Towards Kazakhstani Virtual Observatory Using Data Archive of the Fesenkov Astrophysical Institute

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What we did at school?

We have studied such programs as

- CDS instruments;
- TOPCAT;
- STILTS;
- Aladin;
- MOC;
- HiPS

from the user's position. However, for my work it is necessary **to change the position**.

Fesenkov Astrophysical Institute (FAI)

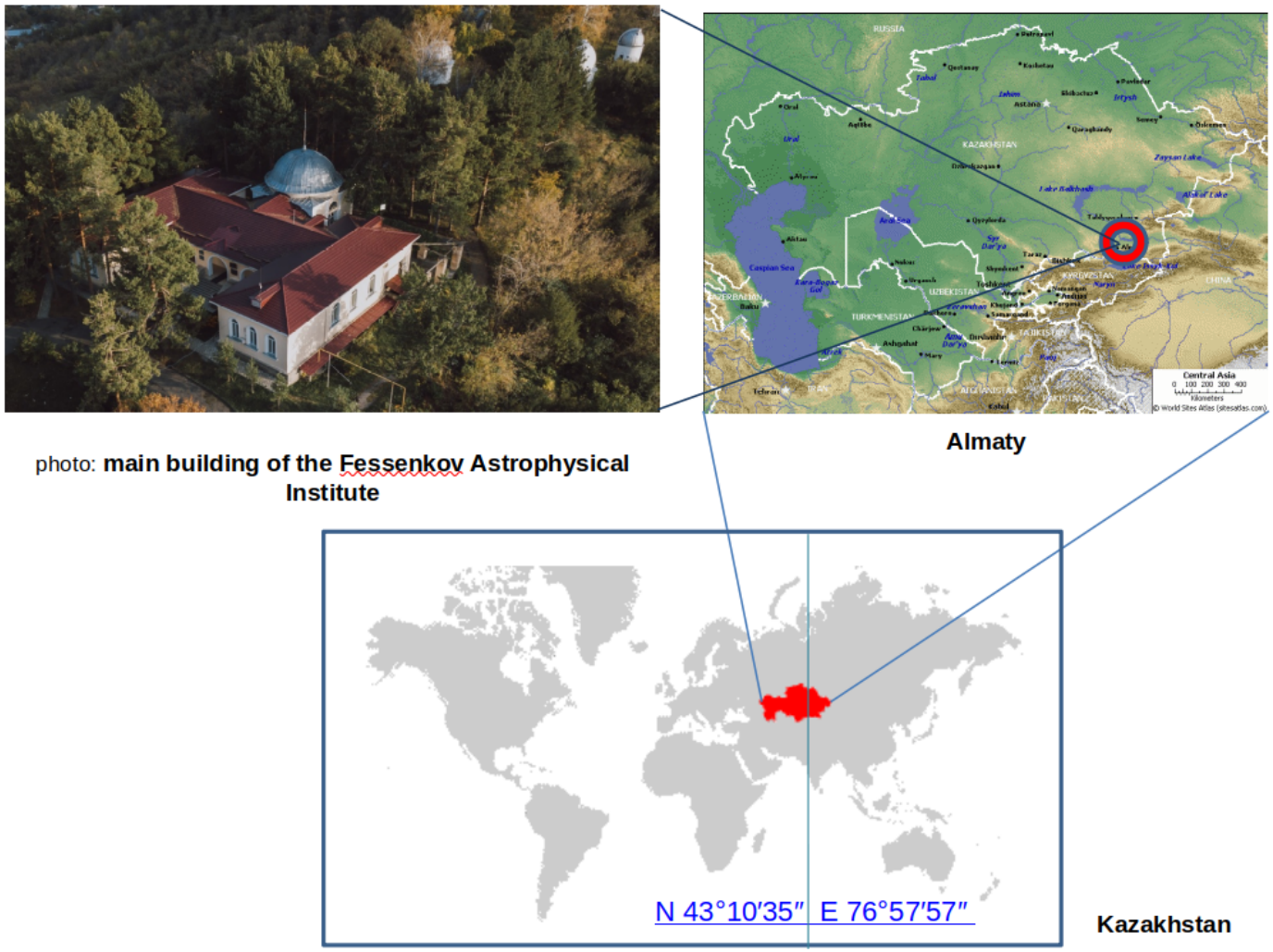

Figure: Location of FAI.

