LAT-MD-00081-05

30 Oct 01

Memorandum of Agreement

Between

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

Naval Research Laboratory (NRL),

and

Swedish GLAST Consortium (SGC)

Regarding

Swedish 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 Swedish 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.

GLAST is a NASA high-energy gamma-ray mission to be launched in early 2006. The Large Area Telescope (LAT), primary instrument aboard GLAST, is being fabricated by a collaboration led by Peter F. 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 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 hardware development in parenthesis):

- Tracker (Stanford University-Stanford Linear Accelerator Center (SU-SLAC), UC Santa Cruz (UCSC), Italian Institute for Nuclear Physics (INFN) and Hiroshima University (Japan)).
- Calorimeter (Naval Research Laboratory (NRL), CEA/DSM/DAPNIA and IN2P3 (France), Royal Institute of Technology (Sweden), and SU-SLAC)
- Anti-Coincidence Detector (Goddard Space Flight Center (GSFC))

Instrument system engineering functions are being carried out by SU-SLAC.

This MoA covers Swedish participation in the GLAST LAT project and work on the LAT Instrument Calorimeter Subsystem. The calorimeter development is a collaboration among the Naval Research Laboratory (NRL), Commissariat à l'Energie Atomique / Département d'Astrophysique, de physique des Particules, de physique Nucléaire et de l'Instrumentation Associée (hereafter CEA/DSM/DAPNIA), Centre National de la Recherche Scientifique / Institut National de Physique Nucléaire et de Physique des Particules (hereafter, CNRS/IN2P3) in France, the Royal Institute of Technology (KTH) and Stockholm University in Stockholm, Sweden (forming the Swedish GLAST Consortium), and Stanford University-Stanford Linear Accelerator Center (SU-SLAC).

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 Swedish institutions involved in the GLAST LAT Calorimeter are the Royal Institute of Technology (KTH) and Stockholm University, hereafter collectively referred to as the Swedish GLAST Consortium

(SGC). The U.S. institutions involved in the GLAST LAT Calorimeter are the Naval Research Laboratory (NRL) and the Stanford Linear Accelerator Center (SU-SLAC).

b) SU-SLAC, operated by Stanford University (hereinafter Stanford), under contract DE-AC03-76SF00515 with the U.S. Department of Energy (DOE), responsible for management and integration of the LAT instrument. SU-SLAC 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 Swedish funding agencies providing support to Swedish institutions collaborating in the GLAST LAT instrument.

e) NRL, the lead institution for the LAT Calorimeter subsystem, with overall responsibility for the Calorimeter Subsystem of the GLAST LAT instrument by direction of Peter F. Michelson, the Instrument Principal Investigator (IPI). NRL's responsibility to NASA is identified, with management oversight and concurrence from P.F. Michelson, in NASA DPR S-15633-Y.

In the present Memorandum the parties considered (hereafter, the Parties) are SU-SLAC, represented by the SLAC Director, the NRL, represented by the Superintendent of the Space Science Division, CEA/DSM, and the SGC, represented by the Swedish Principal Investigator. Peter F. Michelson of Stanford University, as Instrument Principal Investigator (IPI), has overall responsibility for the investigation. W. Neil Johnson of NRL, Calorimeter Subsystem Manager, has overall responsibility for the Calorimeter Subsystem of the GLAST LAT instrument.

Per Carlson of the Royal Institute of Technology, Stockholm is the Swedish Principal Investigator. The Swedish PI has overall responsibility for the GLAST LAT program in Sweden. The Swedish PI is also responsible for coordinating and representing the interests of all Swedish scientists involved in the LAT Collaboration with respect to national funding agencies and the LAT collaboration.

This MoA defines the working relationships among the Parties. The participation of the French institutes in the LAT Project shall be ratified under a separate MoA with those parties, NRL, and SU-SLAC. That agreement and this agreement shall be made available to all of the parties concerned.

NRL is responsible for managing the development of the calorimeter subsystem, including Calorimeter design, fabrications, test, and calibration. NRL is responsible to deliver the Calorimeter Modules to SU-SLAC. The responsibilities of the Swedish parties are listed in section 8.4 of this MoA. The Swedish groups are responsible for the procurement and acceptance testing of the CsI crystals for the calorimeter subsystem.

3. Scope of This Memorandum of Agreement

This MoA ratifies the GLAST LAT Flight Proposal and establishes the basic working agreement among SU-SLAC, NRL, and the SGC, regarding Swedish participation in the

GLAST LAT Project, in particular in the definition, development, fabrication, and integration of the GLAST LAT Calorimeter Subsystem; calibration of the LAT calorimeter and the LAT instrument; and subsequent mission operations and data analysis activities for the GLAST mission. Reference is also made in this MoA to the role of French institutes, but the roles and responsibilities of the French institutes are ratified under a separate MoA. This MoA establishes the understanding between the signatories and is not a contract.

4. Authority

Work on GLAST at SU-SLAC is authorized under DOE Project Number KA050102-EQU01CC and NASA Contract NAS 5-00147. NASA DPR S-15633-Y with NASA/GSFC provides NRL authority for performance of work on GLAST as part of the overall program led by Peter F. Michelson at Stanford University.

5. Schedule

The Collaborating Institutions 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 Calorimeter Subsystem Manager and the GLAST LAT Instrument Project Manager (IPM), and are included in the LAT master schedule. All entities shall use all reasonable means to adhere to such approved schedules and shall report progress periodically. The Calorimeter Subsystem Manager, the Swedish PI, and the IPM shall be immediately informed of any departure from the schedule.

6. Funding

NASA/GSFC will fund Stanford University and the Naval Research Laboratory for the LAT program incrementally at varying intervals. SU-SLAC will also receive funding from the Department of Energy at varying intervals. The Centre National d'Etudes Spatiales (CNES) will endorse responsibility for French participation with an International Agreement between CNES and NASA. CEA/DSM/DAPNIA and CNRS/IN2P3 will each be funded partly by CNES and partly by their own budgets. The Swedish institutions will be funded by the Wallenberg Foundation, the Swedish Space Agencdy, and partly by their own budgets. The funding will cover primarily technical and management staff, and external activities, such as industrial contracts, equipment, and travel.

7. International Exchange of Information and Materials

The development, fabrication, and operation of the 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.

All exports of U.S. technical information and materials related to this MoA by the U.S. Naval Research Laboratory will be handled by the Naval Research Laboratory through its Security Office using procedures approved by the Navy International Programs Office.

The SGC will assure compliance with all applicable Swedish laws and regulations concerning the import and export of technical information & materials related to this MoA.

8. Management and Technical Direction

8.1 Project Structure

The LAT program, as accepted by NASA, draws upon the resources of the consortium institutes to create a working group for the program. It is not intended that an autonomous project group be created, nor that the institutes relinquish control over their personnel. The main bodies of the organization are:

8.1.1 Instrument Principal Investigator, Peter F. Michelson

The Instrument Principal Investigator (IPI) is the ultimate authority within the LAT team for all decisions concerning the instrument development and 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 for subsequent integration with the GLAST spacecraft and launch. These persons, co-located at SLAC, form the leadership of the LAT Instrument Project Office (IPO) at SU-SLAC. The subsystems will each have a subsystem manager, each responsible for the design and fabrication of the particular subsystem.

8.1.2 Calorimeter Subsystem Management

The Calorimeter Subsystem Manager is responsible for the design, fabrication, and testing of the LAT calorimeter subsystem. By delegation and authority of the Calorimeter Subsystem Manager, the Calorimeter Project Manager at NRL is responsible for the technical management of the NRL effort. The Calorimeter Subsystem Manager reports to the IPM. The Swedish PI is responsible for all day-to-day decision-making and authority with regard to management of technical, cost, and schedule issues for the areas specified in Section 8.4 of this MoA for which Swedish institutions have responsibility. For matters concerning the LAT calorimeter development in Sweden, the Swedish PI reports to the Calorimeter Subsystem Manager. The Swedish PI is also responsible for overall matters concerning science and programmatic issues (e.g. overall scope of funding and human resources) and for coordinating and representing the interests of all Swedish scientists with respect to national funding agencies and the LAT collaboration.

8.1.3 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 by senior members from the collaborating institutions, with an elected

Chairperson. The Calorimeter Subsystem Manager and the Swedish Principal Investigator are members of the SSAC.

8.1.4 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 Swedish PI is a member of the IDT as well as the key technical scientists from NRL, CEA/DSM/DAPNIA, and IN2P3 involved in the instrument development. Members of the IDT are obliged to attend IDT meetings as part of their responsibilities. Meetings of the IDT are open to the Collaboration.

