Wednesday, November 8

Week 45 of 2023

- Home
- Moon
- Work
- UA Holidays
- NOAO
- Siri Suggestions
- ADASS 2023 Calendar
- Telescopes

November 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

December 2023

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

7AM

8AM

7:30AM MORNING COFFEE
Where
POSTER ROOM (Catalina/Tucson rooms)
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?

9AM

8:30AM C501: High throughput VLA Imaging with multiple GPUs
8:45AM C502: The Gaia AVU-GSR Parallel Solver: CUDA solutions for
9:00AM INVITED I501: Streaming Signal Processing on GPUs
Where

10AM

9:30AM C503: From LOFAR to SKA: towards a GPU-based source ex-
9:45AM C504: GPU implementation in radio astronomy: a "giant
10:00AM COFFEE BUFFET
Where
POSTER ROOM (Catalina/Tucson rooms)

10:15AM FOCUS DEMO F401: Building a production ML pipe-

11AM

11:00AM C601: Multi-Spacecraft Observatory Data Analysis Tech-
11:15AM C602: Cartographic Mapping using High-Resolution Shape
11:30AM C603: ESA Heliophysics archives interoperability and data
11:45AM C604: The Python in Heliophysics Community: an overview

Noon

12:00PM LUNCH BREAK

1PM

2PM

1:30PM C605: Improving detection of small planets in upcoming
1:45PM C606: Improving the visibility and citability of exoplanet re-
2:00PM INVITED I601: FAIR approach for Low Frequency Radio Astronomy

3PM

2:30PM C607: An Adaptive-Scale Multi-Frequency CLEAN Deconvo-
2:45PM CANCELLED: C608: HelioLinC3D: Software for Discovery of
3:00PM AFTERNOON BREAK
Where
POSTER ROOM (Catalina/Tucson rooms)

3:15PM FOCUS DEMO F902: The Rubin Science Platform: powered

4PM

4:00PM C609: DOIs at the ESDC and the new ESDC DOI TAP Service.
4:15PM C610: CATCH: Finding celestial objects with Googles Spatial
4:30PM C611: Comet Statistics - A graphical representation of in-
4:45PM C612: MPEC Watch, a novel community reference resource

5PM

6PM

6:00PM ADASS Program Organizing Committee Dinner

7PM

8PM

9PM

10PM

11PM

12AM

• Timed Events

7:30AM to 8:30AM MORNING COFFEE
Location: Where
POSTER ROOM (Catalina/Tucson rooms)
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?
level=level3]
Notes: Event Description

Coffee breaks will be held in the poster room.

Hot beverage service.

8:30AM to 8:45AM C501: High throughput VLA Imaging with multiple GPUs
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?
level=level3]
Notes: Event Description

THEME: GPU IMPLEMENTATIONS FOR CORE ASTRONOMICAL LIBRARIES
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--5]

pretalx [https://pretalx.com/adass2023/talk/TV7LLB/]

The increasing data volumes from present observations with the Very Large Array (VLA) and the prospects for orders of magnitude increase with the next generation VLA (ngVLA) have motivated the development of
a high performance and high throughput data processing model to enable
data processing rates to be compatible with data acquisition rates.
The high performance component is achieved through the GPU-enabled implementation of compute intensive operations. To further scale data processing rates, high throughput is achieved by distributing data partitions across multiple GPUs for independent processing, enabling access to computing resources at a national scale. We present the current state of the development of a high throughput image processing model for VLA data, as well as run time scaling results from our test campaign in the PATh (Partnership to Advance Throughput) facility, that provides access to multiple GPUs on supercomputing infrastructures across the USA.

8:45AM to 9:00AM C502: The Gaia AVU-GSR Parallel Solver: CUDA solutions for linear
systems solving and covariances calculation toward Exascale infrastructures
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?
level=level3]
Notes: Event Description

THEME: GPU IMPLEMENTATIONS FOR CORE ASTRONOMICAL LIBRARIES
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--5]

pretalx [https://pretalx.com/adass2023/talk/8SB3FP/]

We ported to the GPU with CUDA the Astrometric Verification Unit-Global Sphere Reconstruction (AVU-GSR) Parallel Solver, developed for the ESA Gaia mission, by optimizing a previous OpenACC porting of the code. The code finds, with a 10-100 µas precision, the astrometric parameters of ~10^8 sources, the attitude and instrument settings of the Gaia satellite, and the parameter γ of the PPN formalism, by solving a system of linear equations, A×x=b, with the LSQR iterative algorithm. The coefficient matrix A of the final Gaia dataset is large, with ~10^11x(5x10^8) elements, and sparse, reaching a size of ~10-100 TB, typical for the Big Data analysis, which requires an efficient parallelization to obtain scientific results in reasonable timescales. In the matrix size, 10^11 is the number of equations, i.e., of stellar observations, and 5x10^8 is the number of unknowns, Nunk. The speedup of the CUDA code over the

