ASTERICS

What is Europe doing to facilitate multi-messenger astrophysics worldwide?

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NWO-I / ASTRON

ASTERICS

Astronomy ESFRI & Research Infrastructure Cluster

Project

- EC Horizon 2020 funding 2015 – 2019
- 26 partners (Institutes and Universities; no RIs)

ESFRI

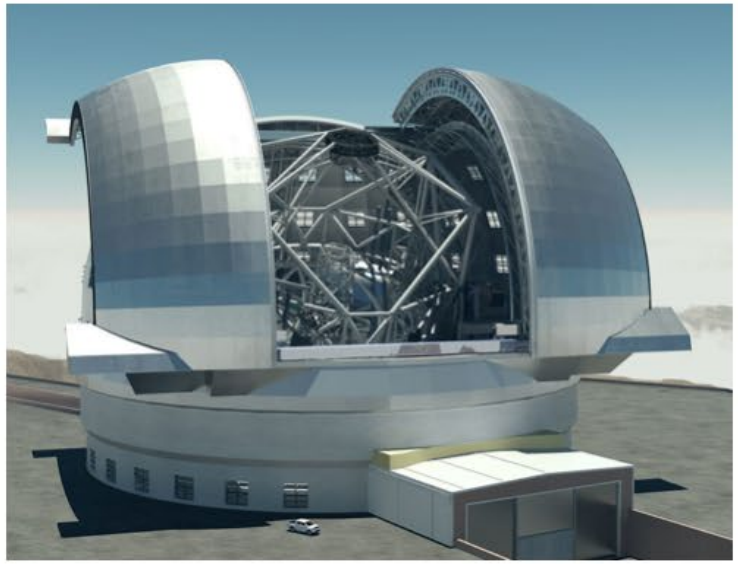
European Strategy Forum on Research Infrastructures

[kind of quality certificate for RIs]

