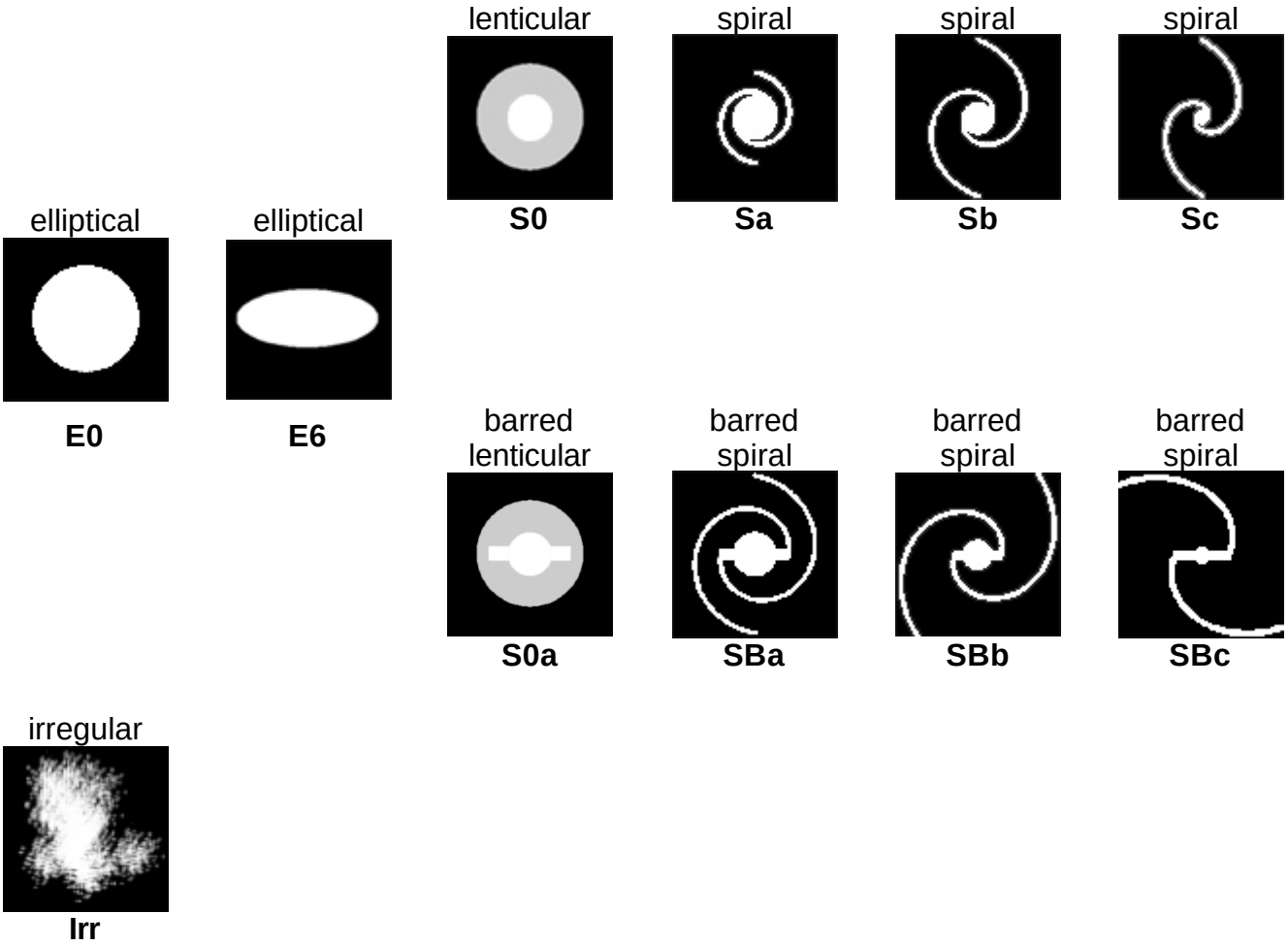
The Hubble Classification of Galaxies

Richard Beare
Version 1.0

Hubble's original classification of galaxy types was published in 1936 in a book called "The Realm of the Nebulae". Since then several people have suggested modifications and additions to his original scheme, but the basic idea of his "tuning fork diagram" has continued to be found useful by astronomers. Below is a diagrammatic representation of one commonly used simple modification of his diagram.



Elliptical galaxies (on the left) look roughly egg-shaped and are relatively featureless. All that can usually be detected is a decrease in surface brightness as one move outwards from the centre of the galaxy. Apparent shapes range from almost circular (E0) to quite elliptical (E6) - these have the long axis four times the short axis.

Disc galaxies have a bulge in the centre, which is very similar to an elliptical galaxy, but outside of that they have a thin disc of stars. The disc is usually fairly close to being circular in shape. However, because galaxies are randomly oriented relative to our line of sight, we see most of them tilted, giving them a more or less elliptical shape in the sky, somewhere between face-on and edge-on. The greater the viewing angle , the more

elliptical they appear (i.e. a viewing angle of zero means face-on). (For the same reason an elliptical galaxy may well be a lot flatter in reality than it appears to us.)

Most disc galaxies (Sa, Sb, Sc above) also have spiral arms and are called spiral galaxies. About half also have well-define "bars" near the centre, and these are called barred spirals (SBA, SBb, SBc above).

A few disc galaxies (S0, SB0) do not have any spiral arms and these are called lenticular (or "lens shaped") galaxies. They consist of a disc and a smaller bulge of variable size. The S0 and SB0 diagrams above are just diagrammatic representations - in practice it is hard to tell lenticular galaxies at various viewing angles from elliptical galaxies (because a face-on lenticular would look like an E0 elliptical, while one inclined at 66 degrees would appear like an E6, for example).

A very few galaxies show no obvious symmetry and do not fall into any of these categories. We will simply call all of these irregular galaxies (Irr), although astronomers have identified many different types which have been given different names.

As already remarked, different astronomers have invented slightly differing versions of the above basic classification, in order to fit in with the particular aspects of galaxies that they have been researching. The above classification is however a simple basic one which will do very well for work with the Faulkes Telescopes.

Elliptical galaxies contain very little gas and dust and their stars are moving in random orbits around the centre. Spiral galaxies on the other hand contain large quantities of both dust and gas, especially those at the ends of the fork, Sc and SBc.

Hubble originally arranged the different shapes of galaxy in the form of a tuning fork, because he noticed a gradual variation in visual appearance between the different galaxies that he observed. At one time people thought that the Hubble diagram might actually be showing an evolutionary sequence with galaxies starting off on the left hand side and then gradually evolving towards the right. This idea has long since been recognised to be false, but confusingly the terms "early type" and "late type" are still often used. Thus astronomers often refer to an Sa galaxy as an "early type spiral" and to an Sc galaxy as a "late type" spiral.

As we move along the top prong of the tuning fork from Sa to Sc, or along the bottom from SBa to SBc, the following changes generally occur:

1. the disc to bulge ratio increases,
2. the openness of the spiral arms increases (i.e. the pitch angle increases),
3. individual stars and pink emission nebulae (HII regions) become easier to pick out, and the overall colour of the galaxy gets bluer as the spiral arms contain more young bright bluish stars,
4. the hydrogen gas content of the disc increases (but you will not be able to detect this from your FT images)