original AVU-GSR solver, parallelized on the CPU with MPI+OpenMP, increases with the system size and the number of resources, reaching a maximum of 14x, >9x over the OpenACC code. This result is obtained by
comparing the two codes on the CINECA cluster Marconi100, with 4 16 GB
V100 GPUs per node. We verified the agreement between CUDA and OpenMP
solutions for a set of production systems. The CUDA code was then put in production on Marconi100, essential for an optimal AVU-GSR pipeline and the successive Gaia Data Releases. We aim to port the production of this code on Leonardo CINECA infrastructure, expecting to obtain even higher performances, since this platform has 4x GPU memory per node compared to Marconi100.

To solve a system of linear equations, the system solution, the errors on the unknowns (variances) and the covariances can be calculated. Whereas the solution and the variances arrays have size Nunk~5x10^8, the variances-covariances matrix has a size ~Nunk^2/2, which can occupy ~1 EB. This represents a “Big Data” problem, which cannot be solved with standard methods. To cope with this difficulty, we define a novel I/O- based strategy in a two jobs-pipeline, where one job is dedicated to the files writing and the second concurrent job reads the files as they are created, iteratively computes the covariances, and deletes the files, to avoid storage issues. In this way, the covariances calculation does not significantly slowdown the AVU-GSR code for a number of covariances up to ~10^6.

These analyses represent a first step to understand the (pre-)Exascale behavior of a class of codes based on the same structure of this one.

Acknowledgments: This work is supported by the Spoke 1 “FutureHPC & BigData” of the ICSC- CN di Ricerca in HPC, Big Data and Quantum Computing-and hosting entity, funded by European Union-NextGenerationEU”. This work was also supported by ASI grant No. 2018-24-HH.0, in support of the Italian participation to the Gaia mission, and by CINI, under the project EUPEX, EC H2020 RIA, EuroHPC-02-2020 grant No. 101033975.

9:00AM to 9:30AM INVITED I501: Streaming Signal Processing on GPUs
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: GPU IMPLEMENTATIONS FOR CORE ASTRONOMICAL LIBRARIES
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--5]

pretalx [https://pretalx.com/adass2023/talk/VFJGE7/]

In this presentation, I will discuss the latest developments in radio-astronomical signal processing on GPUs. I will present the Tensor-Core Correlator, a GPU library that combines antenna data at unprecedented speed and energy efficiency. The library is rapidly adopted by radio telescopes worldwide. We currently develop similar libraries for beam forming and filtering.

As I/O is our next bottleneck, we explore new methods (DPDK and RDMA)
to stream digitized antenna data directly from the network into a GPU. I will show how the GPU handles 200 Gb/s Ethernet packets at line speed.

Finally, I will show how a proper codesign of the digitizer FPGA firmware, the network, and the GPU correlator leads to a highly cost- and energy-efficient instrument design.

9:30AM to 9:45AM C503: From LOFAR to SKA: towards a GPU-based source extractor
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: GPU IMPLEMENTATIONS FOR CORE ASTRONOMICAL LIBRARIES
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--5]

pretalx [https://pretalx.com/adass2023/talk/UVNKTC/]slides
[https://pretalx.com/media/adass2023/submissions/UVNKTC/resources/ADASS_From_LOFAR_to_SKA_towards_a_GPU-based_sour-c_7NTQJMr.pdf]

The Amsterdam-ASTRON Radio Transients Facility And Analysis Center (AARTFAAC) is an all-sky radio telescope and transient-detection facility. It piggybacks on raw data from a limited number of antennas of the LOFAR telescope. In 2018, the AARTFAAC 2.0 program started, which couples a planned telescope upgrade with better transient-detection capabilities and new science. The PetaFLOP AARTFAAC Data-Reduction Engine (PADRE) aims to improve the AARTFAAC
processing pipeline to detect transients in real time with low latency, so that the raw samples of all LOFAR antennas (which are available for only seven seconds) can be saved for further analysis, while other instruments, observing at other wavelengths, are alerted to initiate follow-up observations immediately.

The last part of the AARTFAAC pipeline is image based. Every second, for every subband, an all-sky image is produced which may contain anything between several tens up to several thousands detectable sources. The pixels constituting those sources are extracted in order to measure the properties of each source, such as peak flux density, integrated flux, position and shape parameters. These properties are inserted into a database and associated with previous measurements of the same source: a process called source association. Peak flux densities of the same source, ordered in time, form light curves which are analysed, e.g. using machine learning techniques, to find transient sources. Source extraction, measurement and association together form a subpipeline called TraP: the LOFAR Transients Pipeline.

