International Conference MOON BASE a Challenge for Humanity

INTERNATIONAL CONFERENCE MOON BASE
A Challenge For Humanity
Moscow-Star City Workshop: "The Precursor Age"
Moscow, 16th November, 2006

*M*olecules, *C*ells and *M*an: Science and Technology for the 'Moon Base' Project (*MCM*)

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The "Moon Base" project: a **scientific view**

The first step towards the export of Earth life and Humankind to Space

- **First priority: the preliminary assessment of Moon environmental risks**
- **The "MoMa" Scientific/Industrial community can help**
- **MoMa ("From Molecules to Man: Space Research Applied to the Improvement of the Quality of Life of the Ageing Population"): An Italian 'ASI' project in the field of 'Medicine & Biotechnology'**

- **When and How?**
- **What is MoMa, and how it works?**

The Origins
of the ‘MoMa’ Project

From 6 ‘old’ Research Lines in the A.S.I. ‘Medicine & Biotechnology’ area

To 3 ‘new’ Lines:

Radiobiology and Protection

Cellular & Molecular Biotechnologies

Biotechnological Applications

From the 6-Months ‘MoMa’ Preliminary Study (2004)

To the 3-Years Applicative Project ‘MoMa’ Just started (16th June, 2006)

REMODULING has been extensive
For efficency and effectiveness

MoMa 6-months Preliminary Study: the initial status (Jan. 2004)
71 research groups, averaging 3-4 individual labs each

During the 6 months of the MoMa Preliminary Study:
11 *coordinated Groups* identified in *4 Areas*

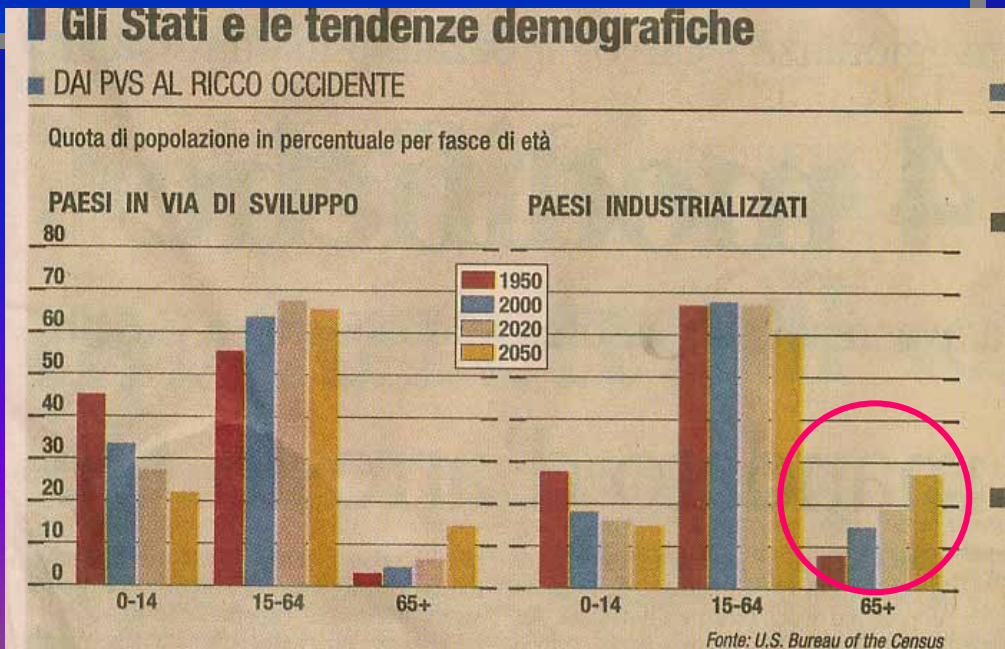
MoMa 3-years project
2006 to 2009

MoMa: One Project, strongly focused towards 1 unifying Goal:

"AGEING and the QoL": A strong, primary goal, particularly in Italy:

- **Italy has the highest *Life Expectancy*: 80y (women: 83, man: 77)**
- **Italy has the lowest *Fertility Rate*: 1,27 ("*Zero Growth*" = 2,01)**
- **"*Demographic implosion*" ready to fire (i.e.: n° retired/working force) due to increasing *ageing-related pathologies* (i.e.: Tumors, Cardiovascolar and Neurological Diseases, etc.)**

***MoMa*:**
relevant 'Fallout' from Space research, particularly relevant in Industrialized Countries, especially in Italy



SPACE relevancy of the MoMa topic: "AGEING and QoL"

