UNIT 4:

GAS GIANTS

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TEACHER'S GUIDE

The aim of this unit is for students to study the morphology of the planets by studying their visible surface and try to extract data of interest with the measurements they can make from the images. Although it is not completely necessary, it would be interesting for students to have a basic knowledge of trigonometry to calculate the inclination of Saturn's rings.

Next, we will show the results of each activity. It should be noted that the results given do not have to match those obtained in the classroom, but they serve as a reference.

ACTIVITY 1

MEASUREMENT OF JUPITER'S FLATTENING AND DETECTION OF ITS RED SPOT

The image we used to calculate Jupiter's flattening was chosen because of its proximity to the date of opposition, so that we see the entire surface of the planet. At any other time (just one month before or after opposition), the phase of the planet would make the distance we measured along the equator smaller than the actual distance.

- The measured equatorial diameter is: 162.8 pixels
- The measured polar diameter is: 153.9 pixels

Applying the formula we obtain:

$$\left(1 - \frac{Diámetro\ polar}{Diámetro\ ecuatorial}\right) * 100 = 5{,}4\ \%$$

That is, the polar diameter is 5.4% smaller than the equatorial diameter.

The most precise data on Jupiter's polar and equatorial diameters are as follows:

- Polar diameter: 135,000 *km*
- Equatorial diameter: 142,800 *km*

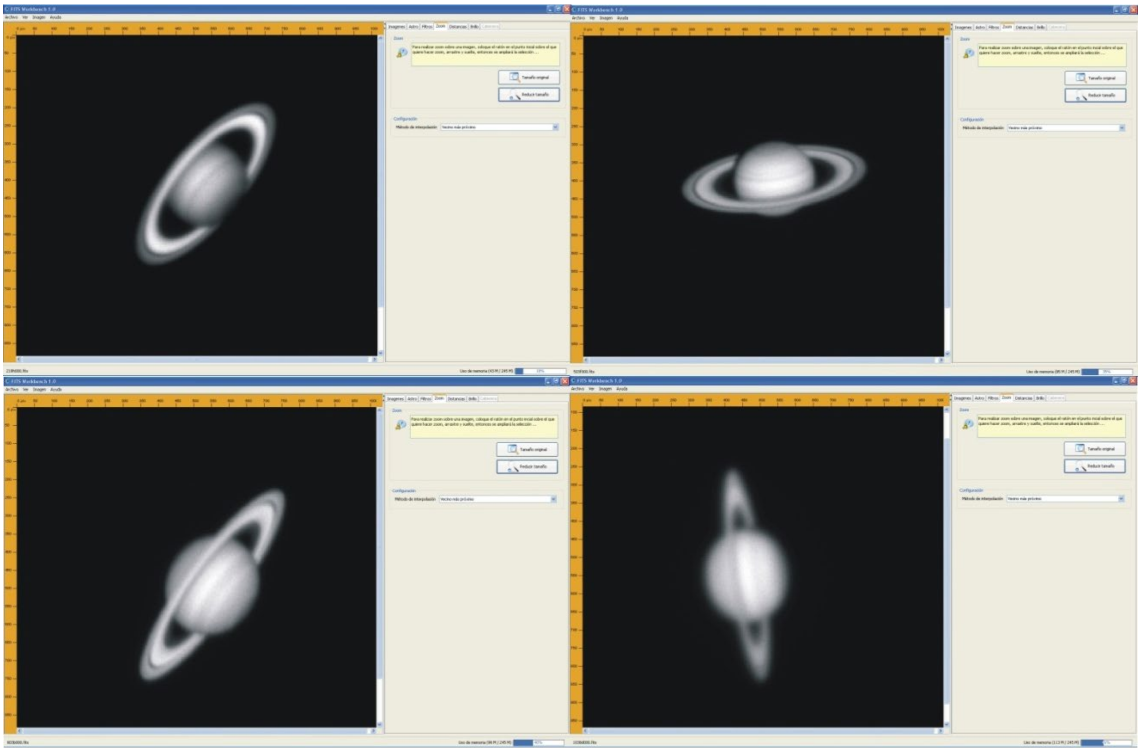
Applying the formula, we obtain a 5.5 % flattening.

The measurement obtained for the GMR is about 32 pixels, which, multiplied by the 1,040 *km* for each pixel, gives a size of 33,280 *km* for this storm, more than twice the size of the Earth. This value is approximate, as it is very difficult to determine where this cloud area begins and ends.

ACTIVITY 2

INCLINATION OF SATURN'S RINGS

As Saturn moves through its orbit, the appearance of its rings changes, as can be seen in the following images taken over four years. The inclination of the rings is decreasing, so that they become invisible during August and September 2009, when they would be seen edge-on.



With the data of the diameters in the equatorial and polar directions of the rings we can obtain their inclination. We have to clarify that, while the ends of the outer ring are perfectly visible in the equatorial direction, this is not the case when we try to measure it in the polar direction, because the planet itself hides the ring system. Therefore, we will have to estimate the position of the edge by extending the visible part on both sides of the planet. Although this is not an exact method, it is useful to have a good estimate of the inclination at which we see the planet's ring at that moment.

Image	Date	Equatorial Diameter (Te)	Polar Diameter (Tp)	Tp / Te	arcsen(Tp/Te)· 180/π
218h000	01/13/2005	172.5	69.7	0.4041	23,8 º
503f000	02/24/2006	168.3	55.9	0.3321	19,4 º
803b000	02/10/2007	170.1	42.0	0.2469	14,3 º
1038d000	03/11/2008	166.4	28.7	0.1725	9,9 º

Data obtained from the measurement made by the students
Data obtained by making the necessary calculations

With the data obtained for the inclination of Saturn's rings as seen from Earth, we found that it was decreasing over those 4 years. At the end of the summer of 2009 the inclination of the rings would be 0º.

We could also repeat the measurement of Saturn's flattening, which is even greater than that of Jupiter. For this we must measure the diameter of the planet, not counting the rings. In the *ASTRO* tab we can see that the scale factor in the first image is 1,630 *km* per pixel. If we multiply this value by the diameter measured in pixels, we obtain

- Saturn's polar diameter: 108,000 *km*
- Saturn's equatorial diameter: 120,536 *km*

Applying the corresponding formula, we obtain that the polar diameter is 10.4% smaller than the equatorial diameter.

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

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