This talk will focus on refactoring PySE, the Python Source Extractor and source measurer in TraP, in order to speed it up: from an original running time of ~20s per typical 2300^2 pixels image with ~2000 sources to less than a second. We will discuss the software engineering effort to turn slow, serial Python code into fast, parallel code. There are abundant options for parallellisation on the CPU, such as Ray and Dask. These tools were used to speed up the compute-intense task of deriving background characteristics through kappa, sigma clipping. Source measurements could be parallellised using Python's multiprocessing module. These and algorithmic improvements were not sufficient to reduce the total time for source extraction and source measurent to below 1s. To achieve further performance improvements the sep library (based on SExtractor) was used for kappa, sigma clipping, segmentation and connected component
labeling. Source measurements were speeded up impressively using Numba's guvectorize decorator. This decorator opened up the way to perform the source measurements on the GPU, by adding the "target='cuda'" argument. In combination with replacing Numpy arrays by CuPy arrays all the naturally parallel workload can now be shifted to the GPU, which will make it a suitable source extractor for SKA, processing 4K * 4K images with tens of thousands of sources in less than 1s.

9:45AM to 10:00AM C504: GPU implementation in radio astronomy: a “giant leap” into the SKA era
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: GPU IMPLEMENTATIONS FOR CORE ASTRONOMICAL LIBRARIES
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--5]

pretalx [https://pretalx.com/adass2023/talk/KWSPPF/]

Since the last decade, radio astronomy has started a new era: the advent of the Square Kilometer Array (SKA), preceded by its pathfinders (like Low Frequency Array, LOFAR, or MeerKAT), will produce a huge amount of data that will be hard to process with a traditional approach. This means that the current state-of-the-art software for data reduction and imaging will have to be re-modelled to face such data challenge. In order to manage such an increase in data size and computational requirements, scientists need to exploit modern HPC architectures. In particular, heterogeneous systems, based on complex combinations of CPUs, accelerators, high-speed networks and composite storage devices need to be used in an efficient and effective way.

Our goal is to develop a software for radio imaging, that is currently one of the most computational demanding steps of the radio astronomy data processing, both in terms of memory request and computing time. The GPU porting is a key point that allows to make the most out of the accelerators parallel computational capabilities, minimizing the communication and data movement.

Starting from the original code presented in Gheller et al. (2023), I will present the implementation of the Fast Fourier Transform (FFT) on the GPUs adopting the distributed version of the NVIDIA optimized library (so-called cuFFTMp) to be able to allot the large datasets produced by the radio telescopes across multiple GPUs. This is a key point for the GPU development of the code, given that the size of the involved problems is so huge that cannot be handled by a single accelerator.
I will show the results in terms of speedup and scalability of this new accelerated version of the code based on a scientific case, namely real LOFAR VLBI data, and discuss the comparison with the CPU version of the FFT presented in the original code.

Overall, we would set a new way to approach not only radio astronomy, but astrophysical software all-round. This will represent the first example of radio imaging software enabled to GPUs, becoming a potential state-of-the-art work for the future SKA software suite.

10:00AM to 11:00AM COFFEE BUFFET
Location: Where
POSTER ROOM (Catalina/Tucson rooms)
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

Coffee breaks will be held in the poster room.

Continental buffet.

10:15AM to 10:45AM FOCUS DEMO F401: Building a production ML pipeline for gravitational wave detection
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

PREV
[https://adass2023.lpl.arizona.edu/event-categories/wednesday-session-1]NEXT
[https://adass2023.lpl.arizona.edu/event-categories/wednesday-session-2]

THEME: AI IN ASTRONOMY
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--4]

pretalx [https://pretalx.com/adass2023/talk/GD8999/]

Real-time gravitational wave astronomy stands to benefit substantially from the adoption of machine learning algorithms, which have demonstrated an ability to model complex signals, even in the presence of considerable noise, with minimal run-time latency and compute requirements. Moreover, many gravitational wave event morphologies and
noise sources are well understood and easily simulated, acting as physical priors which can be exploited to regularize training to produce more robust models. However, adoption of production ML systems
in this setting has been impeded by a lack of software tools simplifying the development of experimental and deployment pipelines that leverage these priors in a computationally efficient manner. In this demo, we'll introduce ml4gw and hermes, two libraries for accelerating training and inference of models in the context of gravitational waves, and show how they can be combined with other infrastructure tools to build, evaluate, and deploy a competitive model for detecting binary black hole mergers in real LIGO gravitational strain data.

11:00AM to 11:15AM C601: Multi-Spacecraft Observatory Data Analysis Techniques
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/QDMWFD/]

Spacecraft missions of the future, such as HelioSwarm, will consist of collections of many small spacecraft taking simultaneous in-situ measurements. An open question in the field is how to best combine these single point measurements to gain a global understanding of dynamic phenomena. We investigate how to best leverage these types of multi-point data sets to extract meaningful scientific insights, focusing on two particular kinds of analysis techniques.

