NEWTON'S 2ND LAW

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Reaching for the Stars, Across 4.37 Light-Years

Mission to Alpha Centauri

The cosmologist Stephen Hawking and the entrepreneur Yuri Milner released a simulation that shows how a project called **Breakthrough Starshot** aims **to send small robots to the nearest star system, Alpha Centauri.**

Can you fly an iPhone to the stars? In an attempt to leapfrog the planets and vault into the interstellar age, a bevy of scientists and other luminaries from Silicon Valley and beyond, led by Yuri Milner, a Russian philanthropist and Internet entrepreneur, announced a plan on Tuesday to send a fleet of robot spacecraft no bigger than iPhones to Alpha Centauri, the nearest star system, **(((4.37 light-years away.)))** If it all worked out — a cosmically big "if" that would occur decades and perhaps $10 billion from now — **a rocket would deliver a "mother ship" carrying a thousand or so small probes to space. Once in orbit, the probes would unfold thin sails and then, propelled by powerful laser beams from Earth, set off one by one like a flock of migrating butterflies across the universe. (((But it would still take 20 years for them to get to Alpha Centauri.))) Those that survived would zip past the star system, making Within two minutes, the probes would be more than 600,000 miles from home** — as far as the lasers could maintain a tight beam — **and moving at a fifth of the speed of light. measurements and beaming pictures back to Earth.**

INTRODUCTION 1: Our first goal is to confirm these small nanocraft flying at 1/5 speed of light can get to Alpha Centauri(AC) in about 20 years.

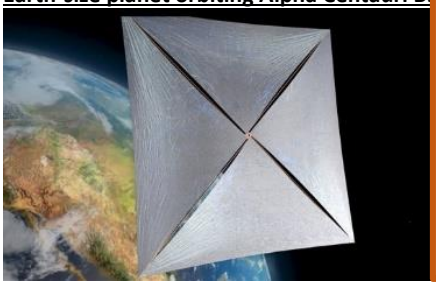
QUESTIONS: (a) Find distance to AC moving at light speed for 4.37 light years? (b) These nanocraft powered by a laser beam would take 20 years traveling at 1/5 speed of light to get to AC. Show these nanocraft do go the distance and reach AC?

HINTS: c = speed of light = 186,000 mi./s. , 365 days/yr., 24 hrs./day, 3600 s./hr., X = v t

ANSWERS: (a) ~25.63 X 10^{12} miles , (b) ~ 23.5 X 10^{12} miles NOTE: (a) & (b) are quite close (-:

Alpha Centauri, the closest star system to Earth's solar system. An effort led by the billionaire Yuri Milner aims to send a fleet of small probes there.

Interstellar travel is a daunting and humbling notion, but Alpha Centauri is an alluring target for such a trip: It is the closest star system to our own, and there might be planets in the system. **The system, which looks to the naked eye like one star, consists of three: Alpha Centauri A and Alpha Centauri B, which circle each other, and Proxima Centauri, which may be circling the other two. In recent years, astronomers have amassed data suggesting the possibility of an Earth-size planet orbiting Alpha Centauri B.**



INTRODUCTION 2: The purpose of part 2 is to confirm the stated force these nanocraft (1 gram) experience (60,000 times the force of normal gravity) to get to Alpha Centauri. c = speed of light = 3.0 X 10^{8} m./s.
QUESTIONS: (a) Compute Force of = 60,000 m g (in units of N) on the 1 gm. Nanocraft? (b) It is stated in article the nanocraft was accelerated 0 to 1/5 speed of light in 120 s. Find acceleration(a) in m/s.^{2}?, (c) Find force (in N.) on 1 gm. Nanocraft to produce a?
HINTS: $v = v_o + a\,t$, $F_{NET} = m\,a$, 1 gram = 10^{-3} kg. , g = 9.8 m./s.^{2}
ANSWERS: (a) 60,000 m g = ~ 588 N , (b) 5.0 X 10^{5} m./s.^{2} , (c) F =~ 500 N, close to 588 N

An image from a video rendering of the **"nanocraft"** that would be sent on a planned interstellar voyage as part of Breakthrough Starshot. Power would come from a tiny radioactive source like americium, the element in smoke detectors. Propulsion would come from foil sails that would unfold to catch laser light. The laser is the most intimidating and expensive of the challenges. **(((It would have to generate 100 gigawatts of power for the two minutes needed to accelerate the butterfly probes to a fifth of the speed of light (subjecting its tiny innards to 60,000 times the force of normal gravity, by the way).)))** That is about as much energy as it takes for a space shuttle to lift off, Dr. Loeb said, and about 100 times the output of a typical nuclear power plant. **To achieve that energy would require an array about a mile across combining thousands of lasers firing in perfect unison.**