

SCHEDULE AND TIMELINE

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Last Changed 15 November 1998*

Revision History:

11 November 1998: Complete update from baseline WBS plan. Links to internal NRAO web pages with plan details added. This version supersedes all previous versions. R. Simon.

15 November 1998: Typographic corrections, add notice that HTML version does not have all tables.

Introduction

This chapter outlines the schedule and project planning for the Millimeter Array Project. There are two key aspects of planning for the MMA:

- Tasks and milestones which must be accomplished
- Associated target dates.

The logical structure for the project is built around the concept of a "Work Breakdown Structure", or WBS. The WBS is simply an outline plan of all the work to be accomplished, and provides a framework for scheduling, costing, and tracking progress. Once a baseline WBS has been created, the inevitable changes and unexpected developments any real world project experiences may be incorporated into the WBS, and the impact of problems or unexpected difficulties can be allowed for.

There are three principle tables maintained in this chapter, and updated as necessary:

- A summary table of project milestones and target dates.
- The top most level of the WBS Dictionary, which defines the general task areas for the project.
- The Project WBS, expanded to level 2, presented in the form of a Gantt chart.

The overall form of the WBS for the MMA Project has been agreed upon. The tables in this chapter are a snapshot condensed from the detailed project plan. All tasks and milestones are tied to the WBS. At the present time (November 1998), there are still some inconsistencies in the scheduled dates for some milestones, because of resource and work load conflicts. These will be resolved as work progresses in the early phases of the Design and Development phase.

For internal NRAO users, substantially more detailed views of the WBS Gantt Chart and Dictionary are maintained at the following locations in PDF format (the Project Milestones are included for completeness):

- [MMA Project WBS Dictionary](#)
- [MMA Project Gantt Chart](#)
- [MMA Project Milestones](#)

Note: For practical reasons, the HTML version of this chapter does not include detailed tables listed below, other than as links to the relevant PDF files. Readers are *strongly* encouraged to access the [PDF version](#) of this chapter.

Table 1: [MMA Design and Development Phase Milestones](#)

This table lists all scheduled milestones, sorted chronologically within each top level task.

Table 2: [MMA Level 1 Tasks](#)

This table lists all top level tasks from the project WBS, and includes the brief WBS Dictionary entries for each task, where available (some of the Level 1 tasks are described only at level 2 and lower in the WBS).

Table 3: [MMA Task Scheduling](#)

This Table presents a timeline for the project in the form of a Gantt chart, listing all tasks from level 1 or level 2 in the WBS.