For the first, we have developed a new method of reconstructing a vector field over a large volume of space using a sparse set of local measurements. This is accomplished via distance weighted averaging in a 1D + 2D framework, where we separately weigh components along the
spacecraft direction of travel and the perpendicular plane.
The second method focuses on characterizing the wave-like structures that are often seen in astronomical data. As the direction and velocity of a wave changes, a given configuration of spacecraft will detect a wave with varying levels of accuracy. We have developed a method of quantifying the level of accuracy and precision that a configuration of 4-9 spacecraft will achieve in the detection of an arbitrary wave. The resulting uncertainty quantification allows us to select optimal configurations of spacecraft for characterizing waves in space plasmas.

11:15AM to 11:30AM C602: Cartographic Mapping using High-Resolution Shape Models
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/BXAQ8G/]

NASA's OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer; OREx) spacecraft successfully accomplished its primary mission objective to retrieve a sample from the surface of the near-Earth asteroid (101955) Bennu on October 20, 2020 (Lauretta et al., 2022). The OREx team had been preparing for this event since the spacecraft's arrival at Bennu in December of 2018 by mapping the asteroid and characterizing its geological, chemical, and physical properties. Mapping continued after sample collection to quantify surface changes resulting from contact between the spacecraft and Bennu.

The spacecraft departed Bennu in May of 2021, and the sample is scheduled to return to Earth on September 24, 2023. Image processing, photogrammetric control, and mosaicking were accomplished with a modified version of the Integrated Software for Imagers and Spectrometers (ISIS) planetary cartography package, developed and maintained by the OREx team. In the control process, images acquired by the OSIRIS-REx Camera Suite were registered to and orthorectified onto tessellated shape models created by the OREx team. The shape models are global in coverage and range from 80 cm to 5 cm average ground sample distance. OREx ISIS improves the execution of critical tasks in the cartographic process such as precision ray tracing, manual and automated image measurement, accurate determination of terrain-relative photometric/observation angles and characteristics, orthorectification, and the detection of occlusions and shadows.

These improvements in operational efficiency and mapping accuracy provide enhanced support not only for irregularly shaped bodies such as asteroids and comets, but for small-body mapping in general, and for bodies such as the Moon, for which high-resolution shape models and imagery may be available. Validated over more than three years of proximity operations at Bennu, ISIS enabled the generation of a global

basemap and regional image mosaics at resolutions from ~6 cm/pixel to
1 mm/pixel. These products were crucial to the sample-site selection process and the sample acquisition itself. We will submit our enhancements to the public version of ISIS and release them to the scientific community in the form of a standalone shared library developed in C++ as the Planetary Shape Model Ray Tracing System (PSMRTS).

Additionally, we will provide a C-like interface that provides access to many different languages such as C, Python, Rust, and others. The current version of our ISIS implementation supports three publicly available ray tracing libraries. These libraries are the NAIF DSK, the Bullet Physics SDK, and the Intel Embree ray tracing systems.

This work is supported by NASA under contract NNM10AA11C issued through the New Frontiers Program. Lauretta, D.S., et al., 2022. Spacecraft sample collection and subsurface excavation of asteroid (101955) Bennu. Science. 377 (6603), 285-291. doi.org/10.1126/science.abm101

11:30AM to 11:45AM C603: ESA Heliophysics archives interoperability and data access enhancements
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/WEBPRS/]

The ESAC Science Data Center (ESDC) develops and operates the science archives for the ESA missions. Within the ESDC, a different archive provides the scientists with access to the data of every Heliophysics mission: Ulysses, Soho, Cluster/DoubleStar, Proba-2, ISS-Solac, and Solar Orbiter.

The ESDC is taking steps towards the homogenisation of the interoperability mechanisms and the ways to access the data for the different Heliophysics archives. This abstract provides an insight on the enhancements implemented/planned for the ESA Heliophysics archives.

The first step to homogenise the interoperability is the IVOA TAP protocol. Due to the demanding requirements for data download of the Heliophysics missions, the TAP+ extension developed at the ESDC is currently used by the Soho, Proba-2, Solar Orbiter and Cluster/DoubleStar archives. On top of that, the helio-commons library developed at the ESDC allows the download of any set of products via filters on any column as for usual metadata queries. The next step in the Heliophysics archives evolution regarding IVOA is to become EPN-TAP compliant.

The Heliophysics archives data access requirements vary a lot between in-situ and remote sensing data.

For remote sensing, a product listing approach is enough to access and download the products (examples of FITS files for Solar Orbiter, Soho, Proba-2). Additional features are provided by some archives: HEK events overlay on the remote sensing images (Soho archive), or visualisation of simultaneous Carrington rotation movies (Proba-2).

However, for in-situ data (Cluster/Double Star), a concatenation mechanism is used to build on-the-fly products including the metadata and data for the desired custom timeframe. This mechanism has been implemented on top of the TAP+ extension for the Cluster archive. In addition, this approach opens the door for the next step in interoperability evolution: to make the archives compliant with the HAPI standard, with the Cluster archive being the first one at ESA to integrate a test HAPI server which will become operational in the near future.

11:45AM to 12:00PM C604: The Python in Heliophysics Community: an overview and call to connect with the wider ADASS Python community
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/HLRJRS/]

Since its creation in 2018, the Python in Heliophysics Community (PyHC) has strove to facilitate scientific discovery by promoting the use and development of sustainable open-source Python software across
the solar and space physics community, improve communication and collaboration between disciplines, developers, and users, establish and maintain development standards, and foster interoperability and reproducibility. Through the community's resources, bi-annual meetings, bi-weekly telecons, PyHC summer schools, and other meeting outreach opportunities, PyHC continues to educate scientists on the importance of open source software in open science and demonstrates how the PyHC can aid scientists in Heliophysics research.

Although PyHC has an obviously heavy focus on Heliophysics research, the impact can be broadened. PyHC seeks to connect with the wider ADASS community on open source Python software tools and standards. In
that vein of collaborative spirit, many of PyHC’s packages are already extensible to disciplines outside the scope of Heliophysics. PyHC packages often leverage astronomy packages such as Astropy (who
were invited to hold a tutorial session at the inaugural PyHC 2022 summer school). Finally, the PyHC package standards are even modeled off of the example set by Astropy. This talk will give a brief overview of the PyHC, how PyHC can be an answer to the open science needs of today in Heliophysics and beyond, and how to get connected with the community.

12:00PM to 1:30PM LUNCH BREAK
Notes: Event Description

There are many lunch options with walking distance or via the free streetcar or if you are in a hurry on the 2nd and 3rd floors of the Student Union.

1:30PM to 1:45PM C605: Improving detection of small planets in upcoming transit surveys
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/BNLNCG/]

A major goal of space-based exoplanet transit survey missions (Kepler, K2, TESS, Plato, Roman) is to detect small Earth-sized planets. However, almost all of the detection pipelines use the Box-Least Squares (BLS) periodogram algorithm following the detrending of stellar light curves with common approaches such as Gaussian Processes
Regression or Splines. Such detrending approaches cannot effectively remove short-memory autocorrelation, resulting in a severe degradation
in BLS's sensitivity to small planets. We find that a combination of AutoRegressive Integrated Moving Average (ARIMA) modeling and the Transit Comb Filter (TCF) periodogram improves sensitivity over BLS. To show this, we simulate transiting planets in stellar light curves with two different noise models: pure Gaussian and AutoRegressive Moving Average (ARMA). Two measures are used: the periodogram signal-to-noise ratio (SNR) and False Alarm Probability (FAP) based on the generalized extreme value distribution for quantifying periodogram peak significance. We compare the relative sensitivities of the BLS

and TCF periodograms by varying the number of transits in the light curve and, for each case calculating the minimum detectable depth (i.e., the lowest depth at which FAP < 0.01 or SNR > 6). Considering the goal to detect small planets reliably, we find that the combination of the ARIMA + TCF pipeline and the SNR detection metric is preferred since it yields the lowest MDD. The application of our approach to real TESS light curves with small exoplanets agrees with the simulation results. We recommend analysts replace the BLS periodogram with the ARIMA + TCF pipeline for greater sensitivity to small planets in future transiting surveys.

1:45PM to 2:00PM C606: Improving the visibility and citability of exoplanet research software
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/RXEPJ9/]

The Astrophysics Source Code Library (ASCL, ascl.net) is a free online registry for source codes of interest to astronomers, astrophysicists, and planetary scientists. It lists, and in some cases houses, software that has been used in research that has appeared in, or been submitted to, peer-reviewed publications. It now has over 3300 software entries and is indexed by ADS and Clarivate's Web of Science.

In 2020, NASA created the Exoplanet Modeling and Analysis Center (EMAC, emac.gsfc.nasa.gov). Housed at the Goddard Space Flight Center,
EMAC serves, in part, as a catalog and repository for exoplanet research resources. EMAC currently has 223 entries, 77% of which are for downloadable software.

This presentation will cover the collaborative work the ASCL is doing with EMAC and with NASA's Astrophysics Data System (ADS) to increase the discoverability and citability of EMAC's software entries and to strengthen the ASCL's ability to serve the planetary science community.

