

Laboratory of Data Analysis

MSc in Astrophysics and Space Physics

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Class 02

What we have learnt last class (practice):

2. Why do galaxies in the same galaxy cluster seem to exhibit different colours ?

GROUP 6

What are the physical variables that determine the color of a galaxy? How do the relations between these variables change according to the environment (e.g. number density) of origin?

4. Is the color of an observed galaxy related to their shape?

♥ GROUP 4 ♥

What are the physical processes that determine the spatial distribution (velocity dispersion, luminosity profile) of stars in a galaxy? What is the physical relation that connects the stars spatial distribution to the observed color of a galaxy, if there is any?

5. What is the most probable galaxy to find in a cluster?

GROUP 1: What is the relationship between the number density of red galaxies and the total number density of galaxies in a group (environment)? Is this relationship observed in different clusters? Does it depend on the redshift?

9. Galaxies that are close to each other also have the same composition ?

Group 3: Given 2 emission lines, what is the line ratio between their fluxes, for a sample of galaxies at different redshifts? Is there a relation between the line ratio and the redshift?

11. Why are most of the galaxies reddish?

GROUP 5: What are the physical processes and variables that determine the color of a galaxy in the optical image (of the Abell Galaxy Cluster)? What is the numerical distribution of the galaxies as a function of the distance from the center of the cluster and color? What is the dominant physical variable behind the yellow emission?

15. What are the main relations between the distribution of Lyman alpha emission in M82 and the galaxy features?

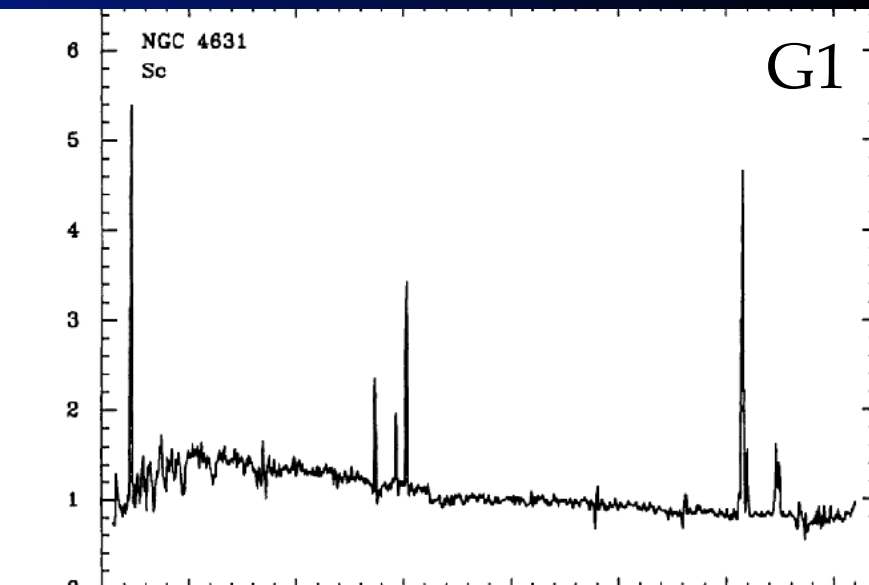
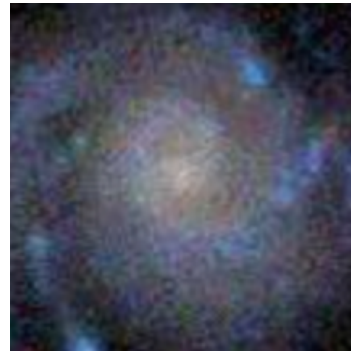
Group 7: What are the main physical variables (like flux, color) that describe the spectrum of the H alpha emission that we see in the perpendicular plane to the M82 galaxy? And what are physical variables that correlate the center of the galaxy to the H alpha emission that we see around it?

They are all great questions!

Essential ingredients of an *investigable scientific* question:

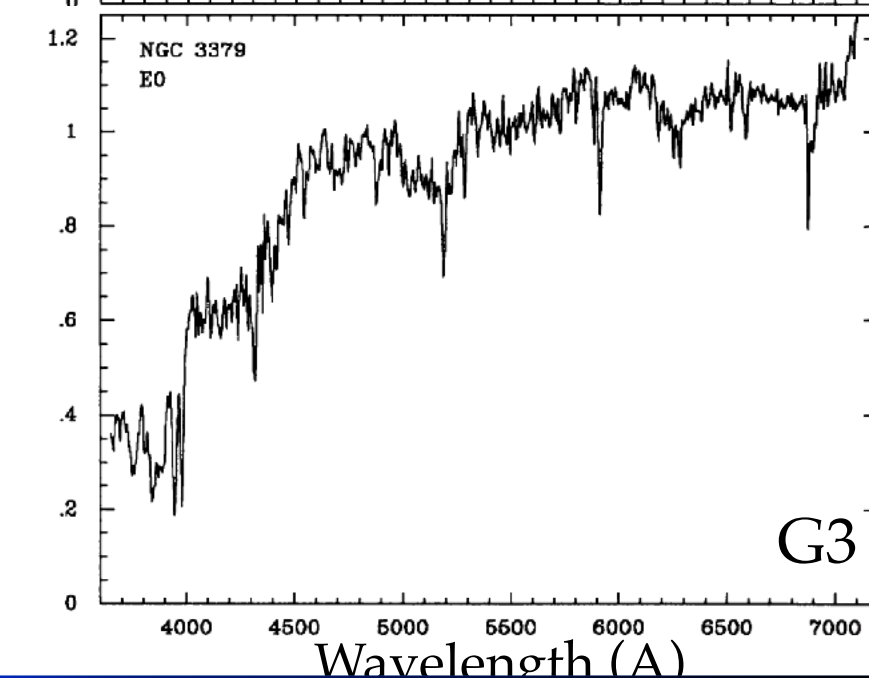
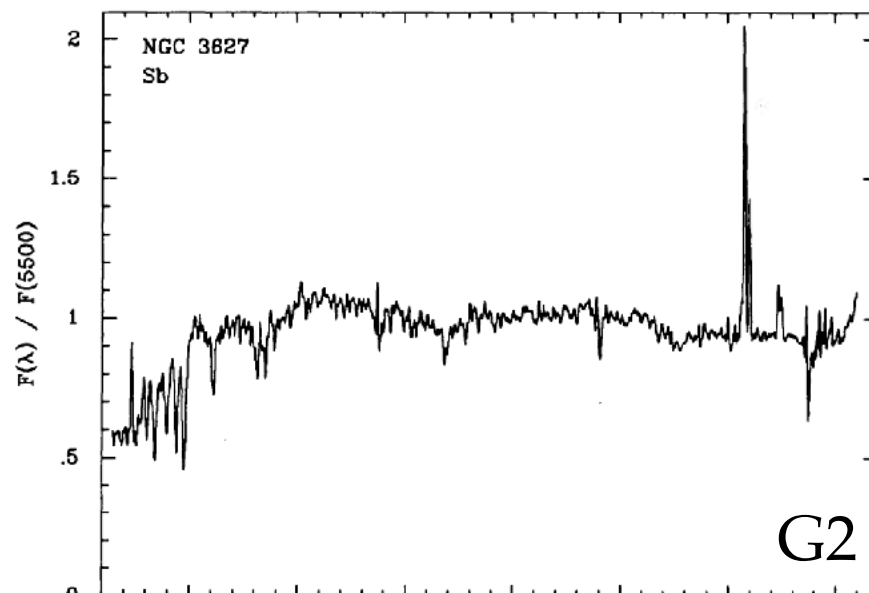
- The “subject” of the question is a clearly specified *physical* variable and / or *observable* variable or the “relation” between such variables;
- The question is (or can be easily turned into) a “testable prediction / statement”;
- If more “subjects” are present, the question can be split into smaller / coherent testable “units”.

Today's activity: investigating the optical spectra of galaxies

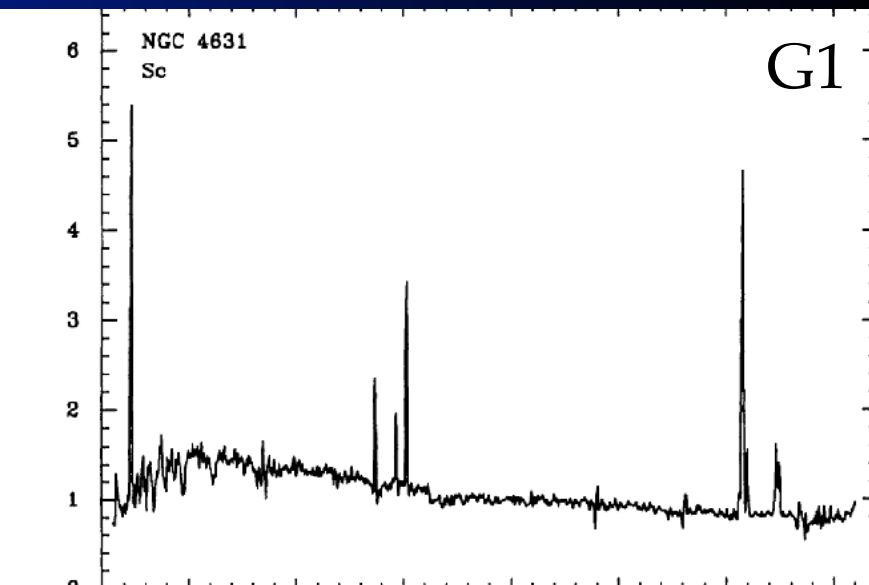
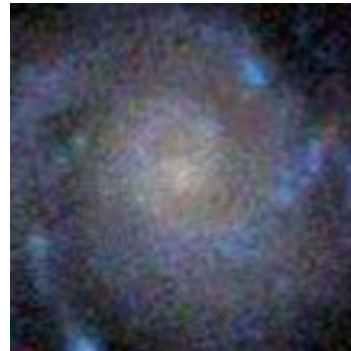


- PART 1: Find and list the relevant features / “components” of these spectra (just observe them without interpretation!)

NB: fluxes are normalised and y-axis scales are different for each galaxy (!)



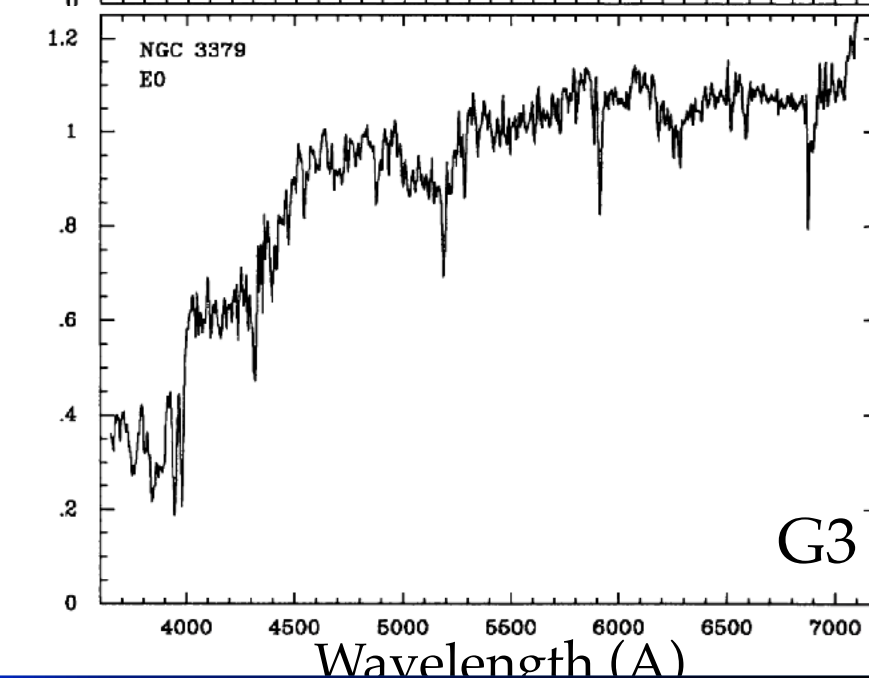
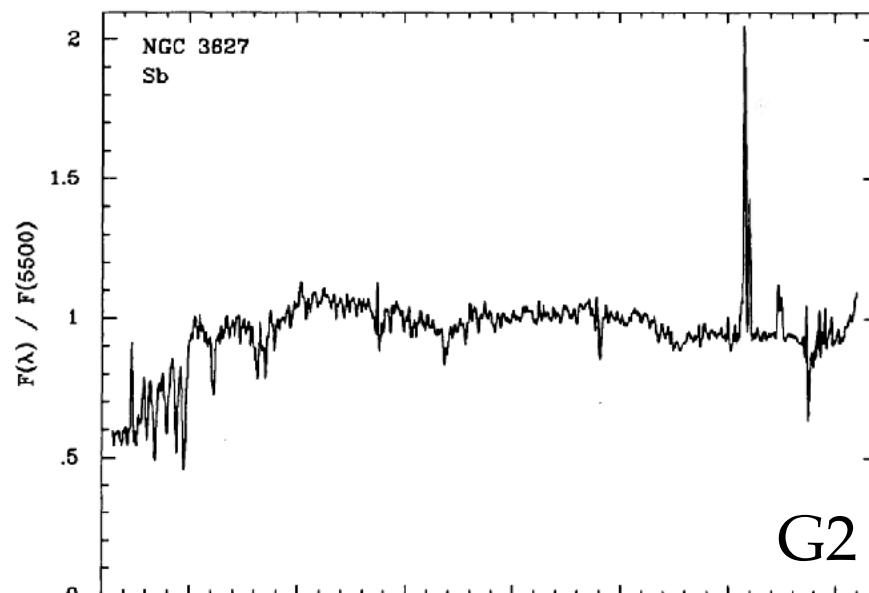
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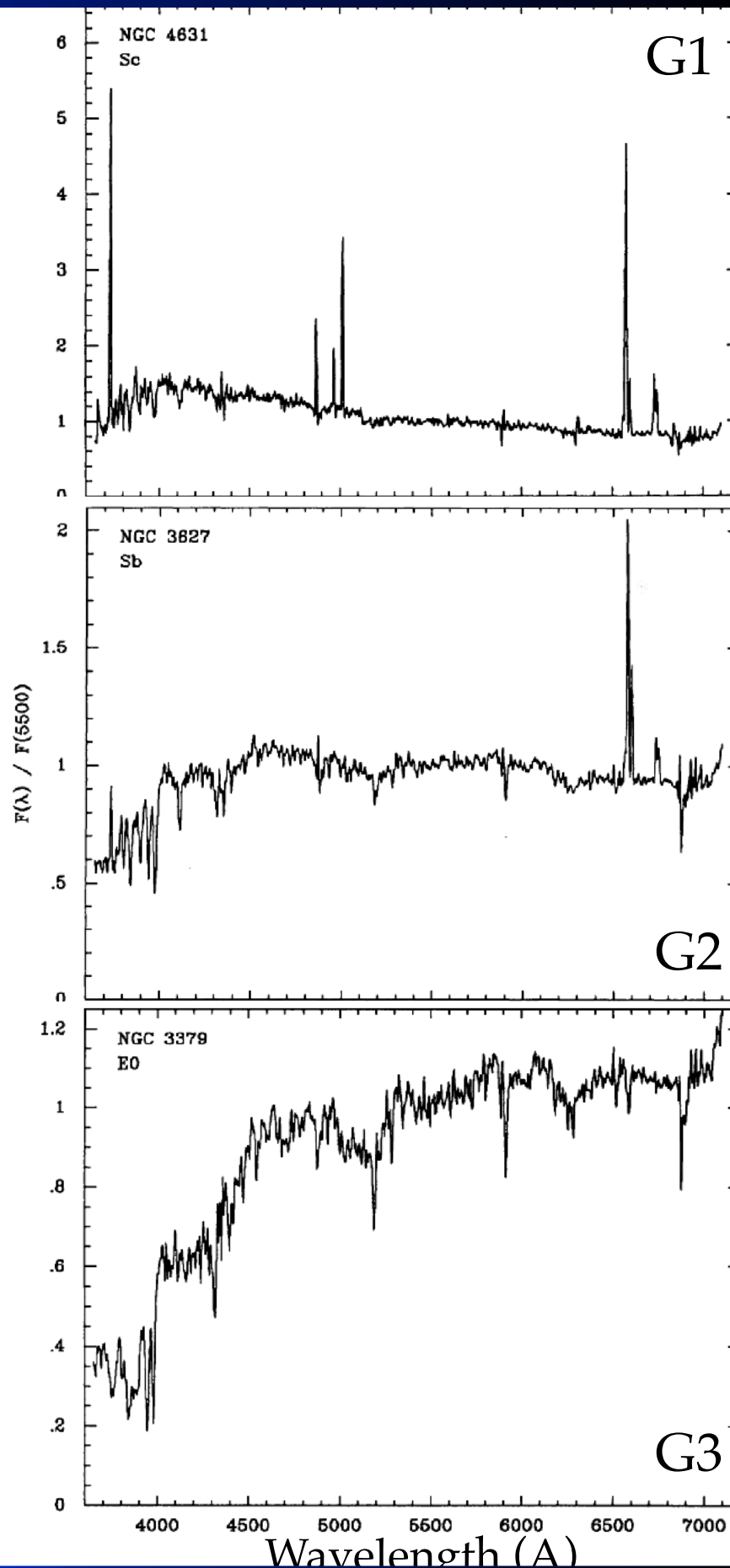
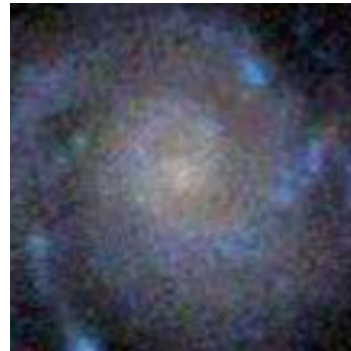
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SHARING



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- PART 1: Find and list the relevant features / “components” of these spectra (just observe them without interpretation!)

NB: fluxes are normalised and y-axis scales are different for each galaxy (!)

- PART 2: What are the physical properties of the galaxies (G1-G3) which determine the galaxies' optical spectral shapes? *Why do they differ from each other?*

- Tips for your investigation (PART 2):

- Focus on one single “component” at a time and split problem in its smallest units.
- List the possible physical processes which can produce such “component”
- Make a testable hypothesis and develop a model based on a set of assumptions (which you can test later, if needed)
- Find relevant physical variable(s)
- Test your models comparing them to the observed spectra