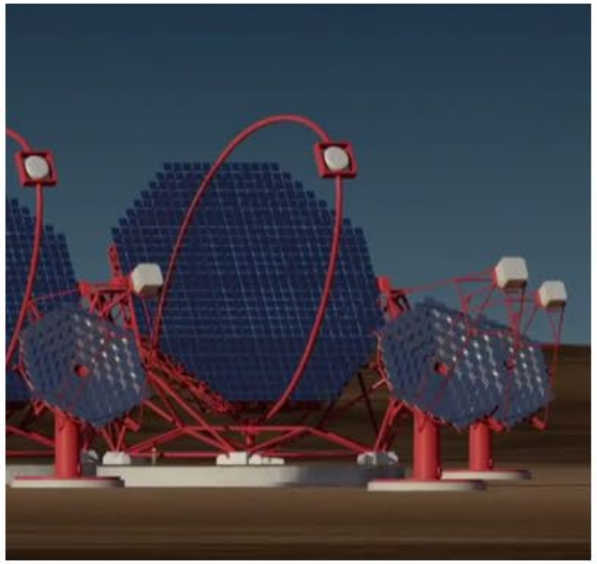
New astro(particle)physics RIs

4 major future telescopes

Optical
E-ELT

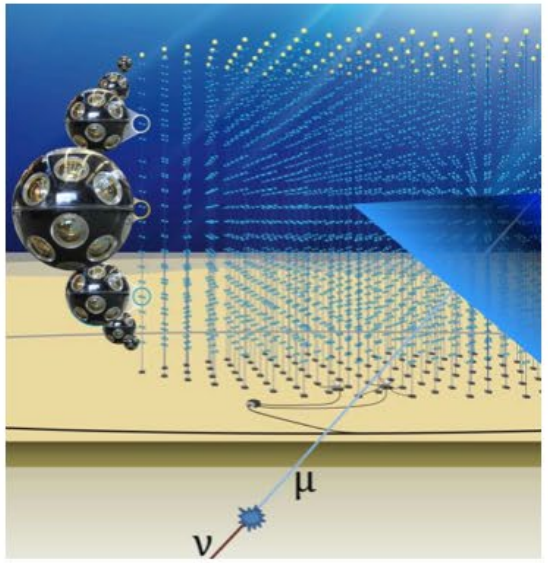


γ
CTA



Radio
SKA

ν
KM3NeT



astro(particle)physics RIs

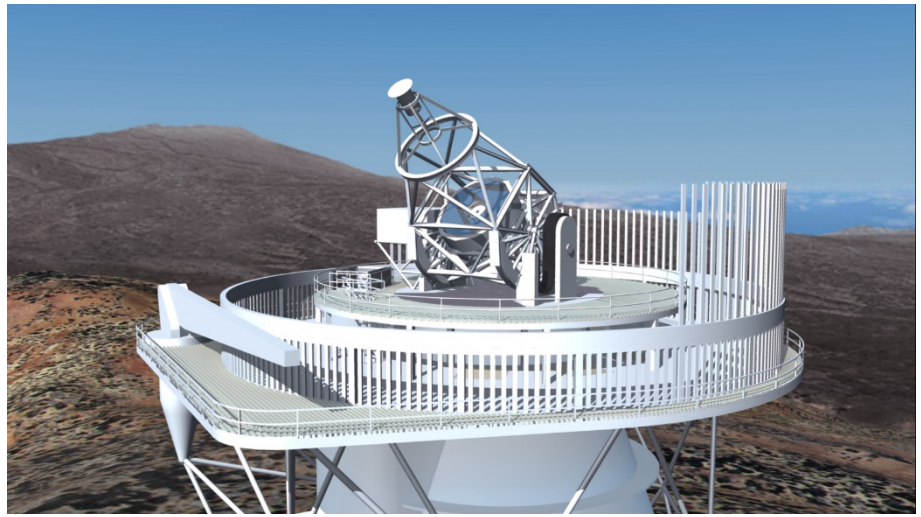
2 projects added later

GW

Ligo Virgo

Optical (Solar)

EST



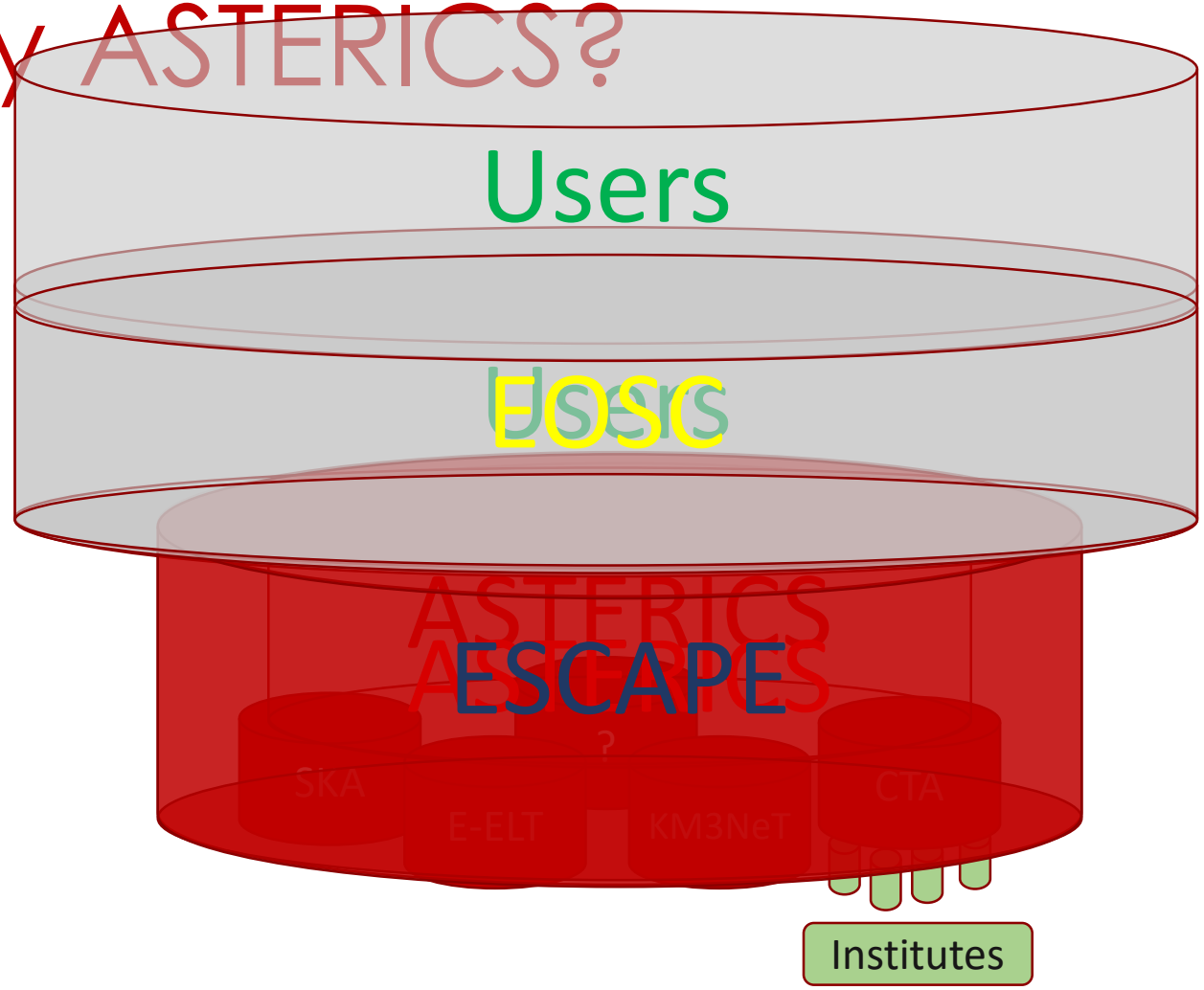
ASTERICS goals

Collaboration where possible

Analysing together	Virtual Observatory (VO)	IVOA: International Virtual Observatory Alliance
	Sharing Data Analysis tools	
	(re-)use data in new ways	RDA: Research Data Alliance
	Citizen Science	
Observing together	Scheduling	Alerting
	Timing	White Rabbit (WRE)
Developing together	Data extraction/movement	
	Data storage/retrieval	International Policy Forum
	Data analysis	

Why ASTERICS?

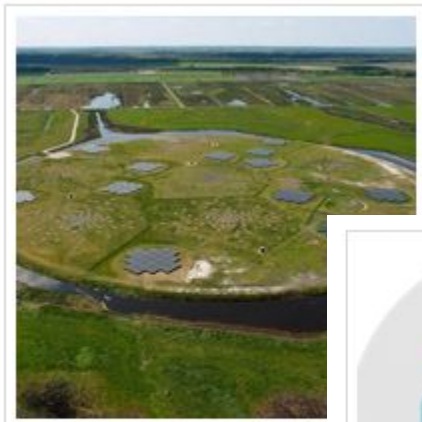
- Flatten boundaries
- Find synergies
- Create community
- Multi-messenger



ASTERICS results

www.asterics2020.eu

- Softv
- Train
- Repc



MULTI-
MESSENGE
ASTROPHYS

SERVICES FOR LARGE DATASETS

SOFTWARE FOR (BIG) DATA ANALYSIS

VIRTUAL OBSERVATORY PRODUCTS

TRAINING

Update and share your knowledge and expertise with the multi-messenger

ASTERICS Follow-up

- Recent increase in collaboration in **multi-messenger astrophysics**, both for planned observations and in response to transients
  - Transient phenomena are the next 'big thing'
  - Gravitational waves → LSST and SKA → millions of raw events per night!
  - All could require follow-up – how do we do this efficiently?
- **ASTERICS**: a network of facilities and organizations involved in multi-messenger astrophysics
- **Multi-messenger platform (MMP)** project used the ASTERICS network and aimed to **play a coordinating role** in translating ideas and tools into a platform to serve the multi-messenger community

The **Multi-Messenger Platform (MMP)** facilitates collaborative, follow-up observing by joining together and adding to available tools

Stakeholders

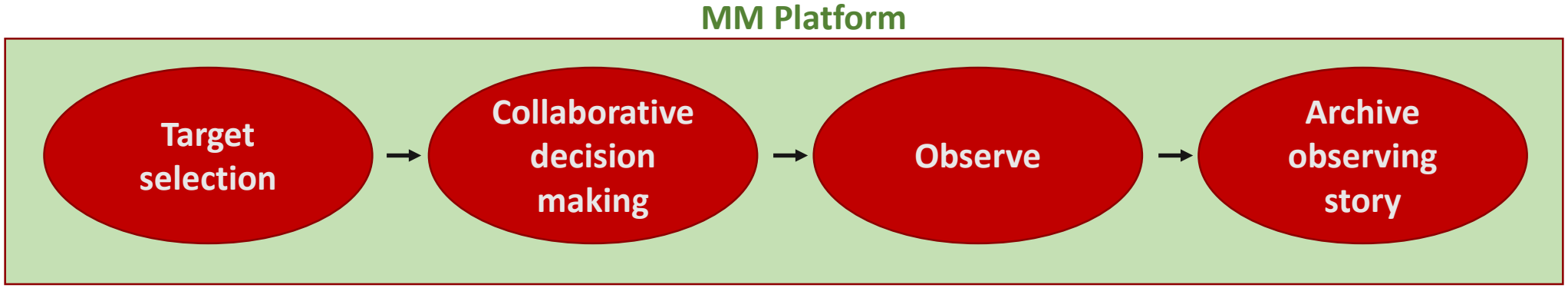
- Participants in ASTERICS video conferences about the needs to coordinate multi-messenger astrophysics, linked to the following organizations/facilities:

Initiative Proliferation

- Target Filtering - event brokers add value to the event stream
- Collaboration - skills, access to instruments, manpower
- Observation scheduling – multi-instrument coordination, editing
- Context building – harvest archive data, correlate alerts
- Tools - Aladin Lite, LCO TOM toolkit
- Interface definition
- Umbrella projects

