WBS	WBS Title	WBS Dictionary Description
4.1.4	**Tracker**	
4.1.4.1	Tracker Management	*UCSC:* Provide for analysis of scientific requirements relative to the design of the Tracker. Support the development of requirements for test and analysis, scientific analysis of calibration and performance test data. Support quarterly team meetings and travel thereto.
		SU-SLAC: Provide program scheduling, cost accounting, and performance tracking and reporting for entire subsystem, including managing performance of all activities related to the subsystem at UCSC, SU-SLAC, Hiroshima University, and INFN. Support development of subsystem specifications, verification plans, and interfaces between Tracker and neighboring subsystems, and control subsystems electrical, power, and environmental requirements and performance metrics. Support quarterly team meetings and travel
		Plan for, develop presentation data, and participate in the following reviews: DOE/NASA Reviews, I-SRR, Baseline Review, I-PDR, NAR, I-CDR, and suborbital test report. Support the closure of action items.
4.1.4.1.1	Management	Personnel and management of Tracker tasks.
4.1.4.1.1.1	System Manager	R. Johnson - UCSC
4.1.4.1.1.2	System Engineer	T. Borden - SLAC
4.1.4.1.1.3	Production Supervisor	O. Millican - SLAC
4.1.4.1.1.4	INFN Tracker Management	Reserved for INFN to list personnel
4.1.4.1.1.5	Quality Assurance	D. Marsh - SLAC
4.1.4.1.1.6	Lead Electronics Engineer	D. Nelson - SLAC
4.1.4.1.1.7	SSD Design Testing & Procurement	T. Ohsugi - Hiroshima University

4.1.4.1.1.8	Scheduling, Accounting, and Reporting	Reserved as schedule line item for the Scheduling, Accounting and reporting as required.
4.1.4.1.1.9	Tracker requirements and specifications development	Reserved as schedule line item for the requirements and specification development
4.1.4.1.1.10	Tracker overall layout and interface description	Reserved as schedule line item for the tracker overall layout and interface description
4.1.4.1.1.11	Tracker Instrument PDR	Schedule date for Tracker Instrument PDR
4.1.4.1.1.12	Tracker Instrument CDR	Schedule date for Tracker Instrument CDR
4.1.4.1.2	Tracker Support Personnel	Support science personnel for the Tracker
4.1.4.1.2.1	Physicist	H. Sadrozinski - UCSC
4.1.4.1.2.2	SLAC Tracker Physicists	
4.1.4.1.2.3	UCSC Tracker Physicists	
4.1.4.1.3	Travel (SLAC/UCSC)	Travel effort for UCSC and SLAC
4.1.4.1.3.1	Domestic Meetings (UCSC)	
4.1.4.1.3.2	Domestic Meetings (SLAC)	
4.1.4.1.3.3	Foreign Meetings (UCSC)	
4.1.4.1.3.4	Foreign Meetings (SLAC)	
4.1.4.1.4	Project Support at SLAC	Project support for office supplies, computers and related hardware/software as well as office support contracts at SLAC
4.1.4.1.4.1	Office Supplies	
4.1.4.1.4.2	Computers, Printers, Software, etc	
4.1.4.1.4.3	Office Support Contracts	
4.1.4.1.5	Project Support at UCSC	Project support for office supplies, computers and related hardware/software as well as office support contracts at UCSC
4.1.4.1.5.1	Office Supplies	
4.1.4.1.5.2	Computers, Printers, Software, etc	
4.1.4.1.5.3	Office Support Contracts	
4.1.4.2	Reliability and Quality Assurance	

4.1.4.2.1	Reliability Analysis	Develop written procedures and specifications for the procurement, fabrication, assembly, and testing of components, subassemblies, and complete Tracker modules in conjunction with UCSC, INFN, or any sub-suppliers.
4.1.4.2.2	Quality Assurance Planning	Work with all organizations performing work for the subsystem, to ensure uniform compliance to standards and procedures, and to verify performance. Collect records and test data for the subsystem.
4.1.4.3	Tray Sub-Assembly	
4.1.4.3.1	Silicon Strip Detectors (SSD)	Design and prototype SSD's for the Tracker. Develop flight design, and testing procedures for detectors. Procure flight detectors, perform verification testing, and store detectors.
4.1.4.3.1.1	Finalize SSD Design	
4.1.4.3.1.2	SSD Design Final	
4.1.4.3.1.3	SSD Bidding process	
4.1.4.3.1.4	HPK Prototype run of flight layout	
4.1.4.3.1.5	Test of HPK prototype run	
4.1.4.3.1.6	Preproduction Run and Production Ramp-up	
4.1.4.3.1.7	Ready to Begin SSD Production	
4.1.4.3.1.8	Receive Flight SSD's	
4.1.4.3.1.9	QC SSD's	
4.1.4.3.1.10	Detector long-term testing	
4.1.4.3.1.11	SSD Test and Storage	
4.1.4.3.2	Tray Mechanical Design	Design, prototype, and test of the tracker trays including the development of the tray payload, including converters, bias circuit, and attachment methods including the SSD's, all fixtures required for the tray structure fabrication, and fabrication of all of the required tray structures.

