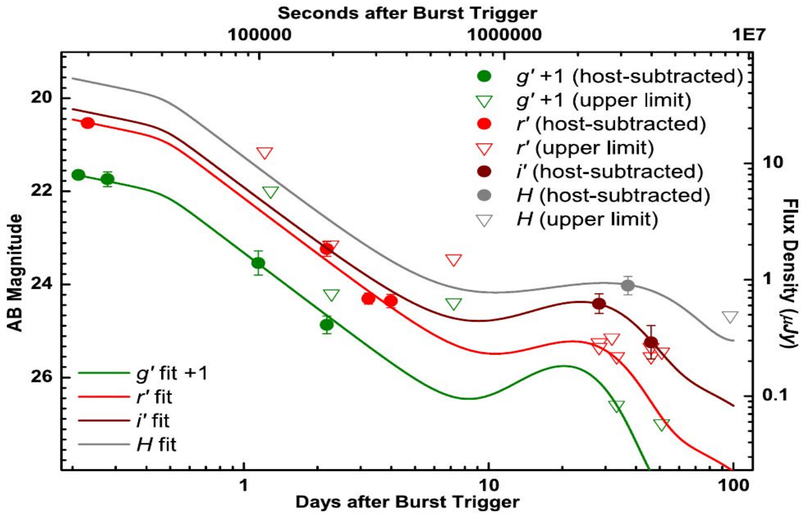


However, a growing fraction of **long GRBs** is now found to be more consistent with **CBC** (e.g. **no presence of associated SN** and/or **old host galaxies**) → *gravitational wave sources!*

Study of GRB Supernovae

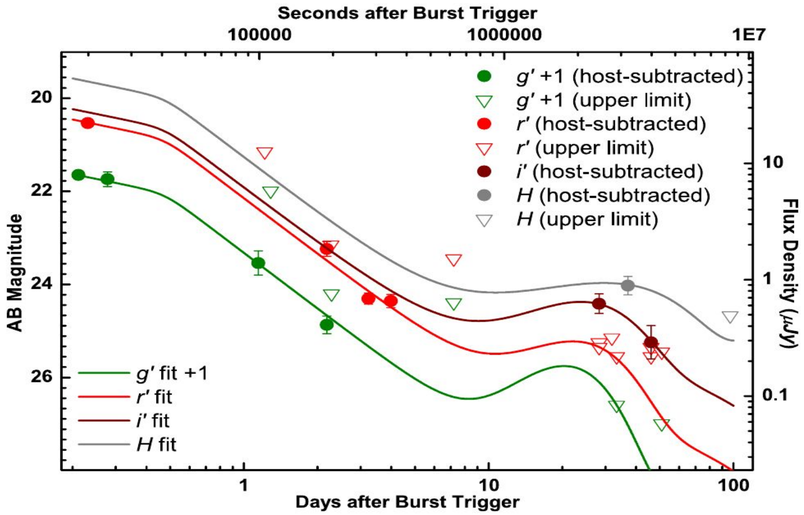


Rossi et al. 2021

To robustly exclude the presence of a GRB-SN we need a better knowledge of SN Ib,c parameter space (e.g. peak luminosity, peak time, etc)

andrea.rossi@inaf.it, eliana.palazzi@inaf.it

Study of GRB Supernovae



Rossi et al. 2021

To robustly exclude the presence of a GRB-SN we need a better knowledge of SN Ib,c parameter space (e.g. peak luminosity, peak time, etc)

QUESTION: Which is the fraction of long GRB associated with CBC?

METHOD: 1) create a database of several SN Ib,c lightcurves not necessarily associated with GRBs, building a simple code that converts observed to rest frame light-curves **2)** Test case: modelling of the optical/NIR light curves of LBT observed long GRB/SN 211023A

DURATION: >=0.5 year

DATA: LBT observations (already available)

Large Binocular Telescope

andrea.rossi@inaf.it, eliana.palazzi@inaf.it

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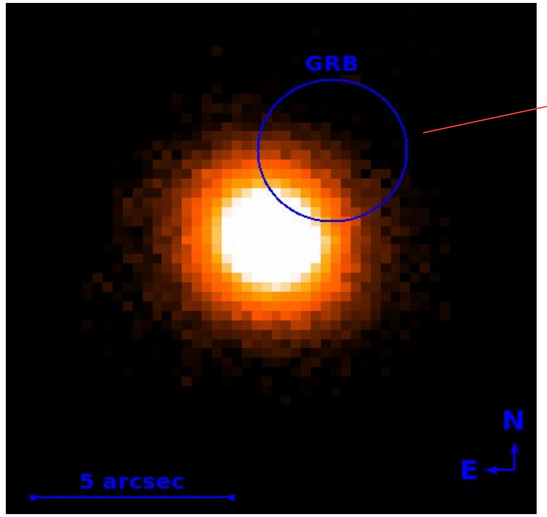
Study of long GRB Host Galaxies

