

SPACE RESEARCH SERVICES

NEANIAS Open Event

Sant Cugat del Vallès, 22-23 Sep. 2022

Eva Sciacca

(INAF-Osservatorio Astrofisico di Catania)

on behalf of the
NEANIAS collaboration
(WP4 SPACE)

Overview and Goals

Co-designing, implementation and delivery of cloud-based innovative services
for
SPACE SCIENCES
(Astrophysics & Planetary Science)

USER REQUIREMENT
collection



SPACE-VIS
VISUALIZATION
and
FAIR DATA MANAGEMENT



SPACE-MOS
MAP MAKING
and
MOSAICKING



SPACE-ML
STRUCTURE DETECTION
with
MACHINE LEARNING

TECHNICAL VALIDATION
assessment



ONBOARDING THE EUROPEAN SPACE SCIENCES TO THE **EOSC**



Listening to the community

147 organised MEETINGS

9 successful DELIVERABLES

USER REQUIREMENT COLLECTION

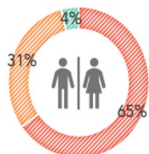
Targeted survey involving experts from European Institutions



329 participants (anonymous)

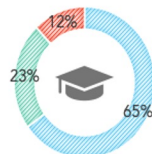
GENDER

Male Female Other



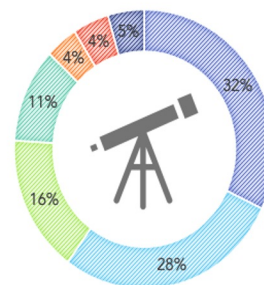
YEARS OF EXPERTISE

> 10 years from 3 to 10 years < 3 years



FIELD OF RESEARCH

Galaxies / Cosmology Stellar physics, populations
 High energies Tech / Instrumentation
 Exoplanets Solar System
 Other



TECHNICAL VALIDATION

Internal technical assessment and independent validation sessions by external experts