- **Space is a challenging, extreme environment (µg, space Radiation, ...)**
- **Lack of natural defences, no Darwinian *Selective Pressure***
- **Cascade of *molecular and cellular damages* similar to Ageing**
- **The phenomenon of *Accelerated Ageing in Space* has been described**
- ***Space Biotecnological Applications:* very likely**
- ***On-earth Biotech Applications fallout:* very likely**

OVERALL GOAL of MoMa

TO STUDY

the accelerated ageing phenomenon in Space

THUS CONTRIBUTING

to the development of Biotec Applications, necessary for a safe exploitation and colonization of the Solar System and beyond

AND PURSUING

relevant fallouts on Earth, by developing Countermeasures against Ageing, thus significanly increasing the QoL of the Eldery

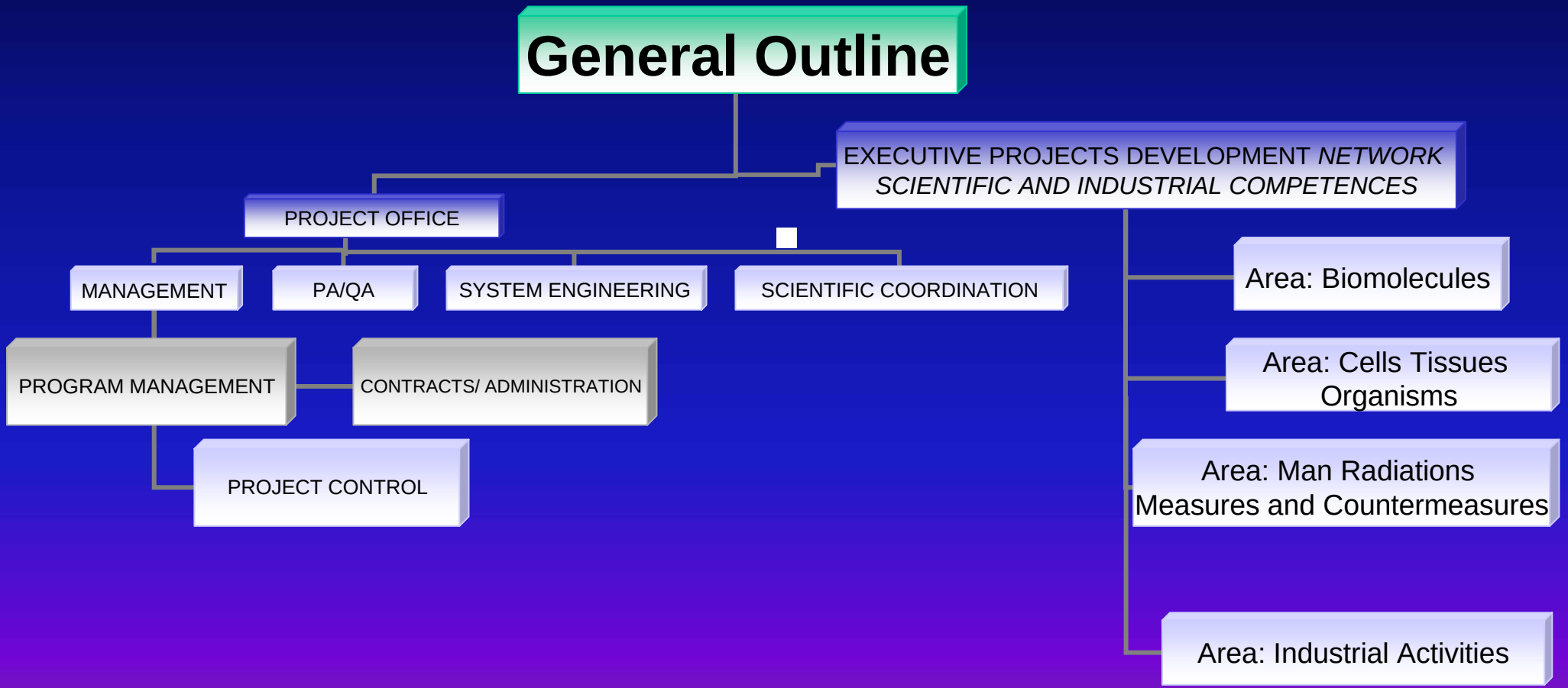
STRONG POINTS OF THE MoMa PROJECT

Subject	Criteria for Excellency
Number of collaborating Staff	**Over 500 groups of Scientists (50% women)**
Number of collaborating Institutions	**38 (nationwide, in Italy)**
Collaborating Industries and SME	**9 (all major Space-related Italian Industries/SME)**
Research / Ph.D. Fellowships	**Over 250 (with Equal Opportunities)**
Co-Financing (as Personnel time devoted to MoMa)	**€ 17.182.211,40 (48% of the entire Project)**
Total contribution to Industries/SME	**€ 6.490.000 (36% the total budged requested to ASI)**

