



A (preliminary) catalog of new blazar candidates by high school students

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Outline

- The Italian PCTO program
- Open Universe
- The Fermi unidentified catalog
- A new catalog
- Outlook



*Ministero dell'Istruzione
dell'Università e Ricerca*

The PCTO program

- Project of the Italian Ministry of Instruction, University and Research
 - Paths for Transveral skills and for orienting
- All high school students shall complement the learning scheme throught social- and work-related skills
- Consolidated tradition of students exchange at University of Padova

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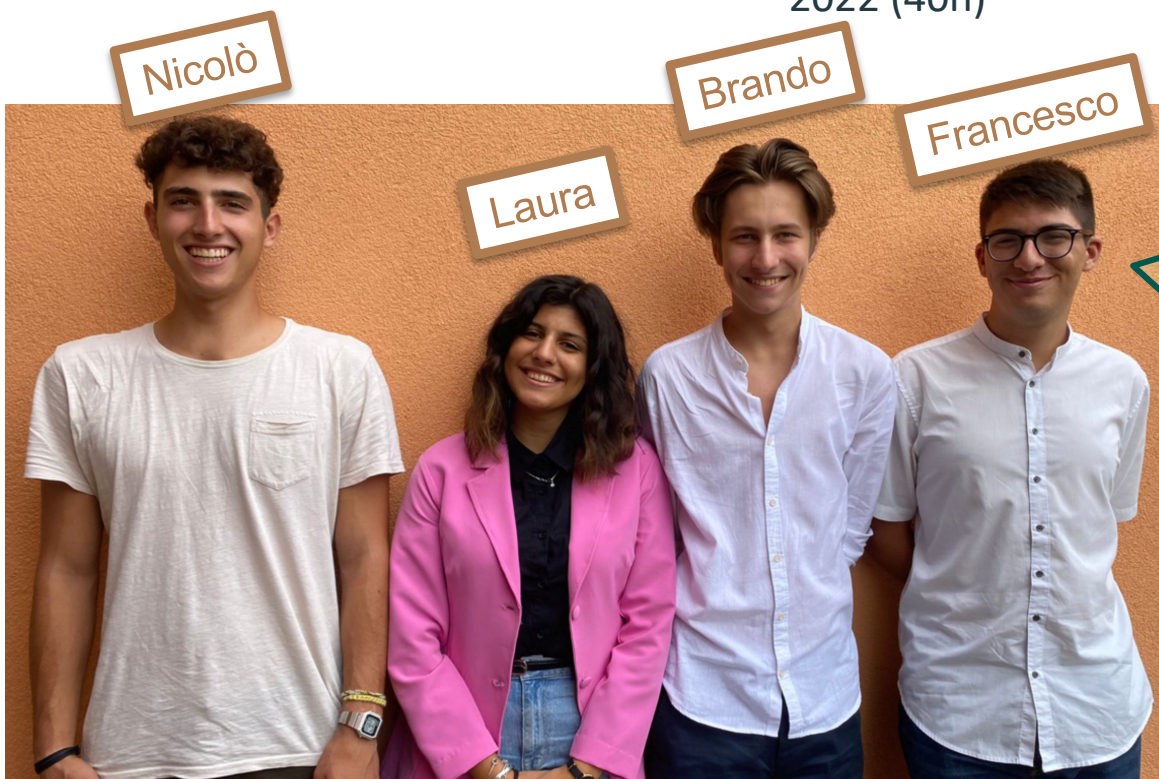


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PCTO from LSS Ugo Morin

4 high school students from the 4th year of Liceo Scientifico Statale Ugo Morin from October 2021 to April 2022 (40h)



“Our experience with UniPD is something unusual, alternative to the classical things that students do for PCTO, such as serving as an assistant in some every day jobs, which is nothing related with specific school subjects.”



What is OPEN UNIVERSE?

The birth of OU



UNITED NATIONS
Office for Outer Space Affairs

- Initially proposed by Italy (the Italian Space Agency within the framework of **COPUOS**, the **UN** Committee for the Peaceful Use of Space.
- Now coordinated by **UNOOSA (United Nations Office for Outer Space Affairs)** and sponsored by Brasil in collaboration with institutions in some countries, such as Italy, Armenia, Argentina and international organizations.



Paolo Giommi (former ASI
now NYUAD)

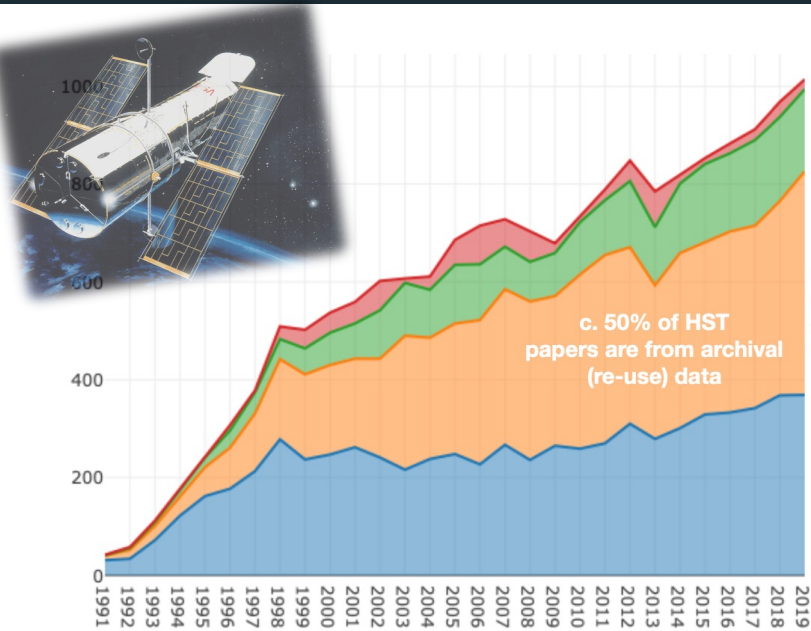
The founding principle is that ***space science data become more and more accessible [...] and usable by the wider community possible, from professional scientists, to academic circles, to "Citizen scientist" [...] realizing a principle of transparency.***

