Werkcollege, Observational Astronomy 2017/2018
Week 1 (17 Nov 2017)

These are the assignments for the first week of the course *Observational Astronomy*. All students are required to hand in the answers to **Problem 1.3** below at a time agreed upon with the teaching assistant.
Once all hand-in assignments have been approved, the student receives 30 of the 100 points on which the final grade will be based. The remaining part of the grade will be based on the final project report.

Online resources

Astronomers were quick to realize the potential of the internet, and today a very large number of on-line resources are available. Here we explore a few that may turn out to be useful when preparing observations.

NED - the NASA-IPAC Extragalactic Database

- URL: `http://ned.ipac.caltech.edu`

The NED website contains a large amount of information for extragalactic objects. This includes images, measurements of distances and fluxes, references to publications, and many other things. It is possible to search for objects with a known name (for example M31, the Andromeda galaxy) or near a given position.

SIMBAD

- URL: `http://simbad.u-strasbg.fr/simbad/`

The SIMBAD database is another database, with more general information about astronomical objects. It is not tailored specifically for extragalactic objects so if you want to know, for example, the coordinates, brightness and other information for a star then SIMBAD will be useful.

Observability calculation via Isaac Newton Group

- URL: `http://catserver.ing.iac.es/staralt/`

When planning observations, one of the first things to check is when the targets of interest are observable. More specifically, we need to know when the objects rise and set and when they reach the maximum altitude above the horizon. Many observatories provide web-based observability calculators. Among these is the *Isaac Newton Group* of telescopes on La Palma, Canary Islands. The ING observability calculator is useful as a general tool, because it is easily configured for other locations than La Palma.

1.1 Planning of observations

You are planning observations for the first half of the night of 14 January 2017. You want to observe a galaxy and are considering three possible targets: M51, M33 and NGC 891.

You are observing with the 35 cm telescope, using a CCD camera with a field-of-view of 10×10 arcmin.

- Which of the three galaxies do you choose?

Think about when it is observable, and also whether the size of the galaxy is suitable for the telescope/camera. The geographical coordinates for the Huygens building are 5.8686°E, +51.8233°

1.2 Orientation on the night sky

There are many on-line resources that can be helpful when trying to get to know the night sky. At the site `http://www.heavens-above.com` you can produce star charts for specific locations on Earth at any given date and time. This site also has databases of things that move with respect to the stars, such as planets, satellites, and comets.

1. Open a web browser and go to `http://www.heavens-above.com`
2. Set your location to Nijmegen
3. Now click on the *Sky Chart* and set the time to 22 o'clock tonight.
   - Looking towards the East, which constellation(s) do you see in that direction? To the North? Straight up?
   - In which direction will the constellation Orion be seen later in the night?
   - The brightest stars in Ursa Major make up the "Big Dipper" (Dutch: *de Steelpan*). Is the Big Dipper circumpolar as seen from Nijmegen? How would the answer change for observing locations closer to the North Pole / Equator?
4. Now suppose you step outside on Christmas Eve at midnight.
   - Where is Orion now?
   - If you draw an imaginary line through the three bright stars in Orion's belt and extend this line towards the left, which bright star do you encounter?
     Hint: Heavens-above also has a list of constellations that includes information about the brightest stars.
   - Which bright star is located near the Zenith?

1.3 The sky as seen from Nijmegen - *hand-in assignment*

In this exercise we will practice some basic concepts related to the night sky above Nijmegen. For the purposes of the exercise, you can approximate the coordinates of the Huygens building as (6° E, +52° N).

Answering the questions does not require any complicated calculations - a pen and paper will suffice!

Recall that the zero-point of the Right Ascension scale is defined as the intersection of the ecliptic plane and the celestial equator. There are, of course, two such intersections – the zero-point is at the *vernal* (spring) equinox, which occurs around 20 March every year.

1. Nijmegen is about 9° west of the centre of the Central European time zone. Approximately when does midnight (in the astronomical sense) *actually* occur?

2. On the 20 March, what is the maximum altitude of the Sun above the horizon, seen from Nijmegen?

3. On the same date, what is the (approximate) siderial time at (astronomical) midnight?

4. Answer the same questions half a year later, i.e. around the time of the autumnal equinox ($\sim$ 22 September)

5. What is the lowest declination that just rises above the horizon (give the answer in whole degrees)? Note that it is not generally useful to observe objects that are less than $\sim 20° - 30°$ above the horizon, due the increasing path length through the Earth's atmosphere.

6. What is the requirement for an object to be circumpolar (i.e., always remain above the horizon)?

7. What is the requirement for an object to pass through zenith?

On 20 November 2016 the Sun sets at 16:39 in Nijmegen. At 18:39 the Sun is 18° below the horizon – this marks the end of astronomical twilight.

8. What is the siderial time at the end of astronomical twilight (give the answer to the nearest hour)?

9. At this time, what are the equatorial coordinates (Right Ascension and Declination) of an object that is just rising in direction due East?