# Informatics for Astronomers - WS2021

**Roland Ottensamer, Marina Dütsch, Miguel Verdugo, Andreas Schanz**

## Exercise sheet 10 - Astropy & GTK

---

*The following will be also part of the assessment:*

*(1) Try to present exercises in a way that everyone can understand (even those who didn't do the exercises), so please explain the vital parts of your solution in a clear way.*

*(2) Try to also include some background information where applicable, and/or explain the possible context/motivation for the given exercise.*

---

1. Smooth the image `MACSJ0416_HAWKI.fits`, `scipy.ndimage.gaussian_filter` using a kernel size of your preference (please explore!). Subtract the smoothed image from the original one.
   Save the smoothed *and* subtracted images in `fits` format (using `astropy`) and display them with with e.g. `ginga` (or `ds9`).

2. Take the image `MACSJ0416_HAWKI.fits`. Now, store the coordinates and pixel value in a list, array or table. Replace all pixels in a box of $20 \times 20$ pixels around that pixel with the median value of the image. Find the next pixel with the maximum value and repeat the process iteratively (let's say a 100 times). Save the results in an `astropy.table.Table`.

   What are we doing here? Draw circles on the original image around these positions

3. In Exercise 9, question 5 you were asked to go to the SDSS SkyServer at http://skyserver.sdss.org/dr15/en/tools/search/radial.aspx and search for objects around a position on the sky, setting the search radius to 30 arcmin. Download the data, setting the number to output rows to "max" (=0) so all objects are returned.

   Load the data with `astropy.table.Table` (`XML`, `CSV`, `VOTable` and `FITS` formats should be supported) and create the following plots.

   - an histogram of the object magnitudes (in 0.5 mag bins). Try setting the y-axis to linear and then switch to logarithmic.
   - a plot of the magnitude (any of them) vs their errors.

   What can we say about the survey characteristics from these plots?

4. The file `SDSS_spec_galaxy.csv` contains the spectrum of a star forming galaxy taken as part of the Sloan Digital Sky Survey. Load the spectrum with `astropy` and make a plot with `matplotlib`.

   Knowing that the H$\alpha$ line at $\lambda = 6562.8$ Angstrom (restframe) is the most intense line in this spectrum, please determine the redshift of this galaxy.

5. Fit Gaussians profiles to the H$\alpha$ ($\lambda$=`6562.8 A`) and to the `[OIII]` ($\lambda$=`5007 A`) lines in the spectrum `SDSS_spec_galaxy.csv` and overplot the fits. You might need to subtract the spectral continuum to make the fitting to work.

   - What is the flux of these lines?
   - What is the `sigma` in `Angstrom` of these lines?
   - Transform these `sigma` to the velocity dispersion in `km/s`.

6. Design a simple calculator with `python GTK` (instructions for installing GTK are below). The calculator should have an entry field and buttons for the numbers 0-9 and the operations add, subtract, multiply, and divide, as well as a result button. Use the `GtkEntry` and `GtkGrid` (or `GtkTable`) widgets for the entry field and buttons, respectively. The calculator does not need to work yet.

   GTK can be installed with conda using the following commands:

   ```
   conda install pycairo=1.18.2
   conda install -c conda-forge pygobject
   conda install -c conda-forge gtk3
   ```

   To avoid conflicts, you can first create a new conda environment:

   ```
   conda create --name=myenv python=3.8
   conda activate myenv
   ```