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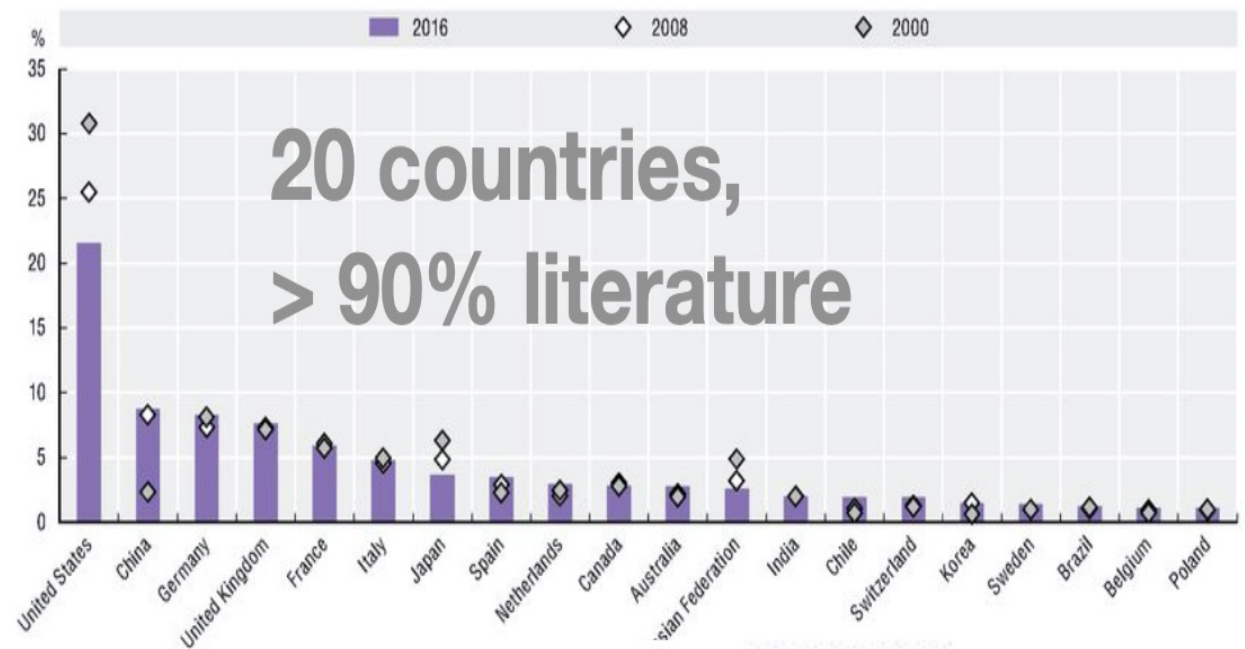
#1 Data use for science



e.g. Hubble Space Telescope

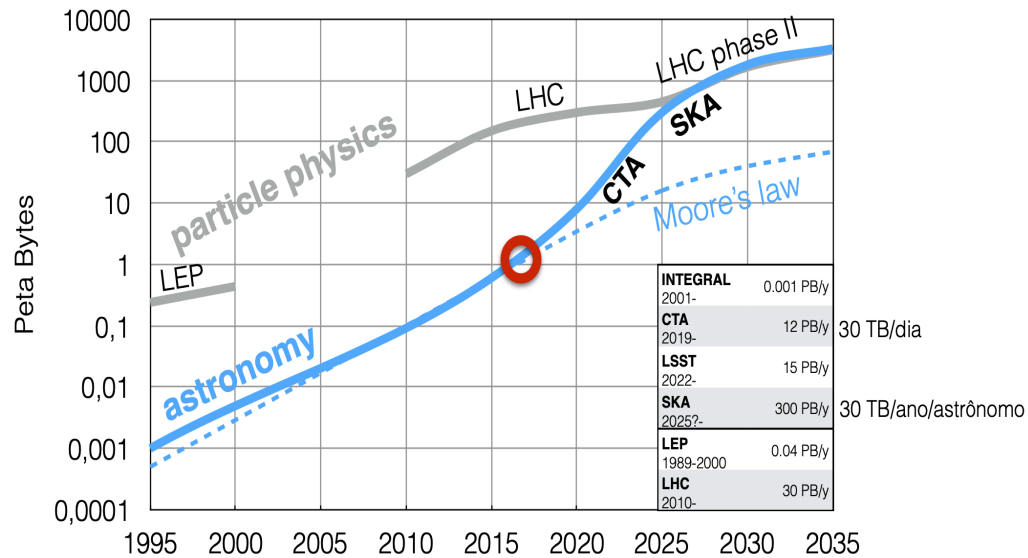
Figure 1.11. Top producers in space literature, per country

Share of total space-related publications



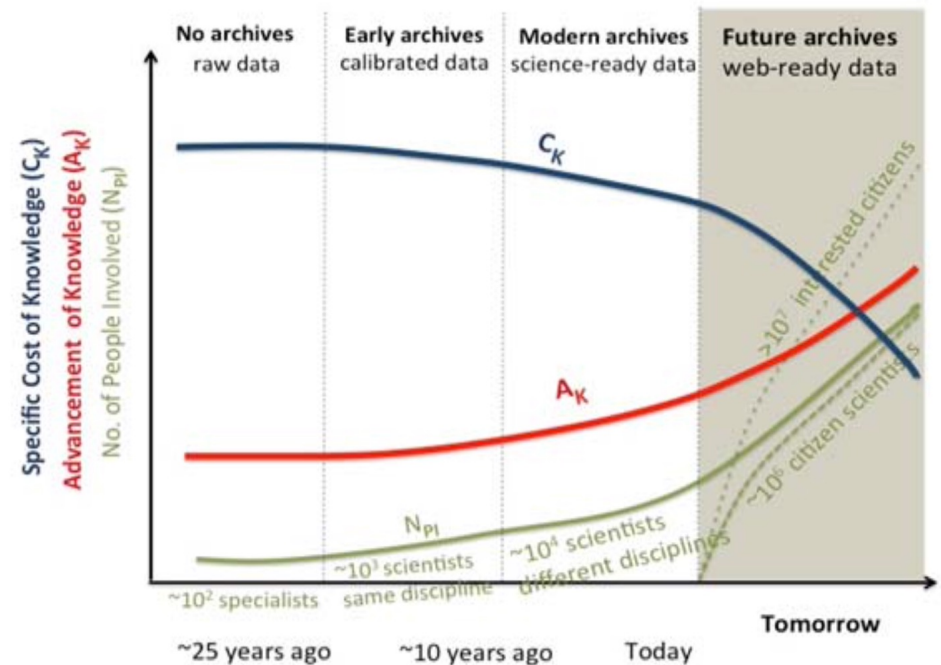
South Africa	14	US	529
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#2 Data amount



