



# GEMMA

# Time Domain Astronomy

# Software

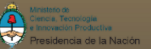
Project Status Review, July 10, 2019

# Overview

- TDA Software Introduction
- Project Team
- Project Plan
  - WBS description
  - Schedule
  - Labor and non-labor budget
- Project Status
- Project Reviews
- Risks



National Science Foundation



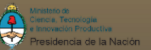


# What is the GEMMA-TDA Software?

- **A system to dynamically schedule** large numbers (order 10-100) of transient observation requests per night at Gemini while maintaining efficiency on other observing modes.
- **Software that automatically reduces data** for at least one legacy imager and one legacy longslit spectrograph.
- **A set of application programming interfaces (APIs)** to allow observations to be requested, provide the required feedback, and allow access to the data.
- **A software toolkit** to help Gemini users work with the new APIs, integrated with the Astronomical Event Observatory Network (AEON).



National Science Foundation



# TDA Main Products

## Gemini TDA APIs

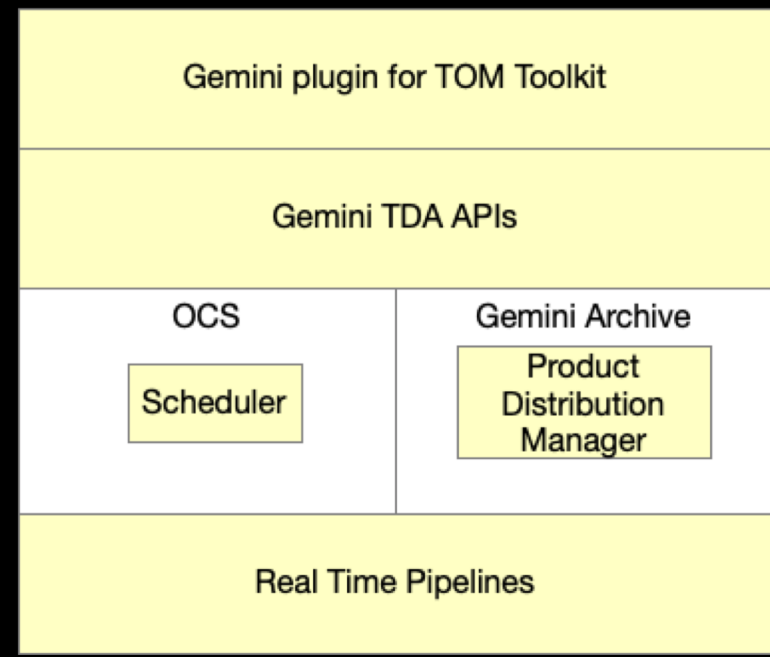
APIs to allow observations to be requested, provide feedback, and allow automated data access.

## Gemini Plugins for Target and Observation Managers

High level software to help users work with TDA APIs.

## Gemini Scheduler

Provide an efficient, dynamic way to schedule a large number of transient observations per night.



## Real Time Pipelines

Automatically reduce imaging and long-slit spectroscopic data for rapid characterization of transient sources.

## Product Distribution Manager

Updates to Gemini Archive to deliver reduced data to users.

# Project Team

## Gemini Director

Jennifer Lotz

## Executive Committee

Henry Roe (Executive)  
Inger Jorgensen  
Scot Kleinman  
Andy Adamson

Rene Rutten  
John Blakeslee  
Cathy Blough  
(GEMMA Program Manager)

Project reports to  
Andy Adamson

## Internal Working Group

**Joint Executives**  
Andy Adamson  
Rene Rutten

**Senior User**  
John  
Blakeslee

**Senior Suppliers**  
Arturo Nuñez  
Atsuko Nitta  
Rene Rutten  
Joanna Thomas-Osip

## Project Manager

Arturo Nunez

## System Engineer

TBD

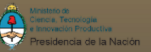
## Project Scientist

Bryan Miller



National Science Foundation

**NRC-CMRC**





# Core Technical Team

Arturo Núñez - Project Manager

Bryan Miller - Project Scientist

Shane Walker - High Level Software Architect/ Middleware

Rob Norris - Senior Software Engineer / Middleware

Sebastian Raaphorst - Software Engineer / Scheduler

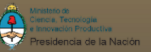
Kathleen Labrie - Data Reduction Software Lead

Chris Simpson - Scientific Programmer / Data Reduction

New Hire - Scientific Software Engineer/ Archive



National Science Foundation



# TDA Advisory Group



The STAC requested that Gemini set up a TDA Advisory Group. This has been in operation since late 2018 and has had more than 6 meetings.

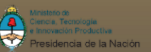
Has representatives from all Gemini Participants, including some who are interested in the Static Universe

Charge: **To advise the Observatory on its plans for the time-domain network**

1. Initial focus on the time allocation model, reported to the STAC in May 2019
2. Now moving onto other issues such as science cases and resulting requirements; expect second report to November STAC meeting



National Science Foundation



# Project Plan Details

# Project Schedule

Work Breakdown > Schedule

WBS Code	Title	Expected Start	Expected End	201	2017					2018				2019				2020				2021				2022						
				Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
1.4.	<b>Time Domain Software Plan</b>	<b>Nov 19, 2018</b>	<b>Jun 10, 2022</b>		Time Domain Software Plan																											
1.4.1	Operational Concept Definition	Feb 21, 2019	May 15, 2019		Operational Concept Definition																											
1.4.2	Scheduler	May 16, 2019	Dec 22, 2021		Scheduler																											
1.4.3	TDA APIs	July 15, 2019	May 4, 2020		TDA APIs																											
1.4.4	Gemini Plugin for TOM Toolkit	May 4, 2020	Dec 2, 2020		Gemini Plugin for TOM Toolkit																											
1.4.5	Real Time Pipelines	April 1, 2019	Jun 10, 2022		Real Time Pipelines																											
1.4.6	Product Distribution	Nov 15, 2019	Aug 3, 2020		Product Distribution																											
1.4.7	Integration and commissioning	Oct 16, 2020	Oct 27, 2021		Integration and commissioning																											
1.4.8	Documentation, Training and Ops Handover	Dec 3, 2020	Dec 8, 2021		Documentation, Training and Ops Handover																											
1.4.9	Project Management and Administration	Nov 19, 2018	June 2, 2022		Project Management and Administration																											

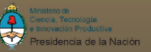


# WBS

WBS #	WBS Title	Deliverable	Responsible Organization
1.4.1	Operational Concept Definition	Concept of Operation for TDA Software	Gemini Observatory
1.4.2	Scheduler	Automated Queue Scheduler	Gemini Observatory
1.4.3	TDA APIs	TDA APIs	Gemini Observatory
1.4.4	Gemini Plugin for TOM Toolkit	Gemini Plugin for TOM Toolkit	Gemini Observatory
1.4.5	Real Time Pipelines	Automation of GMOS and NIR Long Slit Spectroscopy	Gemini Observatory
1.4.6	Product Distribution Manager	Improvements to Data Archive to support distribution of reduced data	Gemini Observatory
1.4.7	Integration and Commissioning	Verification, Validation, Integration, and Commissioning Tests Complete	Gemini Observatory
1.4.8	Documentation, training and Handover to operations	Handover of TDA products to operations	Gemini Observatory