MoMa ***EXPECTED PRODUCTS***

- **Patents**
- **Biosensors**
- **Radioprotective Molecules and innovative Materials**
- **Recombinant proteins**
- **Innovative Enzymes**
- **Molecular Data Bases (sequences, structures, genes)**
- **Experimental proposals, approved by International Space Agencies**
- **Publications in International Journals**
- **Deveolpment of Hardware for “Space” Biotec applications**
- **Deveolpment of Hardware for “Ground” Biotec applications**

The MoMa Project



SUBCONTRACTORS (Coordinators) (1/2)

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ROSSI Mosè
Istituto di Biochimica delle Proteine, CNR, Napoli.

SUBCONTRACTORS (Coordinators) (2/2)

Industries / SME:

ADAMI Giorgio

Alcatel Alenia Space Italia – Vimodrone MILANO (ex Laben)

Organizational Chart of the Coordinated research lines

Area	Denomination	Acronym	Line	Acronym	Coordinator
I	Bio**Mo**lecules	**Mo**	Prebiotic Chemical and Biochemical Processes	GSS&A	Di Mauro
			Hyperstable Molecular Tools	HTM	Rossi
II	**Ce**lls, Tissues, Organisms	**Ce**	Farmaci Anti Invecchiamento	FAI	Giardi
			Space Environtment on Cellular Function: Developments and Applications	SE on CF	Curcio
			Animal Models to Study Deleterious Effects of Space.	ASSC	Rizzo
			New Biotechnologies to Evaluate Radiation and Microgravity Effects on Immune Systyem.	ERMEIS	Piccolella
III	**Ma**n, Radiation, Countermeasures	**Ma**	Cosmic Radiation and Human Risk: Identification and Characterization of Specific Biomarkers.	XMAB	Palumbo
			Biodosimetry in Space: Validation of Novel Biomarkers of Chromosome Damage and Cancer Risk in Astronautas.	BCRI	Bonassi
			Anomalous Long Term Effects in Astronautas.	ALTEA	Narici
			Countermeasures for the Exposures to Galactic Cosmic Rays in Deep Space.	COUNT	Durante
IV	**In**dustrial activities	**In**			Adami

Area I: Bio**Mo**lecules

- **Limits of the present knowledge**

1. 1. Key Molecules in Ageing

1. 2 . Modulating Molecules in Ageing

1. 3. Molecular and Cellular mechanims in the Pathogenesis of Ageing

Area II: Cells, Tissues and Organisms

- **Limits of the present knowledge**

2.1 Check points in the Aging process, cell transformation and death, also referring to differentiated cell systems and to the Immune system

2.2 Biological Models for the study of environmental factors capable of accelerating the Ageing process

Area III: **Ma**n, Radiation, Countermeasures

- **Limits of the present knowledge**

3.1 Ratio between physical doses of radiation and long-term biological risks

3.2 Mechanisms of Central Nervous Tissue Ageing and its modulation from Environmental factors

3.3, 3.4 Lack of effective countermeasures to Space radiation effects

Area IV: **In**dustrial activities

➢ ***OVERCOME*** **the limits of our present *technologies* (just a few examples):**

4.1 Life Support System for RPM Clinostat

4.2 IMI: Italian MoMa Incubator

4.3 Biosensors

4.4 Altea - Altea 2 - Alteino

4.5 Bioreactor – Multiwell

4.6 External Bone Fixator

A synoptic view of the MoMa "Team":

(Areas I-III: *M– C–M*)

Area I *M*olecules

Ernesto DI MAURO
Dipartimento di Genetica e Biologia Molecolare, Università di Roma "La Sapienza"
e Istituto di Biologia e Patologia Molecolari, CNR, Sezione Acidi Nucleici, Roma

Mosè ROSSI
Istituto di Biochimica delle Proteine, CNR, Napoli

Area II *C*ells

Maria Teresa GIARDI
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Enza PICCOLELLA
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Area III *M*an

Giuseppe PALUMBO
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Stefano BONASSI
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Dipartimento di Scienze Fisiche, Università di Napoli "Federico II"

Industrial Coordinator (*In*)

A. IV

Giorgio **ADAMI**
Alcatel Alenia Space Italia - Laben

Besides the Speaker (FSAI), the following MoMa participants are prepared to contribute to Moon Base:

(Areas I-III: *M– C–M*)

Area I *M*olecules

Ernesto DI MAURO
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e Istituto di Biologia e Patologia Molecolari, CNR, Sezione Acidi Nucleici, Roma