I. exponential growth in the availability of data produced by astronomy missions and observatories

II. The specific cost of knowledge in the digital era



Veja A/AC./105/2016/CRP.6



Why cooperation with United Nations



INCREASE TRANSPARENCY of already accessible resources: including promoting FAIR (Findable, Accessible, Interoperable, Reusable) guiding principles, promoting adoption of widely-used standards, processing from raw data to web-ready products, interfacing and facilitating cooperation between data providers and data centres and archives...



RESURFACE DATA and other hidden or otherwise hardly accessible resources: by identifying inaccessible data and working with national and regional entities to solve the challenges to make them public, as well as bringing new main players and actors in the international space science arena into the Initiative and in contact with other public data access solutions.



BROADEN THE USER-BASE of astronomy and space science data: to include as well the rapidly growing community of citizen scientists, by providing the necessary tools to use astronomy and space science data for a range of target groups, including educators and students in universities, schools, planetariums or any amateur scientists or other potential end-user

#3 Gosh how we love it!





How does OU work?

Generalities and a Disclaimer

DISCLAIMER

- OU is a set of evolving tools and ideas
- No central government at the moment, only passionate people
- If you like it, use it or join it!

- Set of web-based tools to have explore the sky, have fun and learn, and possibly do science
- Access to 70+ catalogues, or add you own catalog
- Tools (and problems) provided by experts, plans for supervision

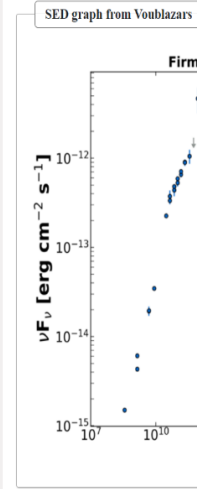




Firmamento

A web based tool to find and work with blazars. [Short description]

SED Error Map Aladin More Documentation



What's to see at RA= DEC=?

- 1/ Take phone from pocket
- 2/ Go to firmamentoo.web.app
- 3/ Type " and push 'run'
- 4/ Enjoy

Mobile App

Download app from the google and apple store.

SED Error Map Aladin More Documentation

A tool

Learn more

Try it out

Docker

Github

Download

Download

laboratories that
massive black
ts of particles
e to the speed of



Sources with precise position

Fermi unidentified sources

eRosita-EDR radio-matching sources

IceCube neutrino tracks

Object name eg. 3c279, or: 192.1549 -5.89653

MRK421 166.1138 38.20883 SSDC 1

Server Status: ● Online

Total Active Jobs: 0

SED

Error Map

Aladin

More

Documentation



Connected - VOUs_Blazars is running. Please wait

Multi - frequency data from over 70 catalogs and databases world-wide is retrieved using VO services. This usually takes between 30 seconds and 3 minutes depending on response time from remote servers.

SED

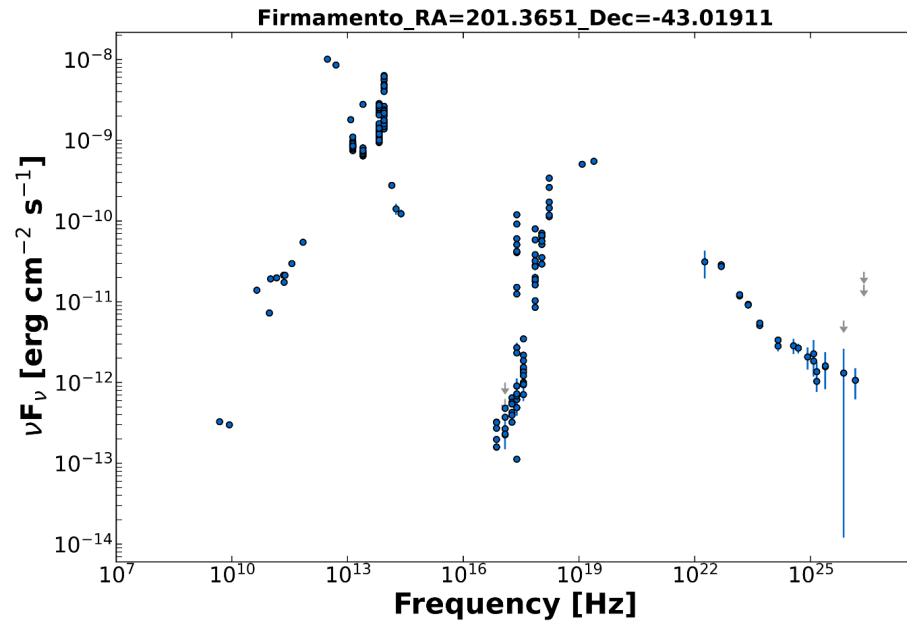
Error Map

Aladin

More

Documentation

SED graph from Voublazars



Results from BLAST [?](#)

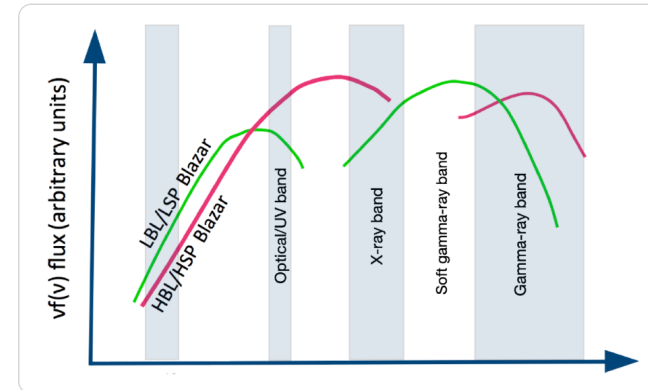
$v_{\text{peak}}: 12.8 \pm 0.8$ (1 sigma)