13 specific REQUIREMENTS

+500 contacted RESEARCHERS





SPACE · VIS



F.A.I.R
data management



Planetary & Astrophysics
data visualization



Innovative approach
exploiting VR



SPACE · MOS



Workflow for efficient map
making



Merging of images for
Mosacking of maps



Generation of large-scale
multidimensional maps



SPACE · ML



Compact source detection
in all-sky surveys

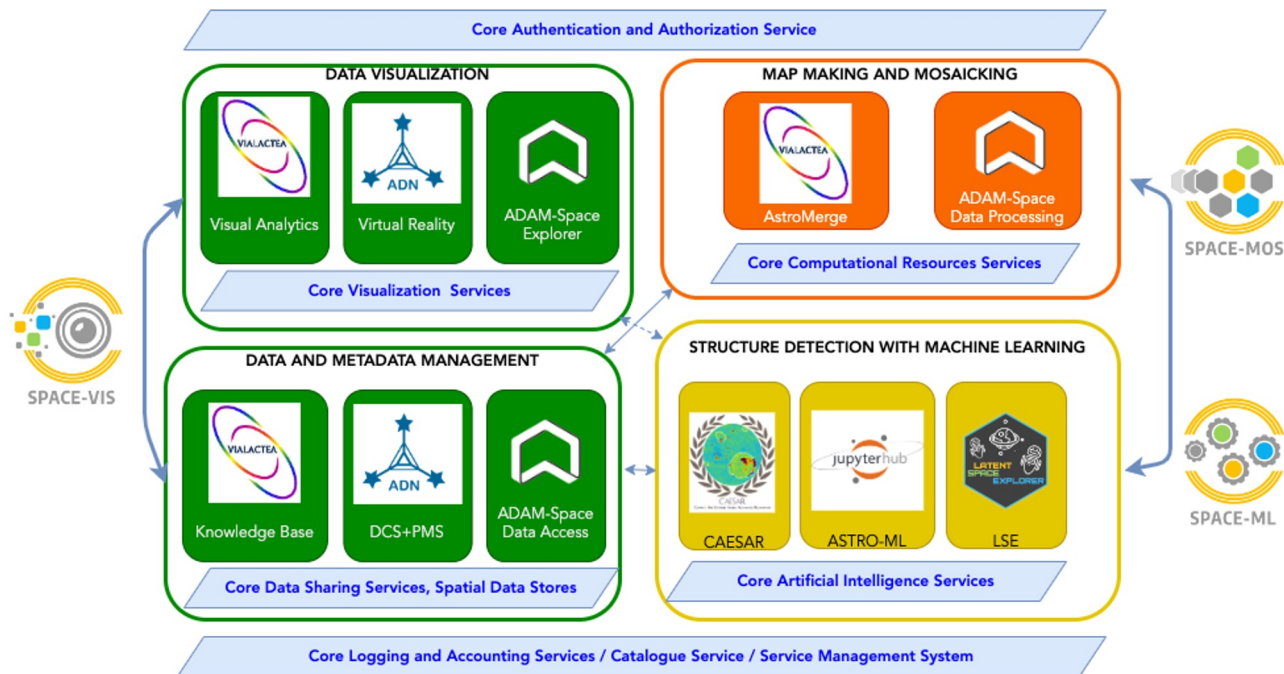


Extended structure
detection and classification



Application on
SKA precursor data

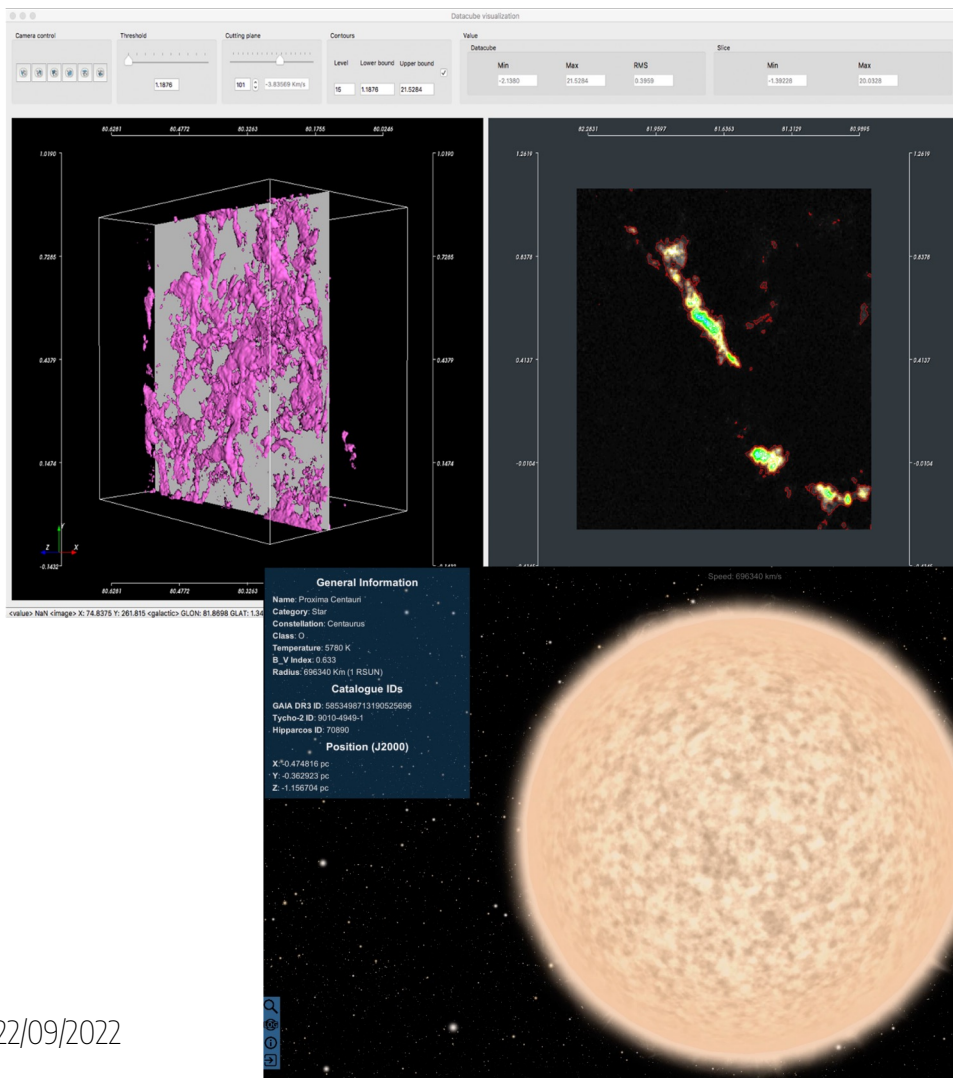
The NEANIAS SPACE Ecosystem



8 space SERVICES
TRL 8

32 core service INTEGRATIONS
AAI, Log, Acc, Mon, DataShare, AI, Vis

