

**HOMEWORK #6 (Due 5:00 pm May 7th)**

**Problem 1: Dark Matter in Dwarf Galaxies**

Ryden 7.2

**Problem 2: Lensing by a Point Mass**

Ryden 7.3

**Problem 3: Gravitational Lensing by a Galaxy**

The Einstein Cross is a set of five images of a quasar at redshift  $z=1.695$ , shining through a spiral galaxy, 2237+0305, at  $z=0.039$ . Four of the images lie close to a circle of radius 0.9 arcseconds.

(a) What is the distance to the spiral galaxy?

(b) Estimate the mass of the spiral galaxy within this radius. [Hint: Notice that  $d_s \approx d_{LS}$ , and see the lecture notes.]

**Problem 4: Collisions between Galaxies**

Ryden 7.5