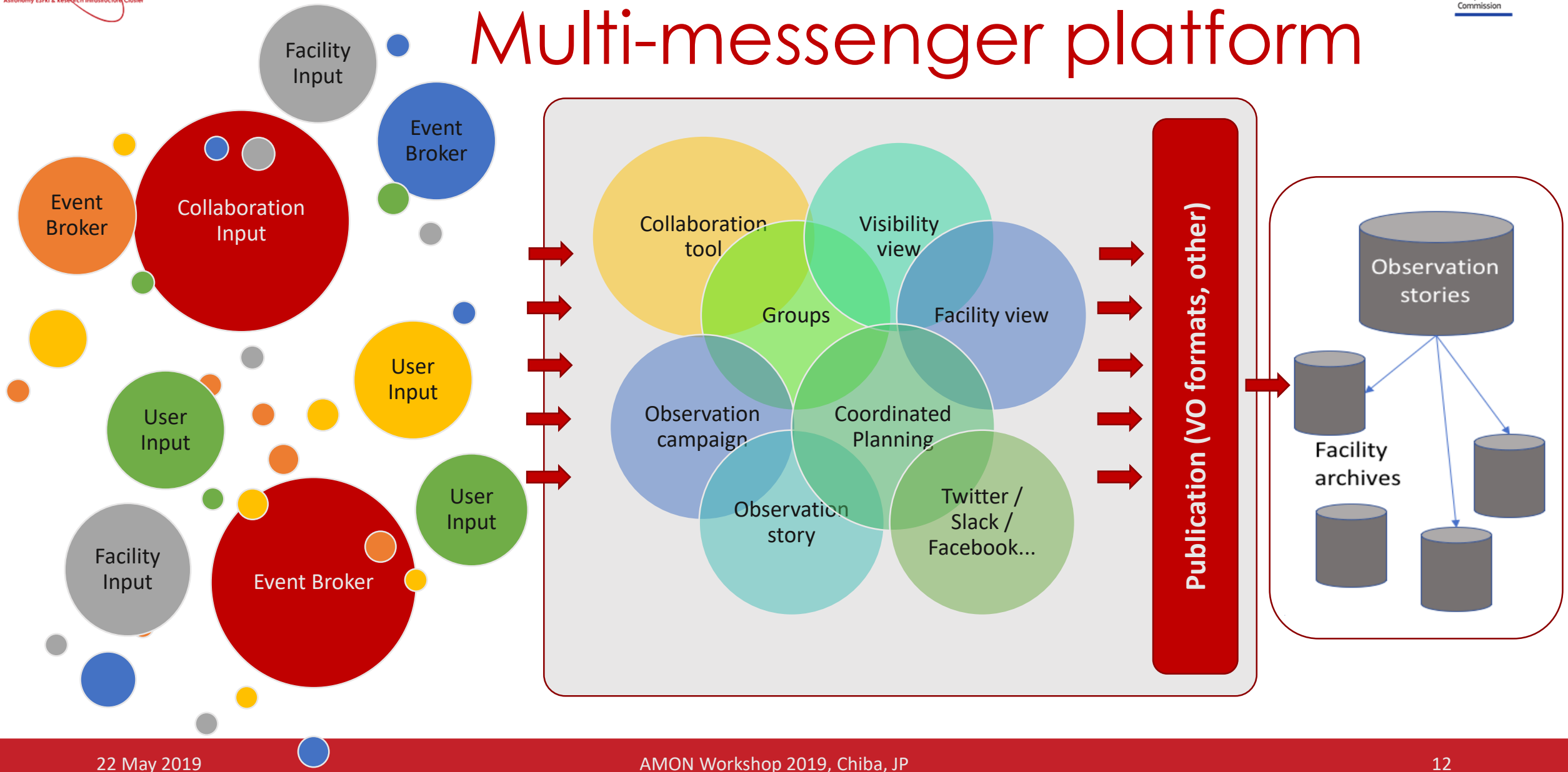
Multi-messenger platform

- Current state of the field:
  - Many components focusing on various parts of the overall process, but no coordinated plan.
  - Can they be joined together to make an end-to-end process?



- Aim of the MMP project:
  - Show where interfaces are required, and gaps that must be filled
  - Complement and add to existing tools – **not** compete!