SED data (double-click to preview:)

ASCII CSV SSDC SED input file

Complete a survey

1. Does the graph alongside have a general trend as any of the curves below (LBL/LSP Blazar, HBL/HSP Blazar)?



Select one:

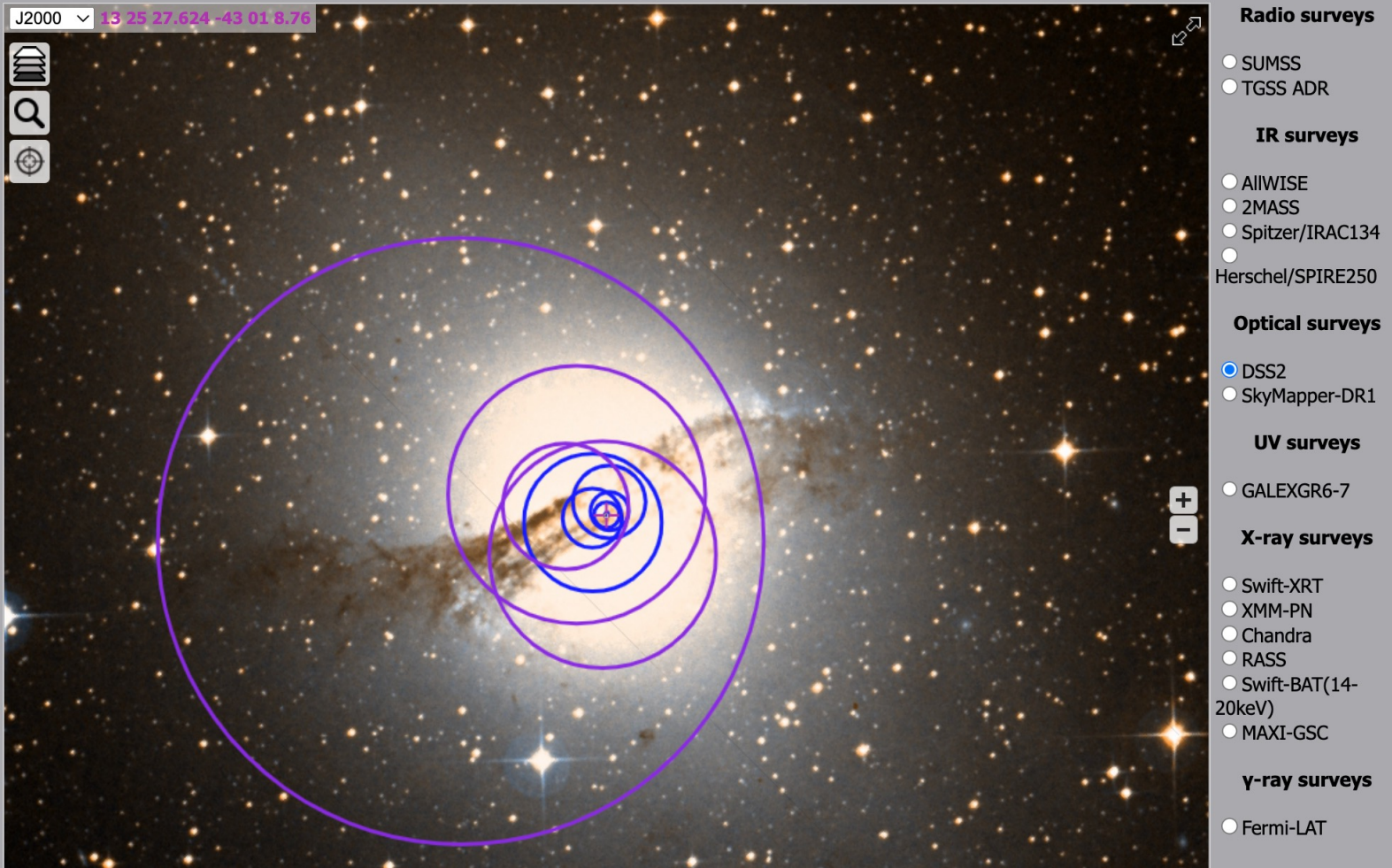
Yes

None

Can't tell

Please complete the other question below.

SED error circles. Generated by VOU-Blazars for *firmamento* Based on "Aladin Lite" developed at CDS, Strasbourg Observatory, France



SED

Error Map

Aladin

More

Documentation

Aladin Lite

Target:

Surveys:

- GLIMPSE360
- Fermi
- SWIFT_BAT_FLUX
- XMM/PN
- Chandra
- GALEXGR6/AIS
- GALEXGR6_7
- DSS2/blue
- DSS2

J2000 AIT

SIMBAD
 Gaia EDR3
 2MASS

Thumbnails

Fov: 11.04'

CXC HiPS



And more...

SED

Error Map

Aladin

More

1. ESA sky [click](#)
2. ESO products [click](#)
3. ESO archives [click](#)
4. Alma archive [click](#)
5. SDSS-DR17 [click](#)
6. SSDC SED [click](#)
7. NED [click](#)