- Long GRB 050219A host is an early-type galaxy (Rossi et al., 2014)



- **Long GRB** associated with CBC are likely **hosted in early-type galaxies** that form very few stars, consistent with old star populations as NS or BH forming NS-NS or NS-BH systems

andrea.rossi@inaf.it, eliana.palazzi@inaf.it,
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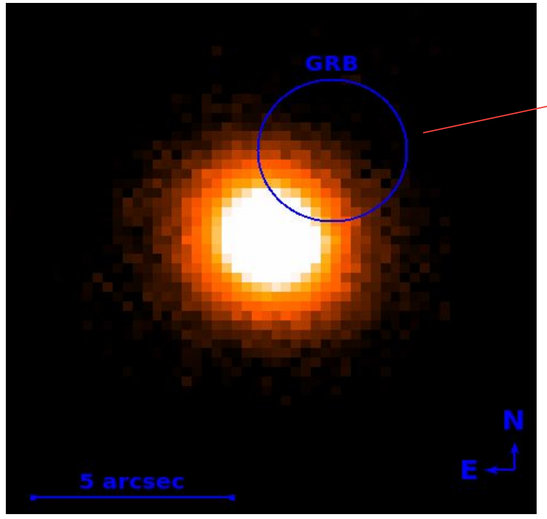

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QUESTION: Which is the fraction of long GRB associated with CBC?

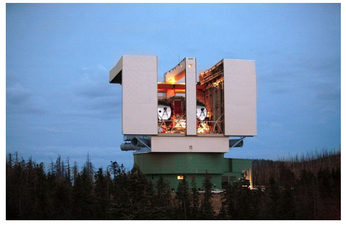
METHOD: study long GRB host galaxies, in particular 1) analysis of LBT and VLT optical/NIR images and spectra of 3 long GRB host galaxies, to measure i) redshift, ii) star formation rates, iii) metallicity **2)**: comparison with other GRB host galaxies

DURATION: >=0.5 year

DATA: LBT and VLT observations already available

ESO Very Large Telescope

Large Binocular Telescope



andrea.rossi@inaf.it, eliana.palazzi@inaf.it,
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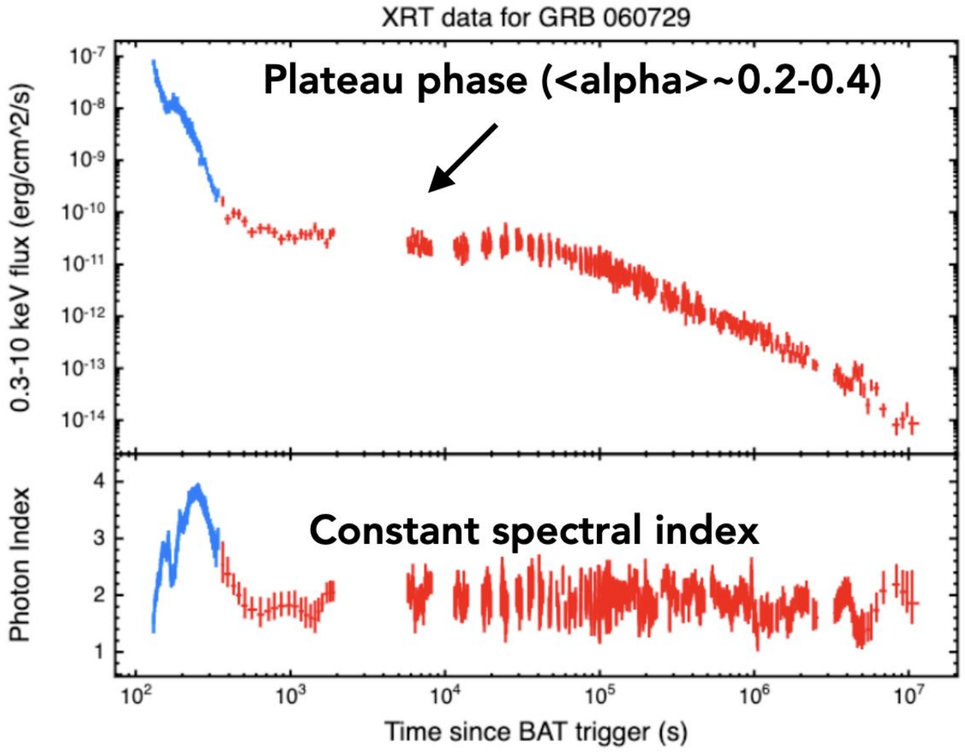
GRB: central engine ?

