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## Space Station

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## International Space Station



### Wearable System for Sleep Monitoring in Microgravity (Wearable Monitoring) - 07.14.16

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#### ISS Science for Everyone

##### Science Objectives for Everyone

Wearable Monitoring validates a new cloth vest that monitors astronaut heart rates and breathing patterns during sleep. It collects data to investigate whether changes in heart activity are related to astronauts' poor sleep quality. Current technology cannot check astronauts' heart activity while they sleep because the test wakes them up. The Wearable Monitor is a lightweight vest with silver wires and sensors embedded into the fabric, making it more comfortable to wear.

##### Science Results for Everyone

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*The following content was provided by Marco Di Rienzo, M.Sc., and is maintained in a database by the ISS Program Science Office.*  
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#### Experiment Details

**OpNom:** Wearable Monitoring

##### Principal Investigator(s)

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##### Co-Investigator(s)/Collaborator(s)

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##### Developer(s)

Fondazione Don Carlo Gnocchi, Milano, Italy

##### Sponsoring Space Agency

National Aeronautics and Space Administration (NASA)

##### Sponsoring Organization

Italian Space Agency (ASI)

##### Research Benefits

Earth Benefits, Scientific Discovery, Space Exploration

##### ISS Expedition Duration

September 2014 - March 2016

##### Expeditions Assigned

41/42, 43/44, 45/46

##### Previous Missions

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#### Experiment Description

##### Research Overview

- The monitoring instrument for this investigation is an innovative system, based on textile technology (MagIC-Space) for the assessment of electrocardiograms (ECG), respiration, body accelerations, skin temperature, indexes of cardiac mechanics (including times of opening and closure of aortic and mitral valve, pre-ejection period, left ventricular ejection time, isovolumic contraction and relaxation times). Through this system the intent is to investigate sleep physiology in microgravity to understand the causes of the commonly reported poor sleep quality during space missions.

- Causes of poor sleep quality during spaceflights are not clear at this time. Based on findings on Earth, this study aims to explore the hypothesis that sleep quality during spaceflight might be reduced by the occurrence of autonomic subcortical arousals in the brain. In turn, it has been suggested that an abnormal activation of the autonomic nervous system might be influenced by changes in the cardiac mechanics induced by microgravity. From the methodological point of view, autonomic activity can be estimated by the analysis of the heart rate (from ECG), but aspects of cardiac mechanics cannot be assessed onboard during sleep with current technology (the echocardiographic assessment awakes the subject). The proposed monitoring instrument for this experiment aims at recording not only the traditional vital signs (ECG and respiration) but also, for the first time, specific aspects of cardiac mechanics. Sensors and wires are embedded into the garment. This feature drastically reduces the instrumentation time and guarantees sleep comfort.

Concerning the possible impact on the research on Earth, it should be considered that about 25% of the western population is affected by sleep disturbances that, at the moment, are studied by complex devices, that require a specialized operator and long time for the instrument setup. The terrestrial version of this instrument might be beneficial to simplify the monitoring of the patients during sleep and would allow a simultaneous assessment of autonomic and mechanical variables.

## Description

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## Applications

### Space Applications

Researchers think microgravity causes changes in autonomic neural control and mechanical heart activity, which interfere with the astronauts' sleep. Wearable Monitoring collects cardiac data by a sensorized vest to study the causes of astronauts' poor sleep quality. The vest could also become a new, unobtrusive monitor for a wide range of vital signs during sleep and waking hours. Its sensors and wires are embedded in the vest, making it easier to put on and more comfortable to wear.

### Earth Applications

About one-fourth of people in developed nations suffer from sleep disorders, and studying them requires complex, specialized instruments that can be expensive and time-consuming to operate. An Earth version of the MagIC-Space technology could simplify patient monitoring during sleep studies. It would be the first garment to simultaneously monitor autonomic, electrical and mechanical heart activity and respiration.

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## Operations

### Operational Requirements and Protocols

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## Imagery



*The MagIC vest (terrestrial version). Image courtesy of ASI. jcr*

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*The ECG textile electrodes*

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*The electronic module containing the accelerometer and the microSD card*



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