Glass Library

The Institute has an archive of plates - the Glass library. It consists of observational data for the period **1950-2000** and consists of about **20,000 plates**.
Data about each plate is stored in paper logs. This data is digitized into a Digital Journal, which represents a table. All data in the table is entered **manually**.

Complete frames

Data in header of each frame is taken from Digital Journal. So, complete frame is

digitized plates + data from Digital Journal

Automatization of header writing

To automatization the writing of headers, we wrote a script in the Python programming language. It allows us

- to minimize the human factor;
- reduce the time required for writing header.

Examples of headers

IC5446_12-13.09.1963_15m_3-2629.fit

File Edit Font

```
SIMPLE  =                    T
BITPIX  =                   16 /8 unsigned int, 16 & 32 int, -32 & -64 real
NAXIS   =                    2 /number of axes
NAXIS1  =                 4269 /fastest changing axis
NAXIS2  =                 4233 /next to fastest changing axis
BSCALE  =   1.0000000000000000 /physical = BZERO + BSCALE*array_value
BZERO   =   32768.000000000000 /physical = BZERO + BSCALE*array_value
INSTRUME= 'EPSON   ' /          instrument or camera used
SWCREATE= 'SilverFast 8.0.1 r45 (Apr 24 2014)  7450a21 24.04.' /Name of
        software
INPUTFMT= 'TIFF    ' /          Format of file from which image was read
XORGSUBF=                   56 /Subframe X position in binned pixels
YORGSUBF=                  136 /Subframe Y position in binned pixels
SWMODIFY= 'MaxIm DL Version 6.11 150610 1S5HR' /Name of software
SWSERIAL= '1S5HR-NNT5S-W38JM-P32PS-MHYMR-82' /Software serial number
HISTORY  Edit Crop
BAYERPAT= 'INVALID ' /          Indicates validity of image's Bayer pattern.
CSTRETCH= 'Moon    ' /          Initial display stretch mode
CBLACK  =                  937 /Initial display black level in ADUs
CWHITE  =                17527 /Initial display white level in ADUs
PEDESTAL=                    0 /Correction to add for zero-based ADU
SWOWNER = 'Maxim Krugov' /      Licensed owner of software
END
```

IC5446_12-13.09.1963_15m_3-2629.fits

File Edit Font

```
SIMPLE  =                    T  /  FITS STANDARD
BITPIX  =                   16  /  FITS BITS/PIXEL
NAXIS   =                    2  /  NUMBER OF AXES
NAXIS1  =                 4269  /
NAXIS2  =                 4233  /
BSCALE  =                    1 / REAL = TAPE*BSCALE + BZERO
BZERO   =                32768
ORIGIN  = 'KPNO-IRAF'           /
DATE    = '2022-01-20T05:32:05'
IRAFNAME= 'IC5446_12-13.09.1963_15m_3-2629.fit'  /  NAME OF IRAF IMAGE FILE
IRAF-MAX=          6.553500E4  /  DATA MAX
IRAF-MIN=          1.400000E2  /  DATA MIN
IRAF-BPX=                   16  /  DATA BITS/PIXEL
IRAFTYPE= 'USHORT  '            /  PIXEL TYPE
INSTRUME= 'EPSON   ' /          instrument or camera used
SWCREATE= 'SilverFast 8.0.1 r45 (Apr 24 2014)  7450a21 24.04.' /Name of
        software
INPUTFMT= 'TIFF    ' /          Format of file from which image was read
XORGSUBF=                   56 /Subframe X position in binned pixels
YORGSUBF=                  136 /Subframe Y position in binned pixels
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HISTORY  Edit Crop
BAYERPAT= 'INVALID ' /          Indicates validity of image's Bayer pattern.
CSTRETCH= 'Moon    ' /          Initial display stretch mode
CBLACK  =                  937 /Initial display black level in ADUs
CWHITE  =                17527 /Initial display white level in ADUs
PEDESTAL=                    0 /Correction to add for zero-based ADU
SWOWNER = 'Maxim Krugov' /      Licensed owner of software
IDN     = '3-2629  '
OBJECT  = 'IC5446  '
DATE-OBS= '1963-09-12T17:51:38.000'
EXPTIME =                900.0
OBJCTRA = '21:51:00.0'
OBJCTDEC= '47:01:12.0'
EPOCH   =                 1950
JD      =    2438285.244189815
TELESCOP= 'Wide aperture Maksutov meniscus telescope with main mirror 50 cm'
OBSERVER= 'Rozhkovskij D.A.'
OBSERVAT= 'FAI     '
END
```

Figure: Header of frame before adding data via script (left) and after that (right).

