SPACEPHARMA

Remote-Controlled Miniaturized Microgravity Solutions

Yossi Yamin

Founder & CEO

www.space4p.com

“Following the light of the sun, we left the Old World.”

— Inscription on Columbus' caravels

“Per aspera ad astra”-

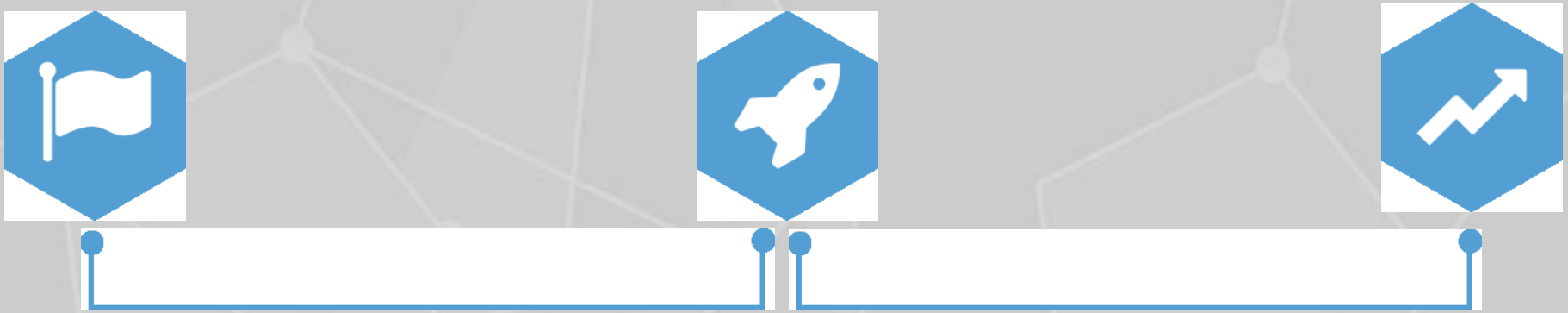
through hardships, to the stars

— Motto of NASA

“Every cubic inch of space is a miracle.”

— Walt Whitman

SPACEPHARMA in Milestones



2012

SpacePharma established

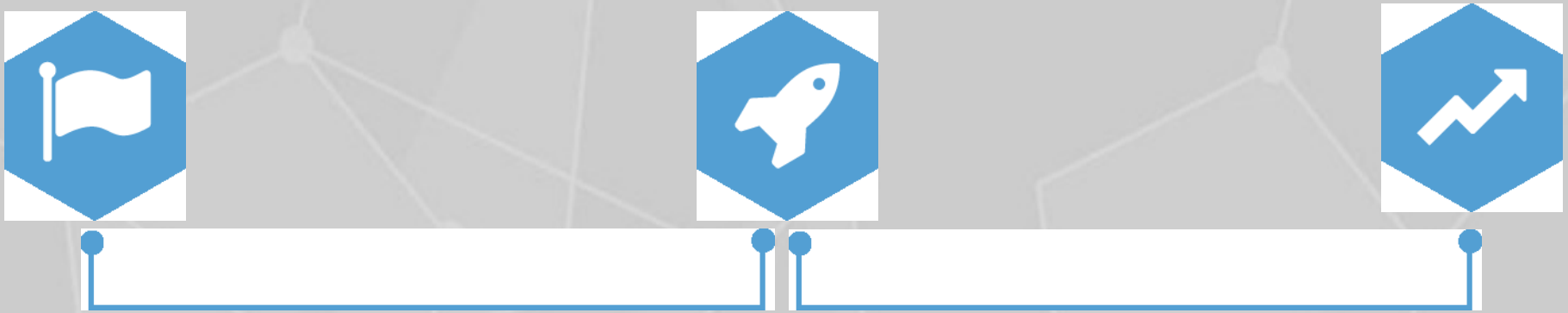
2015

Top world Game-Changers

2016

1# space company to watch

SPACEPHARMA in Milestones



2012

SpacePharma established

SpacePharma was established in 2012 by a unique multidisciplinary team of experienced space and science experts, former satellite developers, operators, engineers

2015

Top world Game-Changers

Announced as one of the top world list of 55 Game-Changers by CB Insights

2016

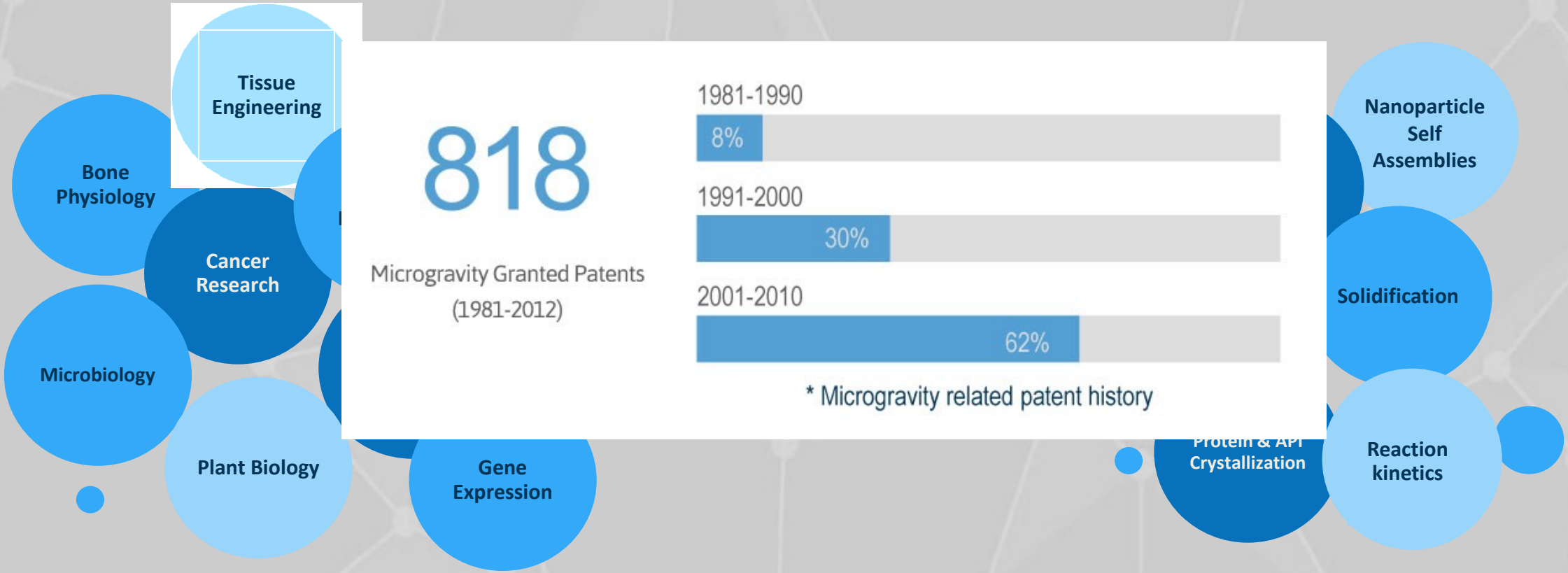
1# space company to watch

Selected by Geektime.com 1st among 10 space companies to watch in 2016 & 2017

Microgravity Research Fields

BioMed & BioTech

Pharma & Chemistry



Access to Microgravity Research today

is limited to International Space Station (ISS)

BARRIER

Control over experiment out of your hands

BARRIER

Limited space agencies, long wait times (years)