MMA Design & Development Phase Milestones

WBS Milestone tasks, sorted by WBS and date

WBS	Milestone / Deliverable	Finish	Responsibility
1	<u>Administration</u>		<u>Brown</u>
1.1.1.10	Project Book: Version 1	7/20/98	Emerson
1.1.4.10	Deliver WBS for D&D phase	9/30/98	Brown
1.1.1.20	Draft Interface Standards	10/30/98	Emerson
1.1.3.10	Complete Draft of Business Procedures	10/30/98	Porter
1.1.4.35	Complete prelim cost estimate	12/31/98	Brown
1.1.1.35	Schedule of Reviews	1/29/99	Brown
1.1.2.15	Schedule of Meetings	1/29/99	Wootten
1.1.4.15	Deliver preliminary WBS Entire Project	1/29/99	Brown
1.1.5.10	Deliver Personnel, Safety & Health Procedures	1/29/99	Brown
1.1.6.10	Deliver Management Plan for D&D	1/29/99	Brown
1.1.3.15	Deliver Business Procedures Text	4/30/99	Porter
1.1.4.40	Deliver Prelim Cost Estimate	4/30/99	Brown
1.3.3.15	Bienes Nacionales Use Permission	6/30/99	Hardy
1.4.4	Partnership Recommendations to NSF	6/30/99	Brown
1.1.6.15	Deliver Management Plan for Construction	9/30/99	Brown
1.3.2	CONICYT Use Permissions	9/30/99	Hardy
1.1.1.25	Interface Standards	1/31/00	Emerson
1.1.4.20	Deliver final WBS entire project	1/31/00	Brown
2	<u>Site Development</u>		<u>Gordon</u>
2.1.4	Deliver Development Plan, v. 1	12/15/98	Gordon
2.2.4	Deliver revised development Plan	6/30/00	Gordon
2.5	Start Facilities Construction in Chile	1/1/01	Gordon
3	<u>Antenna</u>		<u>Napier</u>
3.2.2	PDR: Antenna	7/28/98	Napier
3.3.5	Vendor Information Meeting	9/23/98	Napier
3.2.4	CDR: Antenna RFP	1/22/99	Napier
3.3.15	Issue Prototype Antenna RFP	2/5/99	Napier
3.3.17	Antenna Bidders Meeting	3/5/99	Napier
3.3.20	Receive Prototype Antenna Bid Response	5/7/99	Napier
3.3.30	Sign Contract (#1+Option #2)	8/6/99	Napier
3.4.30	CDR: Antenna Apex	10/29/99	Napier
3.8.2	Deliver Transporter Requirements	3/16/00	Napier
3.6.2	PDR: Antenna Metrology	6/29/00	Napier
3.8.4	Issue Transporter RFP	6/30/00	Napier
3.8.5	Receive Transporter Bids	9/29/00	Napier
3.8.10	Sign Transporter Contract	1/26/01	Napier
3.4.40	Deliver Prototype Antenna Apex	1/31/01	Napier
3.6.40	CDR: Antenna Metrology	3/22/01	Napier
3.6.12	Deliver Prototype Antenna Metrology	5/17/01	Napier
3.3.45	Delivery of Antenna #1	6/1/01	Napier

WBS Milestone tasks, sorted by WBS and date

WBS	Milestone / Deliverable	Finish	Responsibility
3.8.20	Deliver/Accept Transporter #1	6/1/01	Napier
4	<u>Receivers</u>		<u>Emerson</u>
4.1.12.7	Complete 86 GHz vacuum window prototype	11/20/98	Webber
4.1.8.1.10	Complete Eval. 200-300 GHz bal sideband-sep. mixers	1/22/99	Webber
4.1.1.2	PDR: SIS Mixer	1/29/99	Webber
4.1.6.10	Complete 230 LO Plate, sideband source plates	2/19/99	Webber
4.1.11.2.10	First MMIC IF Amplifier Tests	4/9/99	Webber
4.1.12.10	Complete Vacuum Window Development	4/23/99	Webber
4.3.5	Complete Eval. Rcvr. Interface agreements	5/31/99	Emerson
4.1.4.7	Complete Cryogenic IF plates for mixer testing	6/1/99	Webber
4.2.7	Deliver Test Ant Amplifier: 30 GHz Band	6/29/99	Webber
4.1.18.3	Deliver Test Ant mixer: 230 GHz band	6/30/99	Webber
4.1.18.5	Deliver Test Ant mixer: 86 GHz band	6/30/99	Webber
4.1.10.10	Complete Wafer Evaluation circuits	8/13/99	Webber
4.4.4	PDR: MMA Receiver	9/24/99	Emerson
4.1.1.5	CDR: SIS Mixer	9/30/99	Webber
4.1.11.2.14	Complete integrated MMIC IF development	10/1/99	Webber
4.1.6.11	Complete 650 LO plate	10/22/99	Webber
4.1.8.3.1.9	Start 650 building block mixer tests	10/22/99	Webber
4.1.8.2.3.9	230 balanced mixer tests	11/8/99	Webber
4.3.10	CDR: Evaluation Receiver	11/29/99	Emerson
4.1.9.10	Complete automated mixer testing	12/3/99	Webber
4.2.8	Deliver Prototype Amplifier: 30 GHz Band	1/31/00	Webber
4.1.11.4.4	Complete IF development	3/1/00	Webber
4.1.13.15	Complete Fourier Transform Spectrometer	3/3/00	Webber
4.1.8.3.2.9	Start 650 SSB Mixer tests	4/21/00	Webber
4.1.8.3.3.9	Start 650 balanced mixer tests	4/21/00	Webber
4.1.8.2.4.9	230 bal., sideband-sep. mixer tests	5/8/00	Webber
4.1.8.2.10	Deliver prototype 230 GHz	7/3/00	Webber
4.4.35	CDR: MMA Receiver System	7/5/00	Emerson
4.10.10	PDR: Cryogenics	7/5/00	Emerson
4.4.30.4	Deliver Prototype Dewar	1/31/01	Emerson
4.10.15	CDR: Cryogenics	3/30/01	Emerson
4.1.8.3.4.9	Start 650 Bal. sb. sep. mixer tests	4/20/01	Webber
4.3.20	Deliver Antenna Test Receiver	5/1/01	Emerson
4.1.8.3.5	Deliver prototype 650 GHz	11/2/01	Webber
4.10.20	Deliver Prototype Refrigerator	11/30/01	Emerson
4.4.50	Complete Prototype MMA Receiver	3/29/02	Emerson
4.4.65	Release MMA Receiver for manufacture	10/25/02	Emerson
5	<u>LO System</u>		<u>Emerson</u>
5.3.4	PDR: Multiplier Chain LO	12/3/98	Webber