Virtual Observatory

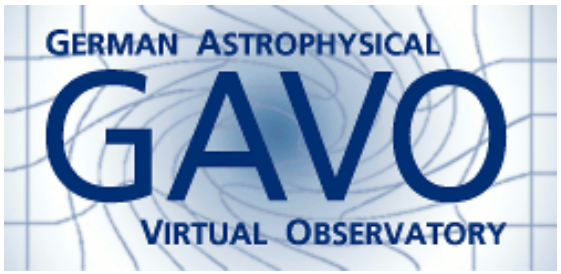
As part of a large project, it is planned to create a Kazakhstan Virtual Observatory using

archive data + new observational data

of Fesenkov Astrophysical Institute.

German Astrophysical Virtual Observatory (GAVO)

The German Astrophysical Virtual Observatory (GAVO) is the German contribution to the IVOA (International Virtual Observatory Association), the international effort to create and expand the Virtual Observatory (VO).



www.g-vo.org

Page on GAVO

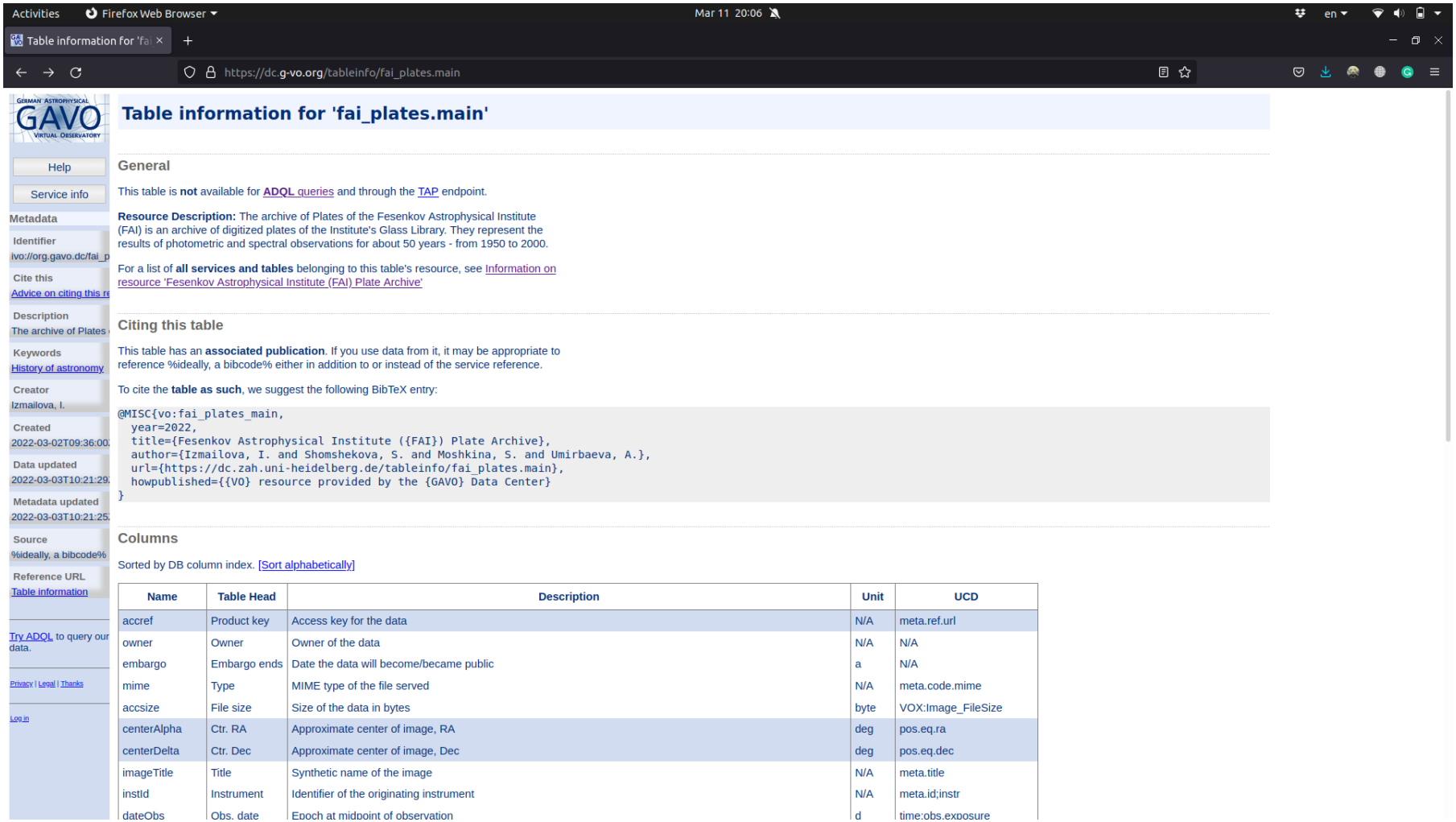


Figure: Main page of resource with data from FAI in GAVO.

Search page

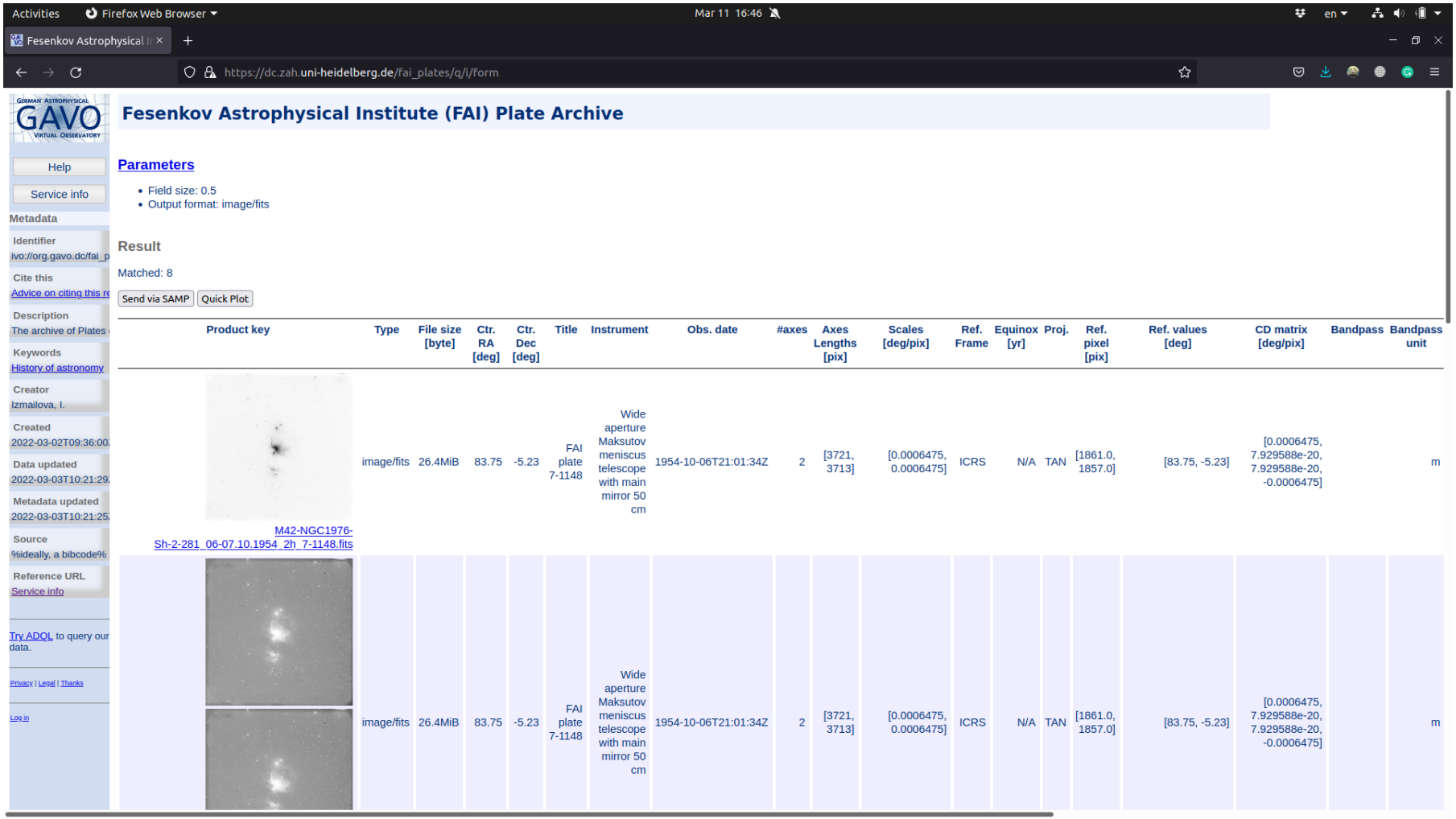


Figure: Page with search results of resource with data from FAI in GAVO.

