

Health, Medicine and Biotechnology

Lighting System to Improve Circadian Rhythm Control

Unique lighting system that can be used to regulate sleep cycles and improve quality of sleep

The Lighting System to Improve Circadian Rhythm Control was designed and built to help regulate the sleep cycles of astronauts working on the International Space Station (ISS) and during long-duration spaceflight. In space, the lack of a true diurnal cycle of sunlight, encompassing the same range of color temperatures and intensities of sunlight experienced on Earth, is one of the potential causes of sleep disorders among the crew aboard ISS. The production of melatonin, a hormone that helps regulate sleep cycles, can be inhibited by light, especially cool white light (with its large blue light component). To help regulate sleep cycles and improve the quality of sleep for the crew, control of the melatonin production cycle through the use of light is key. On Earth, this technology can be used to help treat many sleep disorders, including jet lag, shift work sleep disorder, delayed sleep phase syndrome, advance sleep phase syndrome, and non-24-hour sleep/wake disorder (frequently affects those who are totally blind since the circadian clock is set by the light-dark cycle over a 24-hour period).

BENEFITS

- Helps regulate sleep cycles
- Improves quality of sleep
- Can be used to help treat several sleep disorders, including jet lag, non-24-hour sleep/wake disorder, etc.
- Can help improve the efficiency of workers who work late shifts

technology solution

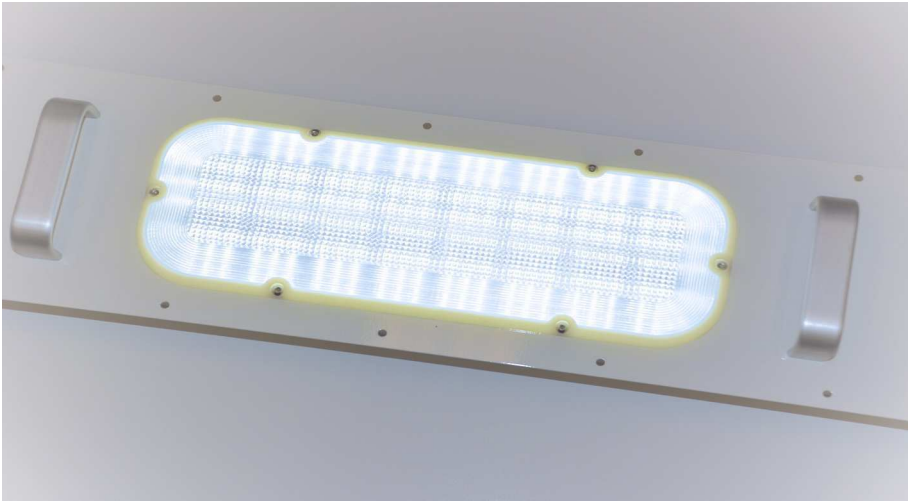


THE TECHNOLOGY

NASA has developed a programmable solid state general illumination fixture with full intensity and color temperature control. This new lighting assembly uses a microcontroller with power relay to adjust color temperature and perceived intensity to simulate a practical diurnal cycle. Color temperature is fully adjustable over the entire range of temperatures. Light intensity varies from a low "night light" level (to minimize or eliminate any delays to the initiation of REM sleep amongst the users) to a daylight or work mode that can be implemented to aid in concentration on normal work day tasks. A manual mode has been added to override the automatic diurnal cycle in the event of an out-of-cycle work requirement. Blue light can be added to assist with circadian rhythm adjustment should sleep cycles need to be adjusted. The microcontroller takes the primary control of the lighting scheme rather than a master controller, making individualized therapies possible.

In operation, the intensity of light gets brighter as you proceed through the beginning of the work day, and the color temperature gets progressively higher (corresponding to a cooler color of light) to mimic the diurnal cycle. As the work day ends, the light gets only slightly dimmer, but significantly lower in color temperature (corresponding to a warmer color of light). As the sleep cycle begins, the light intensity dims, exposing occupants to even less blue light.

The programming cycle for how this system operates throughout the day can be easily modified to adjust for any therapy required given the sleep situations. The diurnal cycle also isn't limited to 24 hours. It could easily be adapted to a 25 hour cycle, as some studies have shown this to be a more natural human cycle. At any time, this automatic programming could be interrupted, and the manual input mode can make any light intensity/color temperature combination possible to cater to the needs of the user.



Lighting System to Improve Circadian Rhythm Control

APPLICATIONS

The technology has several potential applications:

- Light therapy to treat numerous sleep disorders
- Industrial or commercial lighting to improve worker efficiency for second or third shift workers

PUBLICATIONS

Patent No: 10,022,556

National Aeronautics and Space Administration

Kurt Kessel

Kennedy Space Center

MS LASSO-012
Kennedy Space Center, FL 32899
321-867-8480
Kurt.R.Kessel@nasa.gov

<http://technology.nasa.gov/>

www.nasa.gov

NP-2015-02-1348-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

KSC-13789
KSC-TOPS-52