WBS Milestone tasks, sorted by WBS and date

WBS	Milestone / Deliverable	Finish	Responsibility
5.3.3.3.6	Deliver 230 GHz Doubler Demo	1/29/99	Webber
5.4.1.3	Photonic Phase Cal Feasibility Demo	3/1/99	Emerson
5.4.1.5	PDR: Photonic Phase Cal System	4/19/99	Emerson
5.4.2.2	PDR: Optical R/T Phase Demo	4/19/99	Emerson
5.4.2.4	Decision: Proceed to demo of optical R/T phase meas.	6/28/99	Emerson
5.2.3	PDR: LO Reference	6/30/99	Sramek
5.4.5	PDR: Photonic LO	6/30/99	Emerson
5.3.3.5.8	Deliver 660 GHz LO Tripler demo	9/30/99	Webber
5.4.6.6	Deliver 100 GHz Velocity Matched photomixer	10/29/99	Emerson
5.3.5.4	Deliver Prototype 230 GHz LO for Prot. Rcvr.	12/27/99	Webber
5.4.1.7	CDR: Photonic Phase Cal System	12/31/99	Emerson
5.4.2.8	CDR: Optical R/T Phase Measurement	12/31/99	Emerson
5.4.2.9	Decision: Optical or Microwave R/T Phase Measurement for MMA	1/30/00	Sramek
5.3.3.6.3	CDR: Multiplier Chain LO	3/31/00	Webber
5.4.10	CDR: Photonic LO	3/31/00	Emerson
5.5	CDR: LO System	6/30/00	Emerson
5.6	Decision: Multiplier Chain or Photonic LO	6/30/00	Emerson
5.4.1.9	Deliver Photonic Phase Cal prototypes	12/31/00	Emerson
5.2.35	Deliver LO Reference bench prototype	1/31/01	Sramek
5.4.13	Deliver Prototype Photonic LO	8/23/02	Emerson
5.8	Production Review: LO	2/28/03	Emerson
5.4.1.11	Production Review: Photonic Phase Cal	3/3/03	Emerson
6	<u>IF System</u>		<u>Sramek</u>
6.3	PDR: IF System	4/30/99	Sramek
6.7	CDR: IF System	3/31/00	Sramek
6.8	Deliver (Bench) Prototype IF System	1/31/01	Sramek
6.15	Deliver IF Field Prototypes to Test Interfeometer	3/1/02	Sramek
7	<u>FO System</u>		<u>Sramek</u>
7.3	PDR: FO System	5/14/99	Sramek
7.10	CDR: FO System	3/31/00	Sramek
7.12	Deliver Prototype FO System	1/31/01	Sramek
7.20	Deliver FO Field Prototypes to Test Interferometer	3/1/02	Sramek
8	<u>Correlator</u>		<u>Webber/Escoffier</u>
8.5.3.3	Decision: FIR Filter or Analog BBC	12/31/98	Webber
8.5.8	CDR: Finite Impulse Response Filter	7/1/99	Webber
8.3.5	PDR: Correlator	8/2/99	Webber
8.2.6	Deliver Test Correlator to VLA site	3/31/00	Webber
8.10	CDR: Prototype Correlator	7/31/00	Webber
8.5.16	Deliver FIR Filter for Test Interferometer	12/1/00	Webber
8.12.5	Deliver Prototype Correlator to VLA site	5/30/03	Webber
8.13.1.5	Deliver 1/4 Correlator to MMA site	6/18/04	Webber

