Memorandum of Agreement

Between

Stanford University - Stanford Linear Accelerator Center (SU-SLAC),

The Istituto Nazionale di Fisica Nucleare (INFN), Italy,

and

Agenzia Spaziale Italiana (ASI), Italy

Regarding

Italian Participation

in

The Large Area Telescope (LAT)

on

The Gamma-ray Large Area Space Telescope (GLAST) Mission
1. Introduction

The purpose of this Memorandum of Agreement (MoA) is to establish the management policy and areas of responsibility for Italian participation in the definition, development, integration, and operation of the Large Area Telescope (LAT) instrument on the Gamma-ray Large Area Space Telescope (GLAST) Mission. This MoA is pursuant to implementation of the GLAST LAT Flight Proposal entitled “GLAST Large Area Telescope Flight Investigation: A Particle-Astrophysics Partnership to Explore the High-Energy Universe”, selected by NASA on February 28, 2000.

The Gamma Ray Large Area Space Telescope (GLAST) is a high-energy gamma-ray mission to be launched in late-early 2005/2006. The Large Area Telescope (LAT), primary instrument aboard GLAST, is being fabricated by a collaboration led by Peter Michelson (Stanford University). It is recognized by all of the parties to this agreement that the research conducted under this agreement is fundamental research, the results of which are expected to be placed in the public domain.

The GLAST LAT instrument is subdivided into subsystems, which allows a clear definition of responsibilities in design, fabrication, integration and test. The main subsystems are the following (with the institutions participating in the fabrication and/or funding of the instrument indicated in parenthesis):

- Tracker [Stanford University-Stanford Linear Accelerator Center (SU-SLAC); University of California, Santa Cruz (UCSC); Istituto Nazionale di Fisica Nucleare (INFN); Agenzia Spaziale Italiana (ASI); and Hiroshima University (Japan)].
- Calorimeter [Naval Research Laboratory (NRL), CEA and IN2P3 (France), and Royal Institute of Technology (Sweden)].
- Anti-Coincidence Detector [Goddard Space Flight Center (GSFC)].

In addition, system-engineering functions are being carried out by SU-SLAC.

This MoA covers work on the GLAST LAT instrument Tracker.

2. Parties and Their Representation

The parties concerned include:

a) The institutions responsible for the research teams taking part in the GLAST LAT instrument and forming the Collaboration, hereinafter collectively referred to as the Collaborating Institutions. The Italian institutions involved in the GLAST LAT Tracker
are the Istituto Nazionale di Fisica Nucleare (INFN) and Agenzia Spaziale Italiana (ASI). The U.S. institutions involved in the GLAST LAT Tracker are the Santa Cruz Institute of Particle Physics, University of California at Santa Cruz (SCIPP), and the Stanford Linear Accelerator Center (SU-SLAC).

b) SU-SLAC, operated by Stanford University (hereafter Stanford), under contract DE-AC03-76SF00515 with the U.S. Department of Energy (DOE), is responsible for management, fabrication, and integration of the LAT instrument and is the responsible Party accountable to the U.S. Department of Energy for the program execution. Stanford University is responsible for the appropriate expenditure of U.S. Government funds.

c) The U.S. Government funding agencies: the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA).

d) The Italian funding agencies providing support to Italian institutions collaborating in the GLAST LAT instrument.

e) SCIPP, the lead institution responsible for management of the LAT Tracker subsystem by direction of Peter F. Michelson, the Instrument Principal Investigator (IPI).

In the present Memorandum the parties considered (hereafter, the Parties) are SU-SLAC, represented by the SLAC Director, SCIPP, represented by its director, the Istituto Nazionale di Fisica Nucleare (INFN), represented by the President of the INFN, and Agenzia Spaziale Italiana (ASI), represented by the President of ASI. Peter F. Michelson of Stanford University, as Instrument Principal Investigator (IPI), has overall responsibility for the investigation. The funding of the Italian contributions to the LAT instrument project will be equally shared by INFN and ASI. The INFN will have the scientific and technical responsibility of the Italian effort in the construction of the LAT will be of INFN.