2:00PM to 2:30PM INVITED I601: FAIR approach for Low Frequency Radio Astronomy
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/9BNHHA/]

The Open Science paradigm and the FAIR principles (Findable, Accessible, Interoperable, Reusable) is aiming to foster scientific return, and reinforce the trust in science production. We present how the MASER (Measuring, Analysing and Simulating Emissions in the Radio range) implements Open Science through a series of existing solutions that have been put together, only adding new pieces where needed.

The MASER service is a "science ready" and "open science" toolbox dedicated to time-domain low frequency radioastronomy, which
data products mostly covers Solar and planetary observations. The principal data product in this domain is a "dynamic spectrum", i.e., a series of consecutive spectra with the same observing configuration. The observed physical phenomena are related to plasma instabilities and energetic particles in magnetized plasma. Hence low frequency radio astronomy is a remote sensing tool for plasma diagnostics.

MASER covers four community needs:
1. Discovering data products,
2. Exploring data collections before downloading TB's of files,
3. Annotating and then storing and sharing annotations on radio dynamic spectra,
4. Accessing data in Python.

MASER solutions are based on IVOA protocols for data discovery, on IHDEA tools for data exploration, and on a dedicated format developed by MASER for the temporal-spectral annotations. The service also proposes a data repository for sharing data collections, catalogues and associated documentation, as well as supplementary materials associated to papers. Each collection is managed through a Data Management Plan, which purpose is two-fold: supporting the provider for managing the collection content; and supporting the data centre for resource management. Each product of the repository is citable with a DOI, and the landing page contains web semantics annotations (using schema.org).

2:30PM to 2:45PM C607: An Adaptive-Scale Multi-Frequency CLEAN Deconvolution in CASA for Radio Interferometric Images
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/QPWXEL/]

Scale sensitive solvers are widely used for accurate reconstruction of extended emission in radio astronomy. The Adaptive Scale Pixel decomposition (Asp) algorithm models the sky brightness by adaptively determining the optimal scales. It thus gives a significantly better imaging performance, but at a cost of significantly increased computational time. In this report, we described an improved Asp algorithm that can be used in both single-frequency and multifrequency mode. It achieves 3x-20x speed up in computational time comparing to the original Asp-Clean algorithm. It also outperforms the current multifrequency imaging techniques. It is combined with the scale-insensitive Hogbom CLEAN algorithm to achieve even better computational efficiency for both compact and diffuse emission.

We implemented the algorithm in CASA and applied it to data sets from EVLA and ALMA telescopes. We show that this algorithm has performed better than the wide used MS-Clean and MS-MFS algorithms. It has also achieved imaging performance without the need for hand-tuning of scale
sizes or an expensive automasking algorithm, typically used in pipeline processing (like the current ALMA imaging pipeline).

2:45PM to 3:00PM CANCELLED: C608: HelioLinC3D: Software for Discovery of Solar System Objects in LSST-scale Datasets
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/C3XZ7M/]

In about two years, the Vera C. Rubin Observatory, an 8m-class ground based facility currently under construction at Cerro Pachón, Chile, will start scanning the southern sky to produce the Legacy Survey of Space and Time (LSST). Over its 10-year duration, this survey has the potential to produce on average 200 observations of each of about 4-5 million new asteroids it can discover. However, the cadence that Rubin will use -- taking pairs of observations each night -- is not suitable for moving object identification using traditional approaches which generally require three or four. Instead, it requires an algorithm able to connect three or more pairs over a window of nights, in presence of substantial amount of false detections (Kubica et al. 2007; Denneau et al. 2013).

In this talk, we will present the algorithm and a fast C++ implementation of Heliolinc3D. Based on the concept of heliocentric linking presented in Holman et al. (2018), Heliolinc3D can identify asteroids in large surveys taking only pairs of observations per night, with three such pairs over 2-4 week periods. This code has been extensively tested on simulated LSST data at realistic scale, as well as real data from ATLAS. In tests with LSST simulations, we successfully linked 98.8% of potentially discoverable main-belt asteroids and 97% of NEOs. With ATLAS data, we re-discovered numerous
NEOs already found by the ATLAS team, as well as an additional hitherto unknown PHA (2022 SF289). This implementation meets requirements for Rubin's asteroid discovery system (95% completeness), but is also available to any other observatory wishing to use it (https://github.com/lsst-dm/heliolinc2).

In addition to providing the source code, we are working to develop a Heliolinc3D linking web service where observatories could upload data to be linked without the need to run the software themselves. In the longer term, this service-based approach could significantly optimize the global asteroid discovery process. In addition to tracklets, future surveys could choose to submit individual detections to such a "hub", where linking could be performed by state-of-the-art algorithms (e.g. HelioLinC3D, pumalink, or others). This could dramatically simplify the operations of individual surveys -- especially the smaller ones -- as well as open opportunities for cross-survey linking and observation coordination.

3:00PM to 4:00PM AFTERNOON BREAK
Location: Where
POSTER ROOM (Catalina/Tucson rooms)
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

Coffee breaks will be held in the poster room.

Afternoon tea and snacks.

3:15PM to 3:45PM FOCUS DEMO F902: The Rubin Science Platform: powered by IVOA standards and contemporary software deployment methodologies
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

PREV
[https://adass2023.lpl.arizona.edu/event-categories/wednesday-session-3]NEXT
[https://adass2023.lpl.arizona.edu/event-categories/wednesday-session-4]

THEME: OTHER CREATIVE TOPICS IN ASTRONOMICAL SOFTWARE
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--9]

pretalx [https://pretalx.com/adass2023/talk/ACAF7K/]

We present an advance look at the capabilities and implementation technologies of the Rubin Science Platform (RSP). The RSP will be the astronomical community's primary interface to the Vera C. Rubin Observatory's data products, with full operations beginning in 2025. The RSP also plays a key role in the Observatory staff's work, providing internal access to data and a computing environment for interacting with the Observatory control system. The RSP is being used heavily in the commissioning process. It has also been made available to members of the scientific community, serving simulated datasets, for the past two years, enabling community members to gain experience with the system and provide us feedback on how its capabilities meet their needs and how it can be improved.

The RSP provides access to data through three "Aspects": Web APIs based on IVOA standards, a graphical-user-interface Portal based on IPAC Firefly, and a Notebook interface based on JupyterLab and the Python-based Rubin software stack. The RSP, itself entirely open-source, is implemented on top of a deep stack of contemporary open-source containerized software deployment tools, Rubin-developed
authentication and authorization software, and infrastructure-as-code configuration mechanisms from Rubin and from the open-source community. The deployment architecture supports numerous deployments
of the RSP in a variety of configurations, on commercial cloud services, in on-premises datacenters, and in the Observatory's summit computing systems.

We will demonstrate how catalog and image data are made available through the RSP, how a pervasive use of IVOA standards underlies powerful tools to help users find data and navigate relationships between data products, and how the three Aspects of the RSP interact with each other to enable users to use all the data access methods in flexible combinations to support their needs and their varying levels of expertise.

We will also demonstrate the deployment and management tools, showing
how our git-based configuration mechanisms support the many deployments and how the open-source stack we have assembled provides
easily understood Web-based tooling for the management of the platform.

4:00PM to 4:15PM C609: DOIs at the ESDC and the new ESDC DOI TAP Service.
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/DMTYFM/]

For several decades, the European Space Agency (ESA) has been producing a wealth of datasets coming from the spacecrafts launched during its history. Since 2021, the ESAC Science Data Center (ESDC) is in the process of registering and publishing Digital Object Identifiers (DOIs), which ensures a permanent identifier for each dataset in the long term. To this date, more than 30,000 DOIs have been registered by ESA for datasets accessible through the ESA Science Archives managed by the ESDC in order to improve the traceability of the usage of those datasets.

The sheer size and diversity of the ESDC datasets makes creating DOIs a challenging task. This not only requires doing the best possible mapping between the data granularity used by the different missions and what can be considered "DOI-worthy", but also the development of a
tool that is flexible, scalable in time and able to deal with the diversity of data formats and accessing methods implemented by each science archive. In addition to this, there is a third challenge which is how to let the scientific community know that these DOIs exist and the ways to access them.

In the past the ESA DOIs could be accessed in two main ways, via Google Dataset Search (Masson et al., 2021; https://doi.org/10.1016/j.asr.2021.01.035) and the ESAC Data Discovery
Portal, located at data.esa.int, under which all ESA data holdings have been given a dedicated DOI (C.Arviset et al., PV2023). A third way was recently added via the ESA DOI TAP Service.

The ESA DOI TAP Service allows for researches and also science centers and institutions to connect their tools via the TAP protocol to this TAP service to resolve the DOIs associated to specific proposal or experiment in an easy, clean and fast and way.

During the first part of this presentation we will offer a general overview of the tool currently used by the ESDC to generate and register DOIs together with a brief description of the challenges and solution taken for its development. Next we will review the different ways to resolve the DOIs associated to each dataset stored at the ESDC focusing on how the new ESA DOI TAP service works and how can it be accessed with practical examples.