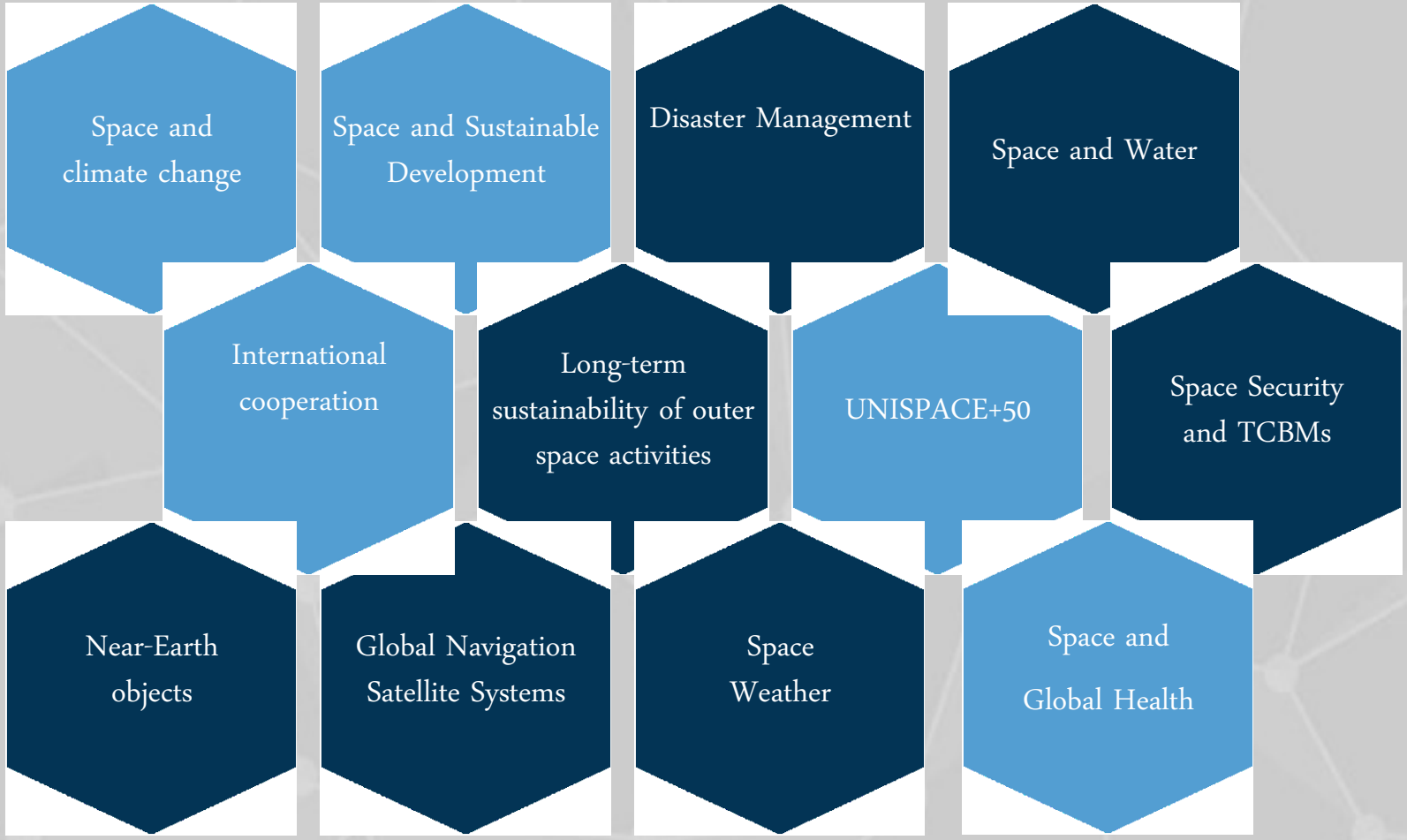
BARRIER

Very expensive

BARRIER

IP ownership issues

Current issues - Space agenda today:



Background: **Climate Change and Virus Outbreak**

Climate change may have triggered Zika outbreak

Israeli and Swedish researchers find link between the virus pandemic and northeast Brazil's very hot, dry winter and spring.

By ISRAEL21c Staff | FEBRUARY 4, 2016, 12:29 PM

Climate change may have triggered Zika outbreak

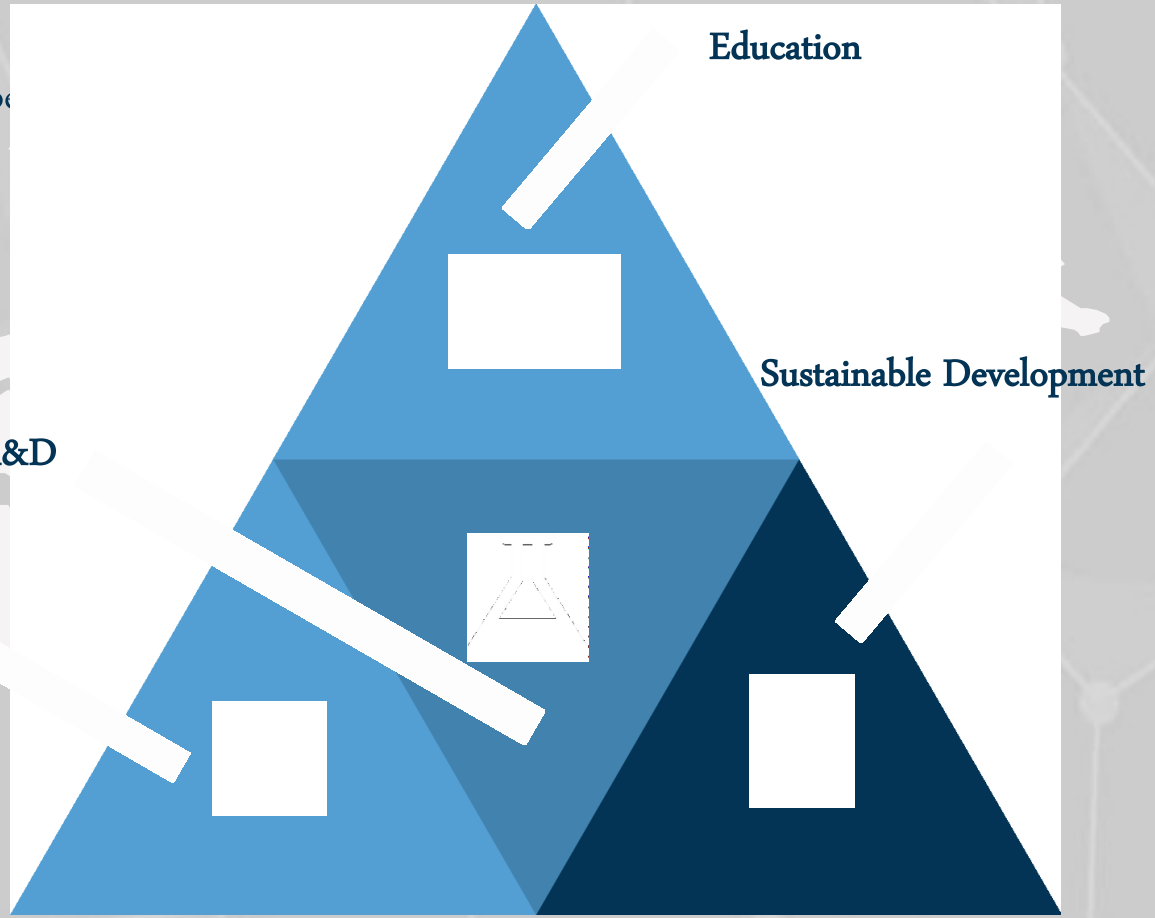
Israeli and Swedish researchers find link between the virus pandemic and northeast Brazil's very hot, dry winter and spring.

By ISRAEL21c Staff | FEBRUARY 4, 2016, 12:29 PM

SpacePharma's Contribution Areas

Enabling research in space will allow us to learn on how space can be

improve Global Health and Sustainable Development



SpacePharma Contribution

Space and Sustainable Development

- Space Farming
- New Vaccines
- Improved Shelf life of collodial-based products

International cooperation

Novel Antiviral & Antibiotics Drug Screening

UNISPACE+50

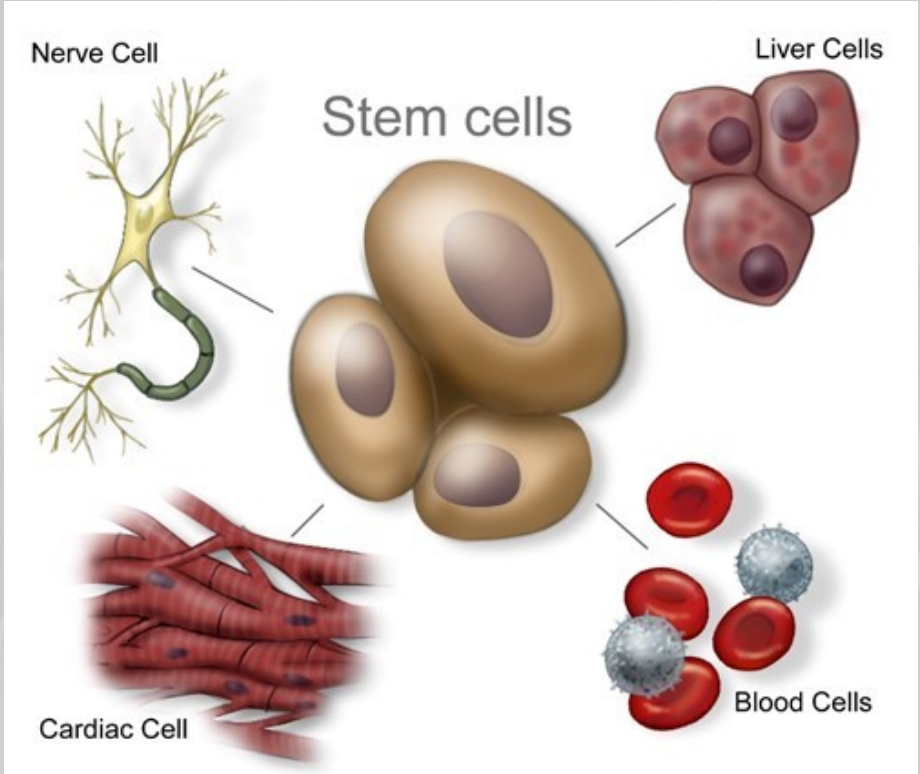
+50

Space and Global Health

- Stem cell therapy
- Differential Gene Expression in Space

I. Stem Cells in Microgravity

- In both space-based and simulated-microgravity experiments, various types of stem cells and progenitor cells have shown distinct responses.
- Some types of cells show **increased proliferation** and viability. Others show **enhanced differentiation**
- Microgravity research has the potential to advance stem cell therapies by identifying novel cell properties and pharmaceutical targets

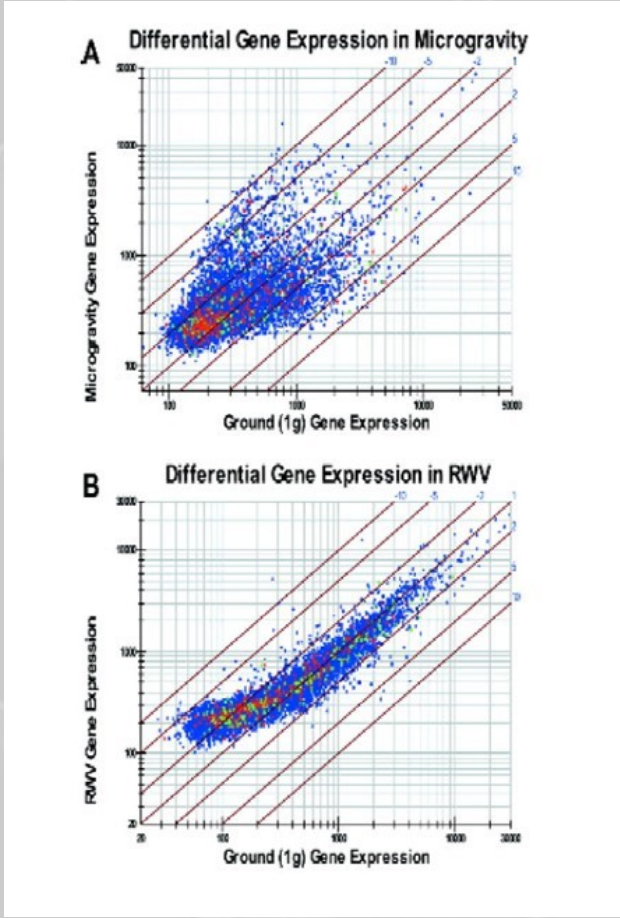


II. Bacterial Virulence In Microgravity

- In microgravity bacterial virulence increases
- Experiments executed across a number of bacterial species reported a reduced lag phase, increased growth rate and increased final cell population densities under microgravity conditions
- In µG, bacteria were shown to become more resistant to common antibiotics and presented enhanced biofilm formation
- Discovering the factors responsible for growth and virulence of bacteria is very important
- Thus, **microgravity has the potential to lead to the identification of novel regulation of genes, providing novel potential targets for vaccine and development of new antibiotic drugs**

III. Differential Gene Expression in Microgravity

- **In the absence of gravity, certain genes in cells turn off and others turn on**. Studying these changes will allow scientists to develop a better understanding on how cells function and how to manipulate them in labs on Earth
- **Out of 10,000 genes evaluated, 1632 genes were altered in µG**
- Genetic expression of cytokines (interleukins, interferon-gamma, tumor necrosis factor) in human cells is changed during spaceflight
- Expression of proto-onco-genes, c-fos and c-jun, in human epidermoid A431 cells flown on sounding rockets are altered

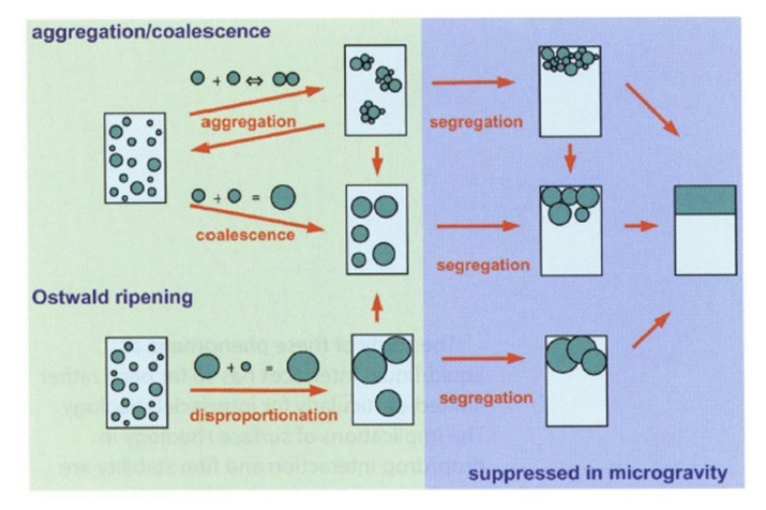


SPACE AND SUSTAINABLE DEVELOPMENT

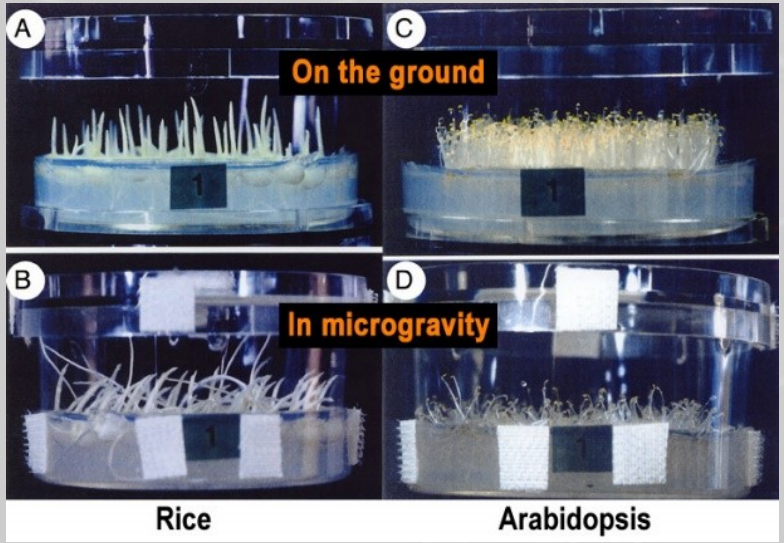
IV. Improved shelf-life of colloidal-based products

Examples of colloidal systems strongly affected by gravity include **macromolecular crystallization, self-assembly of proteins and polymers, liquid crystals, suspensions, emulsions and foams**

- Particles are under constant motion → aggregation → sedimentation & phase separation
- The behaviour is not well modeled (unpredictable) since gravity is a masking and catalytic factor
- The **lack of sedimentation and buoyancy in µG** helps understanding the process allowing differentiation between aggregation/phase separation and sedimentation



V. Space Farming: Plant Biology



Microgravity effects on plants growth

Exposure of cells to microgravity results in various cellular alterations that affect structure and function, including signal transduction, gene-expression, immune response and metabolism

V. Space Farming: Plant Biology

‘Space Cherry’ Tree Blossoms 6 Years Early Following Trip Aboard The ISS, Cosmic Forces May Have Spurred Growth

By Philip Ross
on April 12 2014 4:23 PM

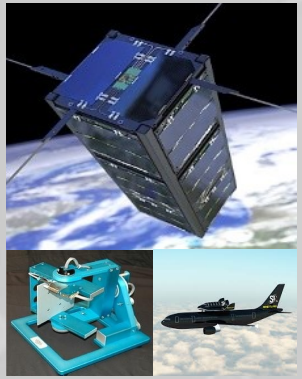
Microgravity enables the examination of fundamental plant biology and contributes to the understanding of main processes such as gravitropism, phototropism, and juvenility

SpacePharma's Solution – µGnify

Simple, Affordable, Accessible, End-to-End µG solution:

Build Research Procedure

Customize Lab for Research Needs

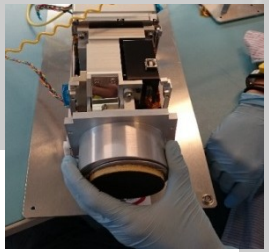


Place Lab in Microgravity Platform

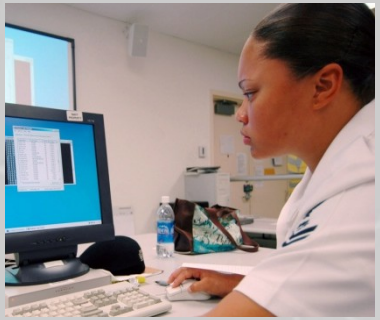
Control Microgravity Experiment and Get Results

1 2 3 4

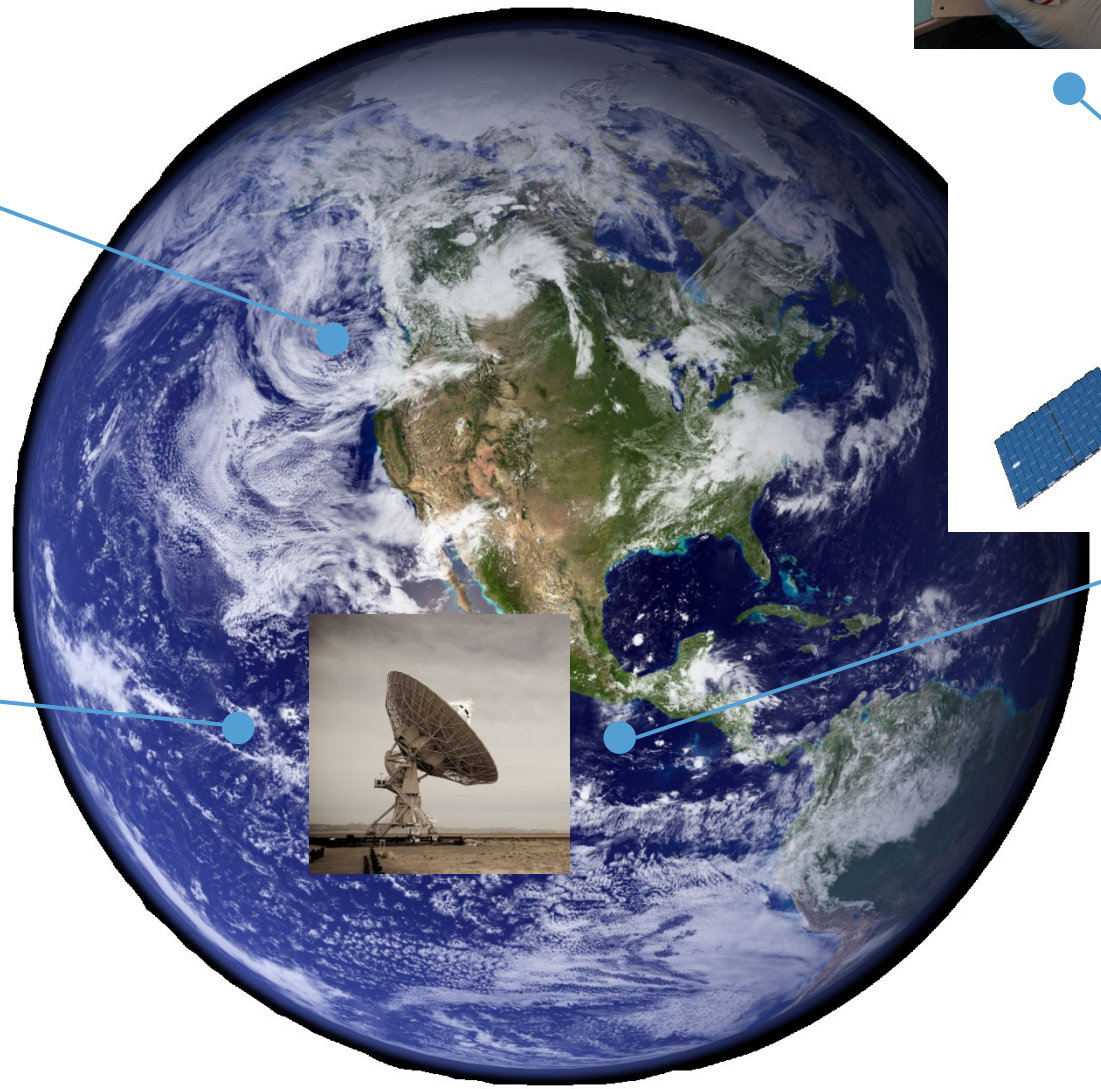
SpacePharma's Technology



Experiment will be preformed in micro-labs inside the satellite



Customers monitor & control experiment from their location



SpacePharma transmits the experiment protocol to the satellite.

The results, including environmental reading, are received at SpacePharma's ground station

SPACEPHARMA
simply microgravity

SpacePharma's Technology

- Miniaturized Nano-laboratory
- Easily customized
- Fits inside multiple microgravity platforms
- Remote controlled by customers
- Flexible usage model
- Secured data protection

SpacePharma's First Satellite – DIDO1

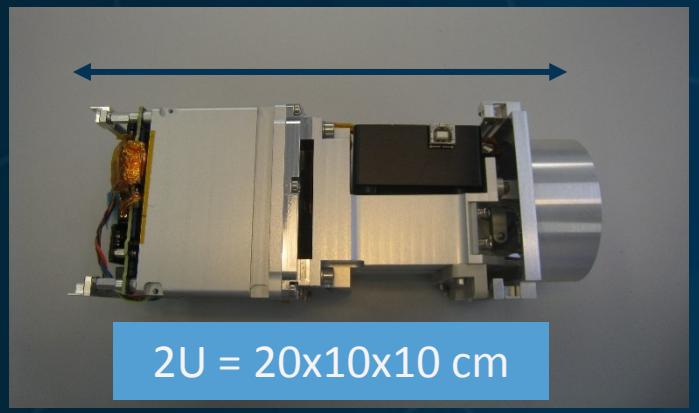
Upcoming launch:

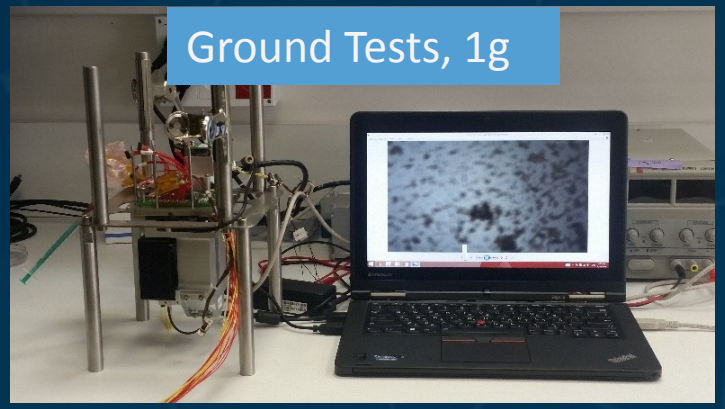
SPmgLab:

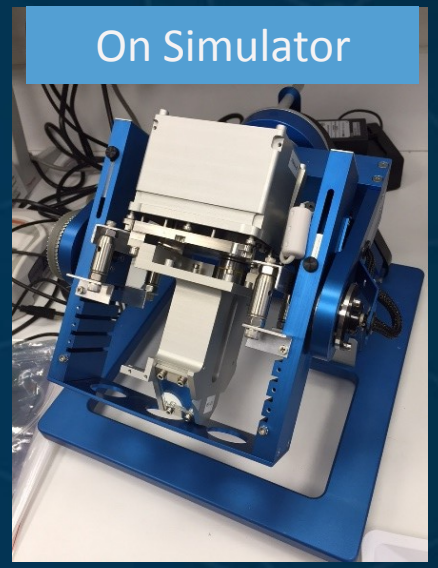
Bacterial growth, Antibiotics resistance, Self-assembly, Enzymatic reactions, Polymerization, Nanoparticle synthesis, Particle aggregation dynamics, Emulsion stability, Crystallization

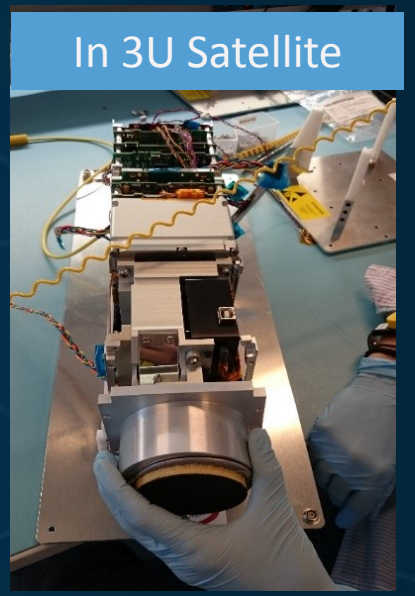
SpacePharma's First Satellite – DIDO1

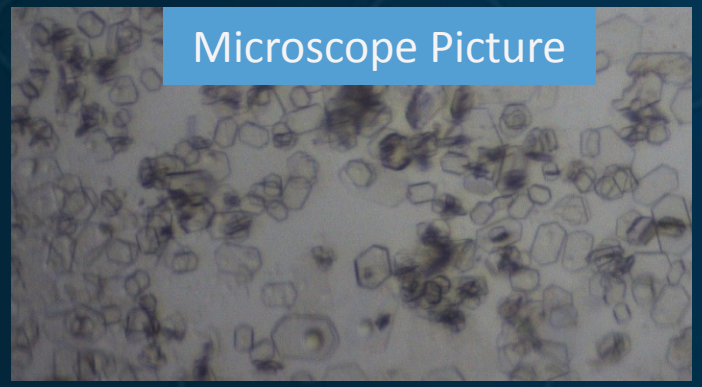
Upcoming launch:





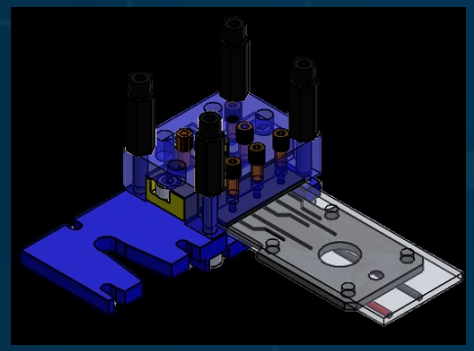






SpacePharma's Capabilities – SPad Lab

- Advanced Labs
  - Plug-n-Play Micro-/Mill-fluidic Chips

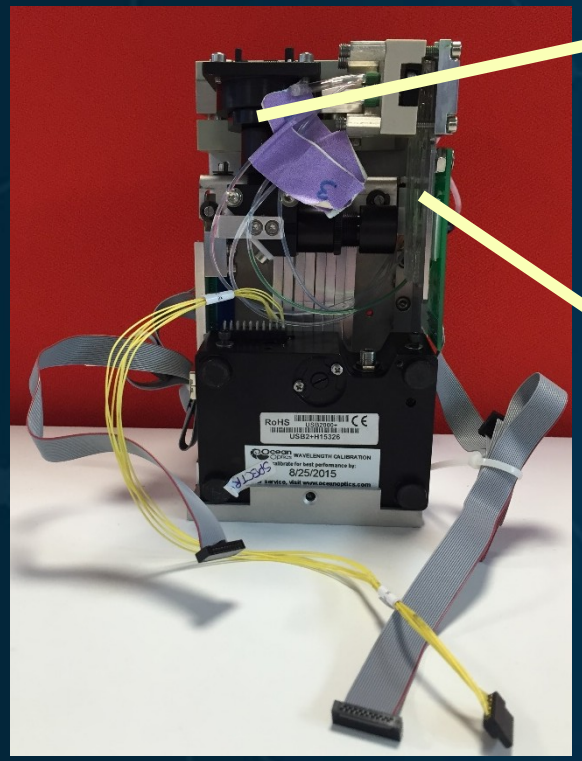


- Example Sensors:
  - Microscopy
  - Spectrometry
  - Fluorescence Microscopy
  - Fluorometry
  - Heating & Cooling

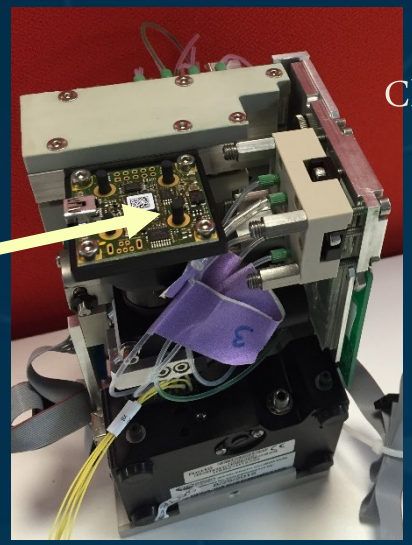
- Multiple Platforms
  - Customizable Payload Wrapper – Interface between App-platform-lab

