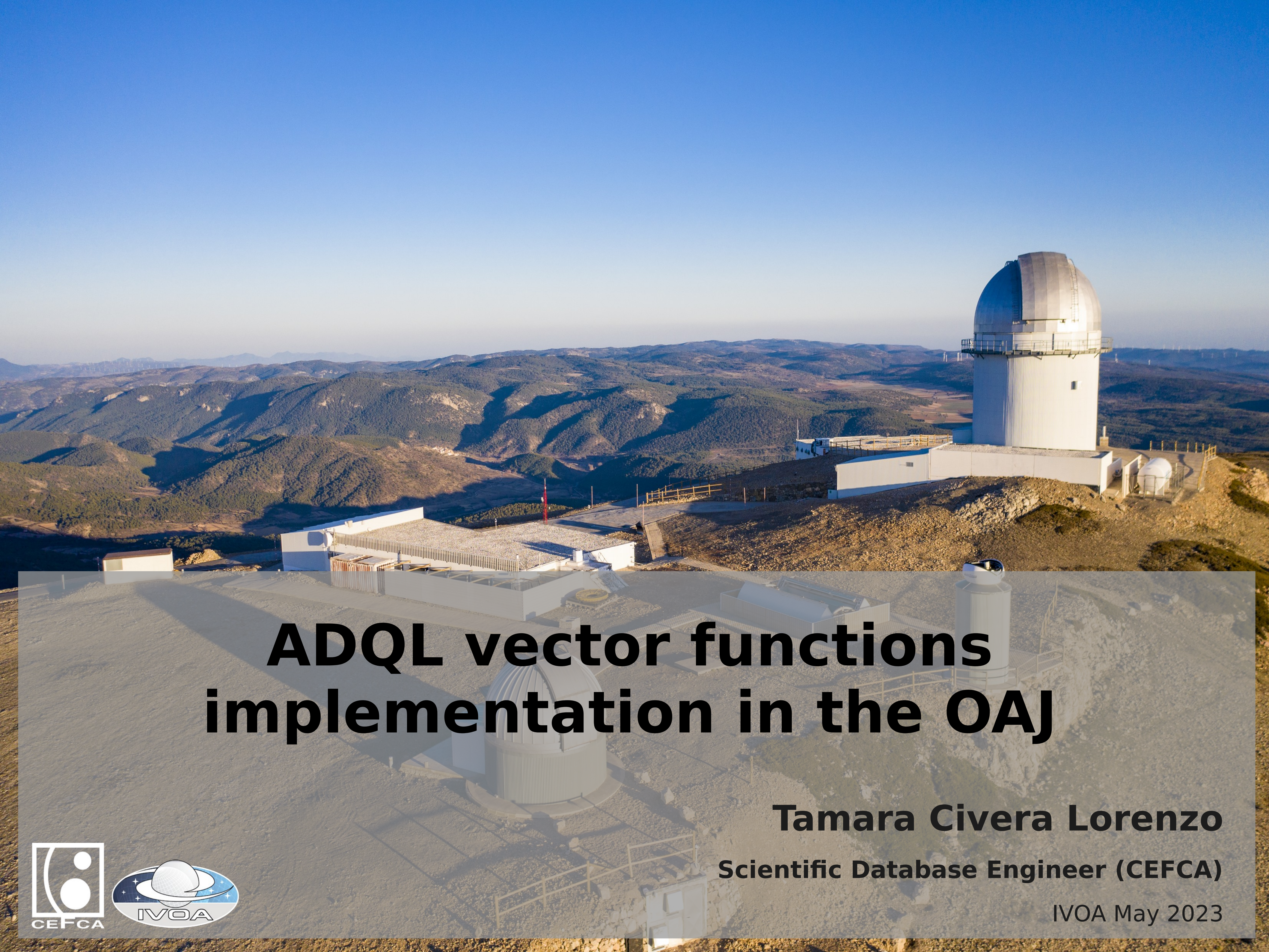

ADQL vector functions implementation in the OAJ

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IVOA May 2023

Observatorio Astrofísico de Javalambre (OAJ)

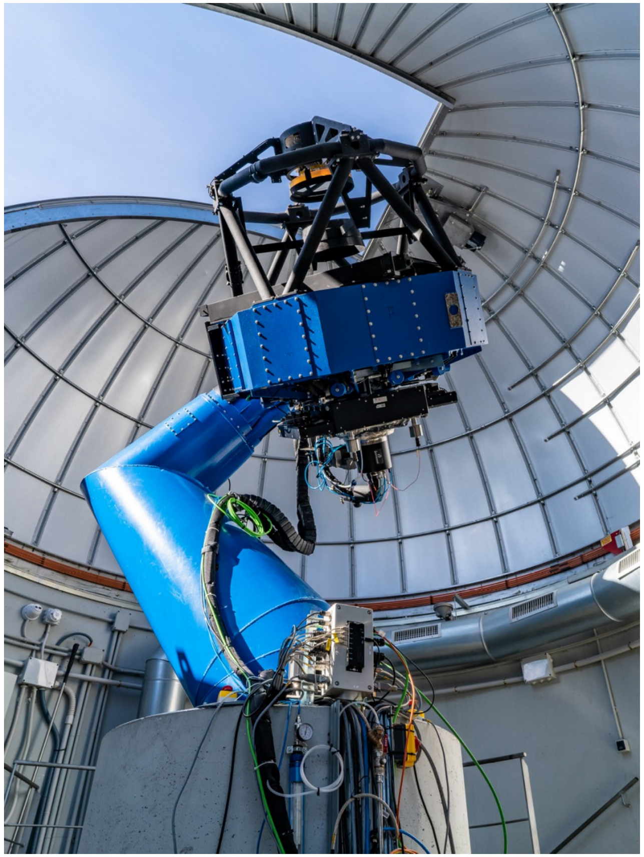
- Spanish astronomical ICTS (Unique Science and Technology Infrastructures)
- Located at Javalambre mountain range in **Teruel, Spain**
- Conceived and constructed by **CEFCA** (Centro de Estudios de Física del Cosmos de Aragón)
- For **carrying out large sky astronomical surveys**