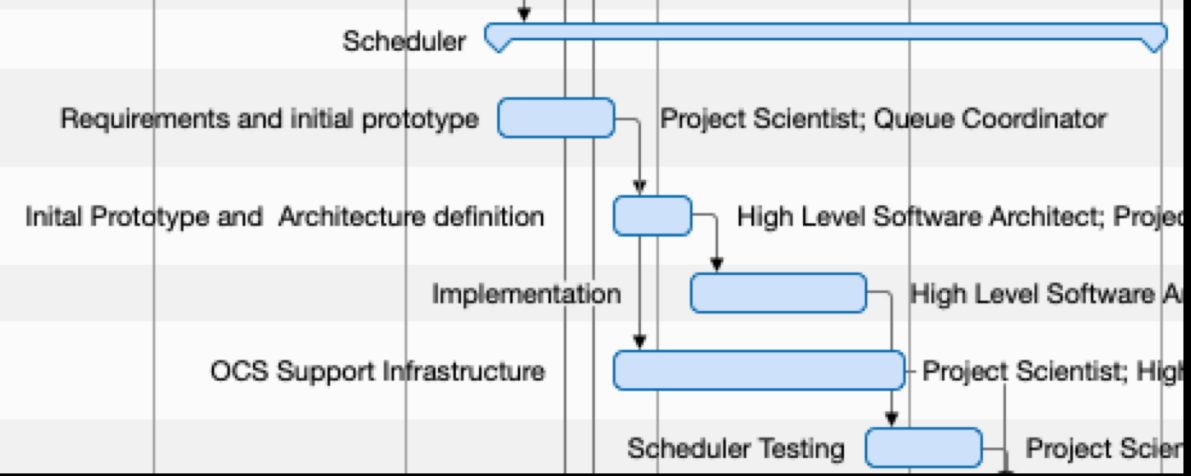


National Science Foundation



# Example - Scheduler Work Package

1.4.2	▼ Scheduler	May 16, 2019	Dec 22, 2021			Scheduler	
1.4.2.1	► Requirements and initial prototype	May 16, 2019	Oct 30, 2019			Requirements and initial prototype	Project Scientist; Queue Coordinator
1.4.2.2	▷ Initial Prototype and Architecture definition	Oct 31, 2019	Feb 19, 2020			Initial Prototype and Architecture definition	High Level Software Architect; Project Scientist
1.4.2.3	▷ Implementation	Feb 20, 2020	Oct 28, 2020			Implementation	High Level Software Architect
1.4.2.4	► OCS Support Infrastructure	Oct 31, 2019	Dec 23, 2020			OCS Support Infrastructure	Project Scientist; High Level Software Architect
1.4.2.5	▷ Scheduler Testing	Oct 29, 2020	Apr 14, 2021			Scheduler Testing	Project Scientist



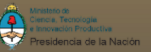
# Scheduler WBS items

## 1.4.2.1 Requirements and initial prototype

Defines the Key Science Requirements and Key Performance Parameters of adaptive queue scheduling for Gemini in the context of the anticipated TDA network of telescopes, and generates software for testing of concepts (not anticipated to be the same architecture as the final version). Also, defines Interface Control Documents to other software systems.



National Science Foundation



# Scheduler WBS items

## 1.4.2.2 Initial Prototype and Architecture definition

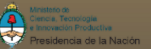
Final software architecture defined, and prototype software created based on that

## 1.4.2.3 Implementation

Scheduler moved from prototype to facility and integrated with the OCS / Observing database



National Science Foundation





# Scheduler WBS items

## 1.4.2.4 OCS Support infrastructure

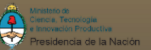
Database infrastructure in support of the automated scheduler, in particular AND and OR logic.

## 1.4.2.5 Scheduler Testing

Testing the scheduler against Key Science Requirements defined in 1.4.2.1, including its ability to match (or better) existing queue planning methods.



National Science Foundation



# Scheduler - Labor Budget Profile

FY2019: \$41,239  
 FY2020: \$285,102  
 FY2021: \$257,744  
 FY2022: \$89,518  
**TOTAL: \$673,602**

<b>1.4.2</b>	<b>▼ Scheduler</b>	<b>\$673,602.08</b>
<b>1.4.2.1</b>	<b>▶ Requirements and initial prototype</b>	<b>\$41,238.60</b>
1.4.2.2	▷ Initial Prototype and Architecture definition	\$77,171.20
1.4.2.3	▷ Implementation	\$115,416.00
<b>1.4.2.4</b>	<b>▶ OCS Support Infrastructure</b>	<b>\$133,574.08</b>
1.4.2.5	▷ Scheduler Testing	\$33,095.80
1.4.2.6	▷ Contingency	\$273,106.40

# Scheduler - Non Labor Budget Profile

<b>FY2019:</b>	<b>\$0</b>
<b>FY2020:</b>	<b>\$26,747</b>
<b>FY2021:</b>	<b>\$17,227</b>
<b>FY2022:</b>	<b>\$0</b>
<b>TOTAL:</b>	<b>\$43,974</b>

## Travel Plans:

- Progress Design Review - Q1/2020.
- Critical Design Review - Q2/2020.
- Scheduler Training - Q3/2020.
- Testing and Cross Training - Q1/2021.