400+ validating END-USERS
feedback/bugs

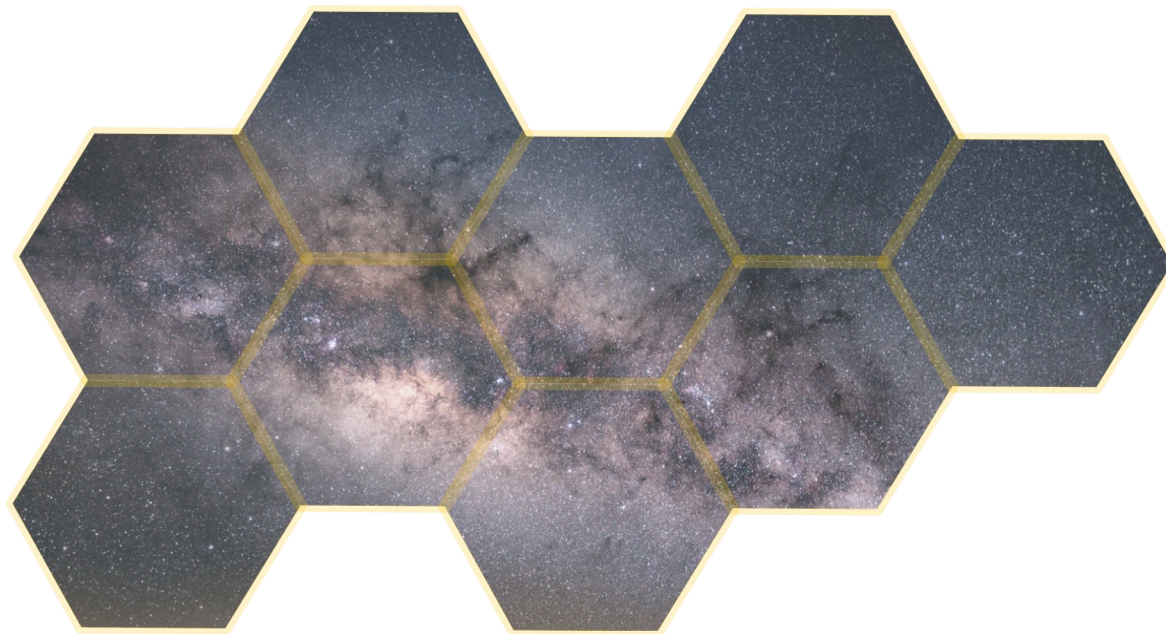


VIALACTEA

- Visual analytics tool
- Exploitation of Galactic Plane surveys
- Handling of 2D and 3D data
- Multidimensional datasets
- Filament & source catalogues
- Data access IVOA compliant

ASTRA DATA NAVIGATOR

- VR 3D visualization of stellar catalogues (e.g. Gaia)



MONTAGE

- Widely adopted map making toolkit
- Integration into ViaLactea
- Optimization to end-user needs



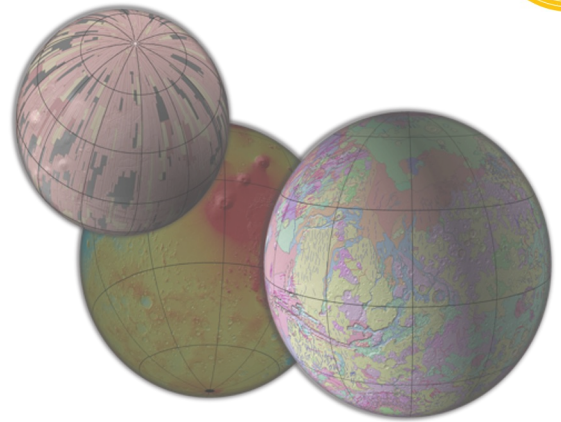
CUSTOMIZED CUTOUT SERVICE

- Cutout extraction from multiple surveys
- Regridding and convolution
- Conversion to same intensity units
- Final images directly comparable