Telescopes and Instrumentation

JAST80 (Javalambre Auxiliary Telescope) + T80Cam

FoV 2deg^2

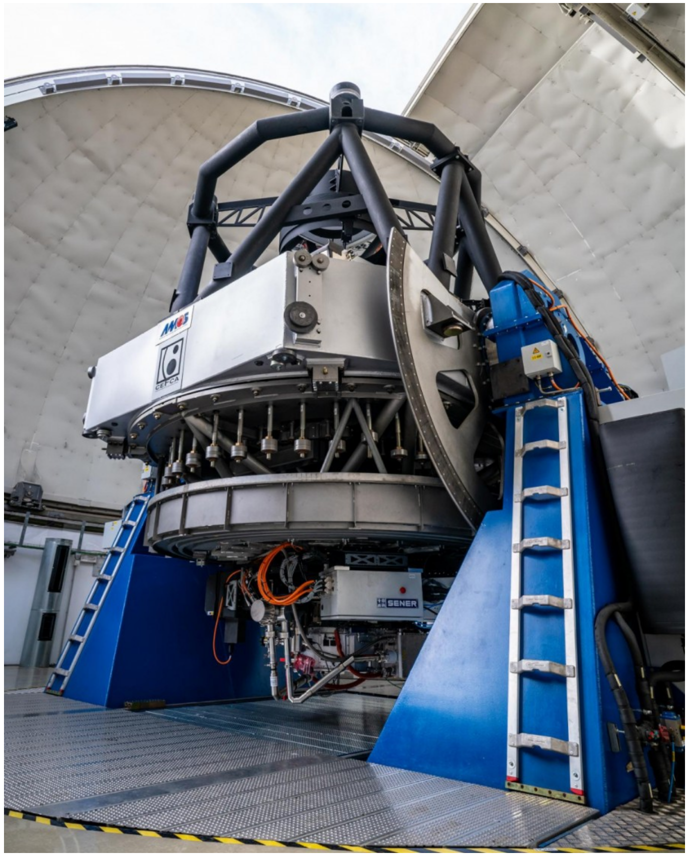
CCD 9.2k-by-9.2k, 10 µm/pix



JST250 (Javalambre Survey Telescope) + JPCam

FoV 3.5deg^2

14 CCD-mosaic 9.2k-by-9.2k, 10 µm/pix



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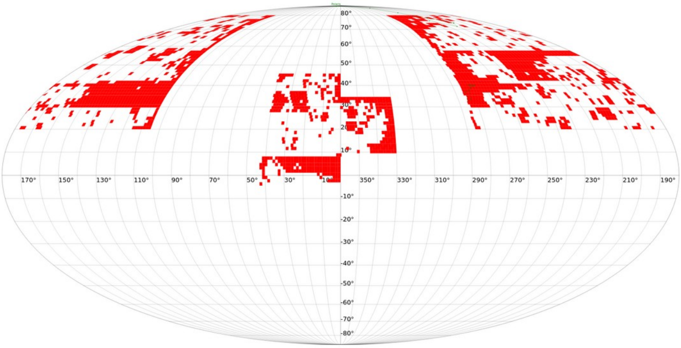
J-PLUS and J-PAS Surveys

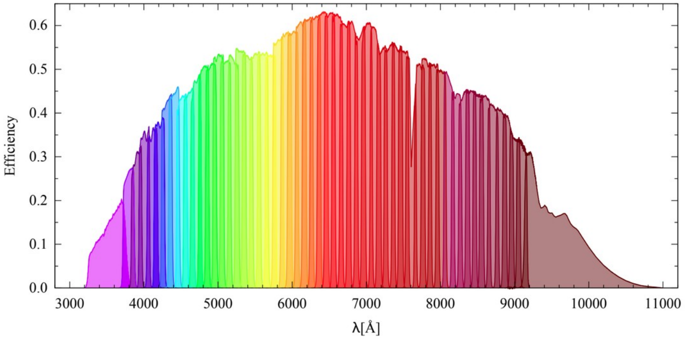
J-PLUS: Javalambre-Photometric Local Universe Survey

- Photometric sky survey of 8500 deg^2
- JAST80 + T80Cam
- 12 broad, intermediate and narrow band filters
- http://www.j-plus.es



J-PAS: Javalambre Physics of the Accelerating Universe Astrophysical Survey

- Photometric sky survey of 8500 deg^2
- JST250 + JPCam
- 54 narrow, 3 intermediate and broad band filters
- http://www.j-pas.org



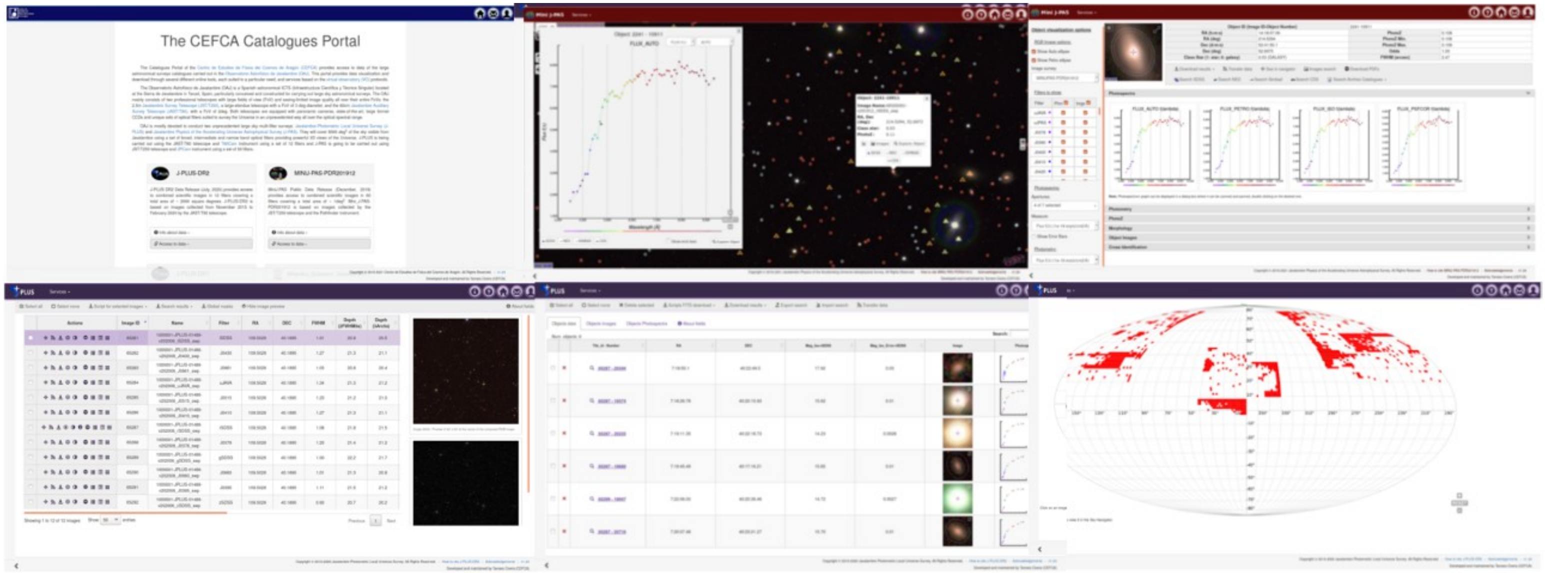
Data Publication: CEFCA Catalogues Portal

F Findable A Accessible I Interoperable R Reusable

- **Web portal:** https://archive.cefca.es

- **Web user interface services:**
  - Sky navigator, image search, object list search, object visualization, asynchronous queries, coverage map

- **VO services:** TAP, SIAP, SCS, HiPS, Obscore, MOC



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Data Publication: Archive Content

- **Reduced Individual Images**
- **Coadded Images**
- **Catalogues data**
  - Parameters measured from coadded images
  - Photometry in the different bands using different methods
  - Information stored in tables

→ **High amounts of vectors columns**

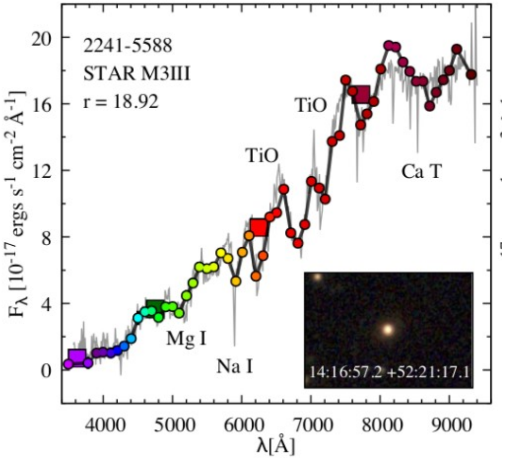
TAP & ADQL: Our vector implementation

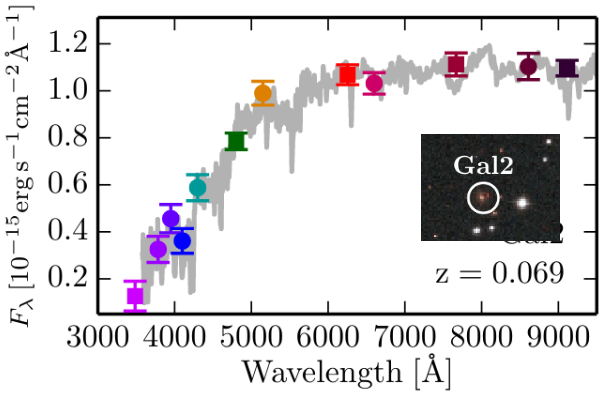
- **Implemented at CEFCA**:

python Pyramid™ PostgreSQL

- **Working with vectors since** our first DR: J-PLUS EDR (**2017**).

- Mainly used to **store objects photometry** and **flags**.
  - **Each position** represents the measure in a **different band**.





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Vectors: Element access

my_array[index]

- Being index an integer value.
- Arrays start at position **1**.
- Elements outside [1,n] range = NULL

- New ADQL extension: **Enumerations**
  - To make data access easier and queries more readable

Enumerations

enumeration::item

- Enumeration: A way of assigning a set of names to a range of numbers.

- Use in **element access** of vectors:

  MAG_AUTO[1] → MAG_AUTO[jplus::rSDSS]

- Use as **constants**:
  - Flags: jplus_img_flag::AFFECTED_BY_CLOUDS
  - Calibration methods: calibration_method::GWDL

Vectors: Math operations implemented

- Math operations between two vectors:

array_add(arr1, arr2)

array_sub(arr1, arr2)

array_div(arr1, arr2)

array_mult(arr1, arr2)

- Currently, only available for float type

Vectors: Math operations implemented

- Math operations between a vector and a scalar:

array_add_scalar(arr, scalar)

array_sub_scalar(arr, scalar)

array_div_scalar(arr, scalar)

array_mult_scalar(arr, scalar)

- Currently, only available for float type

Vectors: Aggregation operations implemented

- Obtain the **largest** and **smallest** elements:

```
array_max_int(arr)            array_min_int(arr)
array_max_float(arr)          array_min_float(arr)
array_max_ts(arr)             array_min_ts(arr)
```

Improvement: Having a single function for different data types

- Create an **array from scalar values** (group by):

```
array_agg(scalar)
```

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Vectors: Other operations implemented

- Check if an **integer** value is **present** in the array:

```
in_array_int(arr, value)
```

- Improvement: Having a single function for different data types

A proposal for vector math in ADQL

- October 2022 IVOA Interoperability Meeting
- Presented by Jon Juaristi **Campillo** & Markus **Demleitner**

- **Main differences** with our implementation:
  - **Basic math operations**:
    - Same operations defined but different syntax:
      - Campillo & Demleitner's: math operators (+, -, /, *)
      - OAJ's: functions (array_add,...)

A proposal for vector math in ADQL

- **Main differences** with our implementation:
  - **Names convention:**
    - **array_operation** instead of **arr_operation**
  - **Interesting functions** we do not have:
    - arr_dot(arr1, arr2)
    - arr_sum(arr1, arr2)
    - arr_avg(arr)
    - arr_map(expr_over_x, arr)
    - Slices

Conclusions and future work

- **Standardization** of vectors and their functions → **important** and **necessary**.
  - ADQL 2.2?

- Proposal for vector math in ADQL of **Campillo** & **Demleitner** → **good point to start**.
  - **Math operations** → Use functions instead of operators
  - **Slices** → Function arr_slice instead of [lower:upper] syntax
  - **Add functions** → in_arr, arr_agg

Conclusions and future work

- **Standardization** of enumerations → **useful**.
    - ADQL 2.2?

- We are going to continue improving our vector functionality:
    - Adding **new functions** → arr_sum, arr_map,…
    - Adding **slices** functionality
    - Implementing **operations** available for **more data types**.
    - Changing **name** convention → arr instead of array

THANK YOU!

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THANK YOU!

Questions or comments?

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