4:15PM to 4:30PM C610: CATCH: Finding celestial objects with Googles Spatial Indexing Library S2
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/CYL7RV/]

We present the Comet-Asteroid Telescopic Catalog Hunter (CATCH), a data archive search tool currently deployed at The NASA Planetary Data System Small Bodies Node. The Small Bodies Node is the main data archive for NASA's near-Earth objects, such as the Catalina Sky Survey data archive (Seaman et al. 2022). These are large data sets, totaling hundreds of terabytes in volume, making them difficult for most researchers to work with. To better serve the research community, we developed the CATCH tool to search these archives for potential observations of solar system small bodies. It works by identifying the intersection between a surveyed portion of the sky at a given time, and the trajectory of an object computed from its ephemerides. A core part of CATCH's architecture is the use of Google's open-source 'S2 library' to perform spatial-indexing on these data sets using a one-dimensional, space-filling Hilbert curve. Metadata for matched data products are presented to the user, and image cutouts around the ephemeris positions are presented. We believe that this tool/technique has great potential for other survey archives.

4:30PM to 4:45PM C611: Comet Statistics - A graphical representation of international comet discovery and observation statistics from the NASA PDS Small Bodies Node and the Minor Planet Center
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/QPXUQH/]

The Minor Planet Center (MPC) is the International Astronomical Union's recognized clearing house for all positional and categorization data for small bodies, a.k.a. comets, asteroids, and irregular satellites. Comprehensive Discovery statistics are often represented as lists and specialized data tables on the MPC's website (https://minorplanetcenter.net). We are creating an interface to summarize the discovery and observation data available through a variety of sources. Specifically, we use the Minor Planet Center's table containing orbital elements for all comets, the NASA JPL Small Bodies Database API, and a copy of the MPC's live processing database hosted by the Small Bodies Node. Each of these are parsed for the relevant data with a Python script using either HTTP requests or a Python-PostgreSQL library. This data is then processed and copied to the live site files, where it is then rendered in graph form by the user's browser by using the Plotly.js framework. The site is designed to work as it is and, beyond a web browser, should not require the user to install any additional software.

Comet Statistics contains three main sections: comet discoveries, orbital elements, and unique observations. Similarly to summary information provided in Bauer et al. (2023), each page also supports overlaying an arbitrary number of user-specified observatory codes onto each graph.

The comet discovery subpage shows statistics by year and comet type. Data is retrieved from the Minor Planet Center, along with the NASA JPL Small Bodies Database to cover potential missing data. The orbital elements section contains subpages for different comet types. Each subpage contains five graphs relating to orbital elements. Orbital element data is retrieved from the Minor Planet Center. The third section of the site, unique observations, shows unique object observations by year and by comet type.

In addition to the three graphical data sections of the site, Comet Statistics is also standing up an engine for converting between the "old" IAU designation system and the "new" IAU designation system. The purpose of this is to allow for a single reference source for comet nomenclature that will open legacy data sources to research investigations. By using this, researchers may be able to avoid confusion and refer to comets using only one designation system, even when source data may be referred to using multiple names.

References:
Bauer et al. 2023. arXiv:2210.09400 [astro-ph.EP]
https://minorplanetcenter.net
https://sbnmpc.astro.umd.edu/cometInfo/

4:45PM to 5:00PM C612: MPEC Watch, a novel community reference resource based on the Minor Planet Center live data
Location: Where
BALLROOM
[https://union.arizona.edu/infodesk/maps/sumc_maps.php?level=level3]
Notes: Event Description

THEME: SOFTWARE, TOOLS AND STANDARDS FOR SOLAR SYSTEM, HELIOPHYSICS,
AND PLANETARY RESEARCH
[https://adass2023.lpl.arizona.edu/themes-0#az-accordion--6]

pretalx [https://pretalx.com/adass2023/talk/DPXAAG/]

MPEC Watch (https://sbnmpc.astro.umd.edu/mpecwatch/) is a utility that digests the Minor Planet Center's publications to present statistical summaries of the reported observations of small bodies that are of high interest to the community. MPECs, or "Minor Planet Electronic Circulars" (https://minorplanetcenter.net/mpec/RecentMPECs.html), are issued in the form of emails and corresponding website postings, with their own DOIs by the Minor Planet Center for announcing discoveries of objects of interest (like Near-Earth Objects - NEOs, irregular satellites, or comets) and updates to the MPC's database. MPEC Watch's backend component is responsible for creating and updating a SQLite database that contains metadata for all MPECs dating back to the first Circular in September 1993. The component queries the MPC website on a daily basis to add the previous day's MPECs to the database. The usage by the community of Planetary astronomers is the target audience. Observations critical to updating the orbits, follow-up, first-follow-up, and discoveries are all MPEC material, and MPEC Watch provides these in aggregate totals, as well as for individual observing sites (Figure 2). The observations by sites can be used to demonstrate the effectiveness of observing programs to the community (e.g. proposals and program reviews). We will present the suite products provided by MPEC Watch, along with the underlying architecture and future planned augmentations to the website.

This work is supported by the NASA Planetary Data System's Small Bodies Node (NASA 80NSSC22M0024).

6:00PM to 11:59PM ADASS Program Organizing Committee Dinner
Notes: Event Description

TBD