CREATION OF IMAGE MOSAICS
HOMOGENEOUS & MULTIWAVELENGTH
 LARGE SCALE MOSAICS

✓ **PLANETARY DATA ACCESS AND ANALYTICS**
 MORE THAN **40 TB** OF PLANETARY DATA

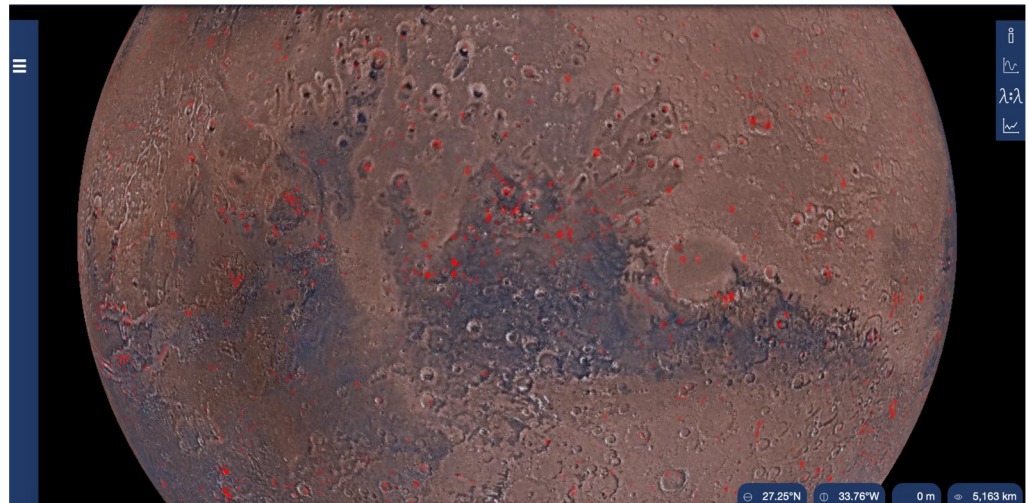


PLANET SERVER

- Calibrated data of Solar System bodies
- Hyper-spectral data cube access
 (OGC WCPS / VO) via REST API

ADAM - Space

- Earth global environmental data
- Access to time series, forecasting
 and long-term predictions



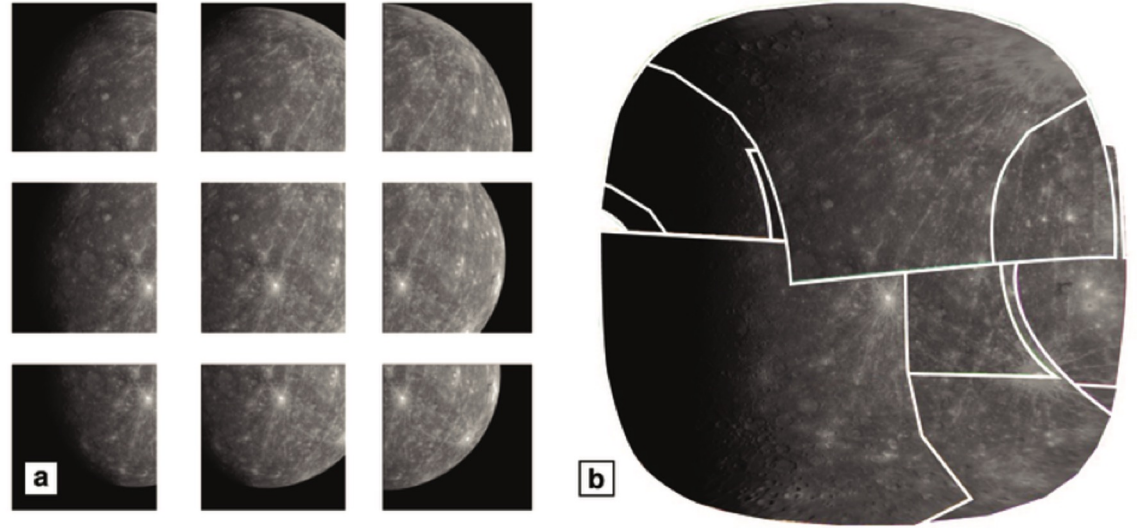


USGS-ISIS3

- Planetary data analysis
- Advanced mosaicking capabilities

NASA-ASP

- Digital Elevation Model Cartography
- 3D modelling from stereo imaging
(from satellite/rover missions)