MMA Design & Development Phase Milestones

WBS Milestone tasks, sorted by WBS and date

WBS	Milestone / Deliverable	Finish	Responsibility
8.13.2.4	Deliver 1/4 Correlator to MMA site	3/25/05	Webber
8.13.3.4	Deliver 1/4 Correlator to MMA site	12/30/05	Webber
8.13.4.4	Deliver 1/4 Correlator to MMA site	10/6/06	Webber
9	<u>Computing</u>		<u>Glendenning</u>
9.4.2	Deliver: M&C Draft Interface specifications	6/1/99	Glendenning
9.2	PDR: Comp. Requirements & Control Software	6/30/99	Glendenning
9.7.4	CDR: Test Correlator Software	9/1/99	Glendenning
9.5.7	CDR: Single Dish Antenna Test System	3/1/00	Glendenning
9.7.7	Deliver Test Correlator Software	3/1/00	Glendenning
9.4.5	CDR: Monitor & Control	3/31/00	Glendenning
9.13.3	CDR: Archiving	5/29/00	Glendenning
9.15.3	CDR: Scheduling	12/28/00	Glendenning
9.5.11	Deliver Single Dish Antenna Test System	3/1/01	Glendenning
9.6.1.4	Deliver Holography System Software	3/30/01	Emerson
9.14.3	CDR: Real-time Imaging	7/24/01	Glendenning
10	<u>System Integration</u>		<u>Emerson</u>
10.5.3	Design Review: Holography System	3/29/99	Emerson
10.3.3	Design Review: M&C Specs	4/1/99	Emerson
10.2.3	Deliver MMA Interfaces and Standards Document	4/30/99	Emerson
10.6.2	Deliver Prot. Ant. Testing Plan	7/2/99	Emerson
10.3.6	PDR: M&C system	11/1/99	Emerson
10.3.9	CDR: M&C System	1/31/00	Emerson
10.3.11	MC Board available	3/31/00	Emerson
10.4.2	Design Review: Test Int. Site Preparation	4/3/00	Sramek
10.5.6	Deliver Holography System	3/30/01	Emerson
10.4.7	Test Interferometer Site Complete	4/30/01	Sramek
10.6.4.4	Antenna #1 Outfitting Complete	9/3/01	Emerson
10.6.9.4	Antenna #2 Outfitting Complete	4/1/02	Emerson
11	<u>Calibration & Imaging</u>		<u>Wootten</u>
11.1.6.1	Site Char. & Monitoring Review (URSI meeting)	1/11/99	Radford
11.3.2.1	Initial Radiometric Phase Cal Review	5/31/99	Wootten
11.3.3.4	Initial Amplitude Cal Review	5/31/99	Wootten
11.2.3	Design Review: Array Configuration	1/31/00	Wootten
11.1.6.2	Mid-term Site Char. & Monitoring Review	3/31/00	Radford
11.3.2.2	Mid-term Radiometric Phase Cal Review	5/31/00	Wootten
11.3.3.5	Mid-term Amplitude Cal Review	5/31/00	Wootten
11.1.6.3	Final Site Char. & Monitoring Review	3/30/01	Radford
11.3.2.3	Final Radiometric Phase Cal Review	5/31/01	Wootten
11.3.2.4	Decision: 183 or 22 GHz Phase monitor	5/31/01	Wootten
11.3.3.6	Final Amplitude Cal Review	5/31/01	Wootten

