Extreme Universe Test Science Project

In EOSC framework

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Extreme Universe-Test science projects in ESCAPE

Astrophysical extreme phenomena exploited through the gravitational waves, GRB, FRB, neutrino messengers are the main guidelines of the “extreme universe” (EU) TSP.

The ‘frontier’ for multi-messenger science is to understand extreme matter and particle processes in strongly curved space-time, equation of state for NS, the phenomena of Core Collapse Supernovae, besides hints on the universe at high redshifts.

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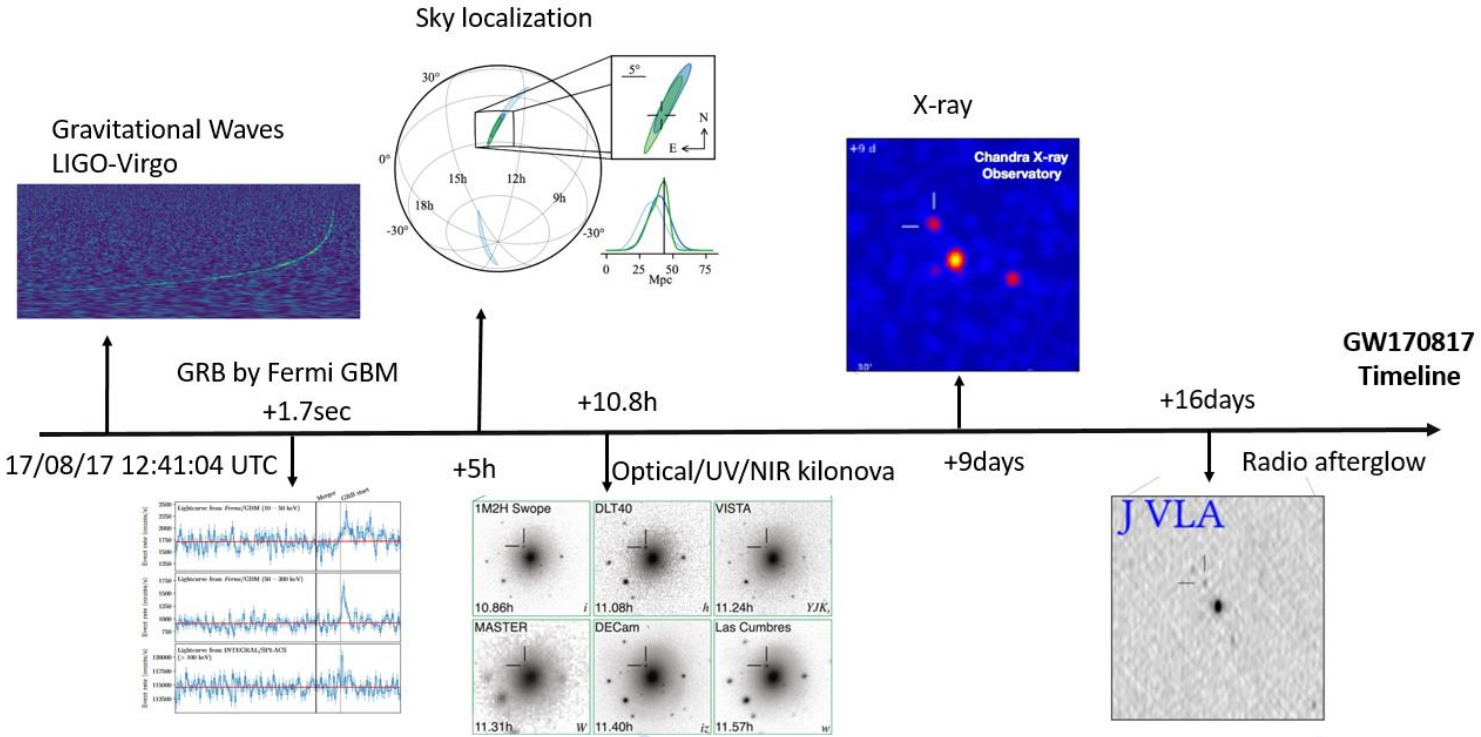
GW170817 detection and EM follow up



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Gravitational Waves & Multimessenger astronomy

- **Short GRB**
  Fermi GBM, INTEGRAL, Astrosat, IPN, Insight-HXMT, Swift, AGILE, CALET, H.E.S.S., HAWC, Konus-Wind
- **Gravitational waves (well-modeled)**
  Ligo/Virgo

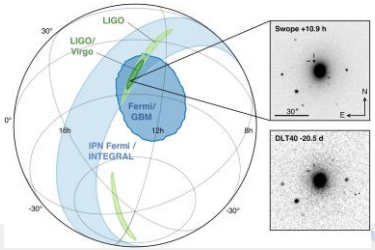
EARLY TRIGGERS (*sec to mins*)

- **X-Ray**
  Swift, MAXI/GSC, NuSTAR, Chandra, Integral
- **UV**
  Swift, HST
- **RADIO**
  ATCA, VLA, ASKAP, VLBA, GMRT, MWA, LOFAR, LWA, ALMA, OVRO, EVN, e-MERLIN, MeerKAT, Parkes, SRT, Effelsberg
- **IR**
  REM-ROS2, VISTA, Gemini-South, 2MASS, SPITZER, NTT, GROND, SOAR, NOT, ESO-VLT, Kanata Telescope, HST
- **Optical**
  Swope, DECam, DLT40, MASTER, VISTA, ESO-VLT + *others*

BROADBAND FOLLOW-UP (*hrs to days*)

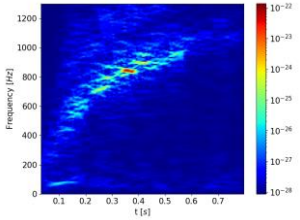
Binary Neutron Star Merger

- *Fast alert and sky Localization for follow-up study*
- *Better understanding of physical processes (e.g. heavy-element nucleosynthesis)*



Abbott et al. (2017)

- **Neutrinos**
  (prompt emission of ~ 90% of total CCSNe energy)
  IceCube, ANTARES, Pierre Auger Observatory
- **Gravitational waves**
  (prompt emission, unknown waveform, carry little energy)
  Ligo/Virgo



Iess et al. (2020)

- **E.M. emission** (delayed emission)

Core-Collapse Supernovae

- *Shed Light on explosion mechanism (neutrino-driven, MHD, acoustic)*
- *Information on physical characteristics of progenitor star (mass, rotation)*
- *Information on proto-neutron star*

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Main themes we want to tackle in TSP: what can we do jointly?

	Objects/sources	Messengers	ESF/RI invoved	ESCAPE cells and services and EOSC-Future integratio ns	DA-tools (AI,ML)	Pilot project(s)	Computing resources required
Compact objects	Pulsars,..	radio, GW,...	LOFAR...	Multimessenger platform/Software catalogue,...	Classification methods,...	?	
High energy Astrophysics	GRBs, jets, CCSN	neutrinos, gamma-rays, radio, X-rays, GW,...	CTA, Virgo, KM3NET, SKA,LSST	Multimessenger platform/Software catalogue,...	Model comparison,...	1)***GRB/neutrino/GW analysis…*** 2) Blazar MWL/neutrino	
Fundamental physics	dark matter, GR,...	GW,...	Virgo,...	Template banks, generation software,...	Classification methods, ...	DM template bank and ML analysis pipeline	

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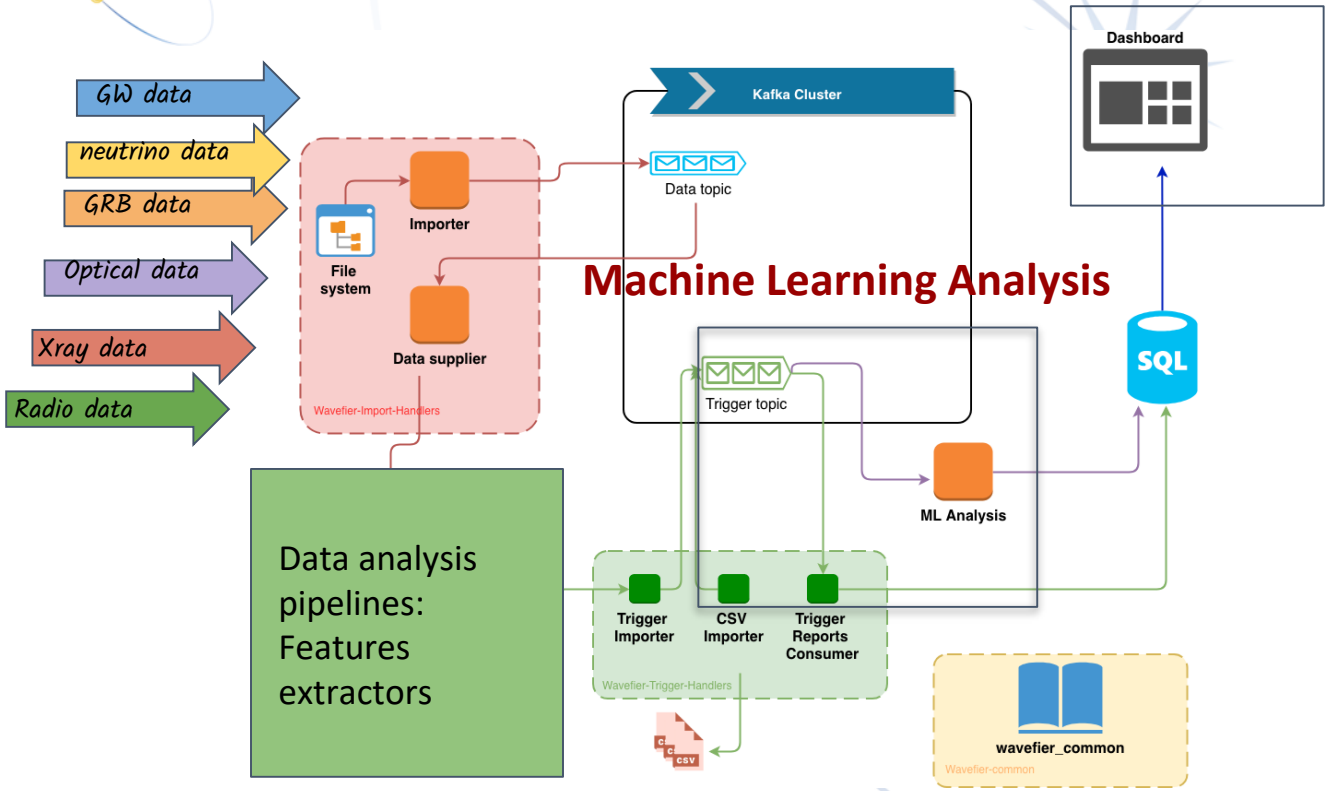
Example: MMA in ESCAPE framework