3. **Purpose of the Collaboration**

The purpose of the collaboration is to design, fabricate, and operate an instrument aboard the GLAST mission to study, with adequate efficiency and precision, gamma rays from space in order to enable the accomplishment of the proposed science program. The collaboration will undertake to carry out the science program, which is described in the proposal response to NASA AO 99-OSS-03 for the GLAST mission. Its primary goal is to accomplish a comprehensive study of the gamma-ray sky. This wide-range program provides an excellent opportunity to search for new phenomena.

4. **Purpose of the Memorandum of Agreement**

The purpose of this document is to define the Italian responsibilities during the instrument fabrication program established by the collaboration and for the instrument integration to be conducted on the SLAC site. With this MoA, the Parties agree to accept the organizational and
managerial structure as described in Vol 2 of the GLAST LAT flight proposal submitted by Stanford University in response to NASA AO 99-OSS-03. Copies of all Memoranda of Agreement (MoA) shall be made available to the funding agencies participating in the collaboration. This MoA establishes the understanding between the signatories and is not a contract.

5. Participants of the LAT Tracker Subsystem

The Parties to this MoA recognize that UCSC-SCIPP and the Japan GLAST Collaboration (JGC) are participants in the LAT Tracker Subsystem. The MoAs between SU-SLAC, UCSC-SCIPP and the JGC shall be made available to the Parties to this agreement.

6. Organization of the Collaboration

The organization of the collaboration is described in detail in the management section (Vol 2) of the GLAST LAT flight proposal submitted by Stanford University in response to NASA AO 99-OSS-03. The main bodies of the collaboration are:

6.1 Instrument Principal Investigator (IPI): Peter F. Michelson

The IPI is responsible for all scientific, technical, organizational and financial affairs of the collaboration. The management of the instrument project is led by the IPI, the Instrument Project Manager (IPM), and the Instrument Technical Manager (ITM). The IPM reports to the IPI and is responsible, by delegation from the IPI, for the day-to-day management of the instrument design, fabrication, testing, and delivery of the instrument to NASA. These persons form the LAT Instrument Project Office (IPO) at SU-SLAC. The subsystems each have a subsystem manager. Among the subsystem managers, the Tracker Subsystem Manager is responsible for the design, fabrication, testing, and delivery of the GLAST LAT Tracker.

6.2 The Senior Scientist Advisory Committee

The Senior Scientist Advisory Committee (SSAC) is the body that advises the IPI on matters that concern the general and scientific policies of the collaboration. The SSAC is formed from senior members of the collaborating institutions with an elected Chairperson. The SSAC membership reflects the level of commitment of the participating institutions. In particular, the SSAC membership will include at least two Italian collaboration members, representative of the participation of Italian scientists sponsored by INFN and ASI.

6.3 The Instrument Design Team

The technical coordination of the LAT instrument development is the responsibility of the ITM. The Instrument Design Team, chaired by the ITM, is
the forum i) for exchange of information between all instrument subsystems, ii) to identify and discuss issues related to the instrument design with the objective of maintaining a coordinated design and, iii) to resolve issues, by consensus or by referral to the IPO for action. The IDT, through the ITM, reports to the IPM. The membership of the IDT includes all subsystem managers and key system engineering personnel. The Italian Project Manager is a deputy chair of the IDT. Members of the IDT are obliged to attend meetings as part of their responsibilities. Meetings of the IDT are open to the Collaboration.

7. **International Finance Committee**

The International Finance Committee, chaired by the Associate Director of SLAC for Research, will meet periodically to review the status of commitments of all partners (U.S. and foreign) in the GLAST LAT Project. The committee membership will be representative of all funding agencies involved in the GLAST LAT Project. The IPI is an ex-officio member of the International Finance Committee. The IPI and IPM will attend committee meetings.

8. **General Conditions**

This MoA ratifies the GLAST LAT Collaboration Membership and Publication Policies. These documents are included as Annex 1 and 2 to this MoA.

The general terms of the Agreement between SLAC and the collaborating institutions are described in the document “General Conditions for Experiments at SLAC”. By signing this MoA, the parties signify their consent with the conditions defined in that document.

Data and Intellectual Properties

Each party shall be entitled to use for its own purposes any acquired knowledge, whether patentable or not, as well as any expertise developed during the manufacture of the components.

All data obtained by the collaboration shall be made accessible to all the collaborating institutions in a timely fashion to provide all equal opportunity to contribute to the analysis.

