ამოცანა

1) რა არის 1კგ მატერიის ედინგტონის გამოსხივების სიმძლავრე?
2) გაიფანტება თუ არა 1 ლიტრი ედინგტონის სიმძლავრით მანათობელი წყალი გამოსხივების წნევის ხარჯზე? იმსჯელეთ რატომ.
3) ვთქვათ მოათავსეთ წყლის ეს ოდენობა ღია კოსმოსის ვაკუუმში დედამიწის გრავიტაციის მოცილებით. როგორ მოიქცევა წყალი? რა კრიტერიუმს გვაძლევს ჯინსის არამდგრადობა? რა ტემპერატურაზე დაჯაბნის თვითგრავიტაცია სითბურ მოძრაობებს?

Problem 2.62. Answer the following regarding the pp chain: (a) How much mass of hydrogen undergoing the pp interaction would be required to power a 1-kW heater for 1 yr and (b) to power the sun for 1 μs? (c) Show that electric charge is conserved in each of the several nuclear interactions illustrated in Fig. 2.6 for the pp chain. (d) How much energy (eV units) is released per nucleon (proton or neutron) in the chemical burning of oil that yields 140 000 BTU/gallon? (1 BTU ≈ 1055 J and 1 gal of water weighs 3.78 kg. The oil density is about that of water.) Compare this energy release with that for the pp chain. Look up the wood-burning yield and repeat. [Ans. ~50 mg; ~600 metric tons; –; ~0.4 eV/nucleon, ~0.2 eV/nucleon]

Problem 2.64. (a) Estimate, from the solar luminosity, the value of the proportionality constant ε_0 in the expression (66) for nuclear power generation for the pp process, where $\beta = 4$. Assume all the luminosity originates within radius 0.1 $R_\odot$, where $T = 1.6 \times 10^7$ K, $\rho = 1.5 \times 10^5$ kg/m^3, and hydrogen has been depleted to a fraction $X = 0.36$ of the mass. The solar luminosity is 3.8×10^{26} W. Hint: what is the energy-generation rate ϵ_{pp} (W/kg) in the sun's center? (b) Find, at this rate, the hypothetical power output (W) from (*i*) 1 m^3 of water and (*ii*) a swimming pool of dimensions 25 m × 15 m × 2 m. Comment on your answers. [Ans. ~10^{-3} W/kg; ~2 W, ~1 kW]

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Problem 2.71 Consider the massive black hole of $\sim 3 \times 10^6\ M_\odot$ at the center of the Galaxy at distance ~25 000 LY from the earth. (a) What is its Eddington luminosity ($\mu_e = 1$)? Compare this with its actual x-ray luminosity during a flare that reached a luminosity of 4×10^{28} W. (b) What is the approximate actual accretion rate during the flare and what would it be at L_{Edd}? Adopt Newtonian energies and assume that all the potential energy loss down to the Schwarzschild radius, $2GM/c^2$, appears as radiation. Give your results in kilograms per second and also in solar masses per year. (c) What is its flux (W/m^2) at the earth and what would it be at L_{Edd}? Compare the latter to the brightest persistent celestial x-ray source, Sco X-1, at 4×10^{-10} W/m^2, to the solar x-ray flux during bright flares at $\sim 10^{-6}$ W/m^2, and to the (mostly optical) total flux from the sun (i.e., the solar constant at 1365 W/m^2). [Ans. $\sim 10^{38}$ W; $\sim 10^{-11}\ M_\odot$/yr, $\sim 10^{-2}\ M_\odot$/yr; $\sim 10^{-13}$ W/m^2, $\sim 10^{-4}$ W/m^2]

Problem 2.72. (a) What is the Eddington luminosity for 1 kg of material for $\mu_e = 1$? (b) Does this suggest that a liter of water in an open pan would start ejecting material if it were radiating at this luminosity? Discuss why or why not. (c) Suppose you took the water into the vacuum of space and released it so it would be free of earth's gravity. How might it behave? What does the Jeans criterion tell you (Section 2.2) about the temperature that would be required for self-gravity to dominate the thermal motions? State your assumptions. [Ans. ~5 W; –;–]