GALAXY MORPHOLOGY[1][2]

What will you learn in this Lab?

In this lab, you will learn how to separate galaxies into the different morphological types of the Hubble Classification scheme. You will also be using ASU's Braeside Observatory to take images of galaxies.

What do I need to bring to the Class with me to do this Lab?

For this lab you will need:

- A copy of this lab script
- A pencil

Background

A galaxy is a gravitationally bound grouping of stars, dust and gas that is isolated in space. Our solar system resides in a galaxy called the Milky Way, which is also sometimes referred to as "the Galaxy." As we have observed many galaxies, we have discovered that the number of stars can vary from millions to billions and that the amount of gas and dust varies between different galaxies. As part of an endeavor to better understand galaxies, in the early twentieth century Edwin Hubble developed a classification scheme in which the galaxies were separated into different types based on shape. These classifications are called "morphological" types, because morphology is the study of form or structure.

In the simplest form of the Hubble classifications, there are three primary types of galaxies:

- Ellipticals – Elliptical galaxies appear as smooth distributions of stars with little evidence of substructure. The usual designation for an elliptical galaxy is "En", where the number n is a function of the relative size of the major and minor axes of the observed ellipse. In this scheme, an elliptical galaxy that was perfectly spherical would be an "E0", whereas the most oblong elliptical would be an "E7".

- Spirals – Spiral galaxies are characterized by a distinct spiral shape in the

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[1] Hubble Morphology Type graphic is from the University of Washington's Hubble Galaxy Classification lab.

[2] Galaxy observations were performed with ASU's Braeside Observatory by ASU graduate student Jason Cook.

distribution of stars. Spirals also appear to have prominent dust lanes, which can be seen even if the galaxy is observed from a side view where the spiral structure is not evident. The subclasses of spirals are related to the size of the galactic nucleus and the tightness of the spiral arms. Also noted is whether or not the galaxy shows a bar; in a barred spiral, the spiral arms appear to trail from an elongated nucleus, as opposed to a spherical nucleus. Spirals are classified Sa, Sb, or Sc, whereas barred spirals are denoted SBa, SBb, or SBc. The nucleus of an Sc galaxy is smaller than in an Sa galaxy, and the arms of the Sc are wrapped more loosely.

- Irregulars – Irregular galaxies do not exhibit an obvious spiral or elliptical structure. Some astronomers hypothesize that irregulars may once have been spirals or ellipticals, but have lost those structures due to gravitational interaction with another galaxy(ies).

Procedure

Now it is your turn to decide the Hubble Morphological type for several galaxies. In this figure are displayed the typical shapes of several morphological types. When deciding which classification to give to a galaxy, make certain to denote a subtype. Please use one of the subclasses given here. If you cannot decide between an Sa or Sb, make a choice and explain why you were having difficulty.
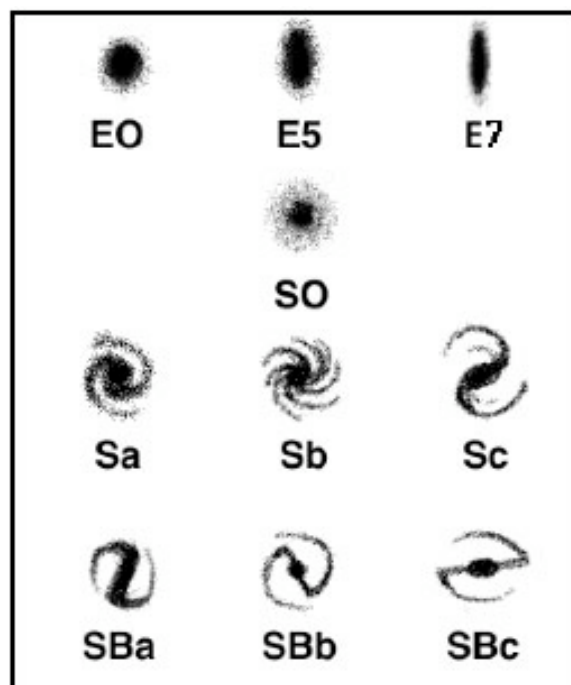
I.   **Provided Images -** Use the classroom computers to view the provided images of galaxies to determine their Hubble Classification type. Fill in the provided table with morphological type and your reasons for choosing the type. Make certain to include an estimate of subtype using the classes established above.

II. **Braeside Observing -** Now you will go to the Braeside control room and make observations of a few galaxies to supplement the provided images of galaxies to

classify. The Braeside telescope is a 16-inch telescope located in Flagstaff, Arizona. With the help of a telescope operator, you will remotely use the Braeside observatory to observe galaxies. (If it is cloudy in Flagstaff or the telescope is for some reason not functioning, please skip this part of the lab.)

- Write down the names of the galaxies you will observe with Braeside and include these in the provided table.

III.   **Additional Questions**

- Could any of the Hubble Classification types represent objects in other classes seen from different angles? If so, which? How could you tell them apart?

- If stars form out of large clouds of gas and dust, in which type of galaxy is there *least likely* to be ongoing star formation? (In other words, in which type (E,S,Irr) did not seem to contain much gas and/or dust?)