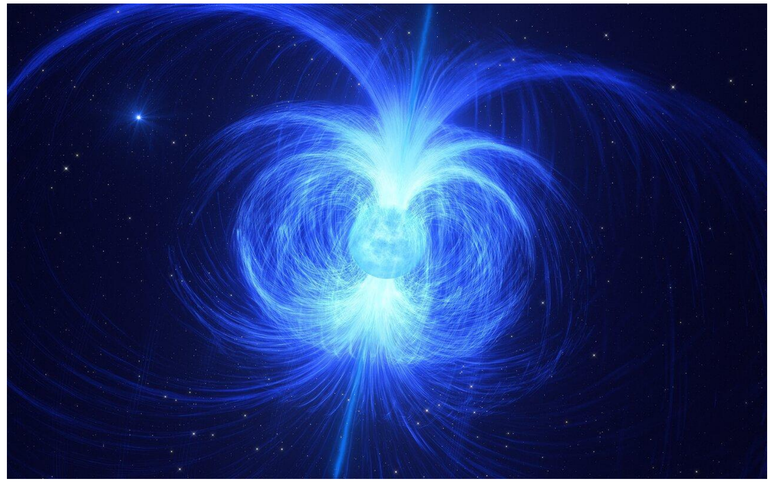
Long GRBs and **Short GRBs** show a “plateau” in the X-ray afterglow

The “plateau” origin is still a mystery and possibly connected with the nature of GRB central engine (NS or BH?)



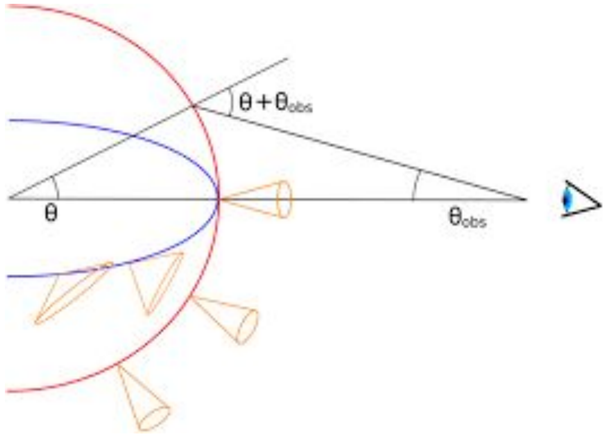
→ *if NS, potential gravitational wave source!*

Study of GRB “plateaus”



Artistic view of a magnetar

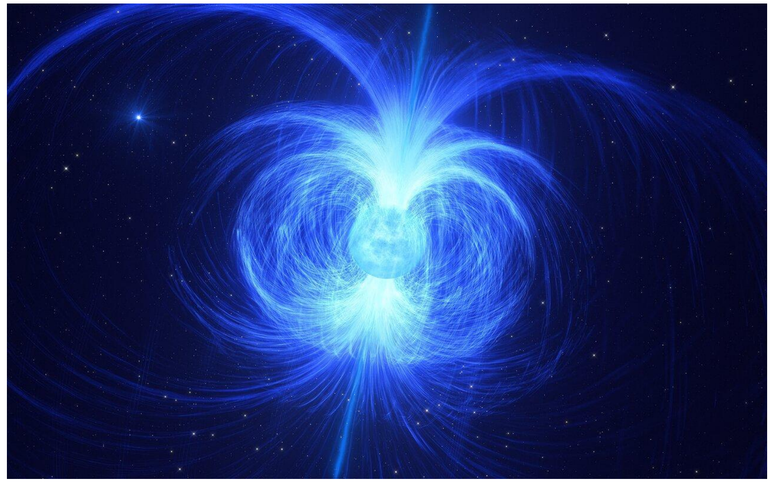
Two possible plateau origins: **1) spinning down NS** (remnant of the core-collapse or of the neutron star merger) **or 2) a geometrical effect from a structured jet**



Structured jet (Oganesian et al. 2020)

giulia.stratta@inaf.it, Simone.Dall-Osso@roma1.infn.it

Study of GRB “plateaus”



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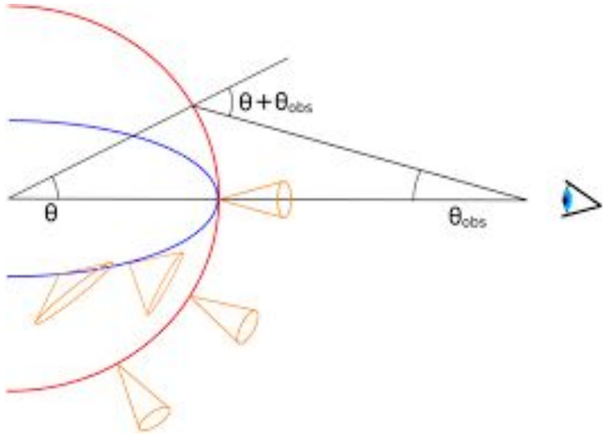

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QUESTIONs: How many GRBs show an X-ray plateau? Which theoretical scenario is compatible with the observed fraction and which implications?

