4.4: All of Space Is Ours!

in one lifetime: go anywhere in the cosmos

Revelation number three strikes us as - dreaming on - we think more about passing Earth-linked lookout stations. Moving at 80 percent of light speed, we travel 8 light-years in the Earth-linked frame in 6 years of our rocket time. Continuing at the same rate will get us to Canopus in 74 years of our rocket time. Better than 99 years, but not good enough.

Let's use - in imagination - a faster rocket! We suddenly remember the super-rocket discussed in demonstrating the invariance of the spacetime interval (Section 3.8). Converting meters of distance and time to years, we realize that traveling in the super-rocket would bring us to Earth-linked Lookout Station Number 20, 20 Earth-frame light-years from Earth, in 6 years of our rocket time. When passing this station, we can see that this station clock reads 20.88 years. Therefore in the *Earth-linked* frame our super-rocket speed amounts to $20/20.88 = 0.958$ light speed. Continuing at the same speed would bring us to Canopus in 29.7 years of our *rocket* time. This is nearly short enough to meet our goal of 20 years.

Five minutes to Canopusor to any star!

Revelation number three gives us a dizzying new sense of freedom. By going fast enough we can get to Canopus in five minutes of our rocket time if we want![1] In fact, no matter how far away an object lies, and no matter how short the time allotted to us, or to any star! nothing in principle stops us from covering the required distance in that time. We have only to be quite careful in explaining this new-found freedom to our Space Agency friends. Yes, we can go any distance the agency requires, however great, provided they specify the distance in the Earth-linked reference frame. Yes, we can make it in any nonzero time the agency specifies, however short, provided they agree to measure time on the rocket clock we carry along with us.

To be sure, the Earth-linked system of lookout stations and printout clocks will record us as traveling at less than the speed of light. Lookouts will ultimately complain to the Space Agency how infernally long we take to make the trip. But when our Space Agency friends quiz the lookouts a bit more, they will have to confess the truth: When they look through our window as we shoot by station after station, they can see that our clock reads much less than theirs, and in terms of our own rocket clock we are meeting the promised time for the trip.

Our dream ends with sunlight streaming through the bedroom window. We lie there savoring the three revelations: economy of description of two events in a reference frame stripped down to one space dimension, speed defined always with respect to a specified reference frame and thus never exceeding light speed, and freedom to go arbitrarily far in a lifetime.

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1 Five minutes to Canopus - or to any star!