# Back to the Overall Project





# Total Resources

## Software Engineering effort

Software Engineers: 6 FTE

Scientific Programmers: 6 FTE

## Science effort

Observers: 0.2 FTE

Queue Coordinators: 0.3 FTE

## Core management team

Project Manager: 0.1 FTE

Project Scientist: 1.4 FTE

Systems Engineer: 0.2 FTE

Status	Title	2018	2019	2020	2021	2022
		2018	2019	2020	2021	2022
○	▶  No resources assigned					
●	▶  Project Scientist	14.54 hours	886.58 hours	922.57 hours	558.31 hours	
▲	▶  Project Manager	10.06 hours	74.81 hours	67.18 hours	57.95 hours	
▲	▶  Project Sponsor	6.21 hours	32.5 hours	16.79 hours	14.49 hours	
▲	▶  System Engineer	12.18 hours	82.7 hours	67.18 hours	137.95 hours	
●	▶  High Level Software Architect	4.23 hours	1170.57 hours	2107.87 hours	1879.33 hours	
▲	▶  Senior Supplier Data Reduction	4.23 hours	41.77 hours			
▲	▶  Senior Supplier Data Product Management	2.11 hours	41.43 hours	301.12 hours		
●	▶  Scientific Programmer		1421.2 hours	1625.93 hours	1321.09 hours	356.45 hours
●	▶  Data Reduction Software Lead		1473.2 hours	1700.99 hours	1424.03 hours	356.45 hours
▲	▶  Queue Coordinator		170 hours	270.67 hours	339.33 hours	
●	▶  High Level Software Developer		940.4 hours	2205.6 hours	1830 hours	
▲	▶  Observer			305.17 hours	184.83 hours	

# Project Resource Profile



National Science Foundation

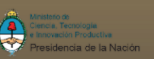


# Project Budget Profile - Labor

WBS Id	Title	FY2019	FY2020	FY2021	FY2022	TOTALS
1.4.1	Operational Concept Definition	\$15,062				\$15,062
1.4.2	Scheduler	\$41,239	\$285,102	\$257,744	\$89,518	\$673,602
1.4.3	TDA APIs	\$75,696	\$123,886			\$199,582
1.4.4	Gemini Plugin for TOM Toolkit		\$77,015	\$22,612		\$99,627
1.4.5	Real Time Pipelines	\$149,273	\$210,844	\$135,688	\$89,931	\$585,736
1.4.6	Product Distribution		\$99,003			\$99,003
1.4.7	Integration and commissioning			\$154,804	\$20,885	\$175,689
1.4.8	Documentation, Training and Ops Handover			\$64,574		\$64,574
1.4.9	Project Management and Administration	\$21,610	\$29,073	\$28,962	\$3,440	\$83,085
	<b>TOTALS</b>	<b>\$302,880</b>	<b>\$824,922</b>	<b>\$664,384</b>	<b>\$203,774</b>	<b>\$1,995,961</b>



National Science Foundation



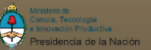
# Project Budget Profile - Non Labor

WBS Id	WBS Title	FY2019	FY2020	FY2021	FY2022	TOTALS
1.4.1	Operational Concept Definition	\$9,168				\$9,168
1.4.2	Scheduler		\$26,747	\$17,227		\$43,974
1.4.3	TDA APIs	\$3,274	\$25,926			\$29,200
1.4.4	Gemini Plugin for TOM Toolkit			\$12,661		\$12,661
1.4.5	Real Time Pipelines					\$0
1.4.6	Product Distribution Manager					\$0
1.4.7	Integration and Commissioning			\$10,837		\$10,837
1.4.8	Documentation, training and Handover to operations				\$13,614	\$13,614
1.4.9	Project Management and Admin					\$0
	<b>TOTAL</b>	<b>\$12,443</b>	<b>\$52,674</b>	<b>\$40,725</b>	<b>\$13,614</b>	<b>\$119,456</b>



