5th IOAA
SILESIA POLAND 2011

Data Analysis questions

Instructions

1. In your envelope you will receive an English and native language versions of the questions.
2. You have 2.5 hours to solve 2 tasks.
3. You can get maximum 25 points for each task.
4. You can use only the pen and tools given on the desk.
5. The solutions of each task should be written on the answer sheets, starting each question on a new page. Only the answer sheets will be assessed.
6. You may use the blank sheets for additional working. These work sheets will not be assessed
7. At the top of each page you should put down your code and task number.
8. If solution exceeds one page, please number the pages for each task.
9. Draw a box around your final answer.
10. Numerical results should be given with appropriate number of significant digits with units.
11. You should use SI or units commonly used in astronomy. Points will be deducted if there is a lack of units or inappropriate number of significant digits.
12. At the end of the test, all sheets of paper should be put into the envelope and left on the desk.
13. In your solution please write down each step and partial results.
14. Graphs for tasks number 1 and 2 should be prepared on the plotting paper.

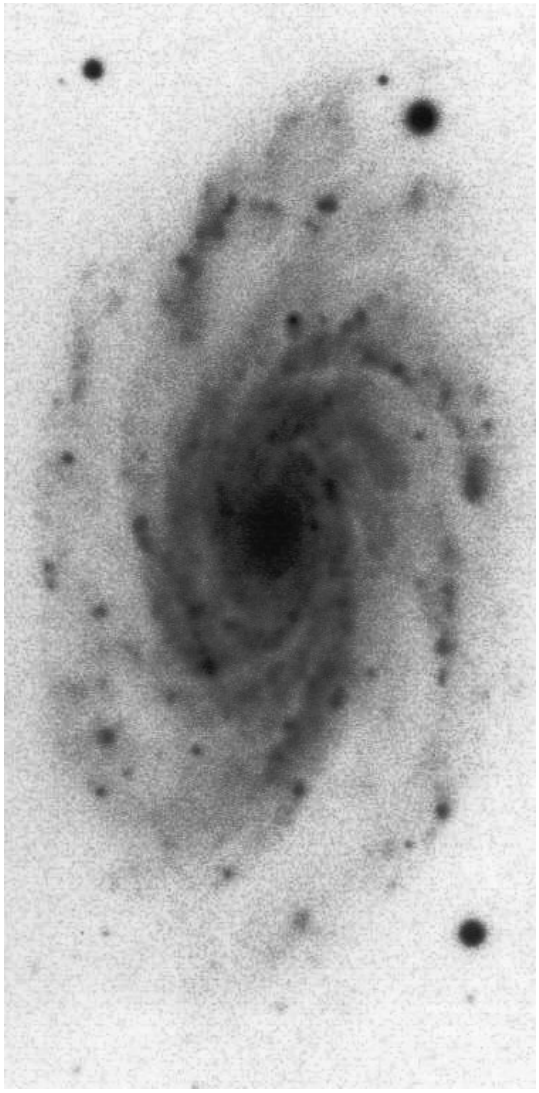
2. Weighing a galaxy

The attached images show a photograph of the spiral galaxy NGC 7083, which lies at a distance of 40 Mpc, and a fragment of its spectrum. The slit of the spectrograph was aligned with the major axis of the image of the galaxy. The *x*-axis of the spectrum represents wavelength, and the *y*-axis represents the angular distance of the emitting region from the core of the galaxy, where 1 pixel = 0.82 arcsec. Two bright emission lines are visible, with rest wavelengths of $\lambda_1 = 6564$ Å, $\lambda_2 = 6584$ Å.