Issue with coordinates

The coordinates of the objects on the astroplates have an **equinox B1950.0**. Therefore, when opening fits files in Aladdin, we observe an **offset in coordinates**.

Issue with coordinates. Aladin (1).

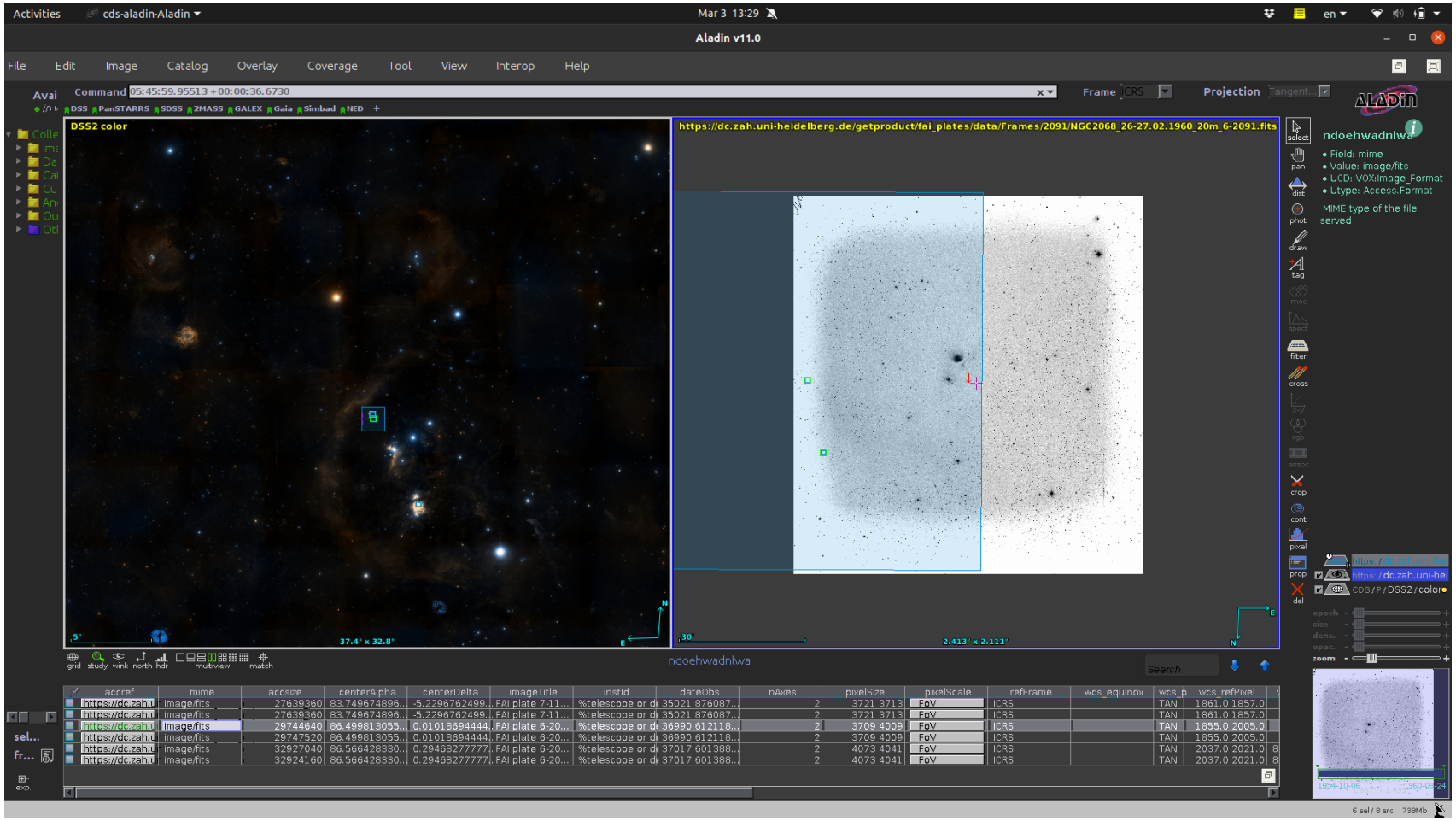


Figure: The shift of the square (blue) showing the coverage of the area in the sky relative to the frame itself.

