Extragalactic Astrophysics: Question Sheet 5

1. **Infinitely thin disk.** Evil space aliens compress the Earth to an infinitely thin disk of uniform surface density Σ_E without changing its radius. Starting from Poisson's equation and using Gauss' law, compute the gravitational acceleration experienced by a survivor standing on the surface of this disk?

2. **Spiral arms.** (i) For a galaxy with a flat rotation curve at 250 km/s, what is the epicyclic frequency at R = 7 kpc? Express your answer in km/s/kpc, and in Myr^{-1}.

(ii) If corotation is at R = 6 kpc, what is this galaxy's pattern speed (in Myr^{-1})?

(iii) For a two-armed spiral, is R = 7 kpc a resonance radius?

3. **Dark Matter.** Large disk galaxies typically show an almost constant outer rotation curve. If the disk is embedded in a spherical dark matter halo with a power-law density profile $\rho(r) = Ar^{\alpha}$ what slope, α, is needed to obtain a constant curve?

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