Mosè ROSSI
Istituto di Biochimica delle Proteine, CNR, Napoli

Area II *C*ells

Francesco CURCIO
Dipartimento di Patologia e Medicina Sperimentale e Clinica, Università degli Studi di Udine

Area III *M*an

Marco DURANTE
Dipartimento di Scienze Fisiche, Università di Napoli "Federico II"

Industries (*In*)

Area IV *In*dustries

Giorgio **ADAMI**
Alcatel Alenia Space Italia - Laben

Roberto AMENDOLA
ENEA-BAS, Istituto per la Radioprotezione, Roma

MoMa contribution to Moon Base (MCM #1, #2):

Area I
***M*olecules**

#1. Prebiotic chemical and biochemical processes.
Ernesto DI MAURO
Dipartimento di Genetica e Biologia Molecolare, Università di Roma "La Sapienza"
e Istituto di Biologia e Patologia Molecolari, CNR, Sezione Acidi Nucleici, Roma

#2. Hyperstable Molecular Tools.
Mosè ROSSI
Istituto di Biochimica delle Proteine, CNR, Napoli

Themes of the AREA I. The Space environment as a tool for the study of Ageing: comprehension and prevention of molecular mechanisms.

1.1 Structural characterization of biomolecules relevant to Ageing;
1.2 Design of drugs relevant to degenerative pathologies;
1.3 Study of the mechanisms involved in DNA replication and repair;
1.4 Study of heath-resistant enzymes and their use in the production of molecules for Health and diagnostics.

MoMa contribution to Moon Base (MCM #3):

Area II
Cells

 # 3. Space Environment on Cellular Function: Development and Applications.

Francesco CURCIO
Dipartimento di Patologia e Medicina Sperimentale e Clinica, Università degli Studi di Udine

Themes of the AREA II. The Space environment as a tool for the study of Ageing: identification of cellular responses.

2.1 Critical mechanisms responsible for Ageing and Cell transformation;
2.2 Evaluation of environmental effects (microgravity, radiation) and study of the mechanisms in:
2.2.1 Plants and microorganisms;
2.2.2 Cellular systems derived from different organs and tissues;
2.2.3 Animal models.

MoMa contribution to Moon Base (MCM #4):

Area III
***M*an**

#4. Countermeasures to the Exposure to Galactic Cosmic Rays in Deep Space.

Marco DURANTE
Dipartimento di Scienze Fisiche, Università di Napoli “Federico II”

Themes of the AREA III. The Space environment as a tool for the study of Ageing: development of countermeasures in Space and their fallout on Earth.

3.1 Biosensors and biodosimetry of ionizing radiation;
3.2 Neurodegenerative effects;
3.3 Physical countermeasures to radiation: development of new screening materials;
3.4 Medical countermeasures to radiation. Innovative molecules and food additives.

MoMa contribution to Moon Base (MCM #5):

Area IV
***In*dustries**

Giorgio **ADAMI**
Alcatel Alenia Space Italia – (ex Laben)

Roberto AMENDOLA
ENEA-BAS, Istituto per la Radioprotezione, Roma

This area will be described separately, hereafter

"From **Mo**lecules to **Ma**n: Space Research Applied to the Improvement of the Quality of Life of the Ageing Population (MoMa)"

CONCLUSIONS

The Proposers are confident that the MoMa Scientific and Industrial knowhow, facilities and technologies, may significantly contribute to the preventing and/or reducing the short- and long-term risks for the ***Biological Organisms*** and ***Humans*** exposed to the Lunar environment.

The PROPOSAL For Moon Base:

_M_olecules, _C_ells and _M_an: Science and Technology for the 'Moon Base' Project (_MCM_)