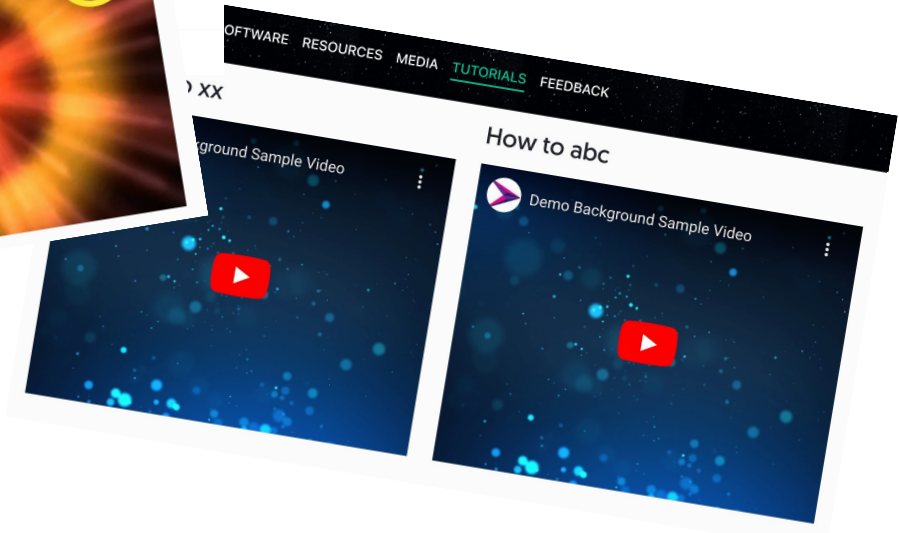
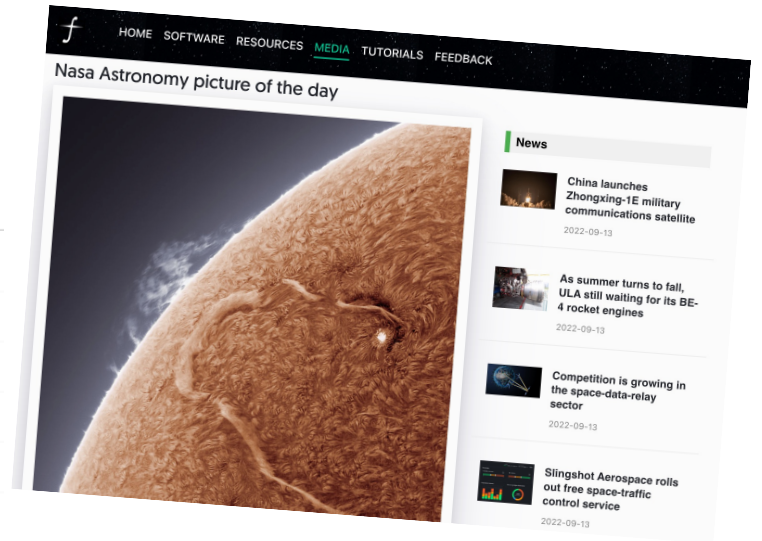
Learn more about blazars




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What did the students do in
the PCTO?



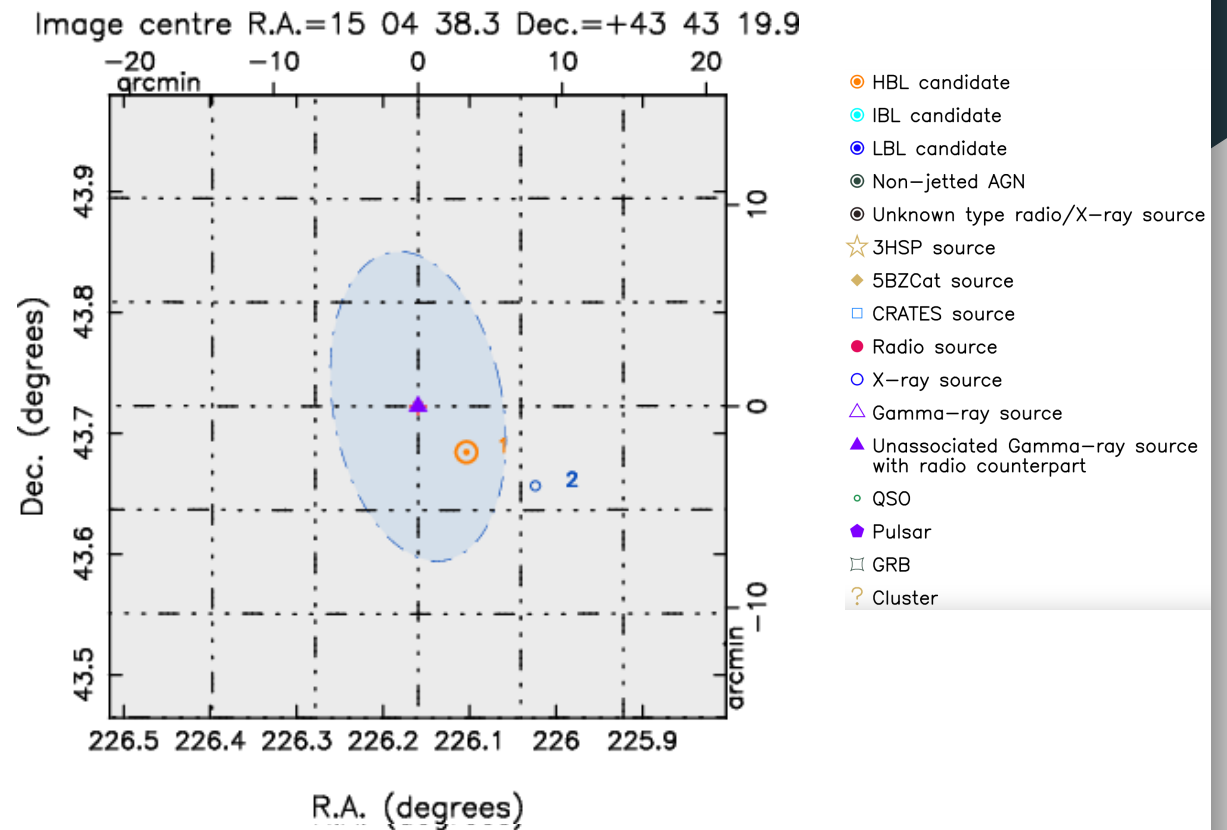
The case of unidentified Fermi-LAT targets



- Due to angular resolution and sensitivity (and maybe some physical mechanisms) Fermi-LAT accumulated in 10 years more thousands of unidentified/unassociated targets
- Fermi-LAT has automatic association tools that can loose targets specially without X-ray counterparts.
- Are there blazars in this list? Very likely?
- We started with a list of 198 4FGL candidates (name, RA/Dec, error circles x,y) and gave them to the students