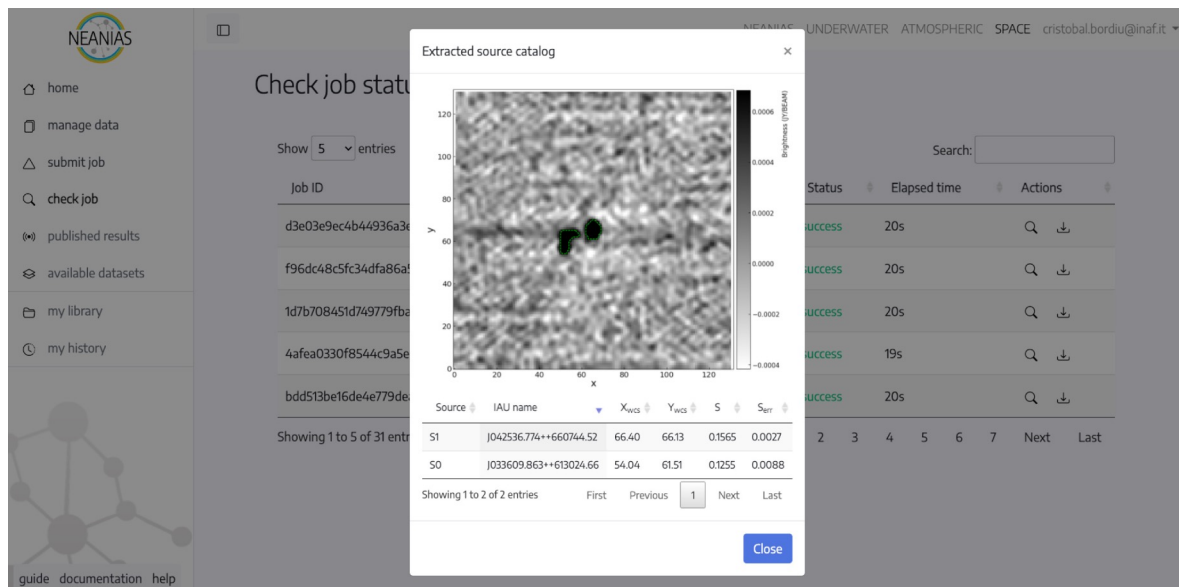


MOSAICKING AND STEREOGRAMMETRY
CREATION OF **CARTOGRAPHIC** MAPS OF **SOLAR SYSTEM** BODIES



CAESAR

Source extraction in radio maps through the CAESAR UI

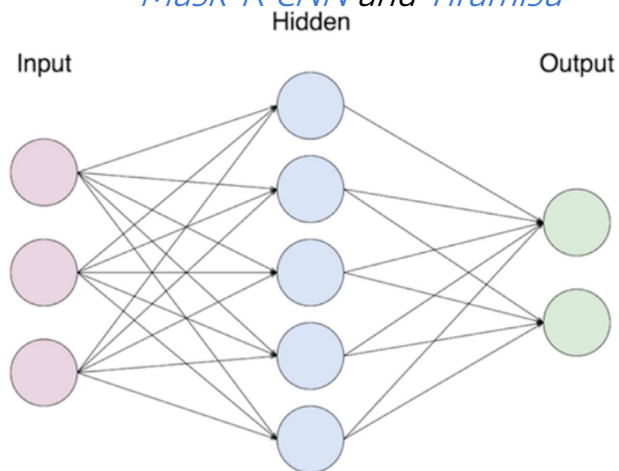


- Unsupervised source finding from astronomical maps
- Compact and extended sources
- Source characterization & post-processing
- Multithread & parallel processing for large images
- Ported to Cloud infrastructures



DNN architecture based on different well-tested models, like

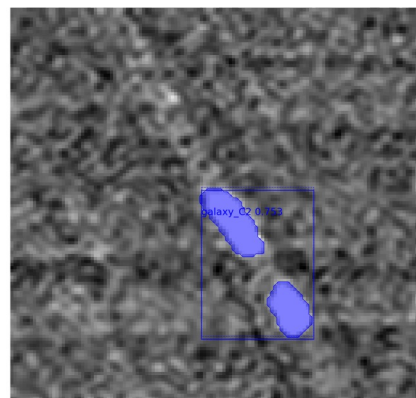
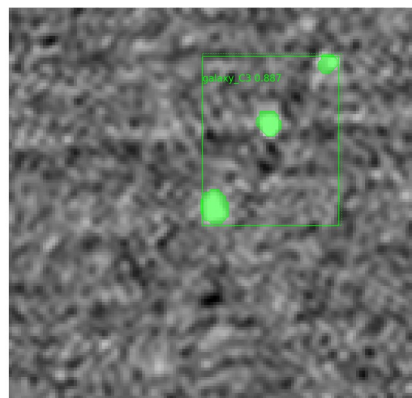
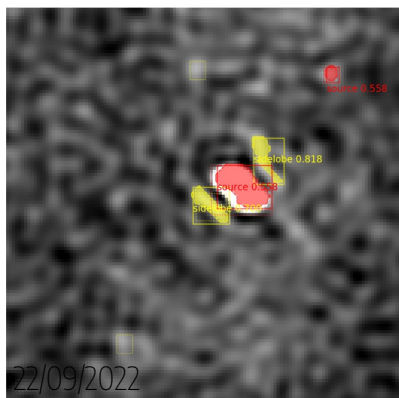
Mask-RCNN and Tiramisu



