
Into a Dark, Cold, Nothing; A Physicist's Viewpoint of *Between*

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"There is nothing *between*" F'lar said in *Dragonflight* and that seems to have been echoed throughout the books. Unfortunately, for a physicist, "nothing" is a difficult concept.

Setting aside the zero-point energy and various bits of quantum physics, nothing means absolute zero temperature and perfect vacuum. In fact, this is entirely plausible (in an SF sense), as *between* quite probably doesn't exist in the real Universe at all. Dragons may well be travelling through something outside our Universe which is truly empty (apart, it seems, from the odd floating carcasses of dead dragons and sometimes their riders).

Why empty? Well, if there were gas filling (even non-oxygen bearing gas, in the unlikely event there was somewhere for the gas to come from) between the odds of that being at a survivable pressure are remote. It is as likely to be the pressure of Jupiter's atmosphere as atmospheric pressure. Given the lack of any light sources or anything else the human brain translates as understandable, it indicates that *between* is in a zero energy state and perfect vacuum.

OK, so if that's the case, how can riders survive this? Dragons evidently can, if they can happily float around in space for up to 15 minutes without a space suit (some skin they must have to cope with vacuum outside them and space is only a few degrees above absolute zero) but humans have problems in such conditions. Firstly, there's the unfortunate tendency to explode under vacuum which would be tricky for many riders and could limit their lifespan a little.

Secondly, there's the minor issue of the biological effects of freezing. Ten seconds may seem like a brief period in such conditions, but think of ten seconds with a finger dipped in liquid nitrogen (well above absolute zero!) and riders would feel a little more than sensory deprivation *between*! In fact, under such conditions, extremities could probably be easily snapped off riders upon emergence from *between* simply by his dragon making a sudden movement (one way to cut down on greenriders' libido?). Even without this minor problem, or the rider exploding, regular and repeated exposure to vacuum would result in a rupturing of skin surface blood vessels which would make the average wino look sober and could have all sorts of problems with ruptured eardrums, burst blood vessels in the eye and other difficulties which it's hard to see riders agreeing to sign up for.



So, given that we want to play in a realistic Pern, how can a rider survive *between* at all? Well, cold air appears to appear from *between* with dragons (another DF reference) Dragons also not only must arrive from *between* in mid-air (sensible enough precaution against materializing IN something) but also, for safety, should take off in mid-air too Maybe, without even being aware of it, a dragon takes a surrounding pocket of air with it, *between*, keeping it intact and emerging with the air at the other end. Air is a fair insulator, so although a bubble of air surrounded by absolute zero will chill in seconds, it won't reach absolute for several minutes. Hence, a rider is still surrounded by air which is rapidly cooling, but it stays at atmospheric pressure for the duration and stays in the livable temperature range, long enough for even an extended stay *between* during a timing jump). This air will have a limited oxygen supply, though only a few dragon and human breaths worth (I foresee a pretty thin "skin" of air, given the tight places some dragons leave from in the books), enough that a gasp whilst *between* won't cause the person to choke but not enough for a badly visualized jump like Lessa's.

OK, so we've sorted out how a rider can go *between* and survive, but a dragon-sized hole in the air suddenly appearing would cause a bit of a bang to put it mildly). Now it might well be that on Pern, dragons going *between* cause noise pollution akin to living near a main airport or being under Concorde's path when it goes supersonic, with the Pernese being too polite to mention it. However the books give the impression of a more-or-less silent transition (with maybe a faint pop when a firelizard appears from *between*). Additionally, people would notice if the volume of the dragon was replaced with inert gas (more backup to the theory that the dragon isn't replacing his or her volume with

inert gas from *between*) else people would start to be worrying about air pollution after 2000 Turns.

Now AIVAS did seem to have jumped to the conclusion that dragons should be able to effect action at a distance (to the confusion of the dragons, who didn't understand the "bang item X from here to there without personally going *between* to pick it up" instruction). Given lack of overt evidence that dragons can use telekinesis as well as teleportation, AIVAS must have realized that the dragons actually shifted air from their destination point BACK THROUGH TIME to the start point at the same time that they shifted themselves. So, in a successful trip, say from Benden to Fort, a volume of air equal to the volume of dragon, rider, passengers and packages arrives at Benden at the same time that the dragon went *between*, being removed from the instant that the dragon appeared at Fort.

That's quite a good trick but it explains why there's only at most a faint pop when they reappear if there's any noise at all. Badly visualized jumps would be noisy (one way a Weyrlingmaster would know if the rider hadn't visualized well, the weyrling wouldn't hear the noise, being *between* at the time). If a rider didn't visualize a destination at all before the dragon went *between* (like Moreta's last leap) then they would literally go out with a bang. Which possibly explains why other dragons start mourning before there is time for the rider to suffocate to death, let alone the dragon (which can last 15 minutes without breathing anyway), as they know that the dragon's a goner and act accordingly!

So, it is possible for a rider and dragon pair to survive *between* without serious effects. Leaving the relatively trivial questions of conservation of energy momentum and angular momentum on a trip *between*.