Step 1/ Check for Counterparts

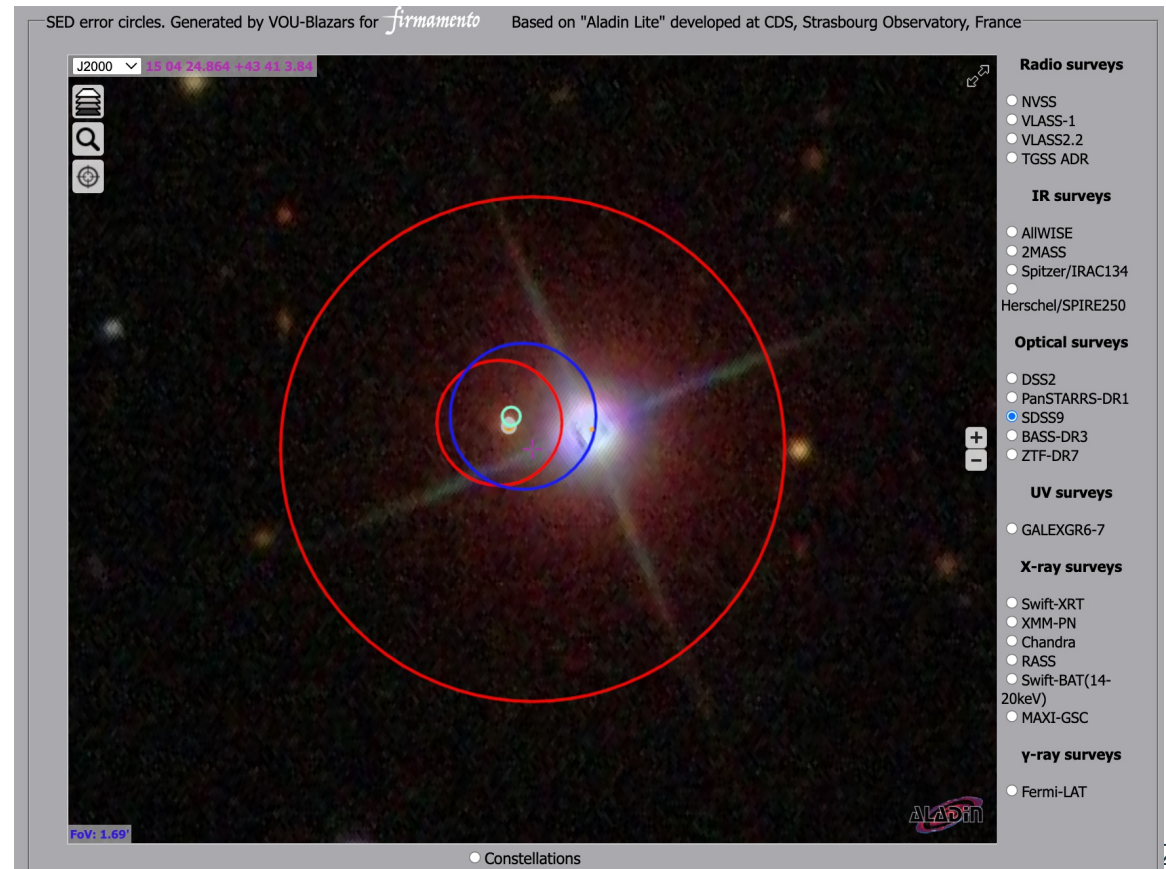
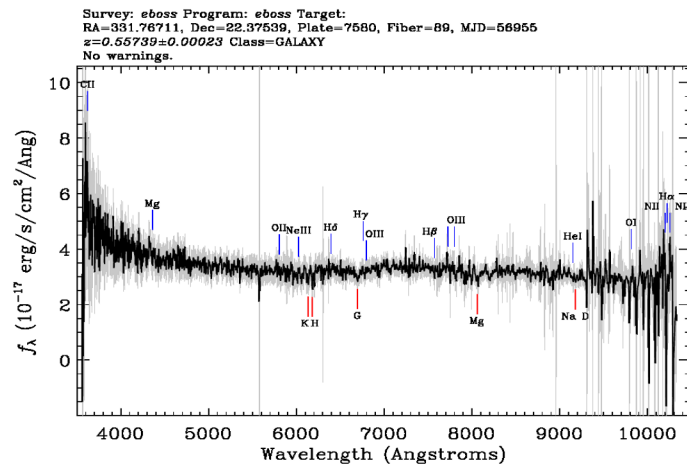
1. Input ra/dec, error region on *Open Universe* portal
2. Code finds catalogs and then **possible radio/x counterparts** within a user-defined error circle
3. Classification based on number and type of counterparts



Step 2/ Check the candidate associates

Take 1st candidate association, visual and quantitative check in the sky

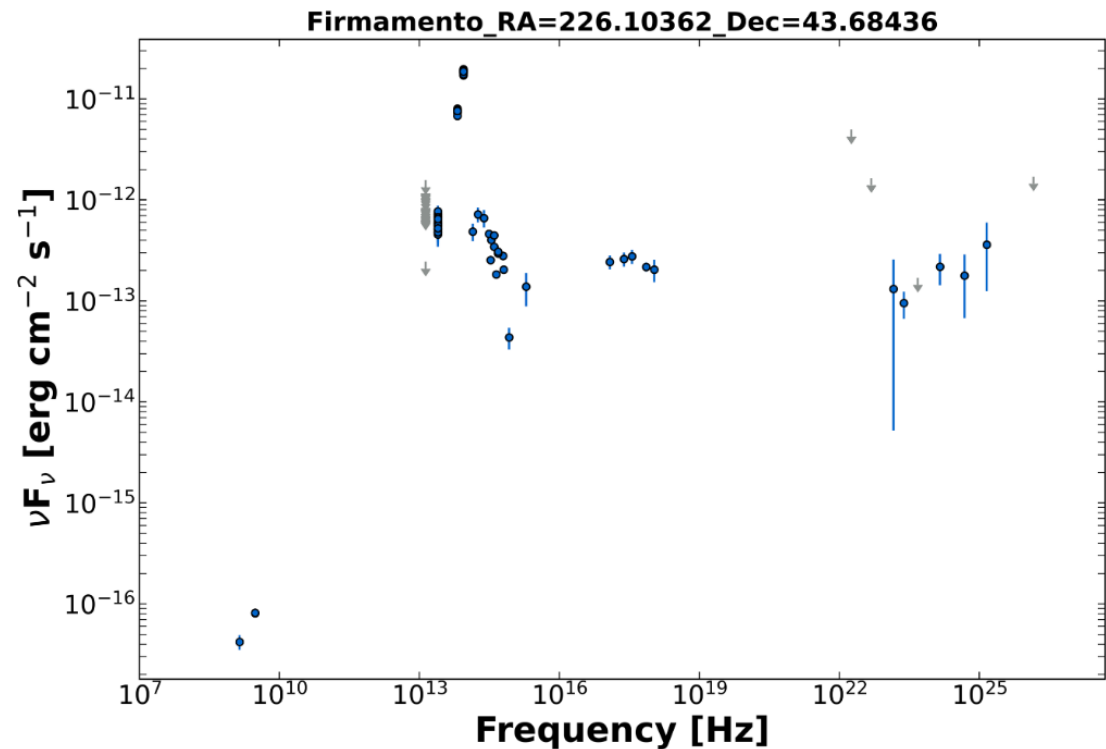
- Presence of a galaxy
- Is redshift available?