METHOD: analysis of Swift/XRT afterglow light curves of long and short GRBs

DURATION: 0.5-1 year

REQUISITES: Python, basics of X-ray data reduction, inferential statistics

DATA: Swift/XRT light curves public database https://www.swift.ac.uk/xrt_curves/

giulia.stratta@inaf.it, Simone.Dall-Osso@roma1.infn.it

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Science with the THESEUS space mission

Transient High Energy Sky and Early Universe Suveryor THESEUS is a candidate space mission for the 7th medium size call (M7) by ESA

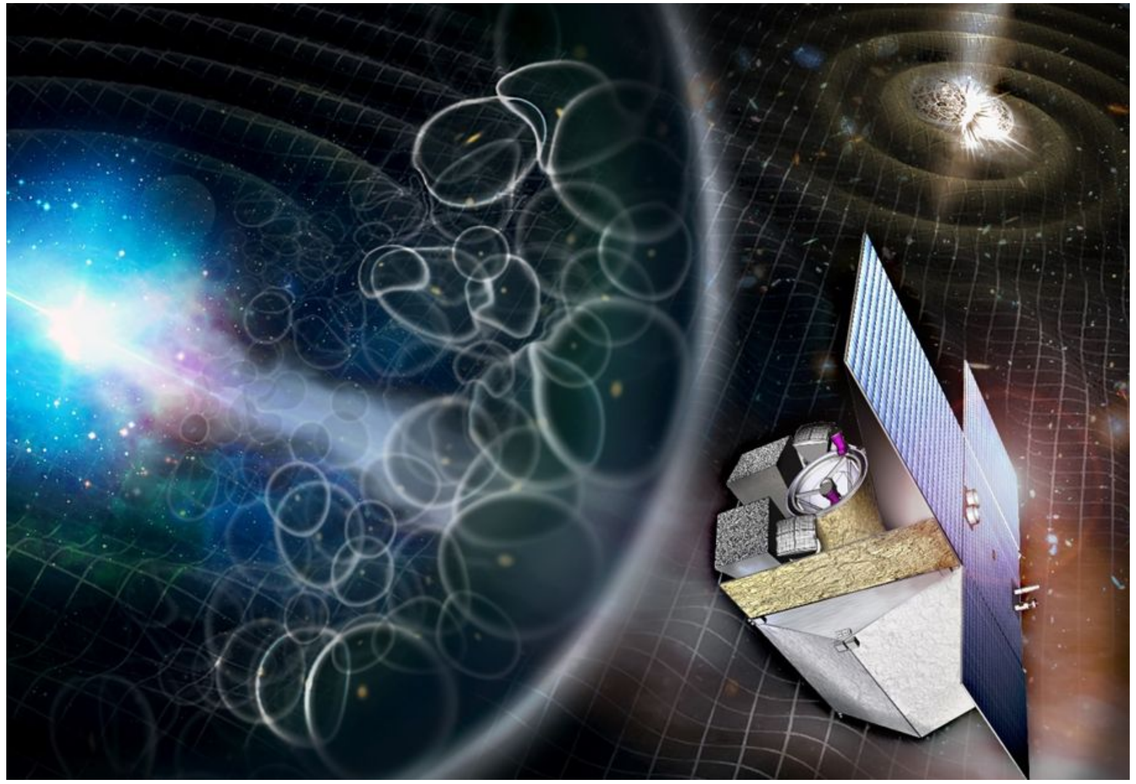
THESEUS will detect **high-redshift GRBs** for investigating the early universe and key phenomena for **multi-messenger astrophysics**

AIMS: study the scientific cases of THESEUS in synergy with the Cherenkov Telescope Array and the gravitational wave interferometer of 3rd generation Einstein Telescope

METHOD: simulations of GRBs and other interesting transients using codes and calibrations developped within the THESEUS consortium

DURATION: >=0.5 year

EXTRA: chance to get involved in the large THESEUS international collaboration



giulia.stratta@inaf.it, lorenzo.amati@inaf.it

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