Gliolab-Nanorack
A University Platform for a Biomedical Mission

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Introduction

- Difference between terrestrial and space environment (microgravity, ionizing radiations)
- Increasing of cancer but at ground for cancers treatment radiotherapy is used. (medical use of ionizing radiation)
- In particular cancer, such as Glioblastoma multiforme (GBM), radiotherapy is only treatment that permits an increasing of the median survival time.

In this perspective study of cancer cell and normal cell behaviour in orbit is proposed

The possibility to board biological samples in a microsatellite has been already developed (Genesat-1 and PharmaSat supported by NASA Ames)
Glioblastoma

Glioblastoma is the most common and most aggressive type of primary brain tumor, accounting for 52% of all primary brain tumor cases and 20% of all intracranial tumors.

Survival rate:
57% @ 1 year,
16% @ 2 year,
7% @ 3 year

radiotherapy is only treatment

Glioblastoma is clinically divided in 4 grades.

Glioblastoma Multiforme (GBM) is the most aggressive of these (grade 4) and also the most common in the humans.
Glioblastoma multiforme

A lot of patients with GBM die in less than a year and essentially none has long term survival.

One of the reasons for the resistance of GBM to the therapeutic intervention is the complex character of the tumor itself (multiform).

(MRI scans of a patient with a GBM)

On average, radiotherapy after surgery can reduce the tumor size to 10/7 cells.

test on board normal neural cell and cancer neural cell behaviours
Normal neuronal cells

Glioblastoma cells

Courtesy of: Dr A. Notarangelo
(Registro Medica, IRCCS-Ospedale CSS San Giovanni Rotondo)
GLIOSAT

investigate the combined effects of ionizing radiation and microgravity on glioblastoma cancer cells and normal neuronal cells.

A cells set similar to the one in orbit will be monitored on the ground at the same time of the mission to compare the cells behaviour in terrestrial conditions to the one on orbit and understand possible differences.
GLIOSAT

- Power
- Electronics
- Mechanical
- Communication
- On board observation system
- Environment monitoring system
- Biological cells maintaining system

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GAUSS-ASL
BIOLOGICAL CELLS MAINTENING SYSTEM

CRITICAL PHASES

- cell transportation ➔ Dry ice / Nitrogen
- satellite integration ➔ Growth rate during integration
- launch phase ➔ Vibration test
- in orbit phase ➔ Thermal and CO2 environment
SAMPLES INTEGRATION ON BOARD

To board glioblastoma cells it is possible to use suitable flasks available in different dimensions, capable to contain a large number of cells. It is important to determine the number of cells to board taken into account:

- Bus dimensions
- Cells growth rate
- Survival rate during the critical phases
ON BOARD OBSERVATION SYSTEM

Main constraint

- very small volume available
- low cost

COTS microscope

COTS camera
ENVIRONMENT MONITORING

In order to have scientific results it is very important to know the radiation environment during the behaviour test.

For this reason a device capable to measure the ionizing radiation is essential.

MICRODOSIMETER
UNISAT microsatellites

Unisat
26 Sept. 2000

Unisat-2
20 Dec. 2002

Unisat-3
29 Jun. 2004

Unisat-4
26 Jul. 2006
Payload Integration

• UNISAT-5 (GLIOSAT)

2 Flasks
(Cancer cells-normal neuronal cells)

2 Cameras

Thermal/CO2 Control System
Other Payload Systems

- Microdosimeter
- Autonomous Power System
- OBDH-Communication System
Payload Dimensions:

- Compatible with 3U Cubesat dimensions
- Can be boarded on ISS using NanoRacks

Payload Dimensions:

~ 30cm x 10cm x 10cm
Payload preliminary in orbit testing opportunity on the ISS

NanoRacks

1. Integrate payloads on the ISS
2. 30 day mission
3. Provides microgravity, radiation testing
4. It provides power – 5V @ 2W
5. It provides communications – USB
6. CubeSat form factor
7. First flights Spring 2010
International Space Station Flight Opportunity
Uses Express Rack on the ISS
CubeLab™ NanoRacks

CubeLabs
- May be powered
- May have data interface
- May be passive e.g. Tool test, structures model, etc.

Heat Rejection Side

USB “B” Jacks

Single CubeLab

Triple CubeLab

Heat Rejection Side
NanoRacks

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GAUSS-ASL
NanoRacks

End showing USB connectors
NanoRacks

1. Return of CubeLab
2. Eject CubeSats from ISS
3. More power
4. More communications
5. External ISS NanoRacks – vacuum, radiation, microgravity
Conclusion

1. In 2009 GAUSS started a biomedical research at Aerospace Engineering School in Roma, involving also the Space Science Center in Morehead State University in Kentucky and the Genetic department of IRCCS-Hospital CSS San Giovanni Rotondo in Italy.

2. Main satellite system necessary to support biological payloads in orbit have been analysed.

3. A system to maintain Glioblastoma Multiforme cancer cell alive during transportation and satellite integration has been identified as a major problem and solutions analysed.

4. A flight opportunity for preliminary testing on Nanoracks has been foreseen, to analyse potential integration and operations problems.