Issue with coordinates. Aladin (2).

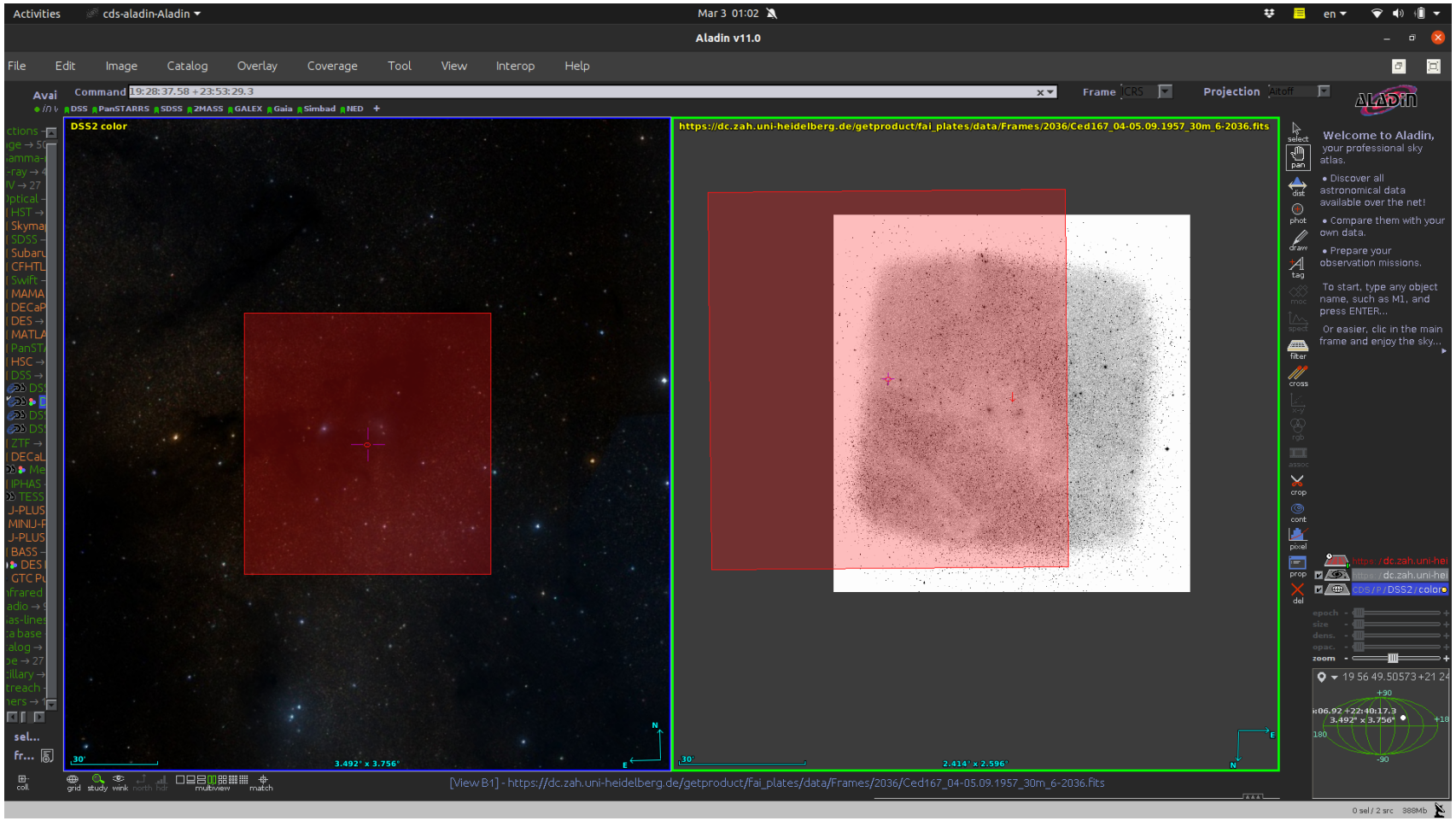


Figure: The shift of the square (red) showing the coverage of the area in the sky relative to the frame itself

Conclusion

- Participation in this school has greatly expanded the range of opportunities in scientific work. Of course, all the knowledge gained will be applied in the future.
- Work on the creation of a Virtual Observatory will continue.

Thank you for your attention!