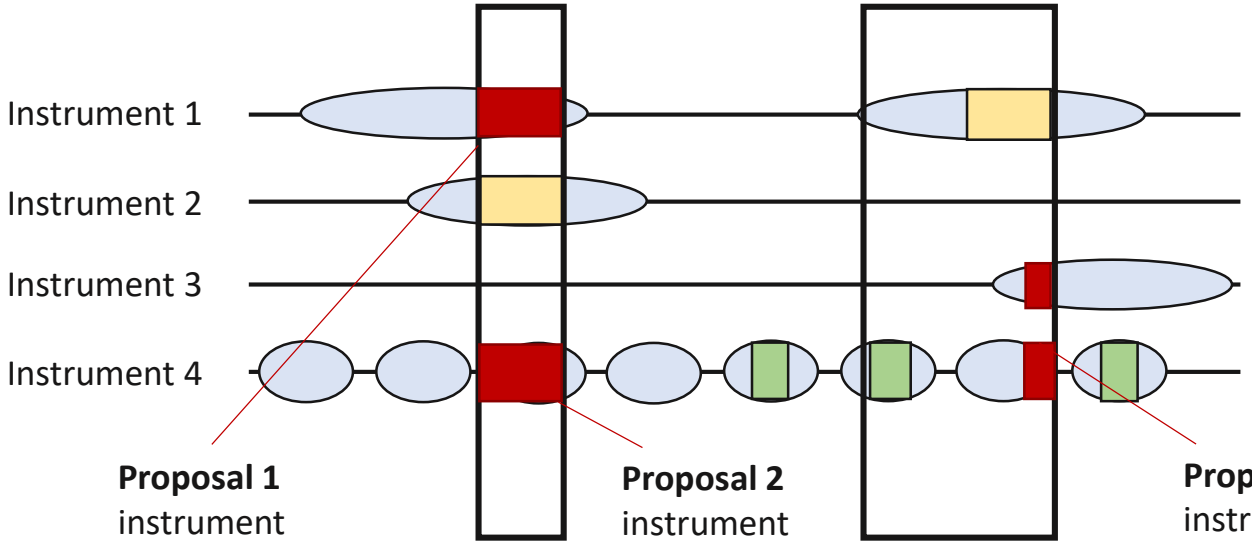
Multi-messenger platform



Pilot Scheduling Visualizer

Query object visibility services to find out what location is visible for each instrument

Query observation locator services to find out which instruments are planning to observe that location in the future



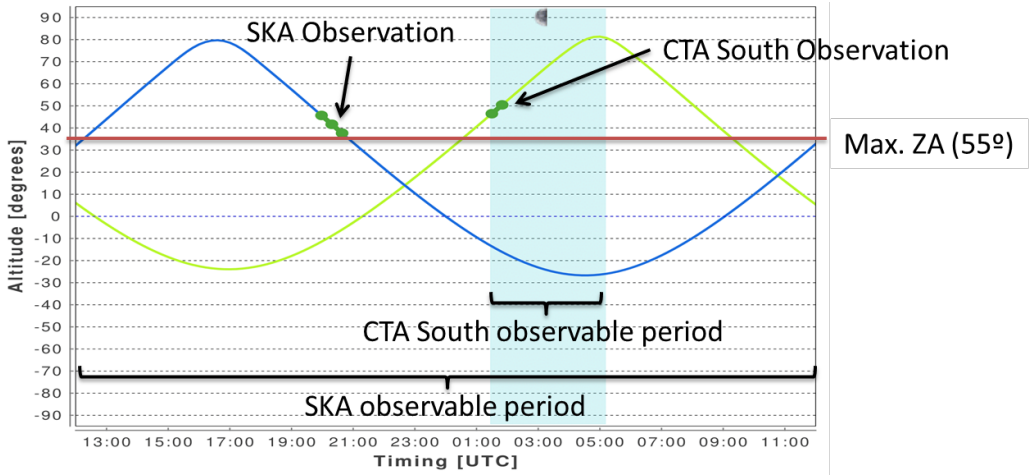
The system plans and tracks new observation proposals for the target objects

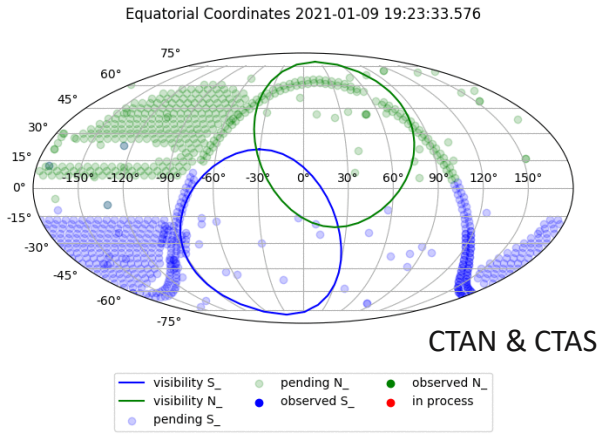
Combine historical information about the location with visibility and future plans for observations