8.2 General Guidelines

The general guidelines for access to the LAT scientific data and the rights to publication of the data have been established by NASA, the DOE, and the GLAST Facilities Science Team. This MoA ratifies those guidelines.

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.

8.2.1 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 from the LAT for 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 by the collaboration in the course of the scientific program.

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 (5 U.S.C. 552), decisions on disclosure of information to the public regarding projects and programs referenced in this MoA shall be made by the IPI following consultation with the other parties’ 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 LAT Instrument by the collaboration will follow the procedure described in the "GLAST LAT Collaboration Publication Policy" document of the collaboration.

8.2.2 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.

8.3 Key Personnel

The key personnel mentioned in section 2 take on primary responsibilities for fulfilling of the tasks. These include the Swedish PI, calorimeter management personnel at NRL, IPO personnel at SU-SLAC, and the French PI, Co-PI, and other key French personnel listed in the MoA with the French institutes.

The commitment of key personnel in the MoA requires that their expertise and continuity of direction will be available during development and subsequent problem resolution for the LAT instrument. They will be held available to the project by their institutions throughout the duration of the GLAST project to the extent this is within the power of the institutions. Each party and its key personnel shall be responsible for providing the resources necessary for solving problems, should they arise in the course of fulfilling their tasks.

8.4 Statement of Work

Under this MoA, the Swedish institutions shall carry out design, fabrication, testing and delivery of work elements listed below. Swedish technical responsibilities include the procurement and acceptance testing of the CsI crystals for the calorimeter subsystem. Swedish institutes will also participate, with NRL, on the calorimeter and instrument-level simulation and software efforts as well as calibration of the calorimeter and the instrument. Swedish scientists are also members of the instrument science team and will contribute to science data analysis and software development. All such work shall be carried out in accordance with applicable IPO-controlled project documents.

The Swedish Institutions' responsibilities in the LAT Program are described in the following sub-sections (whose titles are extracted directly from the applicable subsystem WBS), and specified in more detail in the Calorimeter Implementation Plan.

8.4.1 System Engineering

The Swedish management team shall be responsible for system engineering support for the Swedish components of the GLAST LAT. This includes the development of requirements and specifications in collaboration with NRL and others, management and tracking of resources and margins, and system verification. NRL is responsible for the overall Calorimeter system engineering.

8.4.2 Performance Assurance

The Swedish management team shall be responsible for the reliability and quality assurance of the Swedish components of the GLAST LAT in cooperation with NRL and the IPO at SU-SLAC, in accord with the Mission Assurance Requirements document from the GLAST Project Office at NASA and applicable IPO-controlled project documents.

8.4.3 Design Optimization and Scientific Performance Simulations

NRL French, and Swedish Institutes shall collaboratively develop simulations of the performance of the Calorimeter subsystem for the purpose of optimizing design details.

8.4.4 Detector Element Integration and Test

KTH will provide the CsI crystals for the LAT calorimeter.

8.4.5 Calorimeter Test and Calibration

NRL, French, and Swedish institutes will collaborate on developing Calorimeter test and calibration procedures. Swedish scientists will be involved in all major test and calibration activities, including beam tests at SU-SLAC or other sites.

8.4.6 Instrument Integration and Test

Swedish scientists will actively participate in the calibration and testing of the 4-tower calibration array and in the final instrument integration, test and calibration of the LAT instrument at SU-SLAC and at NASA/GSFC or their designated sites.

8.4.7 Science Analysis Software

Swedish Institutes will collaborate with other members of the LAT Collaboration on the development of requirements for scientific analysis of LAT flight data and the development of algorithms and software for generating high-level science data products to implement the LAT Collaboration's science program as specified in the LAT Flight Proposal. Documentation will be provided for all software code developed.

8.4.8 Mission Operations

All members of the collaboration will collaborate on the planning of the scientific program for the LAT Flight Investigation, in accordance with the GLAST LAT flight proposal. Swedish scientists will be involved from the beginning in the major scientific investigations to be done with data from the LAT. SU-SLAC, NRL and the participating Swedish institutions agree to have the level of responsibility of the participating institutions in the science activities commensurate, as much as possible, to the level of their commitment.

8.5 Deliverable Items and Schedule

The list of deliverable items and schedule shall be maintained as part of the Calorimeter Implementation Plan, developed collaboratively with the Swedish PI, French project management, and approved and maintained by the Calorimeter Subsystem Manager. The Implementation Plan shall be completed before the LAT Preliminary Design Review (PDR).