- A long-term committment -

Area IV: Industrial activities

➢ 4.1 Life Support System for Clinosat RPM

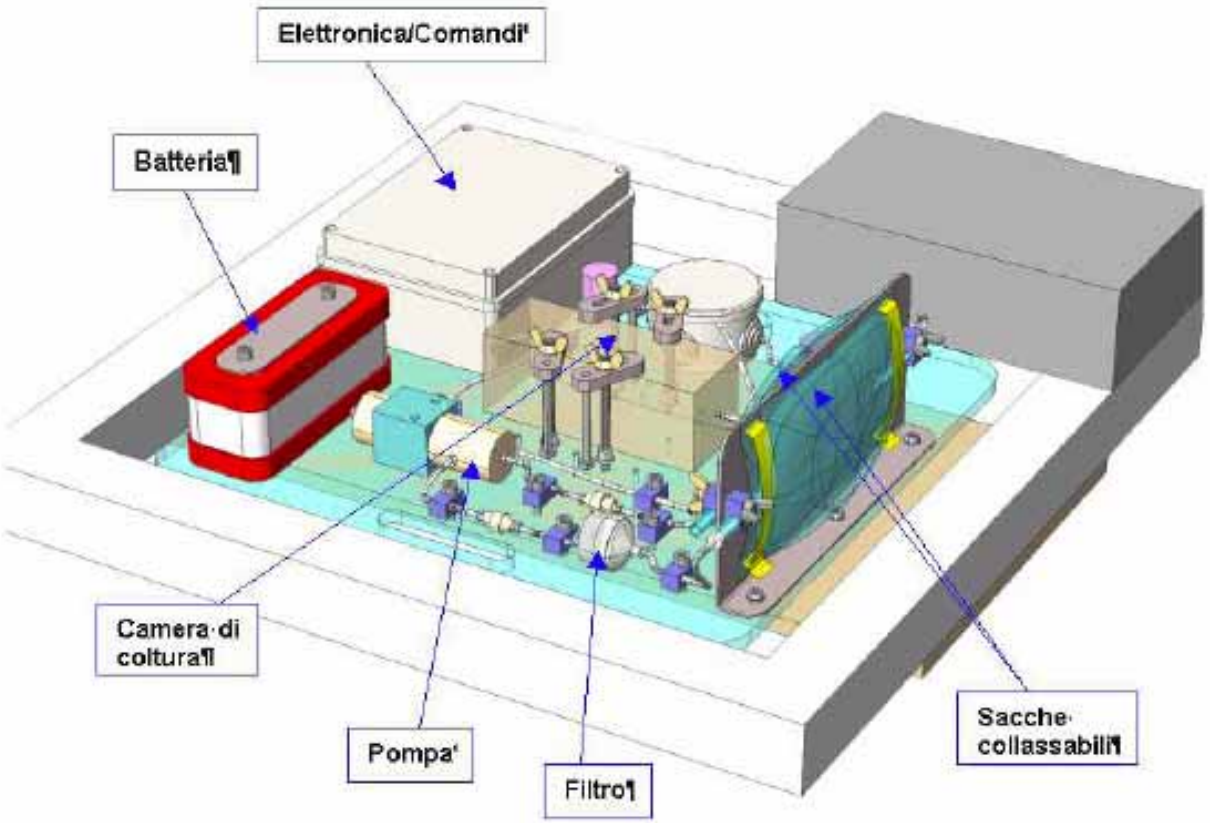
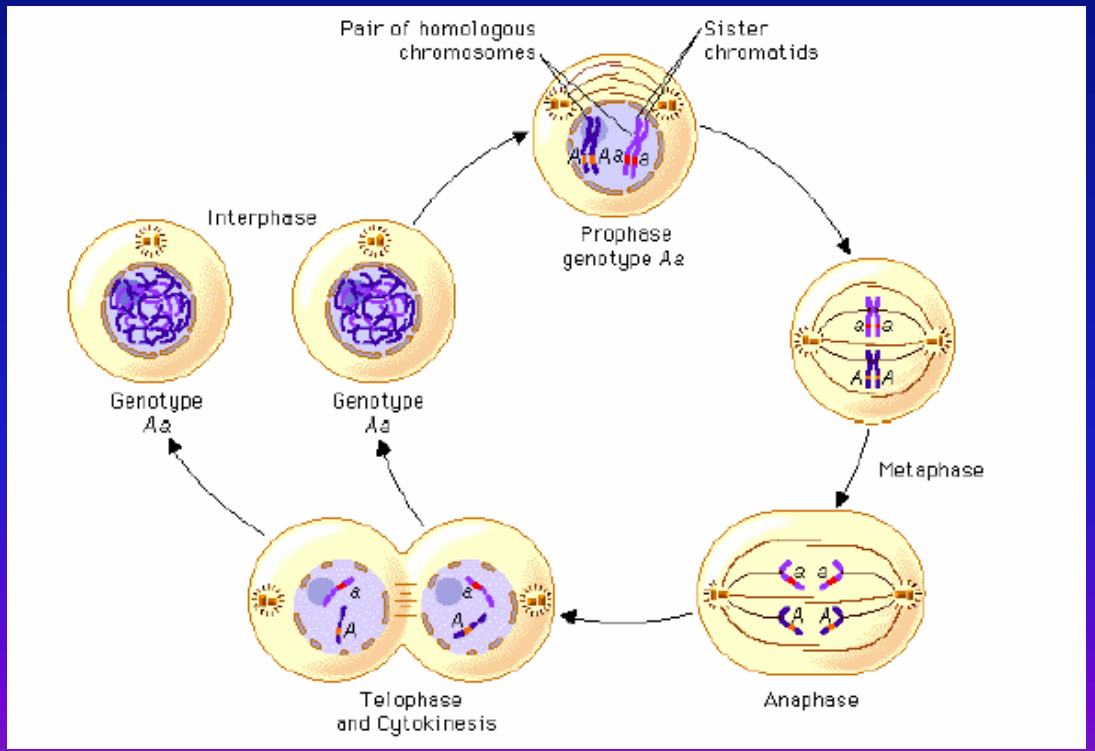