All members of the collaboration are entitled to be involved in the analysis and publication of data obtained in the course of the program according to the Collaboration Publication Policy.

All data, correction algorithms and parameters, detector system analysis software, and physics reactions and detector simulation programs shall be made available to the entire Collaboration.
Subject to the Freedom of Information Act (5U.S.C.552), decisions on disclosure of information to the public regarding projects and programs referred in this MoA shall be made by the IPI following consultation with the other party’s representatives. It is the general intent of the parties to this MoA to place research and results in the public domain.

Press releases and press conferences concerning the analysis of experimental data will require the prior approval of the IPI. The IPI will inform, and where appropriate, obtain the approval of the funding agencies representatives.

The publication of results obtained with the GLAST LAT Instrument will follow the procedure described in the publication policy document of the collaboration.

Cross-waiver of Liability
The parties to this agreement agree that a comprehensive cross-waiver of liability between the Parties to this agreement and their related entities will further the objectives of the GLAST LAT Project. The cross-waiver of liability shall be broadly construed to achieve this objective.

Each party to this agreement agrees to a cross-waiver of liability pursuant to which each party waives all claims against the other party, a related entity of the other party, or an employee of a related entity of the other party. In addition, each party to this agreement shall extend the cross-waiver of liability to its own related entities.

9. **SLAC’s Obligations**

9.1 **General Obligations**

Being responsible for the fabrication of the instrument, SU-SLAC and the IPI undertakes to keep the collaboration and the funding agencies informed of the timescale of GLAST LAT fabrication and Integration & Test (I&T).

SU-SLAC is also a member institution of the Collaboration and agrees to meet the obligations resulting from this role as described in Appendix (“SLAC Responsibilities and Support for the GLAST Instrument as a Member of the Collaboration”).

9.2 **Specific Obligations**

*International Exchange of Information and Materials*

The development, fabrication, and operation of the GLAST LAT investigation as defined by this agreement shall adhere to all applicable U.S. laws and regulations
concerning the import and export of technical information and materials.

INFN and ASI will assure compliance with all applicable Italian laws and regulations concerning the import and export of technical information & materials related to this MoA.

10. Collaborating Institutions’ Obligations

10.1 General Obligations

The collaborating institutions will make available on the SLAC site, in working order for the proper integration and test of the GLAST Large Area Telescope Instrument, the part(s) of the instrument that they have undertaken to supply.

The parties shall prepare and maintain schedules for activities under their respective control. To ensure that such activities are coordinated with other elements of the project schedule, these schedules are subject to review and approval by the Subsystem Manager and the IPM. Parties shall use all reasonable means to adhere to such approved schedules and shall report progress periodically. The Subsystem Manager and the IPM shall be immediately informed of any departure from the schedule.

Each collaborating institution shall provide SLAC with a list of support equipment items that are intended for use on the SLAC site.

A collaborating institution shall be responsible for the transport of its equipment from its point of origin to the SLAC site and testing of the equipment on the SLAC site, unless otherwise agreed to by SLAC and the collaborating institution.

It is expected that a collaborating institution or group that supplies equipment will provide the necessary scientific and technical manpower support, as well as the relevant tools and spare parts, to maintain that equipment in good working order.

11. Specific Agreements

11.1 Scope of Responsibility

INFN and ASI agree to support engineering, manufacturing and testing efforts of the GLAST Large Area Telescope (LAT) Instrument in the following areas:

WBS 4.1.4.3.1 Silicon Strip Detectors

WBS 4.1.4.3.2 Tray Mechanical
11.2 Scientific and Technical Personnel
The Italian institutions presently include laboratories with large scientific and technical staffs. Presently, Prof. Guido Barbiellini is the scientific spokesperson of the Italian institutions and Dr. Ronaldo Bellazzini is the Italian Project Manager for the Tracker. Both are members of the Senior Scientist Advisory Committee. Dr. Bellazzini is a deputy chair of the Instrument Design Team.

11.3 Statement of Work
Under this MoA the Italian institutions will carry out design, testing and fabrication in the project areas listed above. In particular, INFN and ASI will support hardware engineering, manufacturing, and testing in the following areas. All activities identified below shall be carried out in accordance with all applicable controlled project documents.