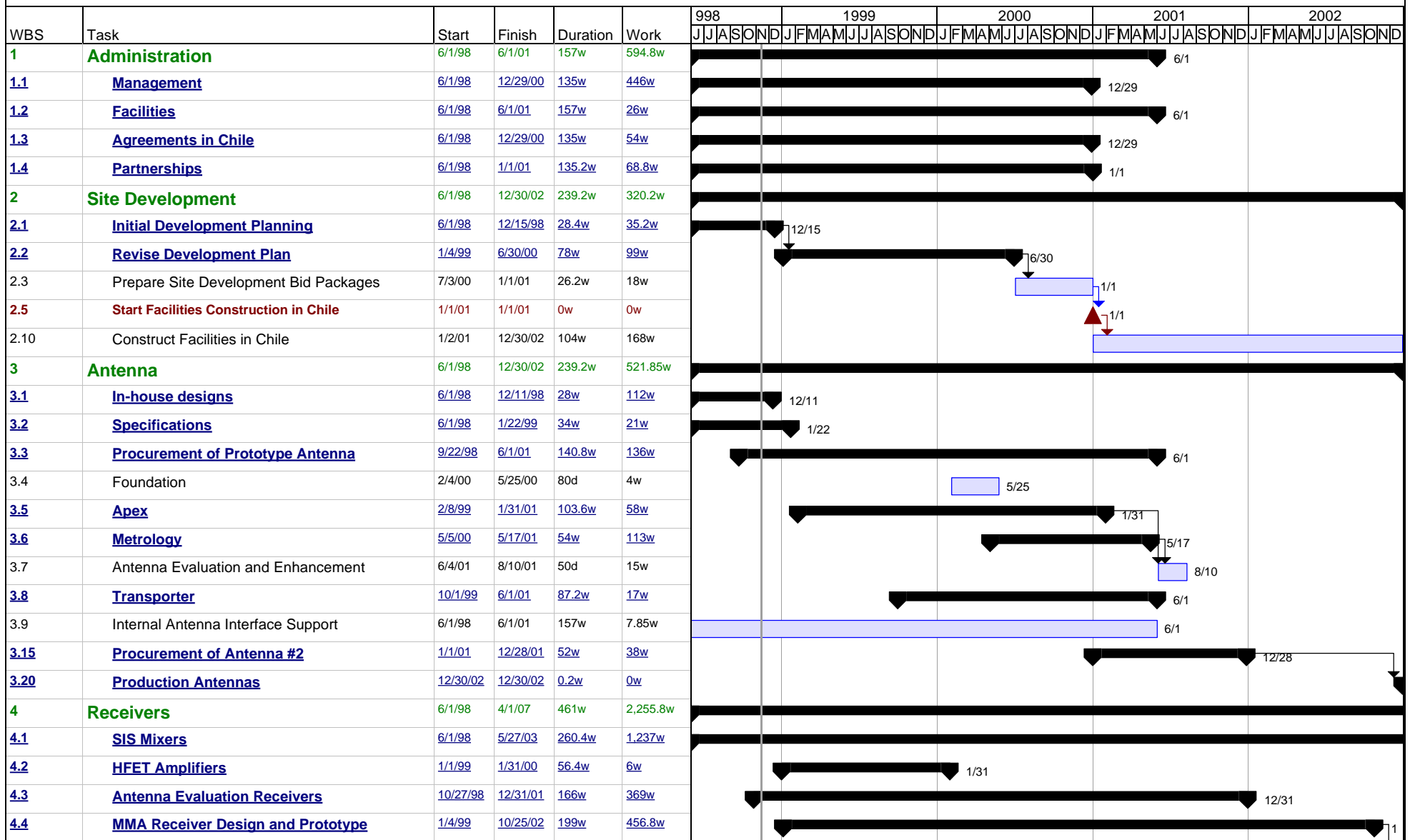
MMA Level 1 Tasks

WBS	Task	Start	Finish	Duration	Work
1	<u>Administration</u> Element Scope: This task includes all the responsibilities for management of the MMA project. Management of the project engineering, business and contracting affairs, personnel, budget and schedule, the WBS, documentation, standards, reporting and archive are all included within this task. In addition it is the responsibility of this task to assure that the MMA project meets its scientific goals.	<u>6/1/98</u>	<u>6/1/01</u>	<u>157w</u>	<u>594.8w</u>
2	<u>Site Development</u> Element Scope: In the initial D&D phase it is the responsibility of the Division Head for Site Development to draft an operating plan for the MMA in Chile. He will do this by establishing the operational requirements and then creating an operational model that meets those requirements. The plan will be developed in consultation with the universities and observatories presently operating facilities in Chile. The plan will be costed. In the construction phase of the project the Division Head will be responsible for construction of the civil works.	<u>6/1/98</u>	<u>12/30/02</u>	<u>239.2w</u>	<u>320.2w</u>
3	<u>Antenna</u> Element Scope: This element includes all steps required for producing all antennas delivered to site on foundation provided. Setting surface to require accuracy. Making certain all antennas meet design specification. Producing antenna transporters. Will provide mechanical support for interfaces to antenna.	<u>6/1/98</u>	<u>12/30/02</u>	<u>239.2w</u>	<u>521.85w</u>
4	<u>Receivers</u>	<u>6/1/98</u>	<u>4/1/07</u>	<u>461w</u>	<u>2,255.8w</u>
5	<u>LO System</u>	<u>6/1/98</u>	<u>3/9/07</u>	<u>458w</u>	<u>#####</u>
6	<u>IF System</u> During the D&D phase, a complete IF system design will be done and select modules and sub-modules will be prototyped. The module construction of the test interferometer system can proceed rapidly when the construction phase begins, and deliver a bench prototype system before 12/00.	<u>11/2/98</u>	<u>3/1/02</u>	<u>173.8w</u>	<u>335w</u>
