



Current and Future Activities of the Space Flight Dynamics Laboratory of ISTI/CNR

Luciano Anselmo

*Istituto di Scienza e Tecnologie dell'Informazione
CNR – Area della Ricerca – Pisa – Italy*

Present and Future Challenges in Aerospace

ISRO Satellite Centre – Bangalore – 14 March 2003

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History

- **1965:** Centro Nazionale Universitario di Calcolo Elettronico (C.N.U.C.E.), in cooperation with IBM, in Pisa. Scope: to provide the national scientific community with electronic computing services and know-how.
- **1973:** The Center becomes an Institute of the Italian National Research Council CNR (C.N.U.C.E. → CNUCE).
Scope: computer science center to promote and develop research activities in selected fields which can take advantage of a large computing facility.



History

- **2001-2002:** Restructuring of the CNR research network: creation of 108 new institutes (basic science, applied science, technology, humanities).
- **July 1, 2002:** CNUCE + IEI = ISTI (Information Science and Technologies Institute “A. Faedo”).
- **December 4, 2002:** Space Flight Dynamics Laboratory
- **2003:** New CNR restructuring. Future → ???



ISTI

- The Institute of Information Science and Technologies (ISTI) is an institute of the Italian National Research Council (CNR). The Institute is located in the CNR Research Area of Pisa (<http://www.area.pi.cnr.it>).
- ISTI was constituted in 2002 as a result of a merger between the “Istituto CNUCE” and the “Istituto di Elaborazione dell’Informazione” (IEI).
- ISTI is named in honor of Alessandro Faedo, former Dean of the University of Pisa and President of CNR, in recognition of his important contribution to the advance of Information Science and Technologies in the Italian academic communities.



IEI

CNUCE

Software

Systems

Graphics

Applications

Software

Systems

Information

Graphics

Applications

Software Quality and Reliability

Formal Methods for Software Specification and Verification

Man-Machine Interaction

Interactive Systems

Parallel Architectures and Applications

Wireless and Mobile

Computer Networks

System Diagnosis and Testing

Dependable Computing Systems

Information Storage and Retrieval on the WEB

Knowledge Discovery in Databases

Information Systems and Applications

Visual Computing

Image Processing

Audio Signal Processing

Computer Music

Non-destructive Testing

Mechanics of Materials and Structural Analysis

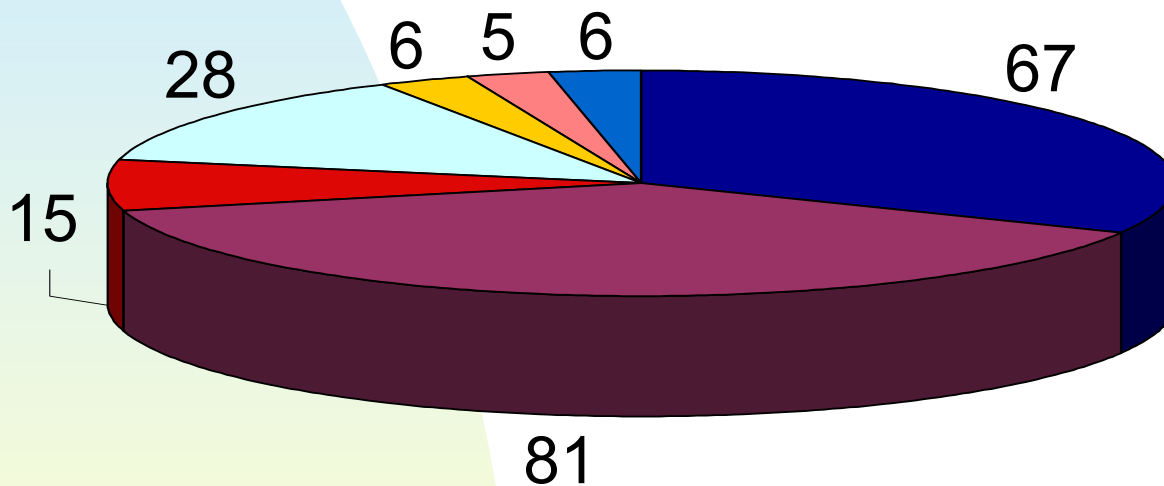
Space-Flight Mechanics

IEI and CNUCE: Combined research [Jump to first page](#)



ISTI Staff

ISTI-CNR: Staff

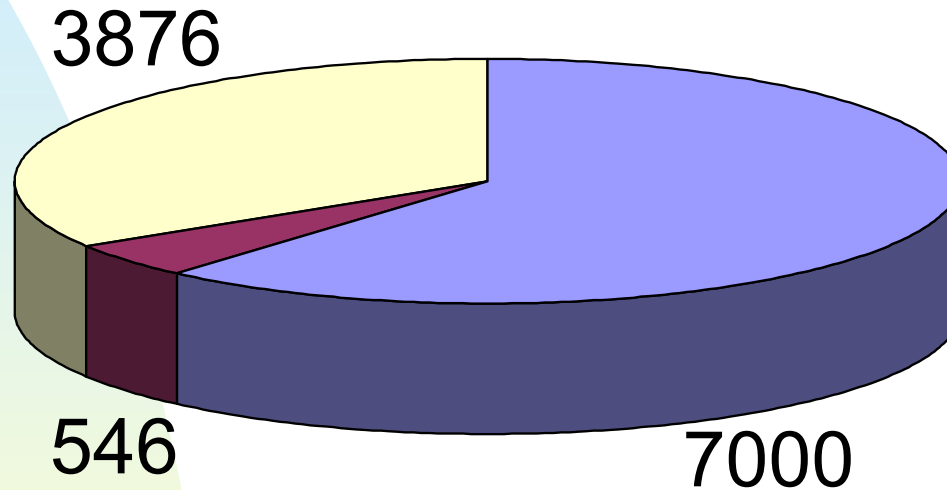


■ Technical and Administrative Staff	67
■ Research Staff	81
■ PhD Students	15
■ Graduate Fellows	28
■ Post-doctoral Fellows	6
■ Visiting Researchers	5
■ Support Fellows	6