ASTRO ML



- Source classification with DNN
- Based on well-known object detection networks, trained on astro data
- Artefacts, Sidelobe & bad detection rejection
- Identification of not-connected source islands associated to same physical object (e.g. galaxies)

Sample sidelobe & galaxy detection





Experiments list

Name	Image size	Channels num.	Preview	Architecture	Latent dim.	Delete
snr-grid-search-img128-ld32-2	128 x 128	3	$[r:0, g:1, b:2]$	cae	32	
snr-grid-search-img128-ld64-2	128 x 128	3	$[r:0, g:1, b:2]$	cae	64	

Visualization

Reduction
spectral embedding — 2C
affinity:nearest_neighbors
2022-02-10 13:31:51

Cluster
gaussian mixture
n components=5 | init pa...
2022-02-10 13:30:43

Label

Reduction

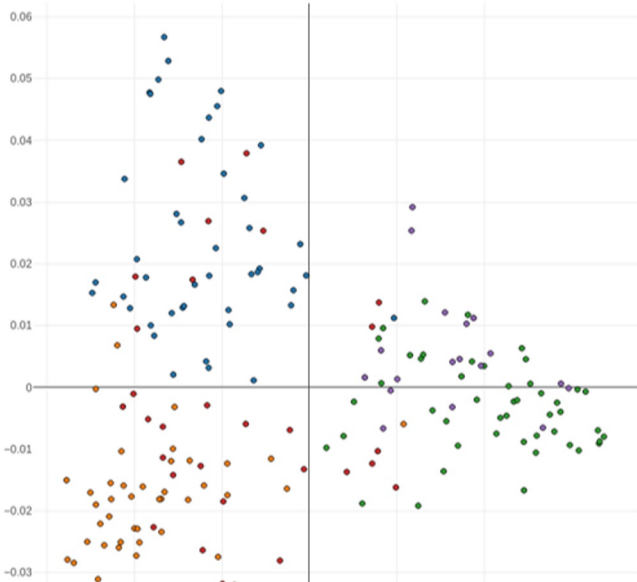
Algorithm
pca

Components
2

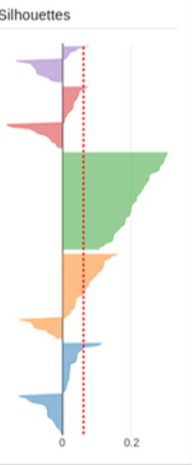
COMPUTE

Cluster

Algorithm
dbscan




Silhouettes



Clusters scores

Calinski Harabasz: 12.88
Davies Bouldin: 3.04

Elements per clusters



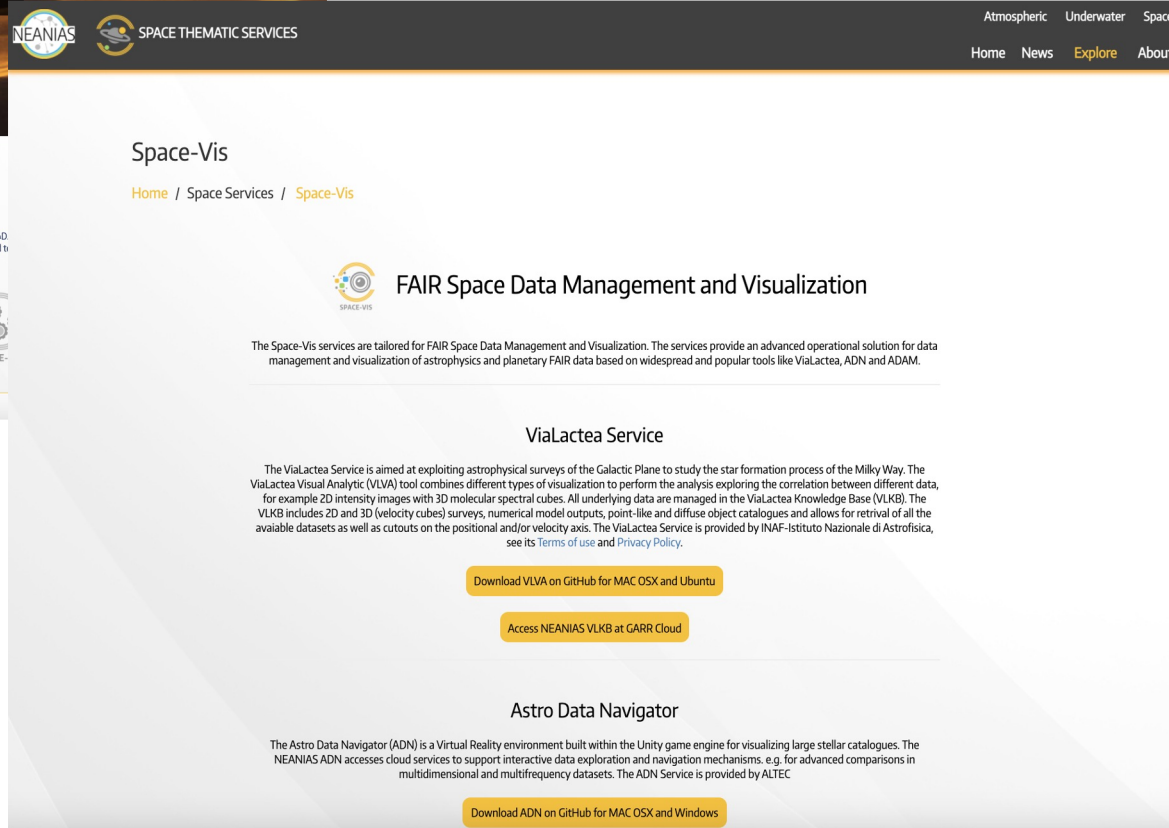
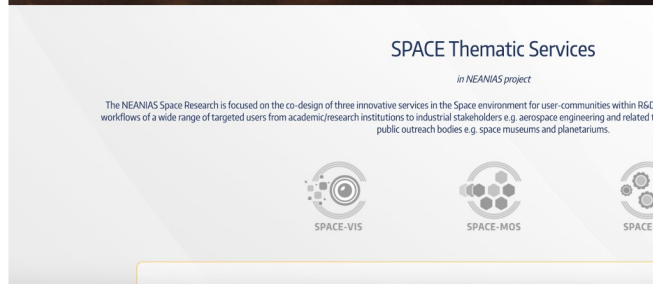
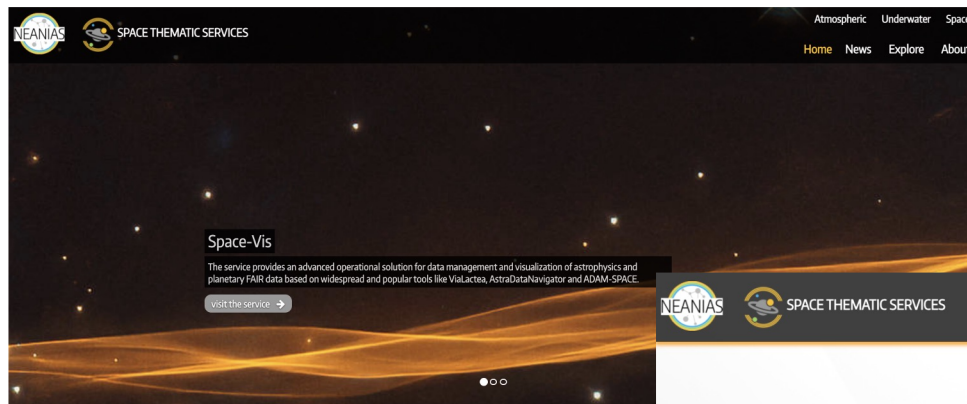
LSE

- Analyse image datasets with unsupervised ML
- Extract a compact representation from data.
- Visualize data interactively.
- Perform clustering to detect hidden common features and support novel classification schemes.