National Science Foundation

**NRC · CNRC**



# Project Status



# Milestones

Status	Title	Expected End	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
✓	Project Plan submitted to NSF	Dec 31, 2018							◆			
✓	Real Time Pipelines Work started	April 1, 2019							◆			
✓	Concept of Operations Completed	May 15, 2019							◆			
▲	Scheduler Work Started	May 16, 2019							◇			
○	Conceptual Review	July 10, 2019							◆			
○	TDA APIs Work Started	July 15, 2019							◆			
○	Operational Requirements Baselined	July 29, 2019							◆			
○	Gemini APIs for TDA baselined	July 29, 2019							◆			
○	Pipeline Interfaces defined	Oct 1, 2019							◆			
○	Progress Design Review	Oct 2, 2019							◆			
○	Requirements and Initial Prototype	Oct 30, 2019							◆			
○	Scheduler Interfaces defined	Oct 30, 2019							◆			
○	Product Distribution Work started	Nov 15, 2019							◆			
○	TOM Interface implementation completed	Nov 18, 2019							◆			
○	Updates to DRAGONS software completed	Dec 16, 2019							◆			
○	Critical Design Review	Jan 22, 2020							◆			



# Milestones

○	Updates to Gemini Archive Completed	Feb 18, 2020			Updates to Gemini Archive Completed	◆
○	Final Architecture Definition	Feb 19, 2020			Final Architecture Definition	◆
○	Scheduler Interfaces Implementation completed	Mar 9, 2020		Scheduler Interfaces Implementation completed	◆	
○	Gemini TDA APIs tested and verified	May 4, 2020		Gemini TDA APIs tested and verified	◆	
○	Gemini Plugin for TOM Started	May 4, 2020		Gemini Plugin for TOM Started	◆	
○	Operational modifications to support automation completed	Jun 30, 2020		Operational modifications to support automation com...	◆	
○	Product Distribution Work ready	Aug 3, 2020		Product Distribution Work ready	◆	
○	TOM plugin and user interface implemented	Oct 7, 2020		TOM plugin and user interface implemented	◆	
○	Scheduler Implementation completed	Oct 28, 2020		Scheduler Implementation completed	◆	
○	Gemini Plugin for TOM completed	Dec 2, 2020		Gemini Plugin for TOM completed	◆	
○	OCS Support Infrastructure completed	Dec 23, 2020		OCS Support Infrastructure completed	◆	
○	Deployment of Quicklook mode	Jan 25, 2021		Deployment of Quicklook mode	◆	
○	Gemini Scheduler ready	Apr 14, 2021		Gemini Scheduler ready	◆	
○	Integration Preparedness Review	Apr 14, 2021		Integration Preparedness Review	◆	
○	Integration completed	Oct 27, 2021		Integration completed	◆	
○	Training Completed	Dec 8, 2021		Training Completed	◆	
○	Handover to operations	Dec 8, 2021		Handover to operations	◆	
○	Project closure Review	Dec 31, 2021		Project closure Review	◆	

### **1.4.1 Operational Concept Definition**

Work completed, final version sent for review by end of June.

Conceptual Design Review scheduled by August 6th.

### **1.4.2 Scheduler**

Evaluation of suitability of Las Cumbres Observatory Scheduler completed in late 2018.

Ready to kick off work to prototype weighting schemes in July.

Science Working Groups reviewing detailed use cases and top level requirements.

### **1.4.3 TDA APIs**

Ready to be kicked off in August, after Conceptual Design Review.

### **1.4.4 Real Time Pipelines**

Work package started in April 2019.

Focus in on completing basic infrastructure.

Initial implementation of core algorithms for wavelength calibration and for source extraction is available.

Interfaces with OCS identified and ready for review.

# Project Reviews

# Planned Project Reviews

Conceptual Design Review

Progress Design Review

Critical Design Review

Integration Readiness Review

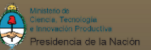
Hand over to operations Readiness Review



National Science Foundation



MINISTRY OF  
SCIENCE, TECHNOLOGY,  
INDUSTRY AND COMMUNICATIONS

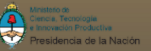


# Conceptual Design Review

- Scheduled for August 2019
- Focus of science goals and top level science requirements.
- Panel formed of internal and external reviewers.
- Goals
  - Review and Approve Operational Concept Document.
  - Review and Approve Top Level Science Requirements and Use Cases.
  - Review and Approve plan towards Progress Design Review.