3/ The candidate SED

- Code is run a 2nd time on the updated position of the candidate to generate the SED
- Synchrotron peak estimated with BLAST [Glauch+ 2207.03813]
- Download data

SED graph from Voublazars



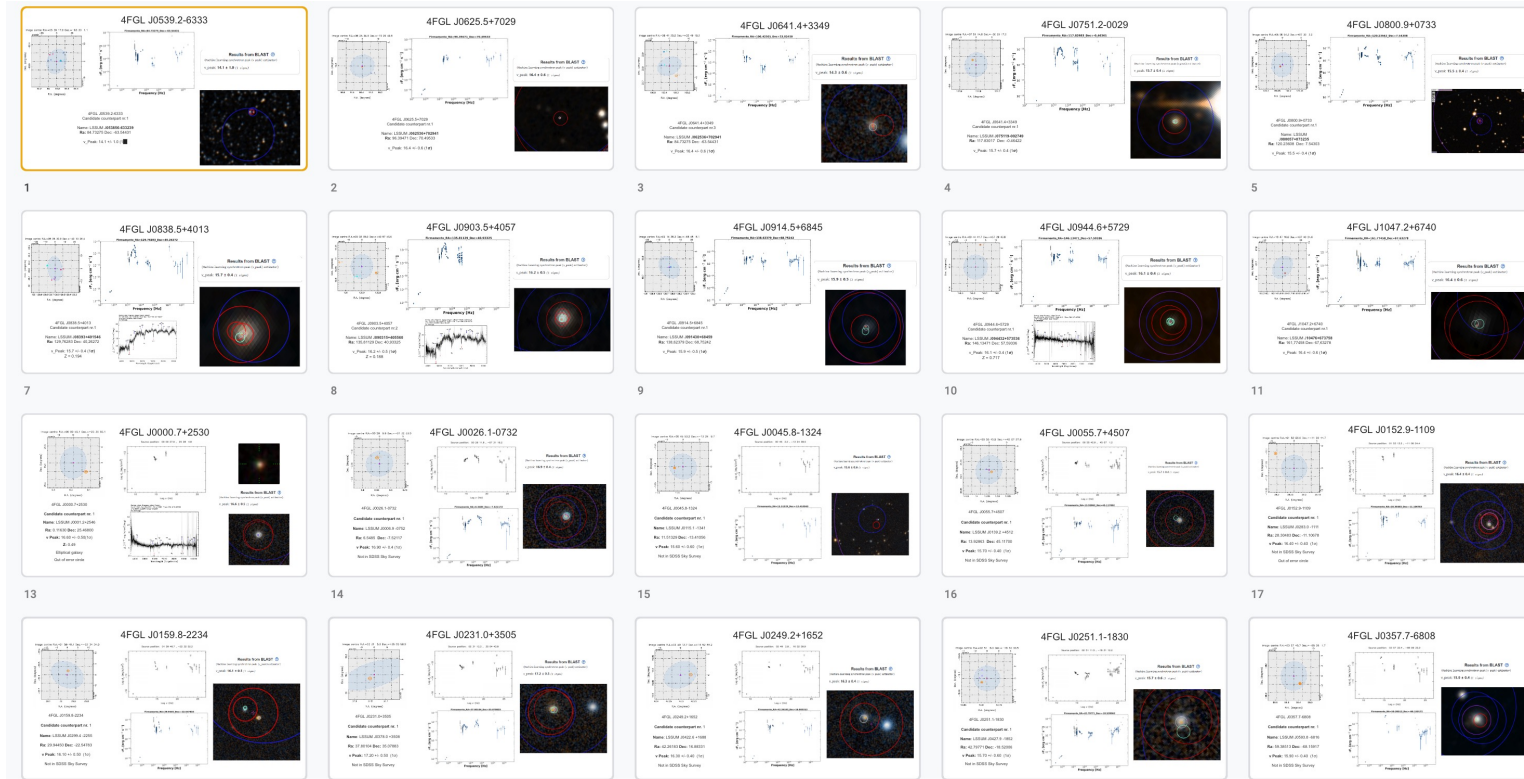
Results from BLAST ?

$\nu_{\text{peak}}: 15.7 \pm 0.7$ (1 sigma)

SED data (double-click to preview:)

ASCII CSV SSDC SED input file

Step 4/ Mumble mumble and further checks





AND....RESULTS!