- Working on being able to mount labs in other platforms
  - Simulator
  - Parabolic Flights
  - ISS
  - Drop Towers

Spad Lab - Packaged

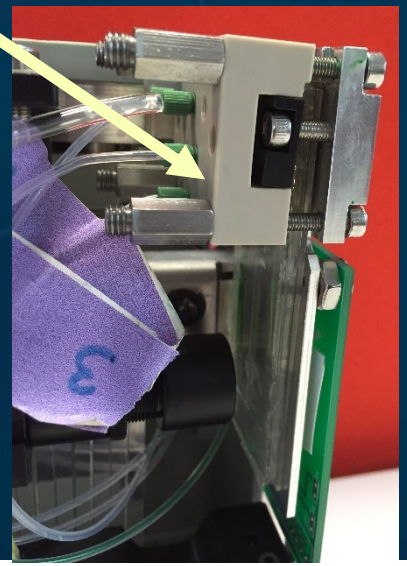


Front View



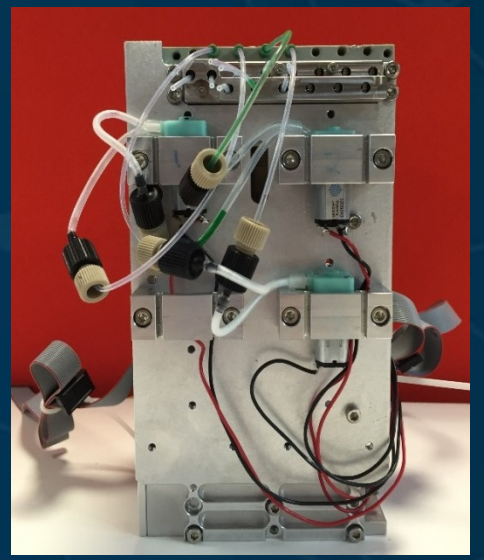
Side View:

Chip Holder & Chip



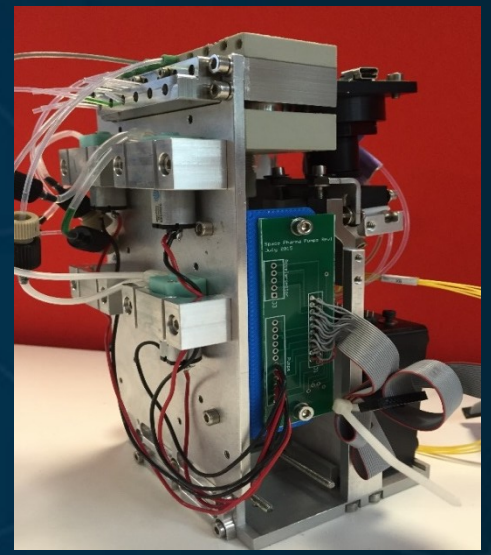
Top View:

Microscope



Back View:

Pump

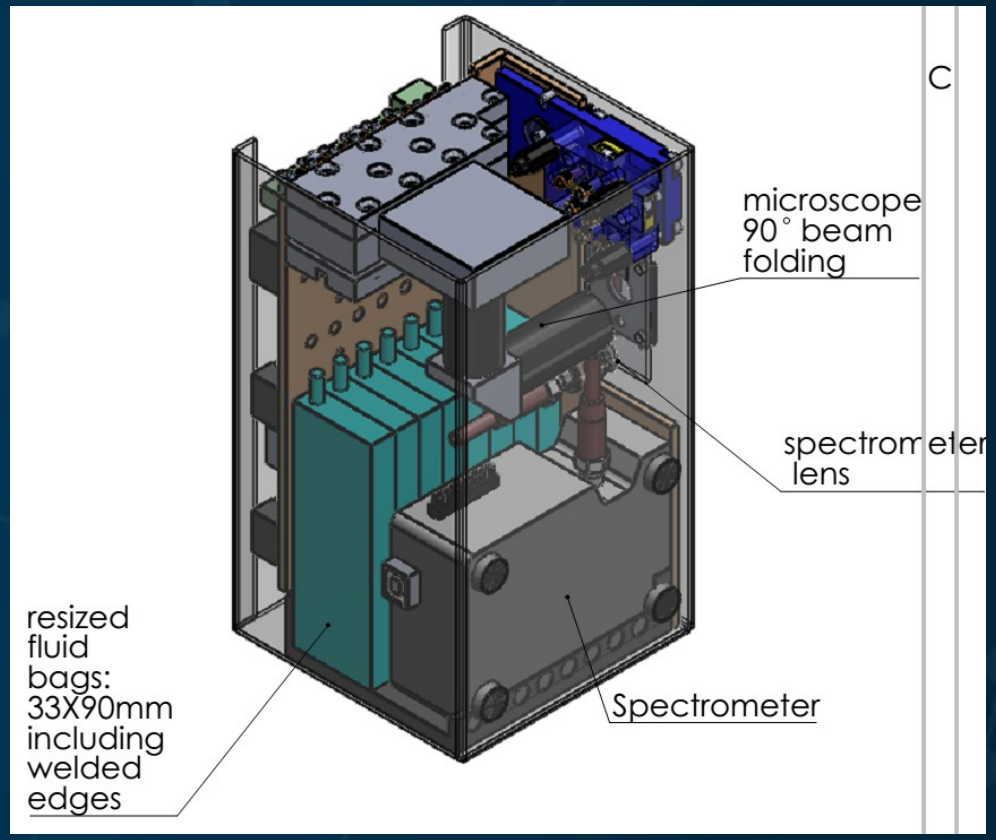


Side View:

Pumps & Pump/LED Electronics

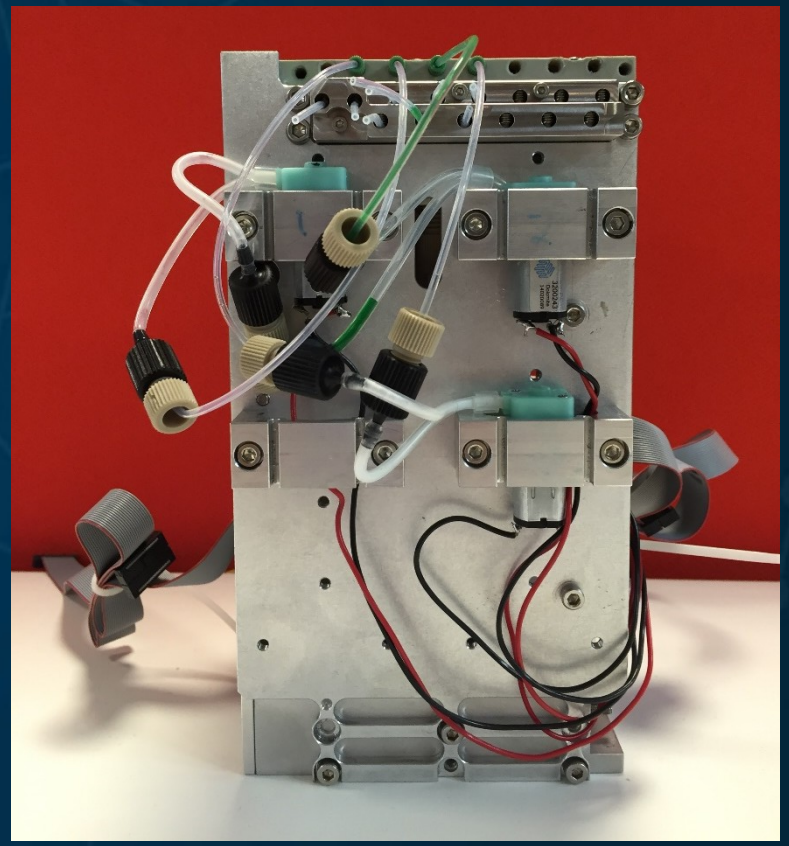
Current Capabilities – Inside the lab

- Microscope with 1x-8x magnification
- Spectrometer – range 300nm-1000nm
- Visible and UV LED light
- Temperature control of the chip to ± 0.5°C
- 10mL reservoir bags
- Smooth or pulsating flow pumps
- Chips
  - Mixing - chemical and bio-chemical reactions, colloidal chemistry
  - Droplet creation – foam and emulsion stability
  - Cell/Bacteria/Yeast culture