Results

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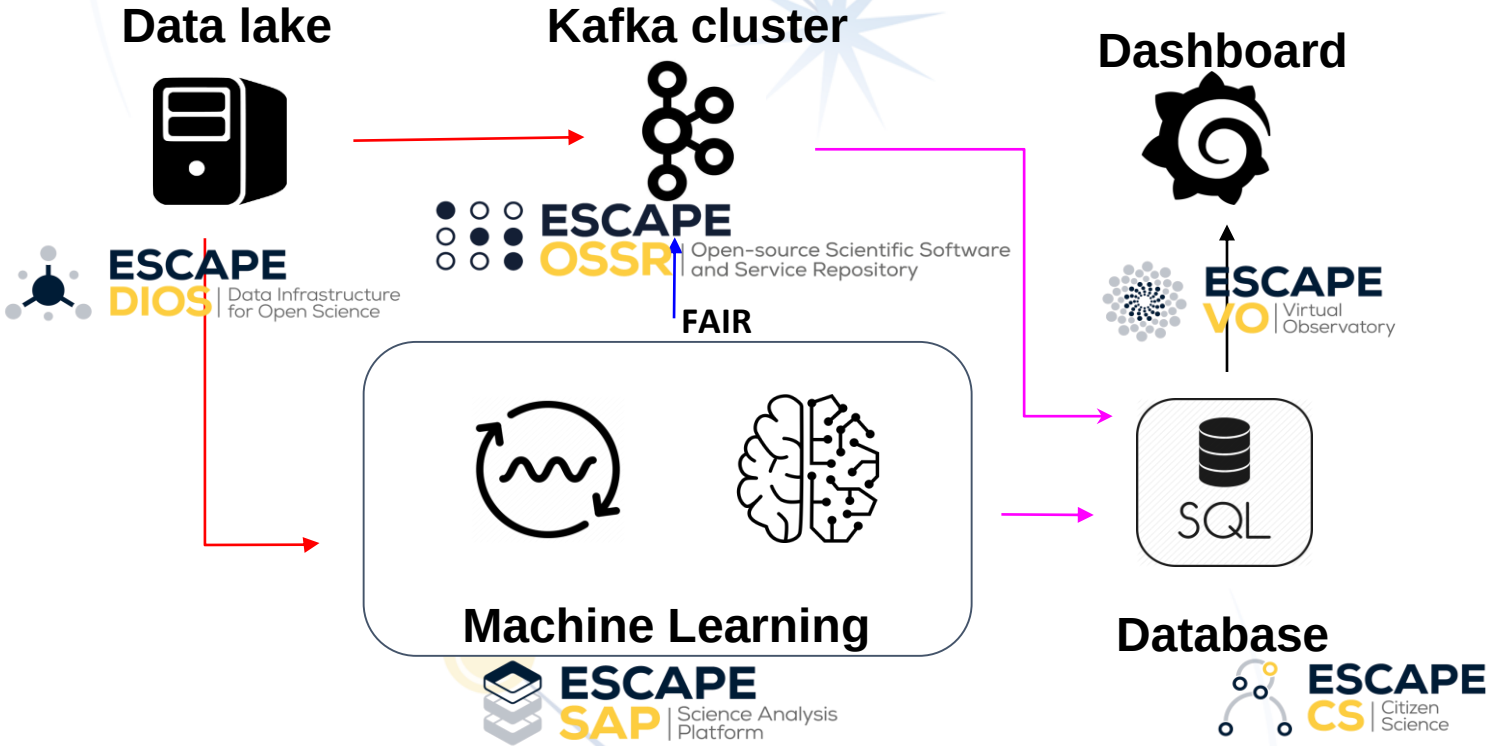
ESCAPE tools



Integration in EOSC-Future project

IWAPP INNOVATIVE WORKFLOWS IN ASTRO & PARTICLE PHYSIC

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IWAPP contribution

Many interesting innovative workflows presented by ESCAPE partners

ESF/RI reported similar challenges

Benefit in cooperation and “interdisciplinary” team working

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Any contribution is welcome

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