4.4.1.3.2.1	Design, Prototype, and Test Tray Structure (HYTEC)	
4.1.4.3.2.2	Thick-Converter Tray Development (INFN)	
4.1.4.3.2.3	Thin-converter payload development (SLAC)	
4.1.4.3.2.4	Thick converter payload development (INFN)	
4.1.4.3.2.5	Mechanical EM Tray Fabrication (INFN)	
4.1.4.3.2.6	Tray Panel Fabrication Fixtures (INFN)	
4.1.4.3.2.7	Fabrication Flight Instrument Tray Panel Structures (INFN)	
4.1.4.3.3	Tray Electronics	Design, prototype, fabricate, and test ASIC's and printed wiring boards for the Tracker subsystem front end electronics
4.1.4.3.3.1	Testing of Prototype Electronics (UCSC)	
4.1.4.3.3.2	Electronics Design Reviews (SLAC/UCSC)	
4.1.4.3.3.3	Detector Bias Circuit (UCSC/SLAC)	
4.1.4.3.3.4	Electronics (MCM) board design (SLAC/UCSC)	
4.1.4.3.3.5	Final Design Readout Chip (SLAC/UCSC)	
4.1.4.3.3.6	Final Design readout controller chip (SLAC)	
4.1.4.3.3.7	Electronics test, QC,burn-in stations for MCM's	
4.1.4.3.3.8	Fabricate 6 MCM's for Engineering Model	
4.1.4.3.3.9	Fabricate and test Flight ASICs (UCSC)	
4.1.4.3.3.10	Fabricate and Test Flight MCM's (SLAC/UCSC)	
4.1.4.3.4	Tray Assembly (INFN)	Prepare plans to assemble SSD ladders, tray structures, assemble trays (using bias/converter and MCM electronics assemblies supplied by UCSC/SLAC), and perform verification tests on assembled trays, in compliance with SLAC requirements.
4.1.4.3.4.1	Ladder Assembly Development (INFN/SLAC)	
4.1.4.3.4.2	Ladder Placement Development (INFN)	
4.1.4.3.4.3	MCM Integration Development (INFN)	
4.1.4.3.4.4	EM Ladder Assembly (INFN)	
4.1.4.3.4.5	EM Tray Assembly (INFN)	

4.1.4.3.4.6	Establish Flight-Tray Assembly Line (INFN)	
4.1.4.3.4.7	Assemble Flight Ladders (INFN)	
4.1.4.3.4.8	Assemble Flight Trays (INFN)	
4.1.4.3.5	SLAC Assembly Facilities	Design, establish, outfit and support clean room facilities at SLAC required for the assembly of the Tracker Towers.
4.1.4.3.5.1	Establish Clean-room at SLAC	
4.1.4.3.5.2	Procure Tracker Environmental Test Equipment	
4.1.4.3.5.3	Procure Tracker Assembly Equipment	
4.1.4.3.5.4	Ongoing Support of Facilities	
4.1.4.3.5.5	Supplies, Operating	
4.1.4.4	Tower Structure and Assembly	
4.1.4.4.1	Tower Structure (SLAC)	Perform structural and thermal design and analysis of the Tracker tower and trays in support of, and in conjunction with, the instrument design. Design and support the testing of the Tracker tower attachment and handling equipment.
4.1.4.4.1.1	Tower Design, Analysis, and Detailing (SLAC/HYTEC)	
4.1.4.4.1.2	EM Engineering Support (SLAC/Hytec)	
4.1.4.4.2	Tower Flex Cables	Design, prototype, and test Kapton flex cables that connect tray front-end electronics to data acquisition system. Supply flight cables.
4.1.4.4.2.1	Layout, Detail Flex Circuit Cables (UCSC)	
4.1.4.4.2.2	Fabricate Flex Circuit Cables (UCSC)	
4.1.4.4.3	Tower Assembly	Develop tower assembly fixtures and procedures. Procure tower components. Assemble EM, Qualification, and Flight units.
4.1.4.4.3.1	Develop Qualification Tower Assembly Line (SLAC)	
4.1.4.4.3.2	Procure EM Tower Components (SLAC)	
4.1.4.4.3.3	EM Tower Assembly (SLAC)	

4.1.4.4.3.4	Procure Flight Tower Components (SLAC)	
4.1.4.4.3.5	Qualification Tower Assembly (SLAC)	
4.1.4.4.3.6	Flight Tower Assembly (INFN)	
4.1.4.5	Tracker Test and Calibration	
4.1.4.5.1	EM Tower Testing (SLAC)	Prepare mechanical and electrical test plans for EM tower. Support integration and test of EM tower.
4.1.4.5.1.1	Mechanical Test EM Tower	
4.1.4.5.1.2	Electrical Test EM Tower	
4.1.4.5.1.3	EM Tower I&T Support	
4.1.4.5.2	Qualification Tower Testing (SLAC)	Prepare mechanical and electrical test plans for qualification towers. Support integration and test of qualification towers.
4.1.4.5.2.1	Mechanical Test Qualification Towers	
4.1.4.5.2.2	Electrical Test Qualification Towers	
4.1.4.5.2.3	Tracker Qualification Towers A and B Ready for I&T	
4.1.4.5.3	Flight Tower Testing (INFN)	Perform mechanical and electrical tests on flight towers
4.1.4.5.3.1	Flight Tower Test Support	
4.1.4.5.4	Tracker Test Facilities (SLAC)	Design, procure and fabricate mechanical and electrical test equipment and fixtures for Tracker at SLAC.
4.1.4.5.4.1	Design Mechanical and Electrical Test Equipment	
4.1.4.5.4.2	Procure Test Equipment	
4.1.4.5.4.3	Fabrication Mechanical and Electrical Test Fixtures	
4.1.4.5.4.4	Assemble and Test Mechanical and Electrical Test Fixtures	
4.1.4.6	Sub-Orbital Integration and Test	Effort transferred to WBS element 4.1.E.2
4.1.4.6.1	Transferred to 4.1.E.2	
4.1.4.7	Instrument Integration and Test	

4.1.4.7.1	Qualification GLAST I&T Support	Support GLAST integration and test effort of Tracker qualification towers. Support beam testing as required.
4.1.4.7.1.1	Integrate Tracker Qualification Towers on Grid	
4.1.4.7.1.2	Mechanical and Electrical Test of Tracker Qualification Towers	
4.1.4.7.1.3	Support Qualification GLAST Beam Tests	
4.1.4.7.2	Instrument I&T Support	Support GLAST integration and test effort of Tracker flight towers into instrument and spacecraft as required.
4.1.4.7.2.1	Integrate Tracker Flight Towers on Grid	
4.1.4.7.2.2	Mechanical and Electrical Test of Tracker Flight Towers	
4.1.4.7.2.3	Support Flight GLAST T&M Tests	
4.1.4.7.2.4	Instrument Delivery	
4.1.4.7.2.5	Support Flight GLAST I&T to Spacecraft	
4.1.4.7.2.6	ED&I Support Flight GLAST I&T	
4.1.4.7.3	Tracker I&T Equipment	Design, procure and fabricate integration and test equipment.
4.1.4.7.3.1	Design Tracker Mechanical and Electrical I&T Equip	
4.1.4.7.3.2	Procure Tracker I&T Equip	
4.1.4.7.3.3	Fabricate Tracker I&T Fixtures	
4.1.4.7.3.4	Assemble and Test Tracker I&T Fixtures	
4.1.4.7.4	Tracker Operations Support	Support Tracker operations after instrument launch
4.1.4.7.4.1	Launch	
4.1.4.7.4.2	Engineering Operations Support	
4.1.4.7.4.3	Physics Operations Support	
4.1.4.8	Mission Integration and Test	
4.1.4.8.1	Tracker Mission I&T Support	Support mission integration and test as required.
4.1.4.8.1.1	Support GLAST I&T to S/C, L/V	
4.1.4.8.1.2	ED&I Support Mission I&T	

4.1.4.8.2	Tracker Pre-Op's Support	Pre operations Support as required.
4.1.4.8.2.1	Launch	
4.1.4.8.2.2	Engineering Operations Support	
4.1.4.8.2.3	Physics Operations Support	
4.1.4.8.2.4	UCSC Physics Operations Support	
4.1.4.8.2.5	End Phase C/D	
4.1.4.9	Mission Operations and Data Analysis	
4.1.4.9.1	UCSC MO&DA Support	UCSC mission operations and data analysis support as required
4.1.4.9.1.1	Tracker Science Support	
4.1.4.9.2	SLAC MO&DA Support	SLAC mission operations and data analysis support as required
4.1.4.9.2.1	Tracker Science Support	