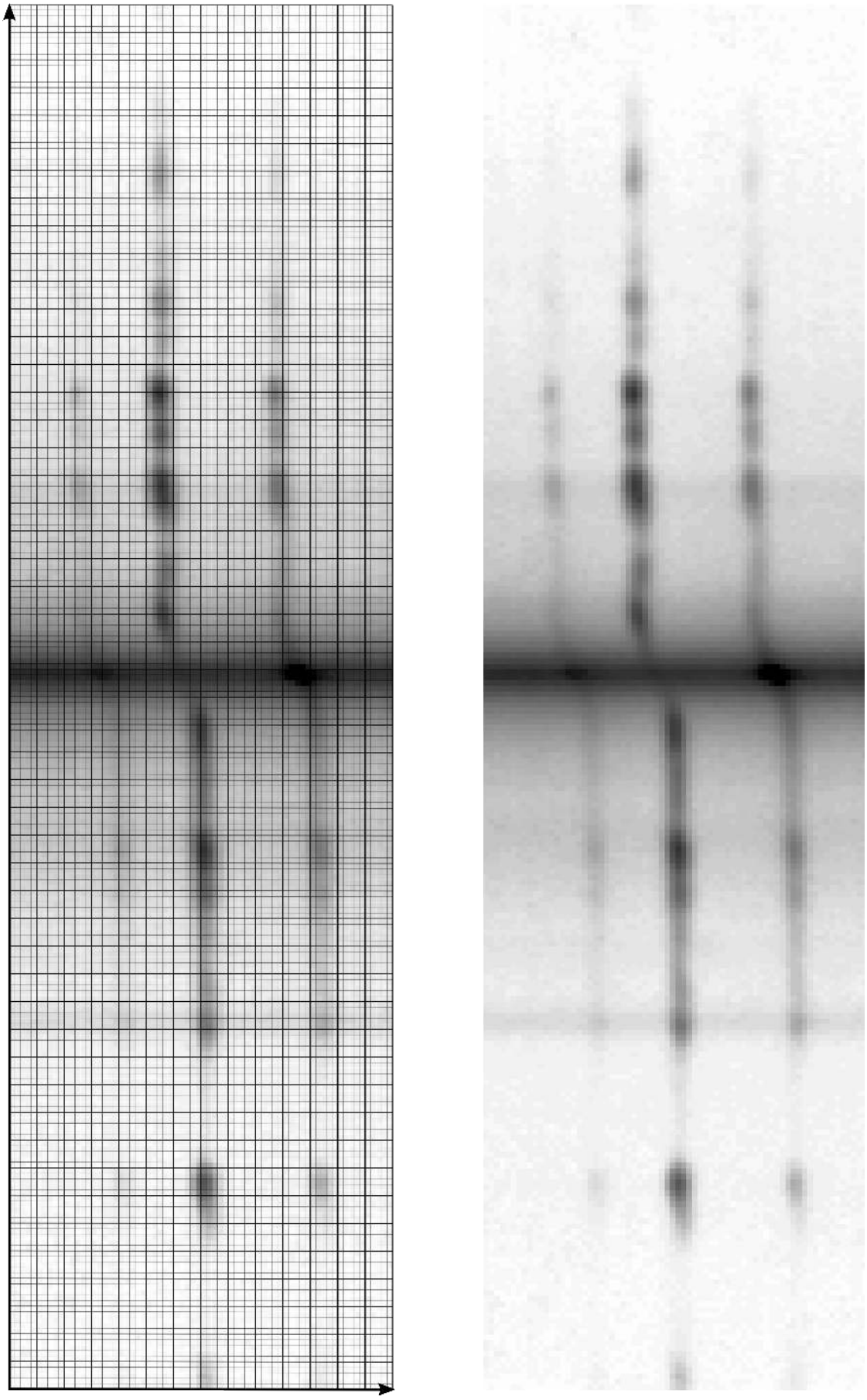
Use the spectrum to plot the rotation curve of the galaxy and estimate the mass of the central bulge.

Assumption: central bulge is spherical.

The photograph of the galaxy has the correct proportions.



NGC 7083



Spectrum of NGC 7083. Grid marks pixels.