

# Cosmology 1

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## Proposed problem, lecture 1

Topic: special relativity, see also exercise 1.19 of Schutz textbook.

A spaceship is to travel to the center of the Galaxy, that is at a distance  $d = 8$  kpc from Earth in a reference frame at rest with the Milky Way. The spaceship starts at rest in this frame, and accelerates at  $a = 1g$ ; in the MCRF of the spaceship this acceleration is kept constant in time. At half way it inverts the direction of its engines and decelerates at  $a = 1g$  until it gets to the center of the Galaxy at negligible speed. We ignore gravity forces in this calculation.

- (a) Express, in the Galaxy reference frame, the spaceship velocity as a function of its proper time, and its Lorentz  $\gamma$  factor.
- (b) Compute the walked distance as a function of its proper time  $\tau$ , and the time needed to reach the galactic center in the Galaxy and spaceship frames.
- (c) What is the largest Lorentz factor reached by the spaceship? is it realistic?
- (d) Draw a spacetime diagram of the spaceship trajectory in the Galaxy reference frame. Can you draw the MCRF axes at the maximum velocity?