Coordinate the best times to request new follow-up observations

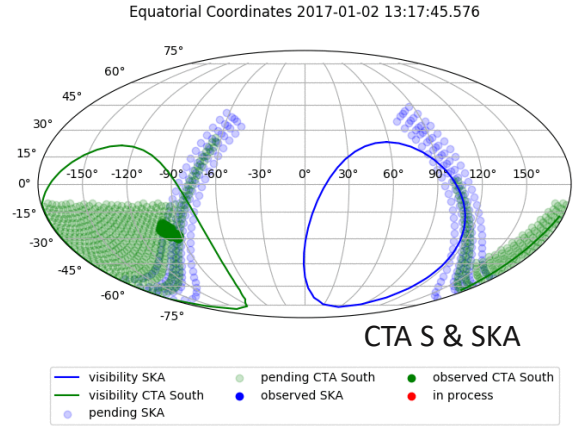
Multi-observatory scheduling

- Science cases
  - **Transient events** (GRBs, GWs, etc.)
  - **Surveys**
  - **Proposals from guest observers**
- Problem conditions
  - Operation constraints from each facility
  - Observational strategies from science cases
  - Common optimization objectives are considered (duty cycle, priority objects, etc.)
  - **Additional Objective for MM science** ➔ Maximize coincident observations or minimize the distance between them





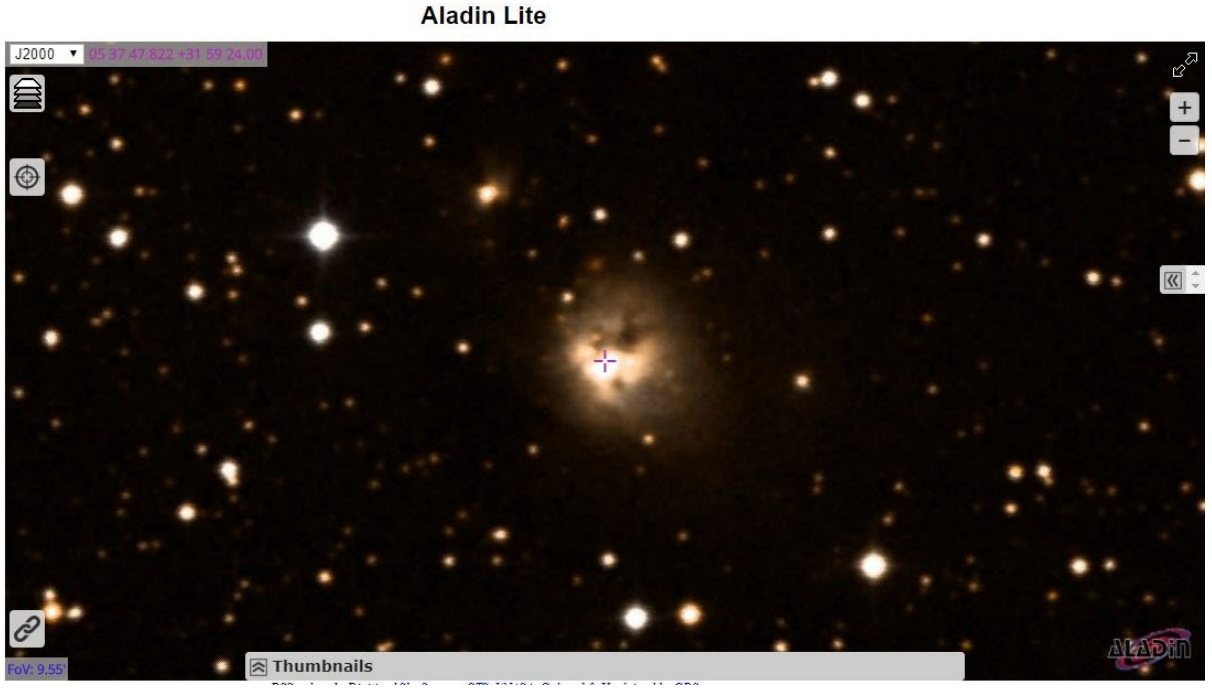
CTAN & CTAS



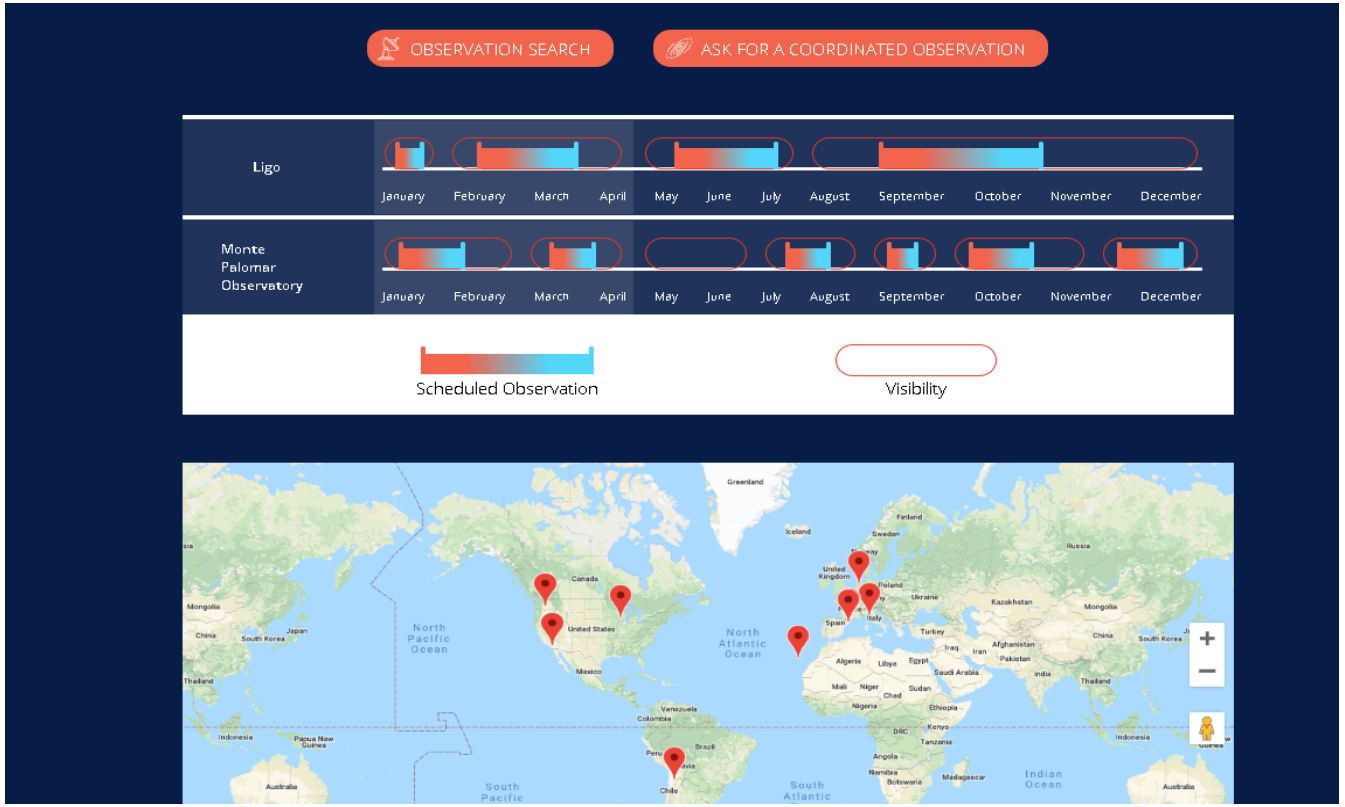
CTA S & SKA

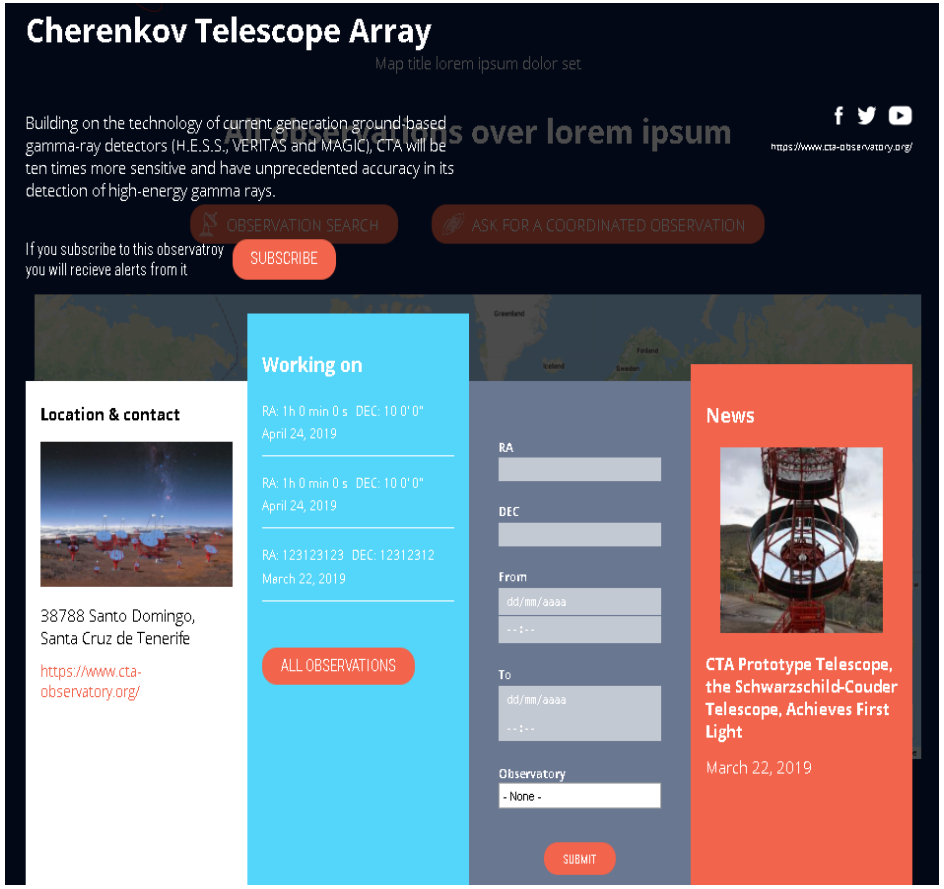
MMP, a VO app

- VO compliant formats for:
  - Data sharing (objects visibility, observatory plans) ➔ ESA protocols on visibility and object location (ObsLocTAP, ObjVisSAP)
  - Data gathering (event brokers, transient events) ➔ VOEvents
- Visualization: Aladin lite
- Coordinated planning format with VO-compliant output



Prototype


OBSERVATION SEARCH
ASK FOR A COORDINATED OBSERVATION
Ligo
Monte Palomar Observatory
January
February
March
April
May
June
July
August
September
October
November
December
Scheduled Observation
Visibility


Cherenkov Telescope Array
Map title lorem ipsum dolor set
Building on the technology of current generation ground-based gamma-ray detectors (H.E.S.S., VERITAS and MAGIC), CTA will be ten times more sensitive and have unprecedented accuracy in its detection of high-energy gamma rays.
All observations over lorem ipsum
https://www.cta-observatory.org/
OBSERVATION SEARCH
ASK FOR A COORDINATED OBSERVATION
If you subscribe to this observatroy you will recieve alerts from it
SUBSCRIBE
Location & contact
38788 Santo Domingo, Santa Cruz de Tenerife
https://www.cta-observatory.org/
Working on
RA: 1h 0 min 0 s DEC: 10 0' 0"
April 24, 2019
RA: 1h 0 min 0 s DEC: 10 0' 0"