For reference, current scheduled dates for LAT PDR, CDR, and launch are:

- LAT PDR: Jan 02
- LAT CDR: Aug 02
- Launch: Mar 06

The table below lists deliverable items and estimated delivery dates in five categories:

- hardware;
- design, documentation, and programmatic support;
- software;
- LAT integration and test support;
- LAT calibration support.

Deliverable	First Delivery	Last Delivery
1. Hardware 1.1 CsI crystals 1.1.1 Engineering Model (80 xtals + spares) 1.1.2 Flight Units (80 xtals/module x 18 modules, including Qualification Unit + spares)	 1 June 2001 1 Apr 2002	 1 Aug 2001 1 May 2003
2. Design, Documentation, and Programmatic Support includes component and subsystem development plans, specifications, and schedules; design, analysis, and interface data as needed; acceptance and performance test reports; integration and test procedures as needed; handling and maintenance procedures as needed; hardware schematics, design data, and drawings for all GSE; Verification Plan; Reliability, Quality Assurance, and Parts Assurance Plan	As needed during program and specified in Calorimeter Implementation Plan	
3. Software 3.1 Simulation software and analyses 3.2 Science analysis software	TBD	
4. LAT Integration and Test Support	Oct 03	Oct 04
5. LAT Calibration Support	Jun 03	Feb 04

8.6 Technical Management, Reporting, and Reviews

Subsystem and component development plans will be generated by the element lead (see Statement of Work, section 8.4), and submitted to NRL by the Swedish PI for review and approval. These plans will be compatible with the overall Calorimeter Implementation Plan, and will address the entire development cycle, from design through fabrication, and integration and test. Detailed schedules will be included in these plans and will be utilized to monitor the technical performance.

Technical work will be monitored via the following activities:

- Instrument Project Office (IPO) level
  - Quarterly joint NASA/DOE Reviews
  - Quarterly reports to the GLAST Project Office (GSFC) and all funding agencies
  - Weekly reports to IDT
  - IDT meetings
  - Subsystem peer reviews

- Calorimeter Internal

- Monthly Progress Reviews (in person or teleconference)
- Weekly reports (to be merged with the other organizations' reports and forwarded to IPO)
- Routine telephone/video conferences as needed

The IPO shall submit quarterly reports to NASA and DOE showing accomplishments, plans for the next period, problems and concerns, disposition of action items, schedule events, staffing changes, contract actions, and financial/schedule status and performance. Subsystem managers shall provide this information to the IPO. In that activity, NRL shall report on the calorimeter subsystem. The Swedish PI shall submit reports on the calorimeter subsystem activities in Sweden to NRL showing accomplishments during the past period, plans for the next period, problems and concerns, and other items as needed such as the disposition of action items, schedule events, staffing changes, contract actions, and schedule performance. NRL shall require the same reports from its contractors. NRL shall assemble these reports with its own input into a LAT calorimeter subsystem report. NRL may add a summary of questions and actions items. NRL keeps track of all action items and attaches to the monthly report a list of all items together with their status of disposition. NRL shall also provide informal weekly reports to the IPO, including inputs from the Collaborating Institutions.

The monthly Reviews will be informal reviews chaired by the Calorimeter Subsystem Manager and with participation of all organizations involved, addressing programmatic, design status, action items, issues, and schedule.

9. 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.

10. Final Provisions

10.1 Modifications and Formal Amendments

The IPO will settle and duly announce to MoA parties any modification or addition to the instrument which affects the terms of the MoA. Major modifications shall be approved as formal amendments to the MoA and, consequently, be accepted and signed by the representatives of the funding agencies.

10.2 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 Dean of Research of Stanford University, the Director of SLAC, the Director of Research at NRL, and the representative(s) of the appropriate funding agency(ies) for joint resolution.

11. Effective Date

This Memorandum of Agreement shall become effective upon the later date of signature of the parties. It shall remain in effect until October 1, 2010.

12. Approvals

SU-SLAC — For JD — Date: 11/5/01
Jonathan Dorfan, Director, SLAC

NRL — Date: 2/8/02
Herbert Gursky, Space Science Division Superintendent

Swedish GLAST Consortium — Date: 17 April 2002
Per Carlson, PI (Sweden)

Date: 1/4/02
Peter F. Michelson, LAT IPI

Date: 1/7/02
W. N. Johnson, Calorimeter Subsystem Mgr