Fig. 6-1 Sistema montato su RPM

Area IV: **In**dustrial activities *(introduction)*

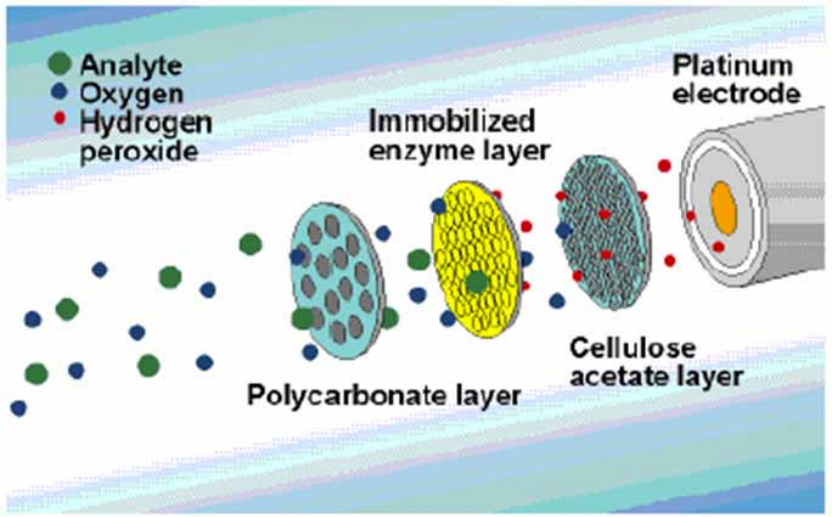
- **IMI: Italian MoMa Incubator** *(facility)*



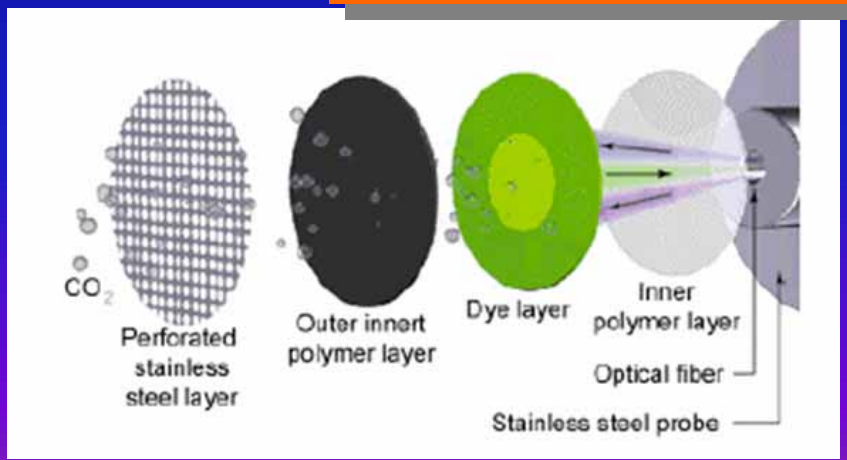
IMI integrated in the ISS Express Rack

Area IV: Industrial activities (introduction)

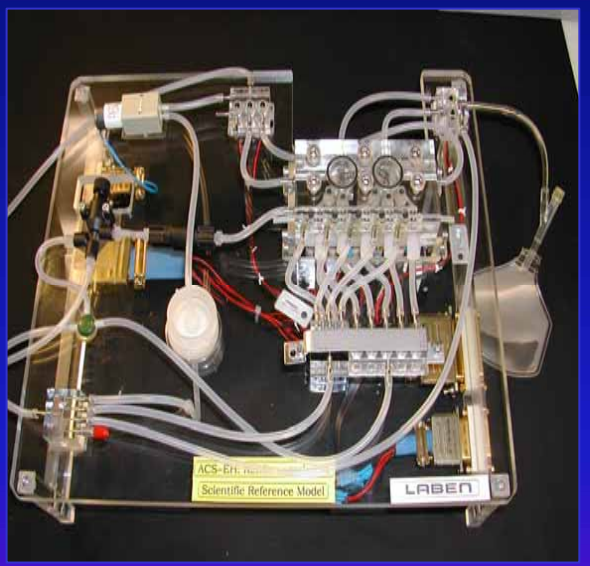
➢ Biosensors and devices (for experiments in Space)