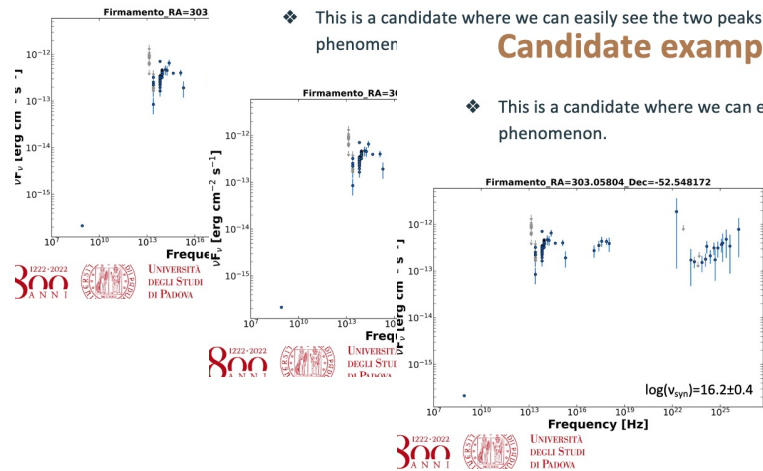


Candidate list

Candidate example: LSSUM* J201213-523251

- ◆ This is a candidate where we can easily see the two peaks which characterize this phenomenon

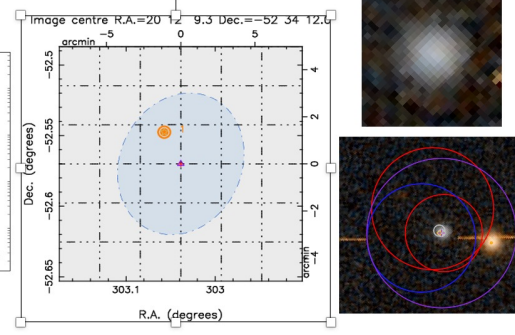
Candidate example: LSSUM* J201213-523251



- ◆ This is a candidate where we can easily see the two peaks which characterize this phenomenon

Candidate example: LSSUM* J201213-523251

- ◆ This is a candidate where we can easily see the two peaks which characterize this phenomenon.



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Out of 189
Fermi-LAT
unassociates,
54 valid
candidates

The LSSUM catalog

We dubbed them **LSSUM** (Liceo Scientifico Statale Ugo Morin)!
(see proceedings of this conference)



4FGL
4FGL
4FGL
4FGL

Table 1. The preliminary LSSUM (Liceo Scientifico Statale Ugo Morin) catalog of blazar candidates.



WHAT NEXT?



Outlook

A preliminary catalog of new blazar candidates by high school students

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² Università di Padova, Dipartimento di Fisica e Astronomia, via Marzolo 8, I-35131, Padova, Italy

³ Istituto Nazionale di Fisica Nucleare, sez. Padova, via Marzolo 8, I-35131, Padova, Italy

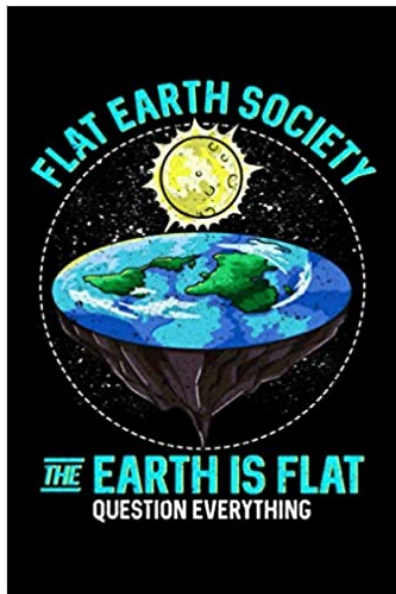
⁴ Agenzia Spaziale Italiana, xxx

⁵ Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro, Brasil

- Expand Fermi-LAT unassociated sample
- Finalize checks
- For some candidates
 - Propose optical observation (redshift estimation)
 - Propose X-ray and gamma-ray observation
- Publication?

Last remarks

Yes, it's taking a lot of time, but...



I believe in such times of mistrust for science, it's our duty to reach out as much as possible...



Can become a powerful tool for citizen science



Many and few...two different things!

Thank you for your
attention!

Call for proposals with MAGIC open to **external scientists**



MAGIC Cycle 18 call for proposals

- ★ Observations: from 2023 February 3rd to 2024 January 23th
- ★ Deadline for submission: **4th November 2022**
- ★ Contact the MAGIC Physics coordinator within **15th October 2022!!**
- ★ Guide for proposal preparation and submission:
<https://magic.mpp.mpg.de/outsidere/magicop/>

Call for proposals with MAGIC open to external scientists

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Contact the Physics coordinator *before October 15th*!

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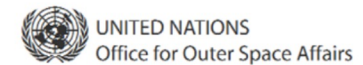
MAGIC

Major Atmospheric
Gamma Imaging
Cerenkov Telescopes



Backup

Open UNiverse for astronomy



[OU for blazars](#) [OU for GRBs](#) [Space Astronomy](#) » [Ground Astronomy](#) » [Planetary Science](#) » [Solar data](#) » [ISS](#) » [VO and General services](#) » [Bibliography](#) » [Cosmic Rays](#) » [Astronomical tools](#) »
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▽ OU Parameters

Aitoff coordinates type: **Galactic** - *Equatorial*

Source Name(s) : **4FGLJ1519.7+6727**

R.A.(J2000) = **15 19 46.24 (229.942703 deg)**

Dec.(J2000) = **+67 27 29.15 (67.458099 deg)**

GLON = **104.22** GLAT = **43.89**

Version 2.0

Object name or coordinates: 4FGLJ1519.7+6727 (SSDC)

4FGLJ1519.7+6727



ESASky	SKY-MAP.ORG	Google Sky	SDSS SkyServer	Aladin Lite	OU Swift XRT	ESO Products	Legacy Surveys	Super Cosmos	Radio Surveys
SSCD Catalogs	SSCD R-X-O	VizieR X-R-G	VizieR IR-Opt	HEASARC Browse	VAO Data Scope	SkyMapper	MAST Archive	CADCArchive	ESO Archive
NOAO Survey Data	NRAO Archive	ALMA Archive	ISDC HEAVENS	SSCD Archive	Radio Telescope DC	INAF IA2	Multi-freq. Explorer	OU VOU-Blazars	OU VOU SED
SED Builder	OU SED Movie	ADS Bibliography	NED Bibliography	EDS Bibliography					