Space Services accessibility

- NEANIAS service catalogue
- EOSC service catalogue
- OpenAIRE community portal



dedicated
thematic portal
for SPACE services
<https://thematic.neanias.eu/SPACE/>

Space Synergies and dissemination

Involved in
INTERNATIONAL PROJECTS
&
INITIATIVES

Presented in
INTERNATIONAL CONFERENCES
&
WORKSHOPS

SPIE. ASTRONOMICAL
TELESCOPES +
INSTRUMENTATION



OpenPlanetary



ASI
Agenzia Spaziale Italiana



eur PLANET 2024
Research Infrastructure

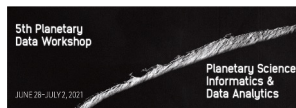


esa
European Space Agency



ADASS XXX
November 8-12 2020

computing
conference 2021



10 scientific
PUBLICATIONS
{proceedings & journals}

30 dissemination
ARTICLES
{on the website}

+5k reached
PEOPLE
{students & researchers}

Hack the SCIENCE 2022

<https://sites.google.com/unimib.it/hack-the-science-2022>



HACK THE STELLAR POPULATIONS

Keywords: Milky Way, stellar populations, clusters, visual analytic, infrared, source finding

Unravel the mysteries of our galaxy! Looking at a region of the Milky Way, your challenge will be to identify all the stellar sources that are grouped together into "stellar clusters" (i.e. group of stars physically bound). NEANIAS Space Services will be at your disposal to face this challenge: the *ViaLactea* service to retrieve the sky maps, the *CAESAR* service to identify the sources and the *Astro Data Navigator* to explore the stellar catalogues.

Be our space explorer!



Globular clusters as seen by the ESO's VISTA instrument (Credit: ESO)

- Remote
- Starting date 5 May 2022 → 25 June 2022
- 28 July 2022 prize ceremony
- 3 challenges
 - HACK THE STELLAR POPULATIONS
 - HACK THE PLANETS
 - HACK THE SERVICES-WEBSITE UX

Teams

- 3 participants per team
- Mentors to guide

Prizes

- e-Voucher to each member of the winning team



Hack the Science 2022

Project: **Hack the Planets**

Work group: **OASBO**



ML4ASTRO International Conference



- In person @ Catania + remote
- 3 days event
- 7 invited speakers
- 33 Oral + 33 Poster presentations

Overview

Timetable

Contribution List

Registration

Registration Fees

Call for Abstracts

Participant List

Important Dates

Invited Speakers

SOC & LOC

Organizers & Sponsors

COVID-19

ML4Astro SOC

Invited Speakers

Kai Polsterer

Heidelberg Institute for Theoretical Studies (Germany)

► Review of supervised and unsupervised learning techniques for astronomy



Kai L. Polsterer received his diploma in computer science at the Technical University of Dortmund, before he switched to physics and astronomy at the University of Bochum where he received his PhD in Physics and Astronomy in 2011. During that time he was responsible for realizing the control software for one of the main instruments (LUCI) at the world's largest optical telescope, the Large Binocular Telescope. Besides working on control software, he started developing and applying machine learning techniques to analyse complex and large data sets. He is involved in the efforts of the International Virtual Observatory Alliance, ensuring uniform access to astronomical data and the IEEE task-force on mining complex astronomical data. Currently he is head of the Astroinformatics group at the Heidelberg Institute for Theoretical Studies.

Supported by NEANIAS and other projects:

- MOSAICO
- CIRASA
- INAF DS

SPACE Services Demo Session (tomorrow)

- 9:30 → [ADN VR](#), S. Velev (UoP)
- 9:40 → [ADAM SPACE](#), S. Mantovani (MEE0)
- 9:50 → [ViaLactea](#), G. Tudiaco (INAF)
- 10:00 → [CAESAR](#) and [AstroML](#), C. Bordiu (INAF) and J. Welsh (UoP)
- 10:10 → [Latent Space Explorer](#), G. Vizzari (UNIMIB)



Interact with the service providers and **try out** the tools!

NEANIAS SPACE thematic page
<https://thematic.neanias.eu/SPACE/>

NEANIAS SPACE services catalogue
<https://catalogue.neanias.eu/search;thematicArea=Space>

NEANIAS SPACE Technical Documentation
<https://docs.neanias.eu/en/latest/#space-services>

NEANIAS SPACE OpenAIRE Community portal
<https://neanias-space.openaire.eu/>

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