Glucose monitoring sensor



CO2 monitoring sensor



Science reference model

Area IV: Industrial activities

➢ 4.3 Biosensor

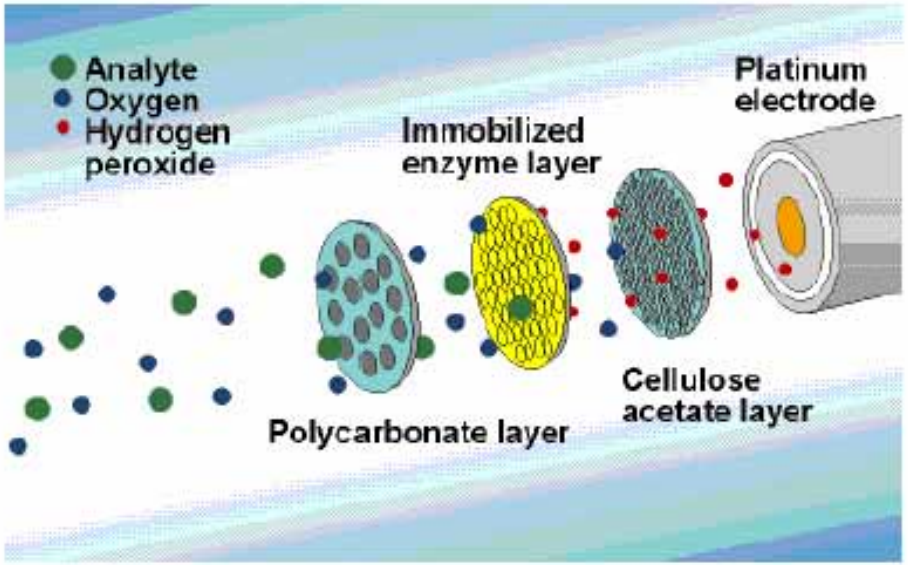


Figura 6.2.2.8-6 Struttura di un sensore di glucosio e lattato

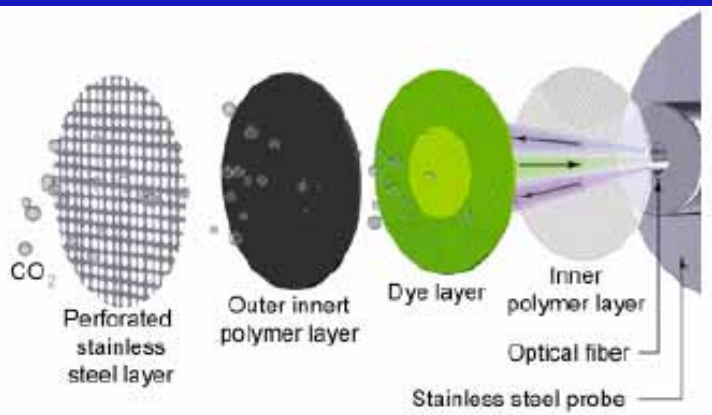


Figura 6.2.2.8-5 Struttura di un sensore di CO_2 disciolta

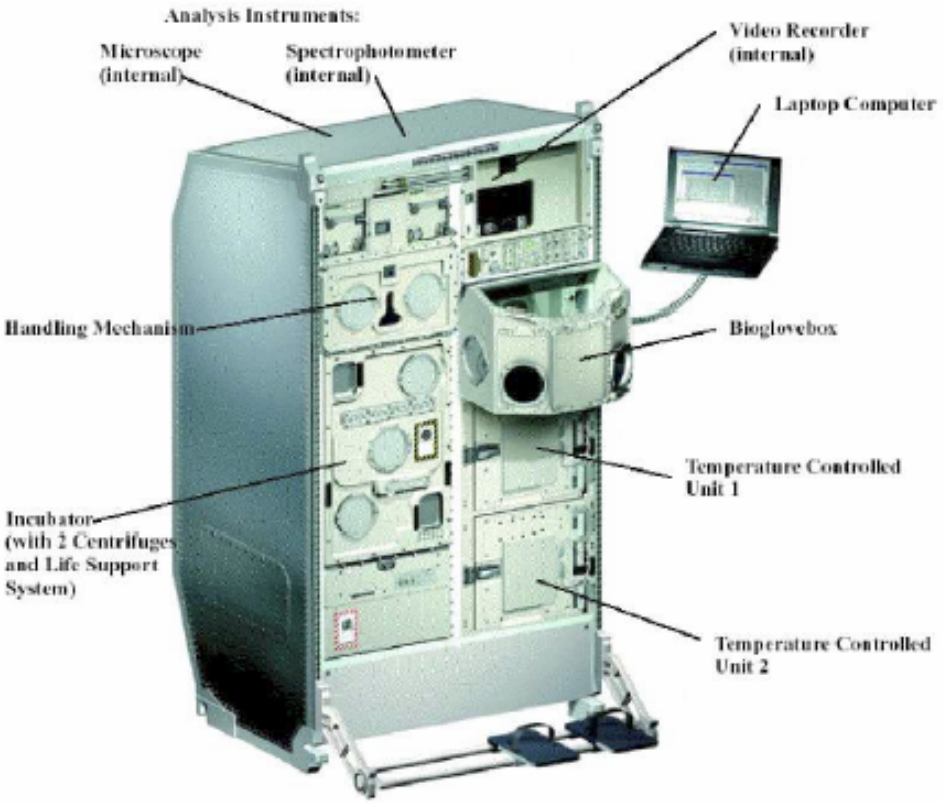