National Science Foundation

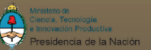


# Progress Design Review

- Scheduled for Q1/FY2020
- Focus of software technical architecture, release process, deployment approach and initial review of interface documents among subsystems.
- Panel formed of internal and external reviewers.
- Goals:
  - Review and approve overall software architecture
  - Review software design of Scheduler and TDA APIs to ensure they meet top level science requirements
  - Review software interfaces for data reduction software and archive
  - Review and approve plans towards Critical Design Review



National Science Foundation

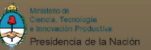


# Critical Design Review

- Scheduled for Q2/FY2020
- Final design review of core software components and their interfaces within the system. Demonstration that solution will meet key science requirements.
- Panel formed of internal and external reviewers.
- Goals:
  - Present final design for scheduler and TDA APIs.
  - Present final interface documents for data reduction software, archive and TOM toolkit.
  - Review plans for implementation of each work package.



National Science Foundation



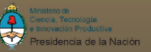


# Integration Readiness Review

- Scheduled for Q3/FY2021
- Assess readiness of different work packages to begin integration.
- Panel formed of internal reviewers and stakeholders.



National Science Foundation



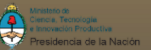
# Hand over to Operations Review

- Scheduled for Q1/FY2022
- Assess readiness the system to hand it over for regular operations.
- Panel formed of internal reviewers.
- Goals
  - Hand over all software products to regular operations.
  - Baseline technical maintenance manuals and user manuals.
  - Show that all science requirements are met.
  - Identify any work that will be carried on as future operational improvements.



National Science Foundation

**NRC · CNRC**



# Risks

# Risks

1. Hiring: Need to secure software engineering effort for TDA.
2. Scope: Level of integration of API compatibility with AEON Network.
3. Dependencies: OCS Upgrades schedule.

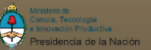
Part I. Risk Identification					Part II. Risk Analysis for Existing Controls			Part III. Risk				
Name	Project Risk Category	Risk Description (ignoring controls)	Impact 1-5 (ignoring controls)	Likelihood 1-5 (ignoring controls)	Total Risk Score Low = 1 - 8 Med = 9 - 16 High = 17 - 25	What Controls (if any) are currently in place?	Control Effectiveness 1-5	Residual Risk Score Low = 1 - 8 Med = 9 - 16 High = 17 - 25	Control or Risk Mitigation Strategy	Control effectiveness based on mitigation strategy 1-5	Residual Mitigated Risk Low = 1 - 8 Med = 9 - 16 High = 17 - 25	Contingency
Software Resources	Resources	If the software effort is not secured, project will be delayed.	4	5	20	Hiring process to hire 3 new SW engineers.	4	15	Use Internal resources to cover, impacting other software projects.	3	10	If suitable so candidates are create Work P specification subcontract asp project
OCS3 Dependencies	Scope	TDA presupposes an OCS that is able to ingest, schedule, and execute observations, but OCS3 remains largely undefined. Lack of definition will delay the project.	5	4	20	OCS Upgrades made a high priority project to operations.	4	15	Preparing OCS Deployment strategy and discussion with Project Board	3	10	
Integration with AEON	Scope	Integration with AEON is assumed to be done at the TOM Toolkit level. If more integration is required, the scope of the project changes as additional software components will be required. Integration with AEON needs to be clarified	3	4	12	Escalation to project sponsor to determine what is the required level of integration.	4	9				

# Hiring Update

- Project heavily dependent on software effort ~ 12 FTE total
- 2 Software Engineers to help with Data Reduction and Archive modifications. Offers being made, expected start Oct 2019.
- 2 open high-level software positions TBF to back fill operational roles working in TDA. Expected start Oct 2019.



National Science Foundation





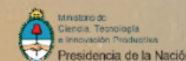
# GEMMA Time Domain Astronomy Software

Project Status Review, July 10, 2019



National  
Science  
Foundation

NRC · CNRC



KASI 한국천문연구원  
Korea Astronomy and Space Science Institute

