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SYNTHETIC TORPOR: A METHOD FOR SAFELY AND PRACTICALLY TRANSPORTING EXPERIMENTAL ANIMALS ABOARD SPACEFLIGHT MISSIONS TO DEEP SPACE

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SYNTHETIC TORPOR: A METHOD FOR SAFELY AND PRACTICALLY TRANSPORTING EXPERIMENTAL ANIMALS ABOARD SPACEFLIGHT MISSIONS TO DEEP SPACE

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Abstract: Animal research aboard the Space Shuttle and International Space Station has provided vital information on the physiological, cellular, and molecular effects of spaceflight. The relevance of this information to human spaceflight is enhanced when it is coupled with information gleaned from human-based research. As NASA and other space agencies initiate plans for human exploration missions beyond low Earth orbit (LEO), incorporating animal research into these missions is vitally important to understanding the biological impacts of deep space. However, new technologies will be required to integrate experimental animals into spacecraft design and transport them beyond LEO in a safe and practical way. In this communication, we propose the use of metabolic control technologies to reversibly depress the metabolic rates of experimental animals while in transit aboard the spacecraft. Compared to holding experimental animals in active metabolic states, the advantages of artificially inducing regulated, depressed metabolic states (called synthetic torpor) include significantly reduced mass, volume, and power requirements within the spacecraft owing to reduced life support requirements, and mitigated radiation- and microgravity-induced negative health effects on the animals owing to intrinsic physiological properties of torpor. In addition to directly benefitting animal research, synthetic torpor-inducing systems will also serve as test beds for systems that may eventually hold human crewmembers in similar metabolic states on long-duration missions. The technologies for inducing synthetic torpor, which we discuss, are at relatively early stages of development, but there is ample evidence to show that this is a viable idea and one with very real benefits to spaceflight programs. The increasingly ambitious goals of world's many spaceflight programs will be most quickly and safely achieved with the help of animal research systems

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