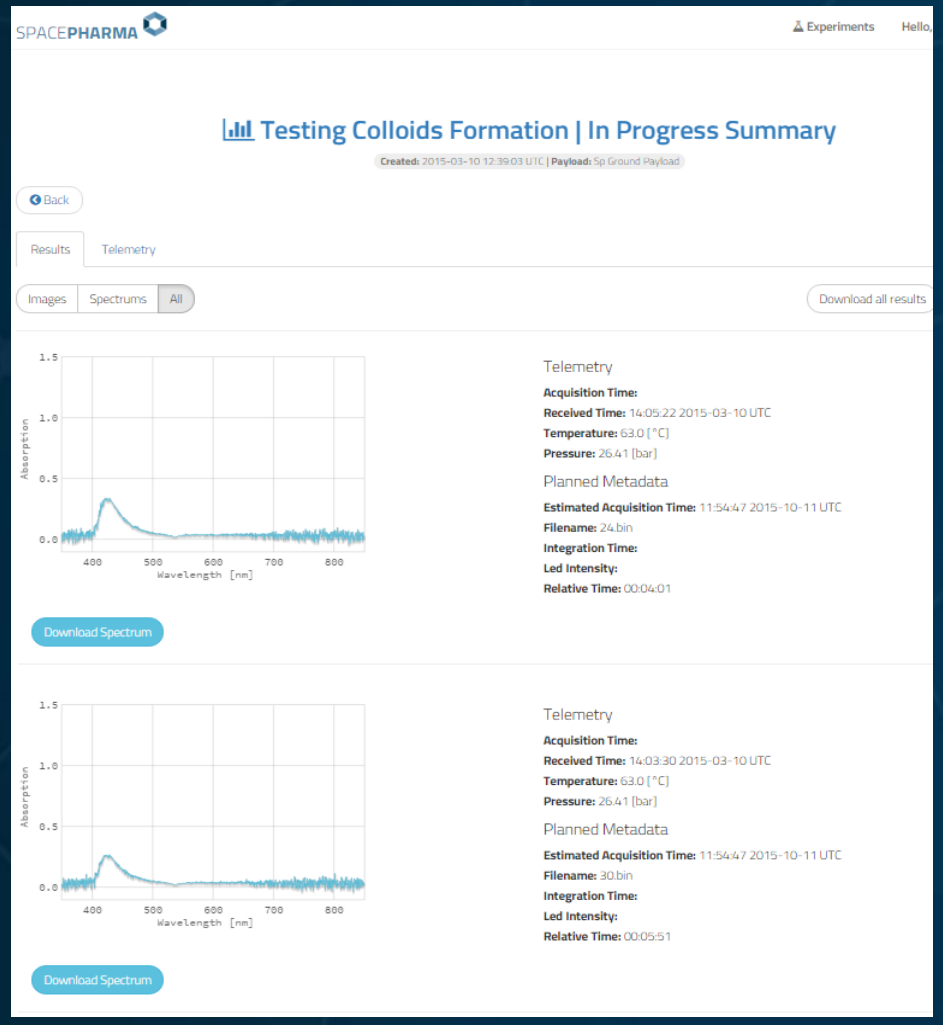


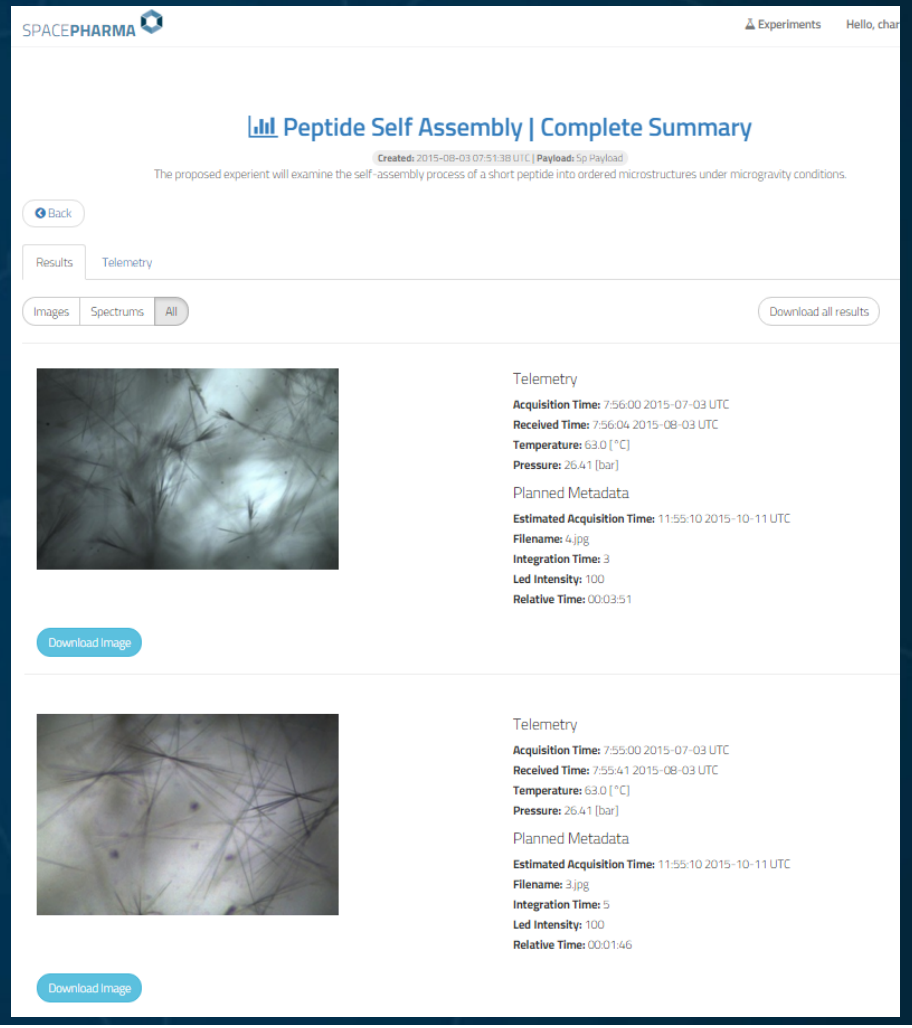
Fluid Handling System

- Contains up to 6 pumps with 8 reservoir bags (6 inlets and 2 outlets)
- Chip holder for plug-and-play changing of chips
- Environmental control of chip
  - Enables biological experiments
- Software to operate pumps and perform end-to-end experiments