7	<u>FO System</u> Fiber Optic System - This element includes the fiber optic transmitter / receiver pairs and all associated M/C and interconnecting FO cabling for relaying the signals of four subsystems: 1) the broadband IF, 2) the LO reference distribution, 3) the round trip phase correction, and 4) the M/C system. During the D&D phase, the complete fiber optic system design will be done and prototype transmitter/ receiver pairs for each of the four sub-systems (IF, LO ref, round-trip phase, and M/C) will be demonstrated. The module interfaces and Monitor/Control interfaces will be developed and tested. The goal is to prototype enough of the system so that construction of the test interferometer system can proceed rapidly when the construction phase begins. The prototype system will be delivered by 12/00.	<u>11/2/98</u>	<u>3/1/02</u>	<u>173.8w</u>	<u>408w</u>
8	<u>Correlator</u> The MMA correlator will accept multiple baseband analog signals from the IF system, digitize them, and calculate the cross-correlation functions on a pairwise basis.	<u>6/1/98</u>	<u>3/30/07</u>	<u>461w</u>	<u>484w</u>
9	<u>Computing</u> These activities implement all MMA system software. This includes real-time and near-real-time software to monitor and control hardware devices, software to schedule the array, software to format the data suitably for post-processing, software to archive and restore the data, software to perform fundamental calibrations (e.g. pointing) required to operate the array, commissioning software (e.g. holography), and software to implement a near-real-time image pipeline. It does not generally include post-processing software, firmware which is "inside" the device (possibly excepting the correlator), or engineering test software which is not needed during operations (i.e., operators would not run it).	<u>10/1/98</u>	<u>7/18/06</u>	<u>406.8w</u>	<u>274w</u>
10	<u>System Integration</u>	<u>6/1/98</u>	<u>3/28/03</u>	<u>252w</u>	<u>660w</u>
11	<u>Calibration & Imaging</u> This covers aspects of characterizing the MMA site at Chajnantor, of designing and optimizing the array configurations, of correcting astronomical observations for atmospheric and instrumental effects, and of understanding the characteristics and quality of the images the MMA will produce.	<u>6/1/98</u>	<u>6/1/01</u>	<u>157w</u>	<u>565w</u>