April 24, 2019
RA: 123123123 DEC: 12312312
March 22, 2019
ALL OBSERVATIONS
RA
DEC
From
dd/mm/aaaa
To
dd/mm/aaaa
Observatory
- None -
SUBMIT
News
CTA Prototype Telescope, the Schwarzschild-Couder Telescope, Achieves First Light
March 22, 2019

MMp Conclusions

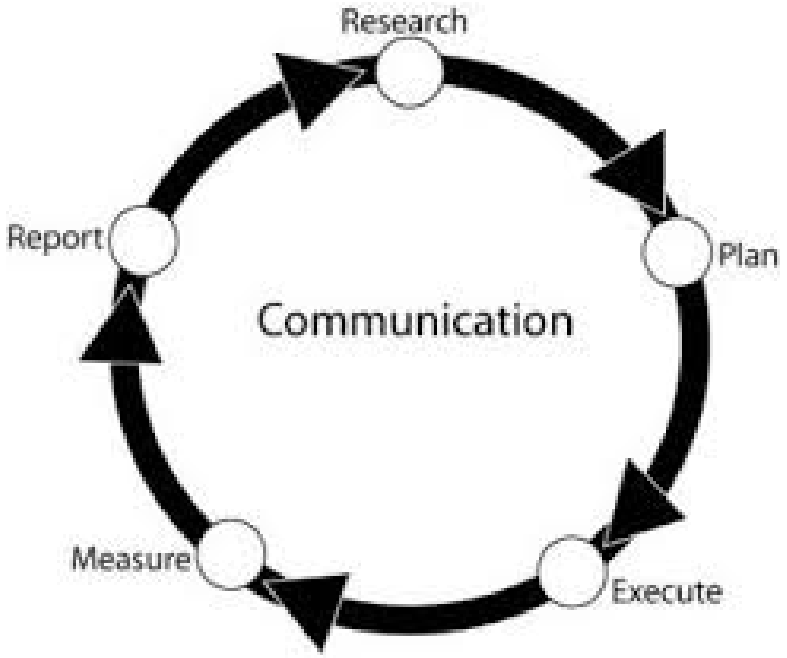
- Multi-Messenger observations give the full context of a source or a phenomenon and new science can be learned.
- The transient flood is coming & the joint observation of steady sources is more feasible.
- Preparations are well underway but are not coordinated.
- A joined-up view of the efforts has been missing - the platform project group was formed to fill the gap.
- **The MMPlatform brings together tools for use in performing collaborative, multi-messenger observations, from target selection, through follow-up observing, to data archive.**
- The ASTERICS community and other stakeholders form an environment favourable to this enterprise.
- The platform will be useful to individual astronomers and facilities alike.
- Next steps: identify opportunities and collaborations to continue the work with the final aim to develop a functioning platform.

Way to continue

- Use prototype
- Review results
- Expand prototype

- Find funding for more
- Policy Forum

- Implement more tools
- Attract users



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