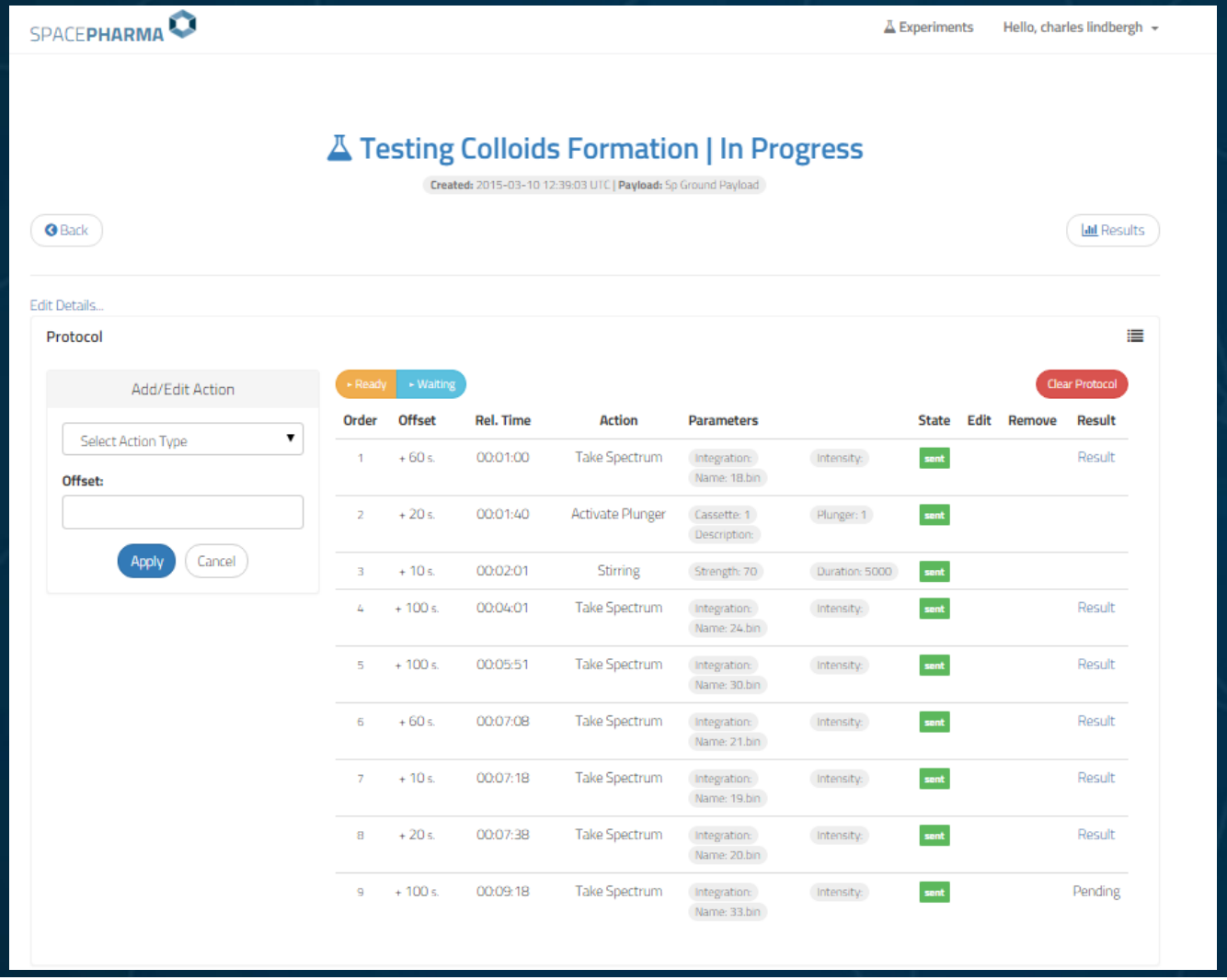
Scientist Front-end Software





SPACEPHARMA
simply microgravity

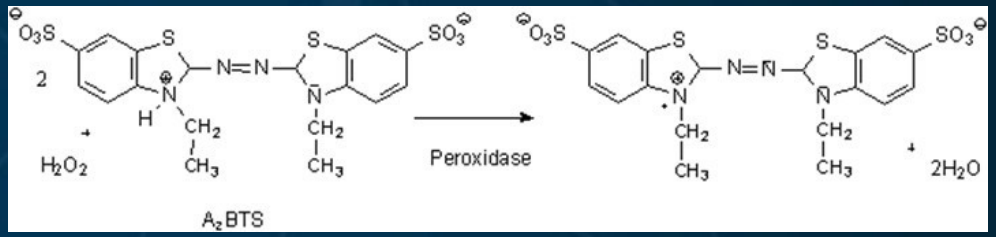
Scientist Front-end Software

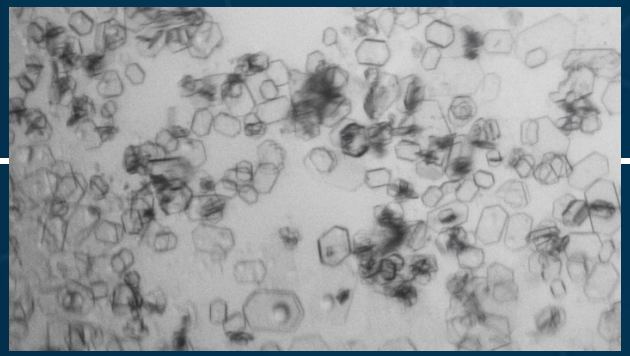


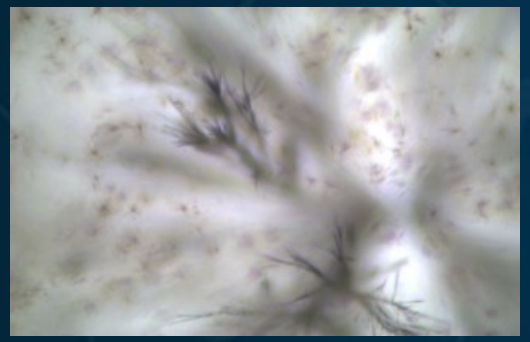
SPACEPHARMA simply microgravity

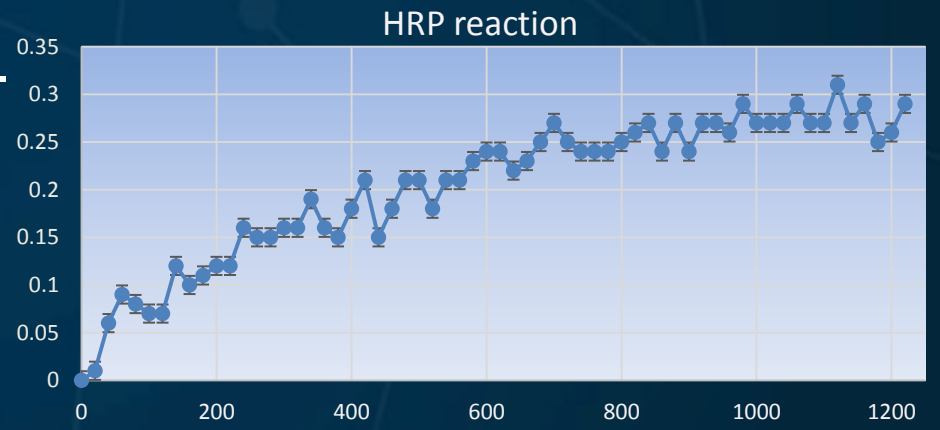
Current Microgravity Research at SpacePharma

- Preliminary feasibility studies have shown the ability of SpacePharma SPmgLab to perform microgravity research in the following fields:
  - Colloidal chemistry: crystal growth
  - Self-assembling of macromolecules
  - Enzymatic reactions
  - Bacterial growth









Status

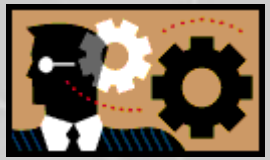
- Ground station : April 2016
- ITU frequencies : May 2016
- First satellite launch: May 2016
- First parabolic flight: August 2016
- 2nd satellite launch: August 2016

Ground Station Switzerland

Ground Simulator

Parabolic Flight

DIDO-I



Reality is just here! – we make it happen!

- DIDO Style
- Self Assembly Clip taken from DIDO
- SpacePharma R&D Labs - Dr. Molly Muligan
- SpacePharma advance Lab on a Simulator
- Our full journey

Thanks for your attention