MMA Task Scheduling All Tasks selected

View: Clean Gantt View



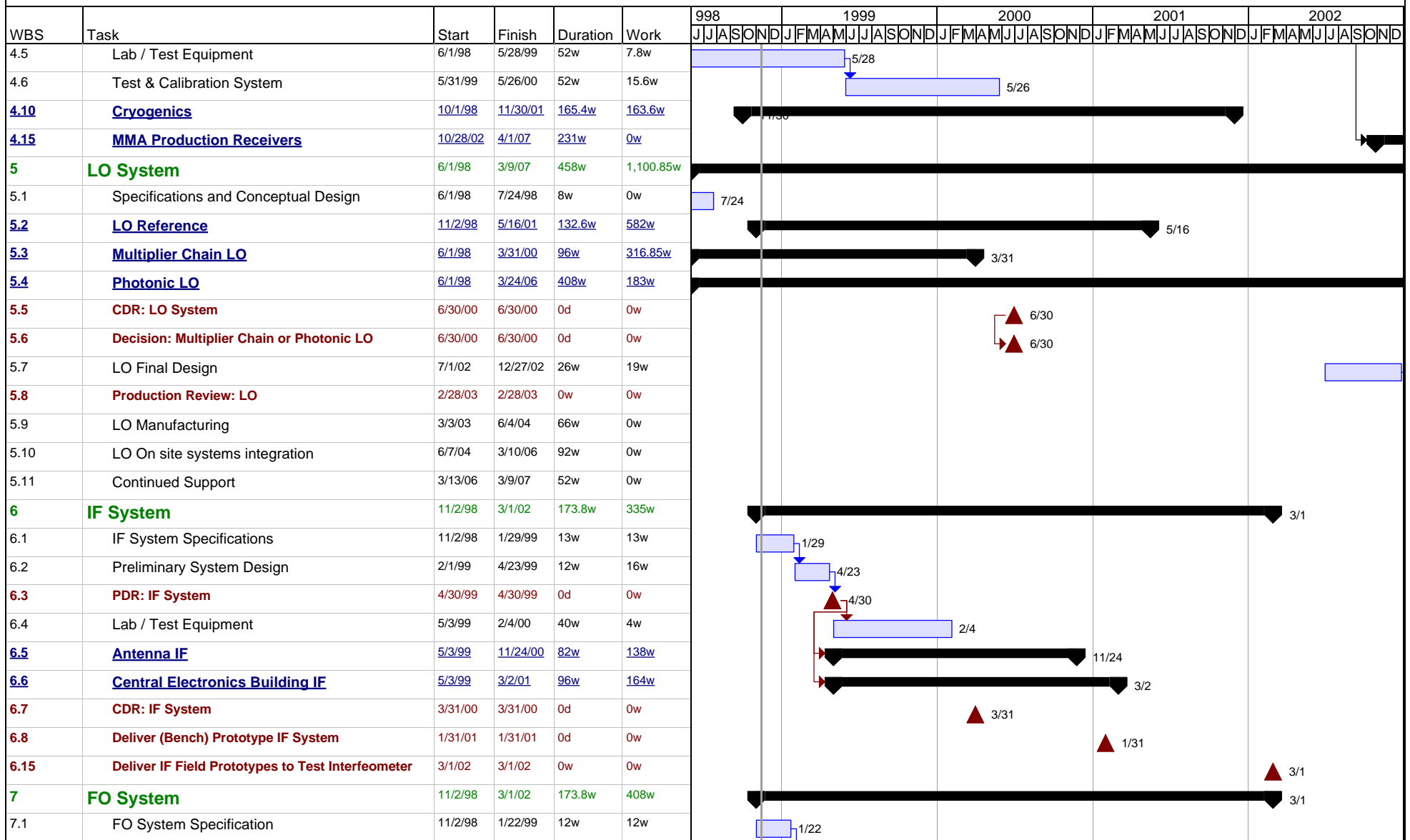
Project: MMA Project Date: 11/12/98	Task		Milestone		Rolled Up Split	
	Split		Summary		Rolled Up Milestone	
	Progress		Rolled Up Task		Rolled Up Progress	



MMA Task Scheduling

All Tasks selected

View: Clean Gantt View



Project: MMA Project
Date: 11/12/98



Selected tasks in current WBS
Milestones in **bold**, Summary tasks in underline type