11.3.1 Silicon Strip Detectors (WBS 4.1.4.3.1)
The fabrication of the LAT tracker will require the procurement of ~11,500 silicon sensor units. INFN and ASI will contribute to this procurement with a share of 5,000 units. The remaining units will be procured by other members of the collaboration. The Italian institutions will also contribute to the process of qualification of the vendors and to the definition of the technical specification for the sensors.

11.3.2 Tray Mechanical (WBS 4.1.4.3.2)
UCSC, SU-SLAC and Italian institutions will share responsibility for the definition and engineering of the panels that support the sensors, each consisting of a carbon fiber-aluminum honeycomb sandwich structure, a
converter foil and two bias circuits. INFN and ASI will provide the panels.

11.3.3 Tray Assembly (WBS 4.1.4.3.4)

UCSC, SU-SLAC and Italian institutions will collaborate on the definition of the technical procedures to assemble the trays, consisting of panels (see above), silicon sensor ladders, and readout electronics. INFN will be responsible for assembly of the ladders. Readout electronics modules will be provided to INFN by SU-SLAC/UCSC, already tested and burned-in. Italian institutions will be responsible for inspection of the electronics modules for integrity after receipt and will mount them on the trays and complete the connections to the sensors. Italian institutions will be responsible for performing the acceptance testing of the assembled trays.

11.3.4 Tower Assembly (WBS 4.1.4.4.3)

UCSC and SU-SLAC will take the responsibility for the assembly and for the testing (including beam test) of the first two qualification-unit towers of the tracker. Italian institutions will be responsible for assembly of the following 16 flight-unit towers. The assembly of a tower will consist in stacking of the trays, integration with custom signal and electronics cables, and closing the towers with carbon-fiber walls. The two qualification-unit towers will be tested to qualification test levels by UCSC and SU-SLAC. The 16 flight unit towers will be tested to flight acceptance levels by Italian institutions. Cables, spacers, fasteners, and walls for the assembly of the towers will be provided by UCSC and SU-SLAC.

11.3.5 Tracker Test and Calibration (WBS 4.1.4.5)

UCSC, SLAC and Italian institutions will collaborate on the definition of Tracker test and calibration procedures. Italian institutions will be involved in all major test and calibration procedures, including beam tests at SU-SLAC.

11.3.6 Instrument Integration and Test (WBS 4.1.4.7)

Italian institutions will actively participate in the final instrument integration and test at SLAC and at GSFC/NASA or their designated site.

11.3.7 Power Supplies (WBS 4.1.7.6)

UCSC, SU-SLAC and Italian institutions will collaborate on the preparation of the technical specifications for the power conditioning system for the Tracker. Italian institutions will participate in the assembly and testing of the tracker power system. The Italian responsibilities do not include procurement of power system components.
11.3.8 Science Analysis Software (WBS 4.1.D)
Italian institutions will work with other members of the LAT Collaboration on development and testing of software needed for instrument operations and science data analysis.

11.3.9 Mission Operations and Science Data Analysis
Italian institutions will participate in the planning of the scientific program of the GLAST mission and will be involved from the beginning in the major scientific investigations to be done with data from the LAT. INFN, ASI and SU-SLAC agree to make the level of responsibility of participating institutions within the scientific working groups of the Collaboration commensurate, to the degree possible, with their level of commitment to the mission.


12.1 Modifications and Formal Amendments
The IPO will settle and duly announce to SU-SLAC any modifications or additions to the instrument that affect the terms of the MoA. Major modifications shall be approved as formal amendments to the MoA and, consequently, be accepted and signed by signatories to this MoA.

12.2 Disagreement
All questions relating to the interpretation or application of this MoA that arise during the period it is in force shall be settled by mutual agreement. Failure to reach agreement will be referred to the Director of SLAC and the representative of the appropriate funding agency for joint resolution.

13. Effective Date
This Memorandum of Understanding shall become effective upon the later date of signature of the parties. It shall remain in effect until October 1, 2010.
14. Approvals

The undersigned concur in the terms of this Memorandum of Agreement.

Jonathan Dorfan, Director, SLAC

Date: ______________________

Enzo Iarocci, President, INFN

Date: ______________________

Sergio De Julio, President, ASI

Date: ______________________

Peter Michelson, LAT IPI

Date: ______________________