Figura 6.2.2.12-1 Immagine pittorica della facility europea Biolab

Area IV: Industrial activities

➢ 4.4 Altea - Altea 2 - Alteino

Area IV: Industrial activities

➢ 4.5 Bioreactor – Multiwell

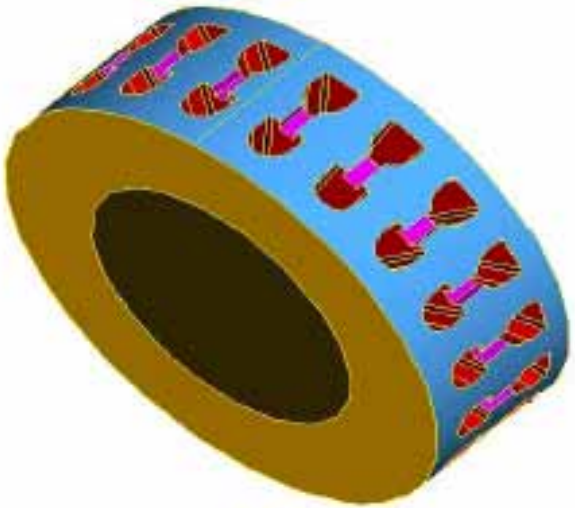


Fig. 6-10 Cilindro con 20 pozzetti da 200 µl ognuno

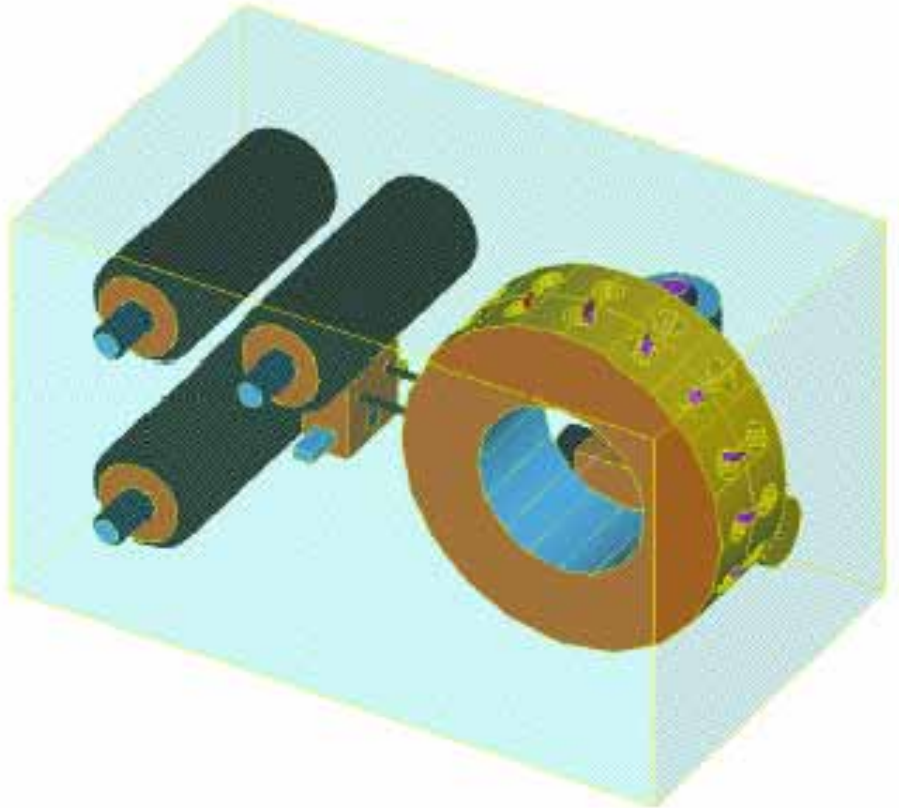


Fig. 6-11 Sezione di gestione dei liquidi