ISTI Budget 2003

ISTI-CNR Budget 2003, kEuro



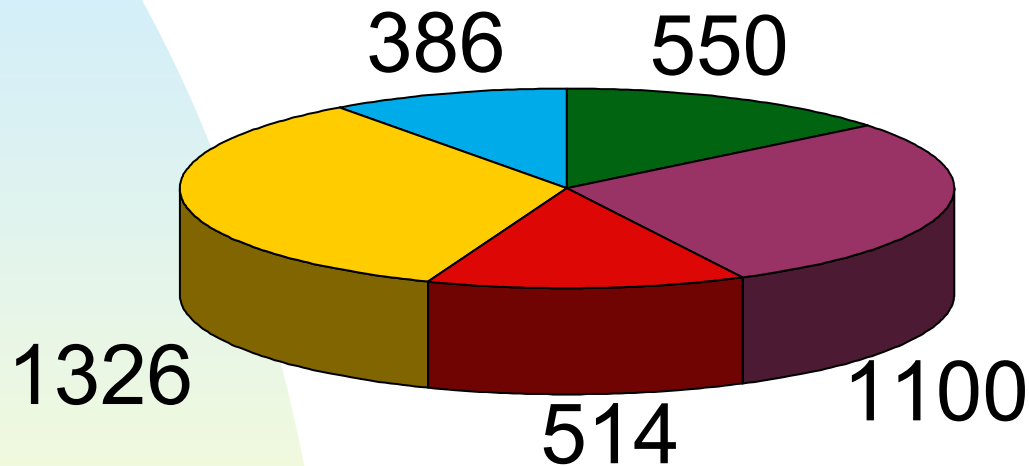
■ Cost of Permanent Staff (administered by CNR)	7000
■ Maintenance and utilities (administered by CNR)	546
■ Cumulative Available Funds	3876



ISTI Budget 2003: Funding Sources

ISTI-CNR

Budget 2003: detail of available funds (kEuro)



■ CNR	550
■ National Research Projects (Government)	1100
■ Public and Local Administrations	514
■ EEC Projects	1326
■ Industry and other Private Sources	386



ISTI Space Activities

- Since 1975 our Laboratory supports the Italian space program, managed by CNR (1975-1988) and ASI (since 1988). The fields of activity are:
 - ◆ Flight Control Systems
 - ◆ Mission Analysis and Design
 - ◆ Mission Planning and Operations
 - ◆ Orbital Dynamics
 - ◆ Reentry Predictions of Risk Space Objects
 - ◆ Space Debris Modeling
 - ◆ Stratospheric Balloons Flight Dynamics



Space Projects Involvement

- SIRIO [CNR] 1975-1989
- SIRIO 2 [ESA] 1980-1982
- STS-52/IRIS-LAGEOS 2 [ASI-NASA] 1982-1992
- COLUMBUS, Phase B2 [ESA-DLR] 1986-1987
- X-SAR (SRL 1 & 2) [ASI-DLR-NASA] 1989-1994
- TEMISAT [Kayser Italia] 1993
- ITALSAT 2 [ASI] 1996
- SAX [ASI] 1984-2003
- SRTM/X-SAR [NASA-DLR] 1998-2000
- MITA/NINA [ASI] 1999-2001



On-going Activities



Space Debris

- Orbital debris environment modeling
- Short and long term orbital debris evolution
- Impact risk assessment
- Mitigation measures evaluation
- Impact on space operations
- Support to national space projects
- Tethers survivability
- Participation in international committees and working groups (IADC, IAA, NoC SD, EDMSWG)
- Software development



Reentry Predictions

- Reentry predictions of risky space objects for the Italian Civil Protection Department
- Lifetime estimations for the Italian space objects
- Test reentry campaigns for atmospheric models and propagation software calibration
- Participation in the Inter-Agency Space Debris Coordination Committee (IADC) test reentry campaigns
- Software development and improvement



Stratospheric Balloons

(up to 1,200,000 m³)

- Flight Dynamics (trajectory forecast)
- Monitoring and control of the flight (gas & ballast drops, impact point prediction)
- Operational support

Flights

- Trans-Mediterranean flights (Trapani Milo - Spain)
- Antarctic flights (in cooperation with NASA)
- Technological flights (e.g. Boomerang, Huygens Atmospheric Structure Instruments)



BepiColombo Mercury Orbiters

- Definition and full simulation of the Radio Science Experiment aimed at:
 - ◆ Gravity field of Mercury
 - ◆ Rotation state of Mercury
 - ◆ General relativity test (PNP)
- Simulation of the measurements (range, range-rate, accelerometer readings)
- Modeling of the planet rotation
- Implementation of the computational algorithms for data analysis



Gravity Field and Ocean Circulation Explorer (GOCE)

- Study and implementation of the time-wise data reduction method for
 - ◆ Earth gravity field determination
 - ◆ Accelerometers calibration
- Study of the computational difficulties (large number of solve for parameters in the orbit determination)
- Study and implementation of new algorithms for the data analysis





Space Flight Dynamics Laboratory
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CNR – Area della Ricerca di Pisa
Via G. Moruzzi 1 – 56124 Pisa – Italy
<http://www.isti.cnr.it/>

