UNIT 2:

DISTANCES (1st part). GALAXIES

Author: Oswaldo González

Content revision and updating: Nayra Rodríguez

Scientific Advisor: Alfred Rosenberg

Ilustrations: Inés Bonet

TEACHERS GUIDE

This unit has been designed for students to have a first contact with astronomical units of distance and the huge distances in the universe, learning the firsts techniques used by astronomers to calculate the distances to distant objects.

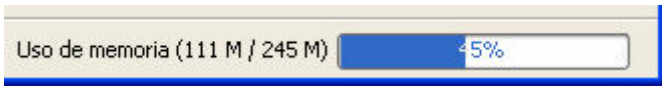
The student should classify 17 previously selected galaxies from a gallery of galaxy images obtained with the Liverpool robotic telescope. To do this, students should study the galaxies shapes using the program visualization tools such as filters, which enhance and highlight certain parts of the galaxies difficult to discern.

Same as in Unit 1, here we ask the student to measure the objects diameter, in this case, with the difficulty of having their limits not as well defined as in the planets. Students will have to work with the images using the software's tools to determine how big they are. As a tip, one of the best combinations of filters to properly observe the galaxies limits and to determine its size more accurately is the tool ***negativizar***, that inverts the grayscale (bright areas become black instead of white), after which the use of ***Ecualizar*** or ***umbral*** (threshold) tools, the last one raising the threshold value until the galaxy begins to be confused with the background.

Galaxies are at different distances, so the physical size equivalent to an image pixel will be related to this distance. That is, the greater the distance, the the greater the physical size corresponding to a pixel too. ***ASTRO*** tab can get the scale in *light-years* per *pixel* of each image.

If, through the opening of such a large amount of images, you notice your computer slows down, you can free up memory by clicking twice on the bar

indicating the memory in use, which is located at the window programs right bottom.



click twice

Even so, you may not be able to open all the images at once, so we recommend closing and opening images as they're being analyzed.

In some images, other galaxies and stars appear near to the galaxy we want to study. To differentiate the galaxy that interests us from other image objects, we should know that it normally appears centered on image (it´s easy to distinguish it if we reduce the image size to full view). The telescope focuses its view on the galaxy coordinates that interests us. Moreover, it's easy to differentiate a galaxy from stars that may be in the image. The stars will be as bright circles with a kind of X that parts from its center, while galaxies have the oval or disc shapes that we have studied. The X pattern is due to the light diffraction that occurs in the secondary reflecting telescopes mirror support (like the Liverpool Telescope), which normally has X-shaped. The stars, being much closer to us than the studied galaxy (the individual stars we see belong to our galaxy), will have much greater apparent brightness than the galaxy and therefore, produce higher diffraction pattern.

Below, we show a table with the names of the galaxies, their classification and the actual diameter size. The student, performing galaxies size measurements, will probably get much smaller values than those shown in the following table, which is due to the limitations of the image analysis program when determining the edge of the object to be measured.

The most detailed morphological classification (which we include in parentheses in the table) has been obtained, in many cases, from deeper images than the ones we use in this activity and with other more elaborate analysis methods. Therefore, it is not intended that students get the exact classification but is given to the teacher as orientation for complementary development of the Activity 2.

Image	Object Name	Classification	Scale (*light-years-/pixel*)	Diameter (thousands *light-years*)
885g000	NGC 7626	Elliptical (E1)	219.7	123,1
885h000	NGC 7479	Barred Spiral (SBc)	156.5	136,2
885i000	NGC 7457	Elliptical (E7/S0)	63.1	57,4
885j000	NGC 524	Elliptical (E0/S0)	154.3	90,8
886a000	NGC 266	Barred Spiral (SBab)	296.6	187,3
920j000	NGC 1161	Elliptical /S0	126.6	76,3
962a000	NGC 2487	Barred Spiral (SBb)	293.4	164,4
975i000	NGC 2776	Spiral (Sc)	162.2	75,2
1013j000	NGC 3193	Elliptical (E3)	80.4	31,2
1053b000	NGC 4567	Elliptical (Sc)	136.1	86
1053c000	NGC 3883	Elliptical (Sb)	429.2	271,1
1055e000	NGC 4618	Barred Spiral (SBm)	36.4	32,5
1059j000	NGC 4914	Elliptical (E4)	290.5	215,7
1073e000	NGC 5908	Elliptical (Sb)	212.7	147,2
1073g000	NGC 5371	Spiral (Sb/SBb)	162.1	150,9
1073h000	NGC 6632	Spiral (Sbc)	304.4	196,6
1090i000	NGC 5850	Barred Spiral (SBb)	157.6	143,4

S(B)ab or S(B)bc: intermediate spirals type among S(B)a and S(B)b, or S(B)b and S(B)c.

S(B)m: irregular spirals. NGC4618 has a unique spiral arm, for example.

- Data obtained from the image information.
- Data obtained from the student estimation
- Real data

For further information, visit our website: **www.iac.es/peter**

Contact: **Nayra Rodríguez Eugenio** (peter@iac.es)
Unidad de Comunicación y Cultura Científica
Instituto de Astrofísica de Canarias
Calle Vía Láctea s/n
38205 La Laguna
Santa Cruz de Tenerife
España

This didactic unit has been financed by: