

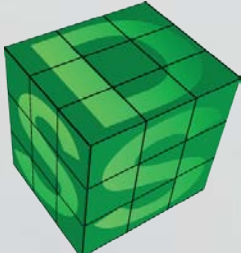
GBT Dynamic Scheduling System (DSS)



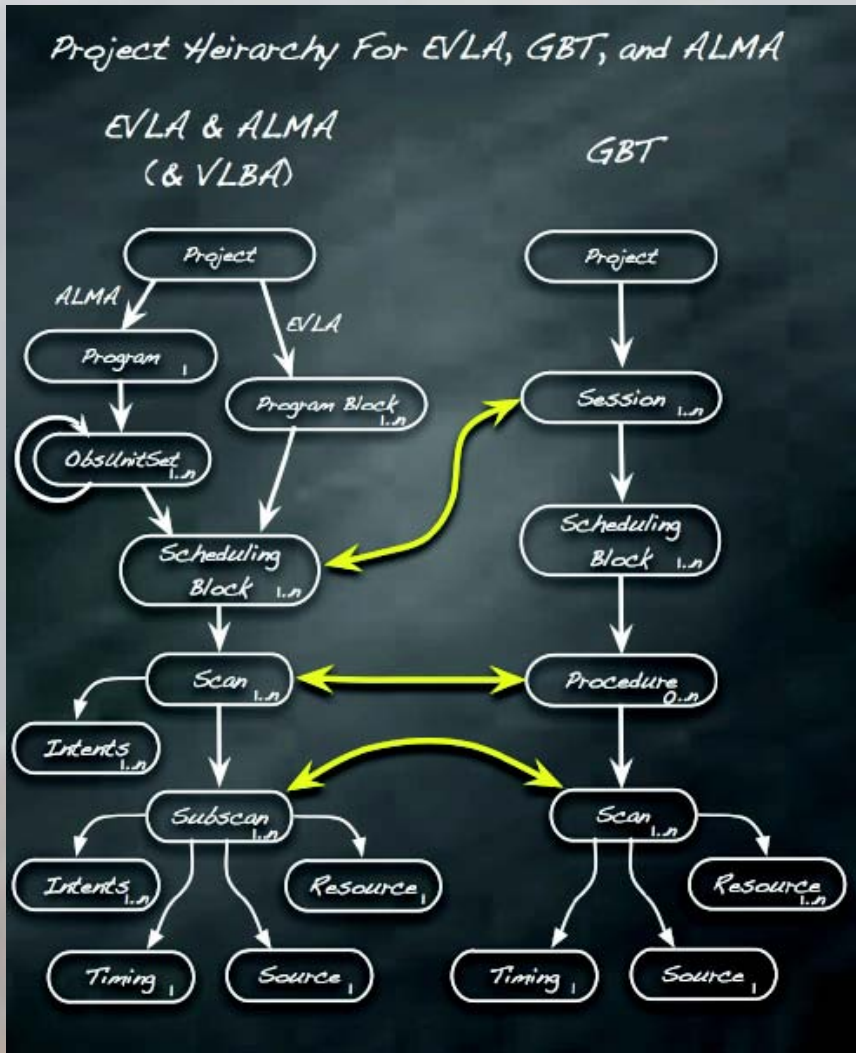
Dana Balser, Jim Braatz, Mark Clark, Jim Condon, Ray Creager,
Mike McCarty, Ron Maddalena, Paul Marganian, Karen O'Neil,
Eric Sessoms, Amy Shelton

Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array



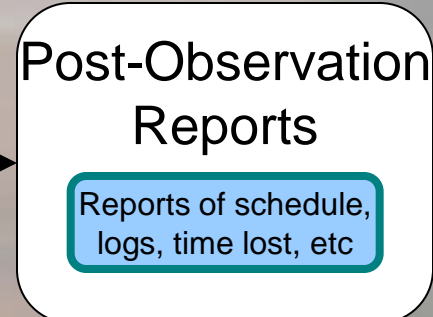
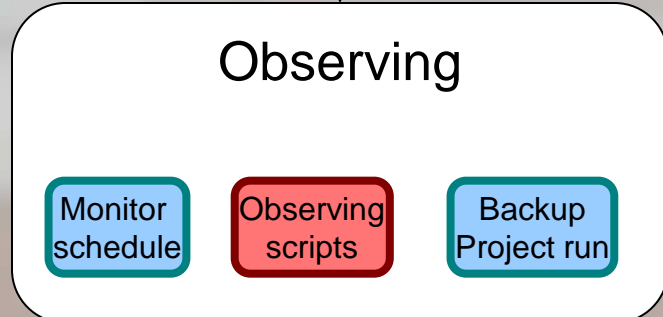
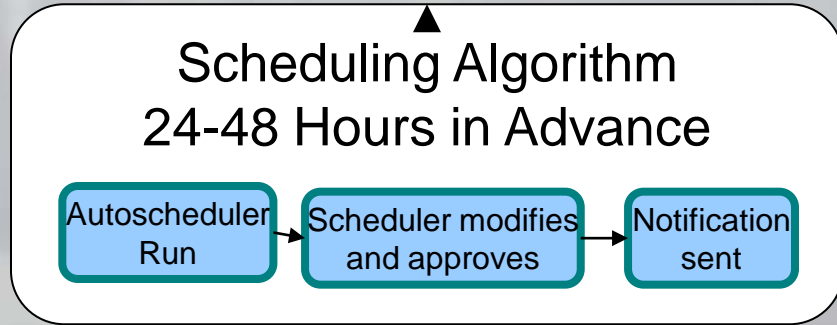
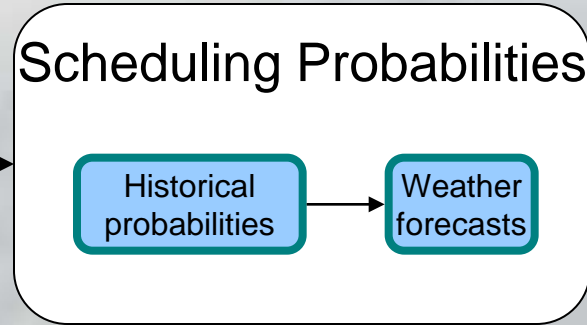
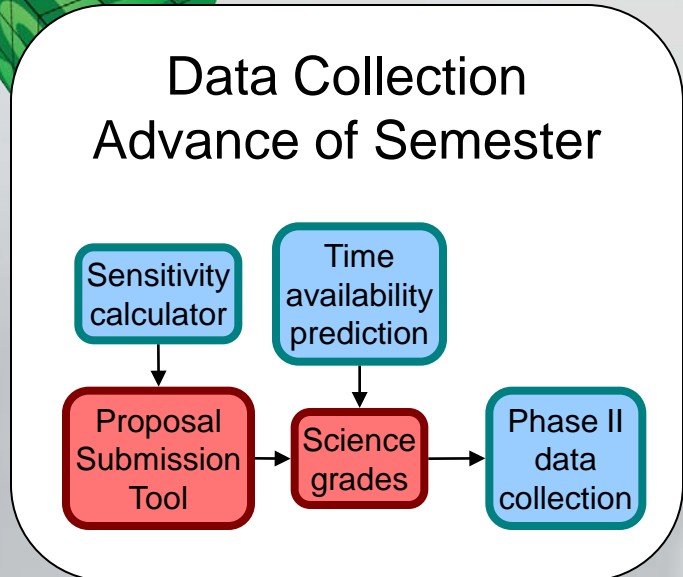


Nomenclature



GBT
Open Sessions
Windowed Sessions
Fixed Sessions

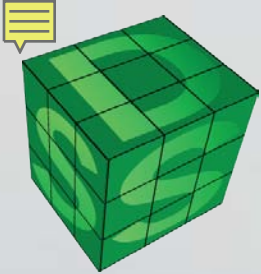
How does it work?



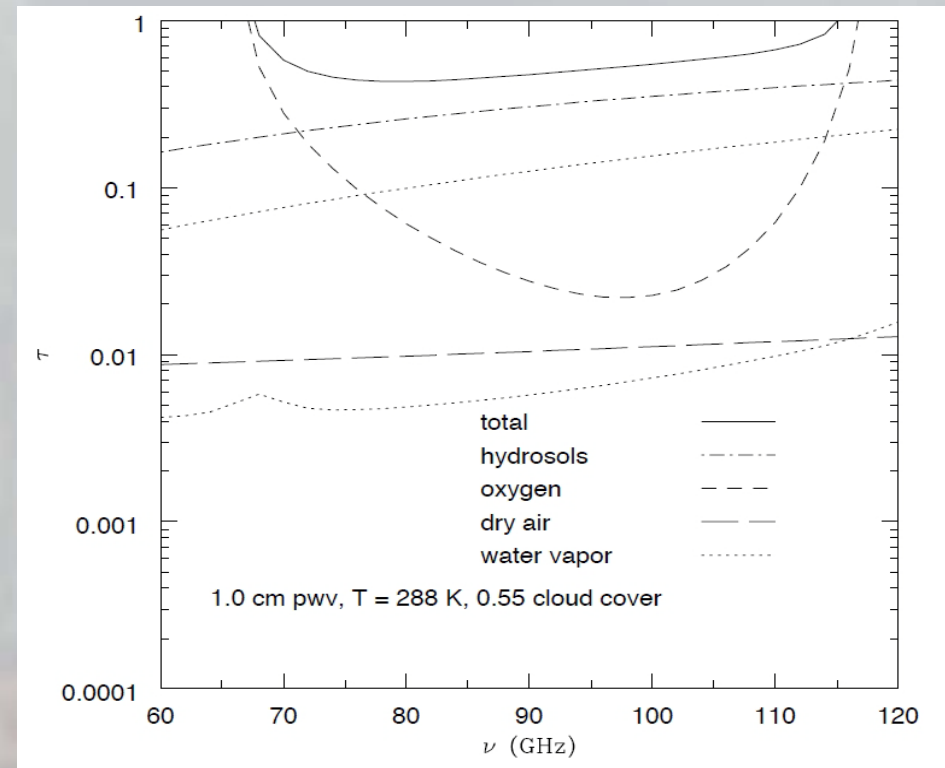
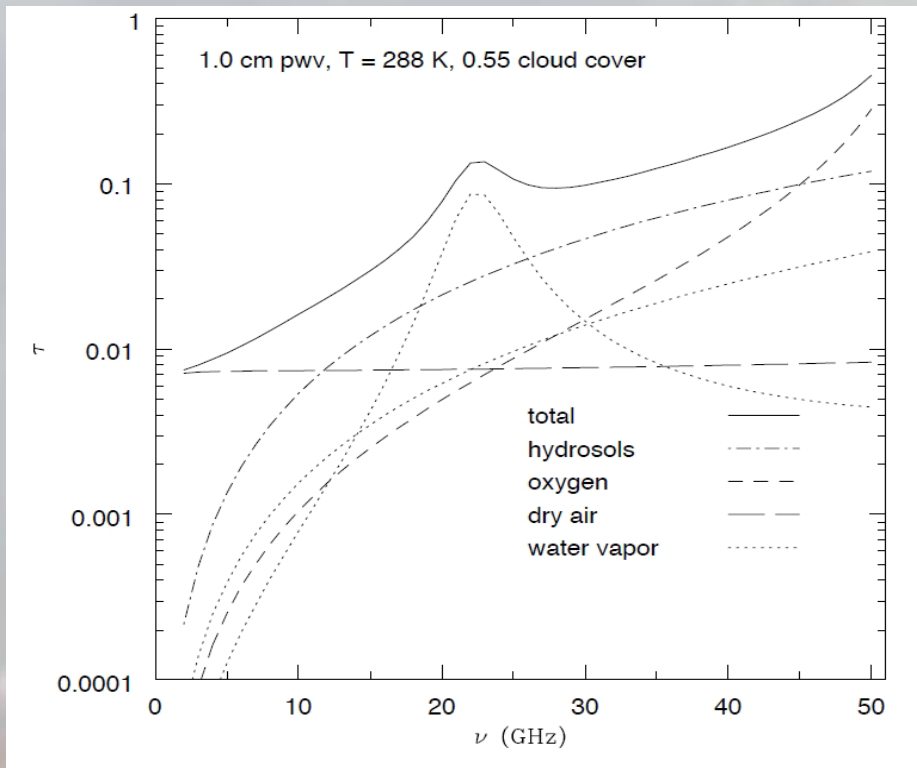
Provided by the DSS

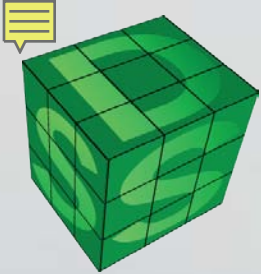
Provided outside the DSS

- Requirements**
- Scheduling observers, *not* scripts
 - Observers retain control
 - Minimum of 24 hours advance notice for observers
 - Wide array of hardware
 - Cannot increase workload of staff or observers

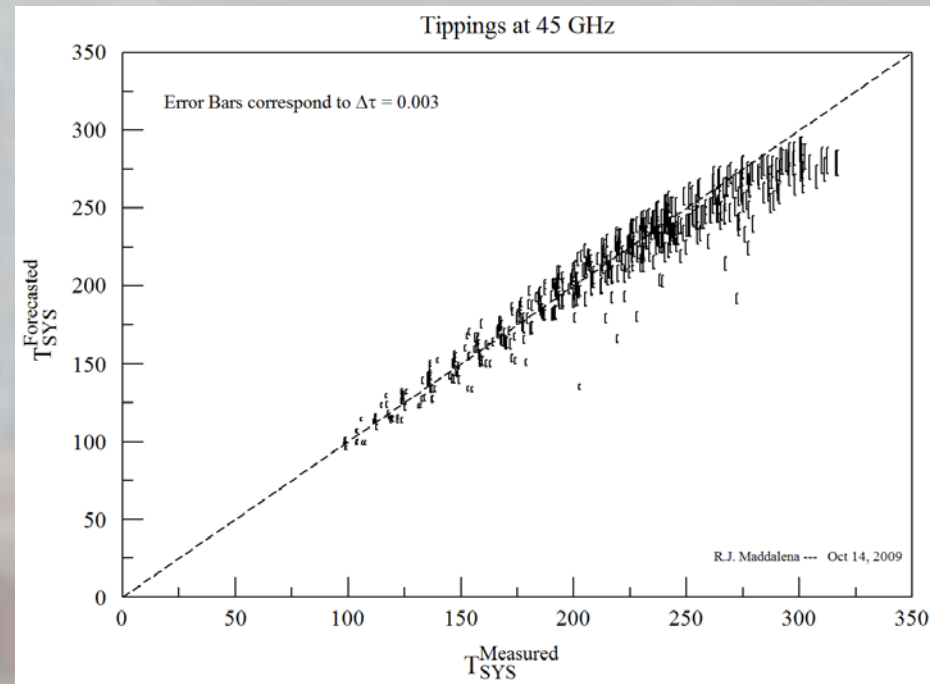
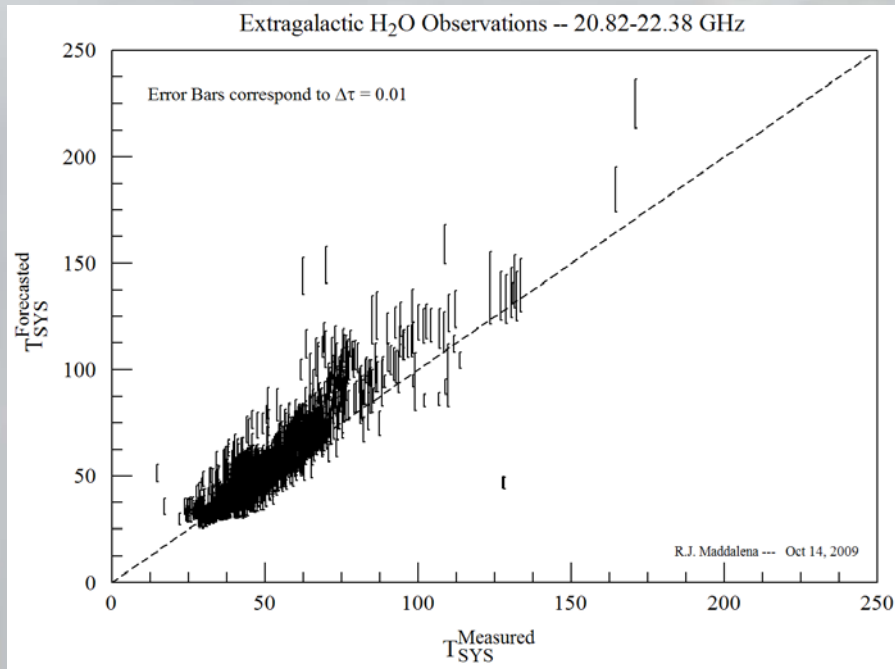


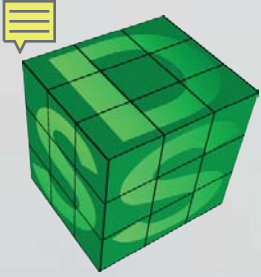
Atmospheric Effects



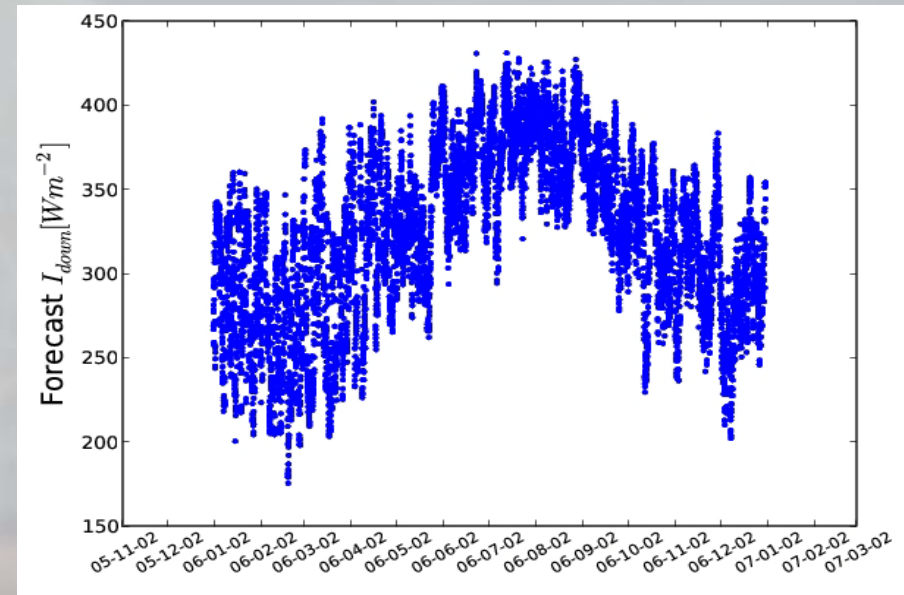
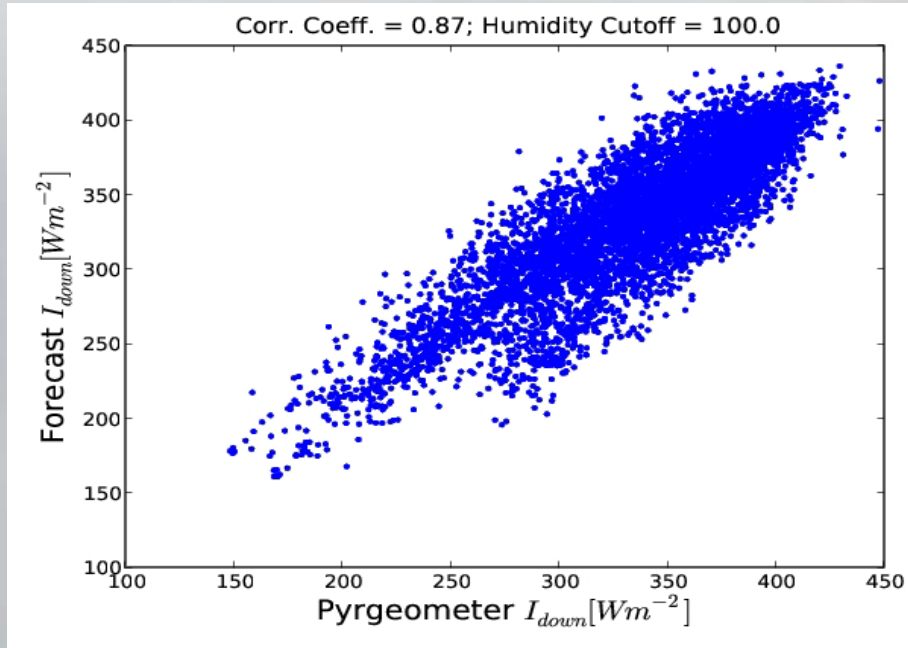


Weather Forecasts



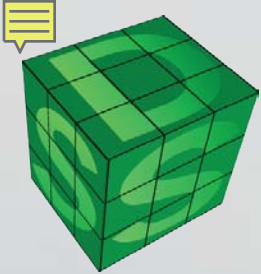


Atmospheric Stability

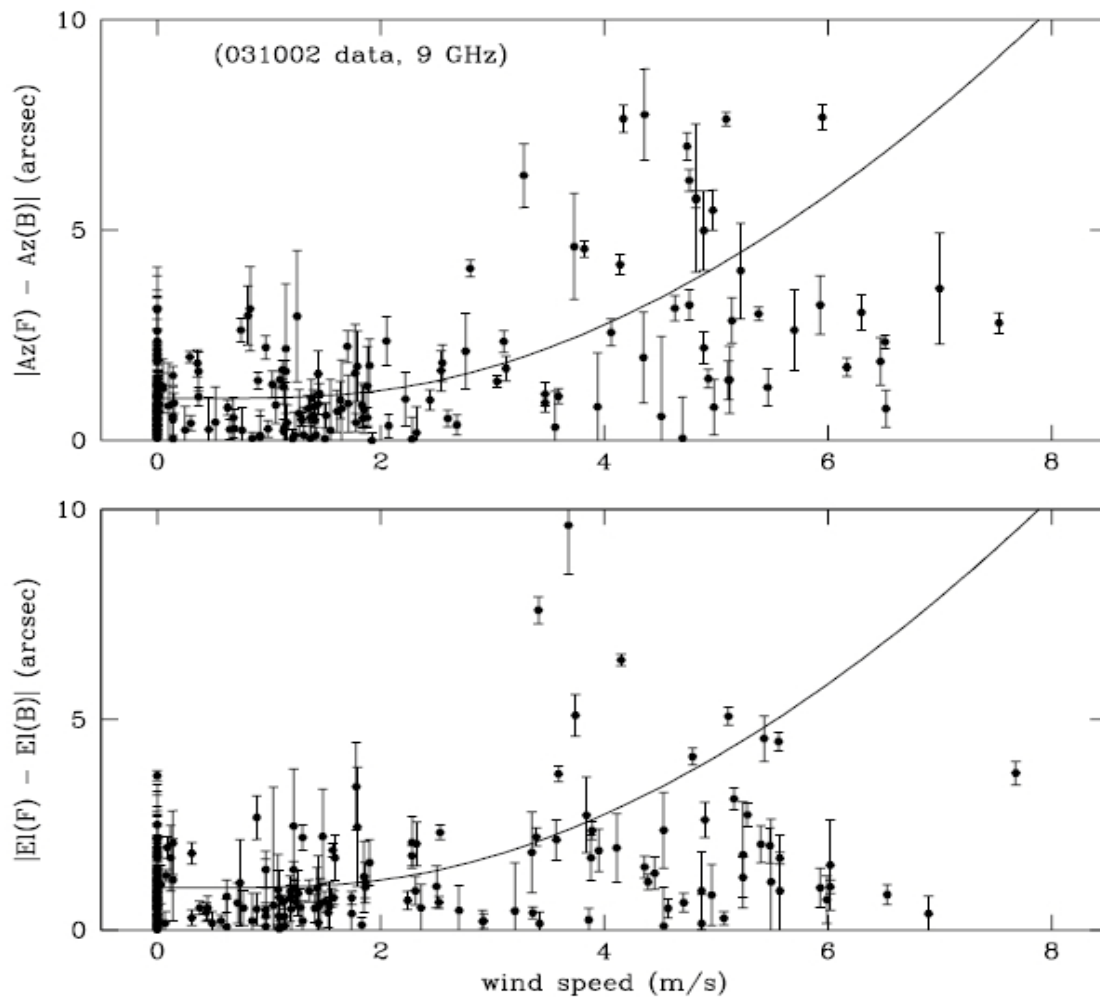


Pyrgeometer: non-imaging device sensitive to 4.5-40 micron over 150 deg fov.

Maddalena; Balser (2011)

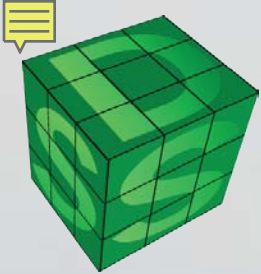


Wind Effects



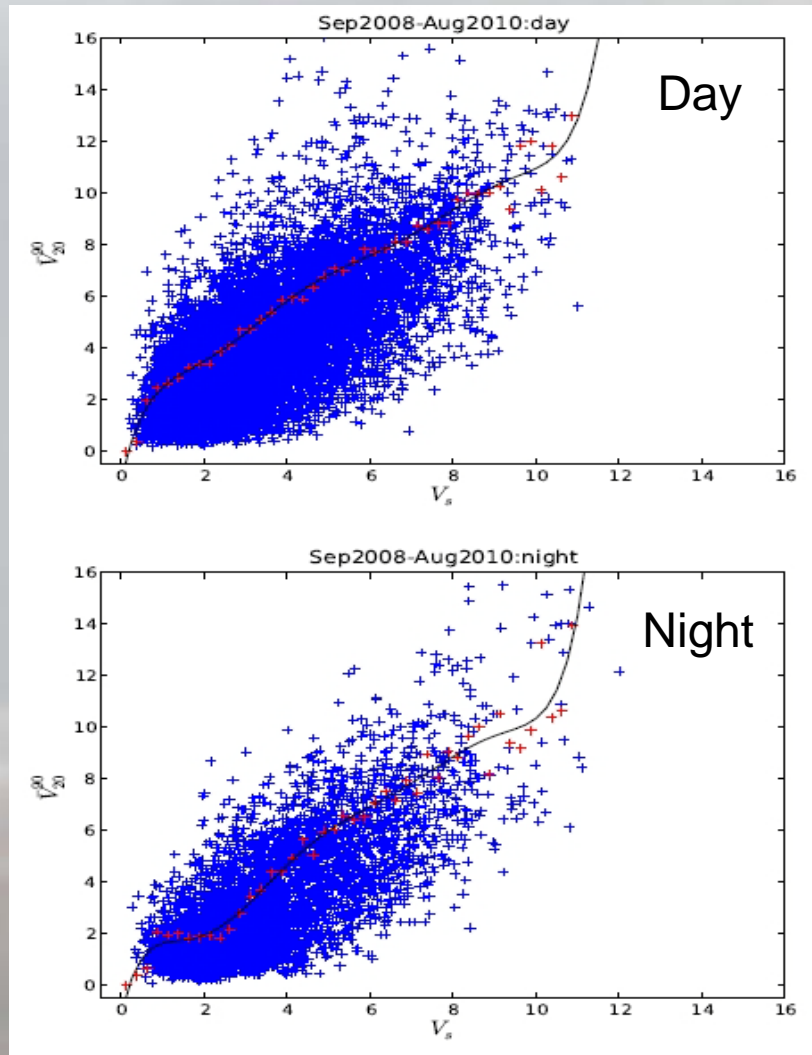
$$\sigma_1 \propto v^2$$

$$\sigma_1 \propto v^2$$

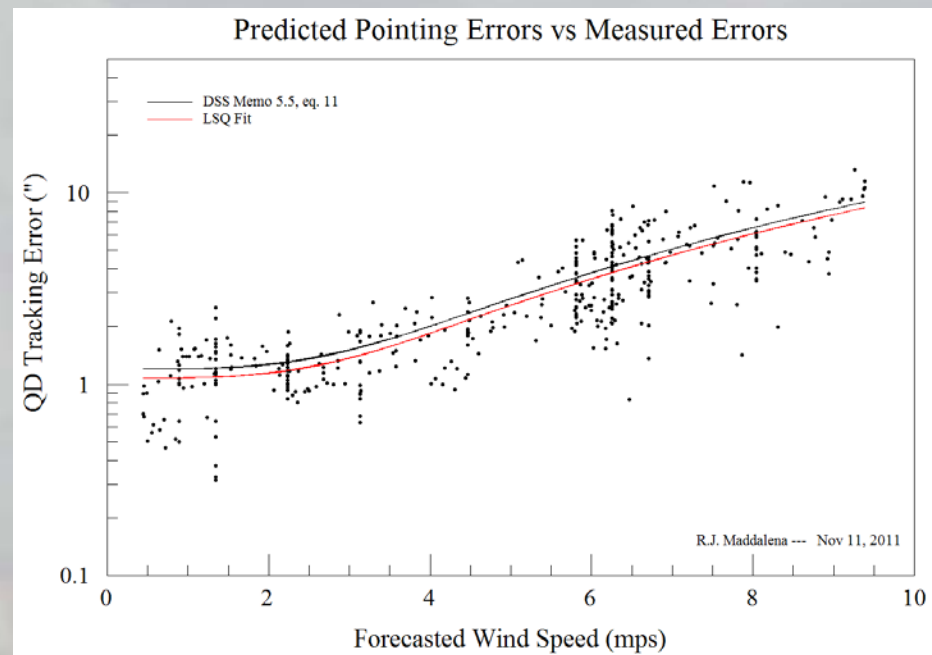


Weather Forecasts: wind

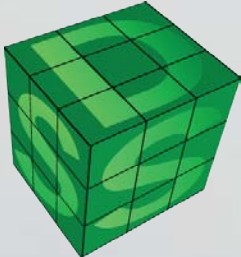
Obs Wind Speed (m/s)



Forecast Wind Speed (m/s)



Balser (2010); Maddalena



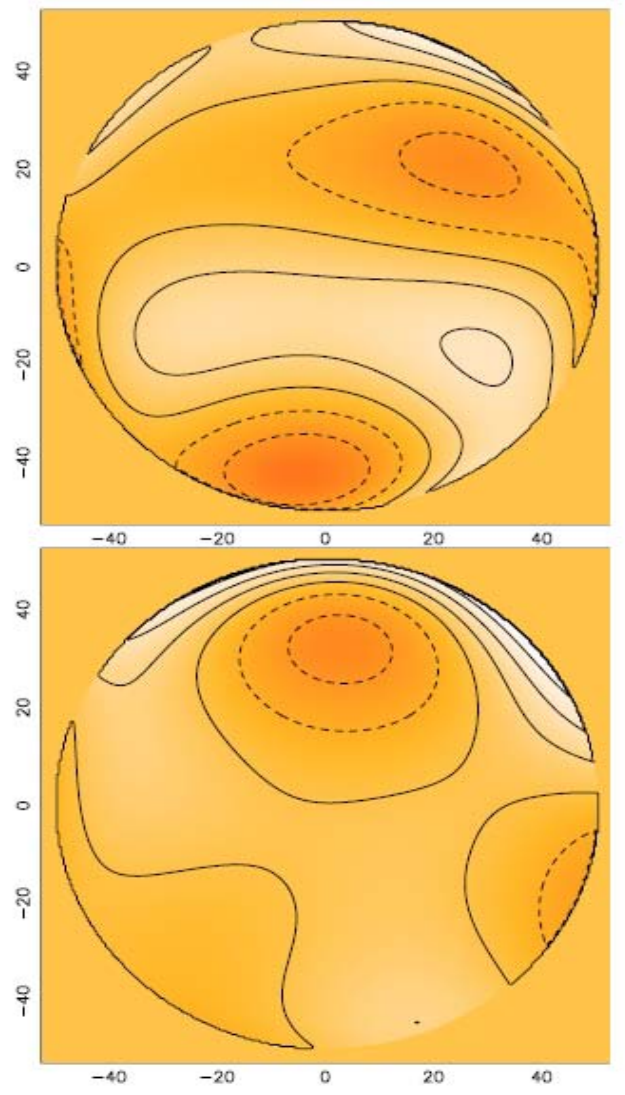
Solar Heating

Primary Surface

Day: 300 micron
Night: 250 micron

Offset Pointing

Day: 3.3 arcsec
Night: 2.7 arcsec



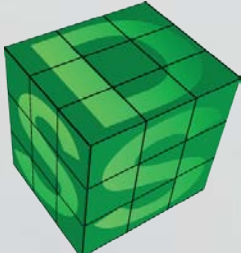
rms
330 micron

rms
220 micron

Surface
Wave front errors from
OOF maps.

Grayscale: +/- 2 rad
Contour: 1/2 rad intervals

Nikolic et al. (2007)



Scoring Equation

Weather:
 Observing Efficiency
 Stringency

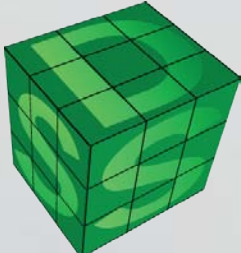
Other Factors:
 Observers on Site
 Completion of Projects
 Science Grades
 Thesis Projects

$$R = (\eta S P_{\alpha}^{\beta} P_v^{\gamma}) (I_{eff} I_{HA} I_z I_{tr} I_{st}) (f_{oos} f_{com} f_{sg} f_{tp}) (t_t t_n t_{le} t_{tb})$$

Pressure Factors:
 Right Ascension
 Frequency

Performance Limits:
 Observing Efficiency
 Hour Angle
 Zenith Angle
 Tracking Error
 Atmospheric Stability

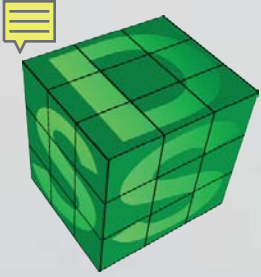
Temporal Constraints:
 Transit
 Nighttime
 LST Exclusion
 Time Between



Scoring Equation

Weather:
Observing Efficiency
Stringency

$$R = (\eta S P_{\alpha}^{\beta} P_v^{\gamma}) (I_{eff} I_{HA} I_z I_{tr} I_{st}) (f_{oos} f_{com} f_{sg} f_{tp}) (t_t t_n t_{le} t_{tb})$$



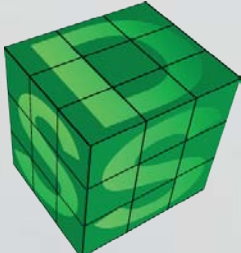
Observing Efficiency

$$\eta = \eta_{\text{atm}} \eta_{\text{sur}} \eta_{\text{tr}}$$

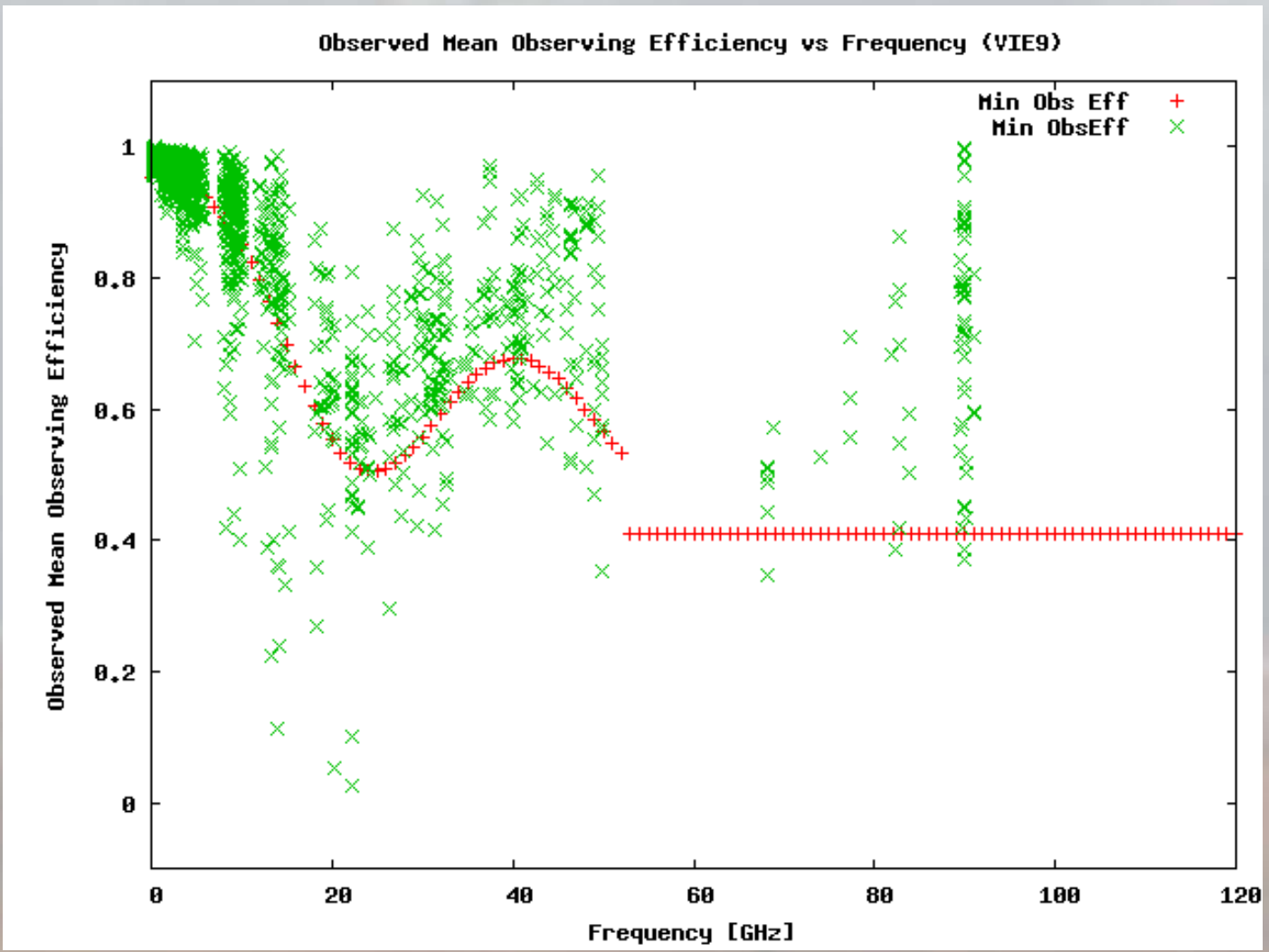
$$\eta_{\text{atm}} = \left[\frac{T_{<\text{sys}} \exp(\tau_{<})}{T_{\text{sys}} \exp(\tau)} \right]^2$$

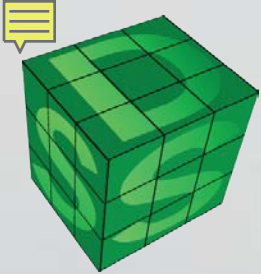
$$\eta_{\text{sur}} = \exp \left[\frac{-32\pi^2}{\lambda^2} (\varepsilon_{\text{d}}^2 - \varepsilon_{\text{n}}^2) \right]; \text{ where } \eta_{\text{a}} = \exp[-(4\pi\varepsilon)^2], \text{ and } \eta_{\text{sur}} \propto \eta_{\text{a}}^2$$

$$\eta_{\text{tr}} = \left[\frac{1 + 4\ln(2)f_{<}^2}{1 + 4\ln(2)f^2} \right]^2; \text{ where } f \equiv (\sigma_{\text{tr}} / \theta), \text{ and } \left(\frac{\sigma_{\text{tr}}}{\text{arcsec}} \right)^2 = \sigma_{\text{o}}^2 + \left(\frac{|\mathbf{v}|}{3.15 \text{ m s}^{-1}} \right)^4$$

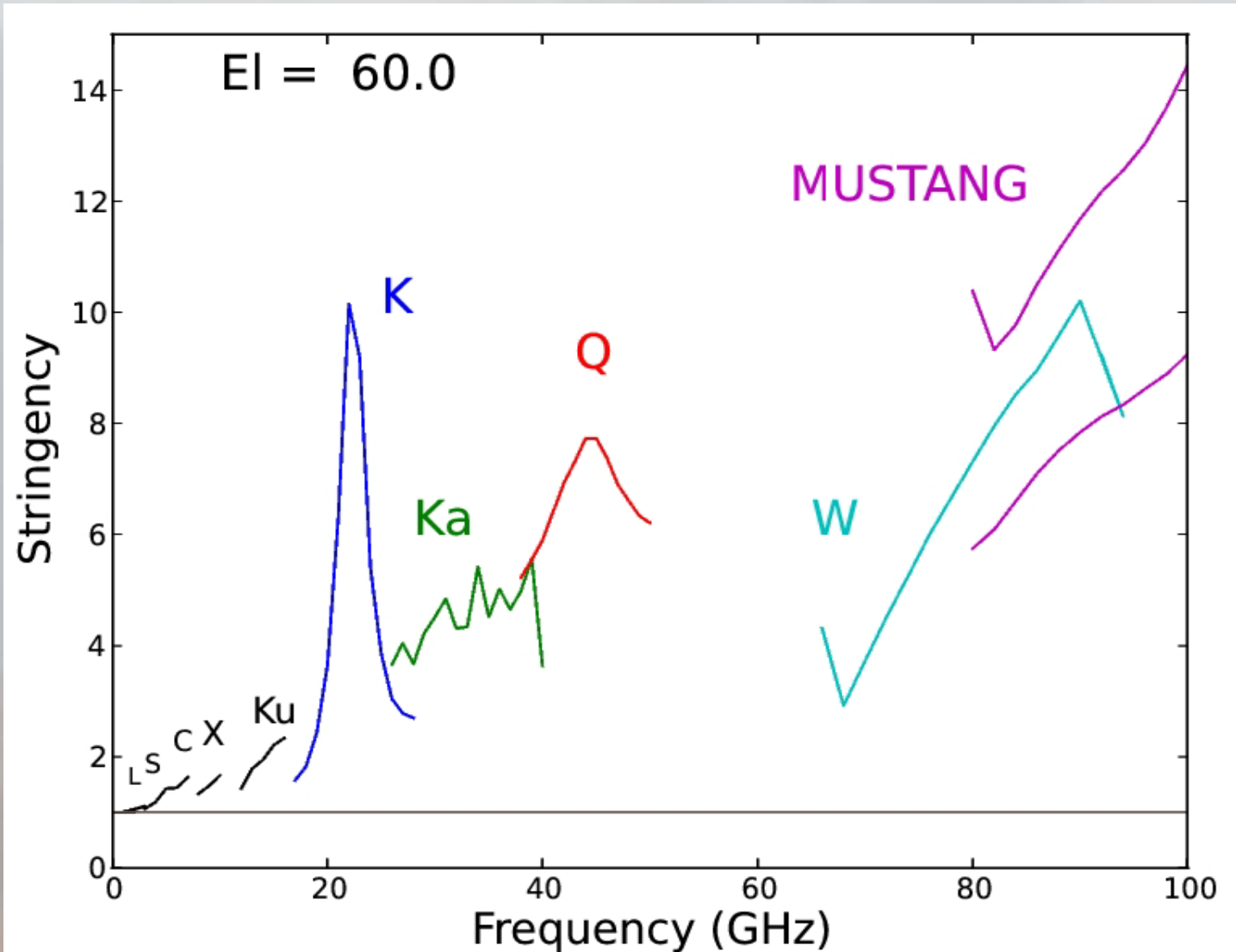


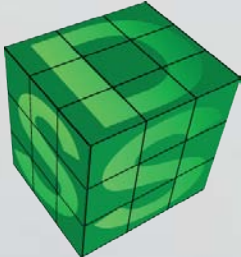
Observing Efficiency





Stringency

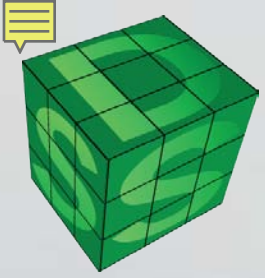




Scoring Equation

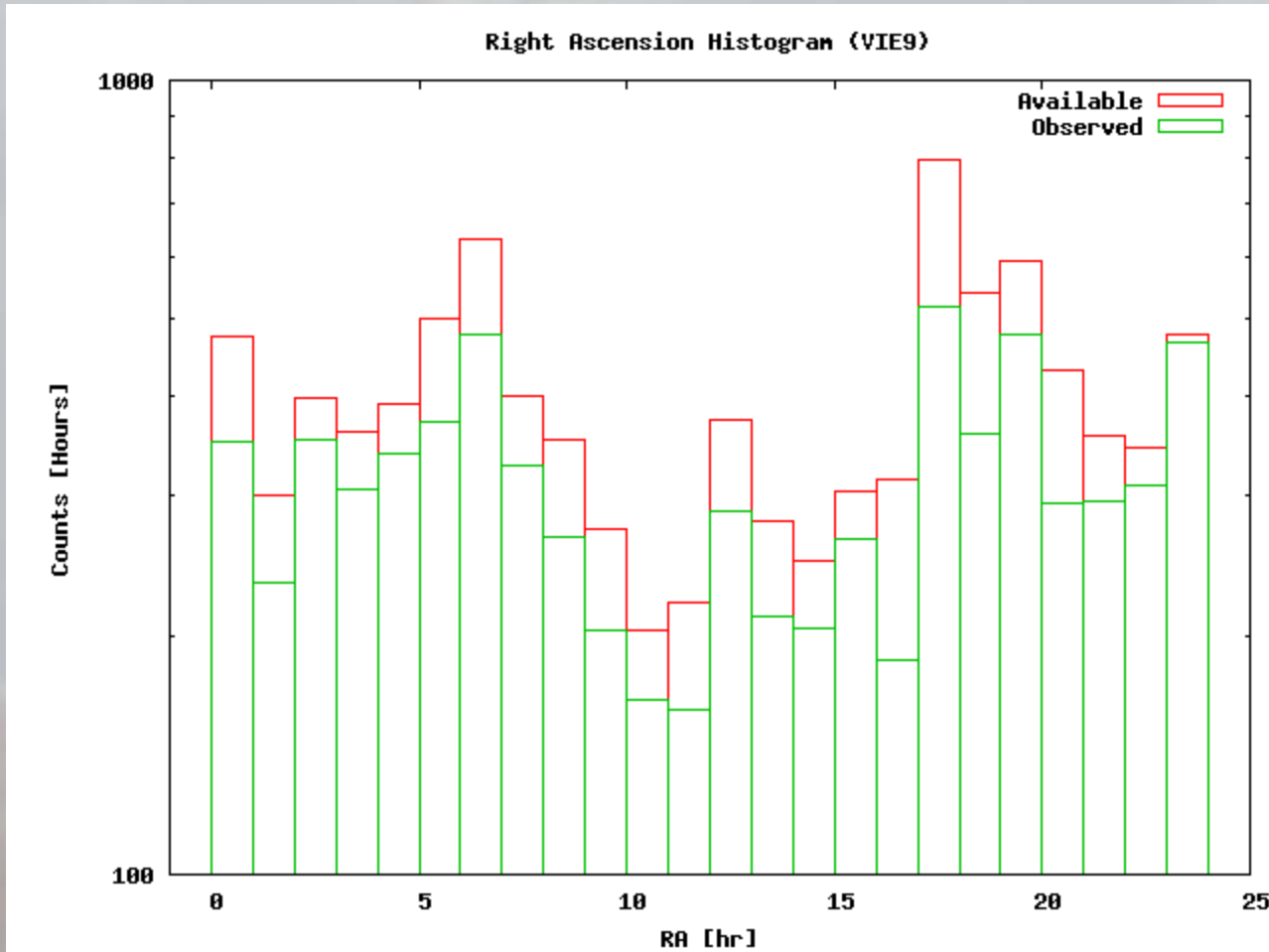
$$R = (\eta S P_{\alpha}^{\beta} P_v^{\gamma}) (I_{eff} I_{HA} I_z I_{tr} I_{st}) (f_{oos} f_{com} f_{sg} f_{tp}) (t_t t_n t_{le} t_{tb})$$

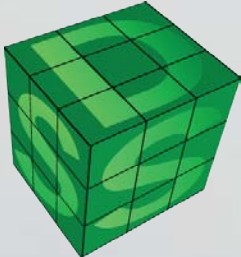
Pressure Factors:
Right Ascension
Frequency



Pressure Factor

$$P_{\alpha} = 1 + \ln\left(\frac{n_{\alpha}}{d_{\alpha}}\right)$$

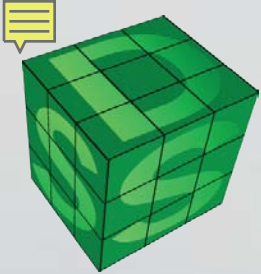




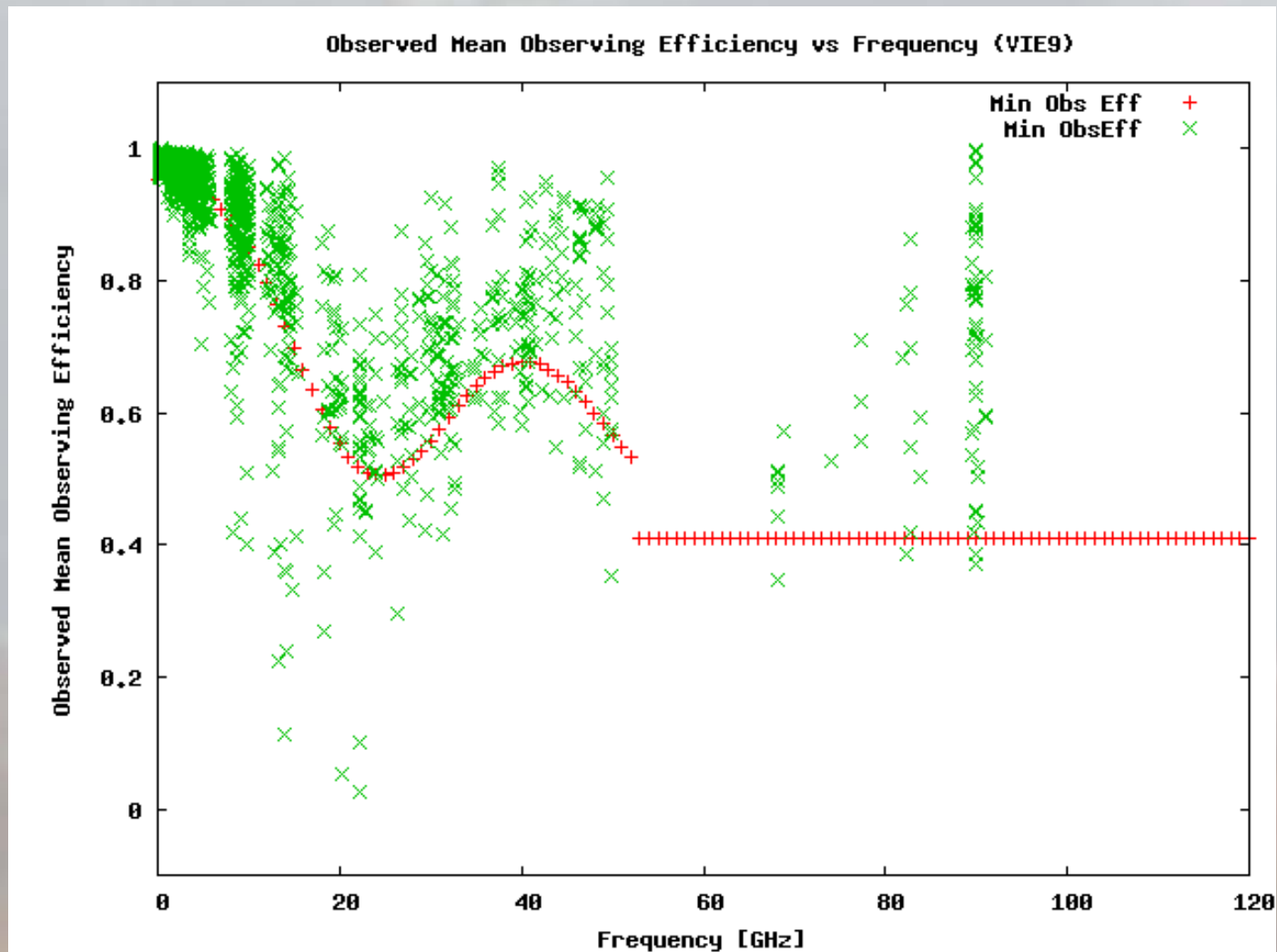
Scoring Equation

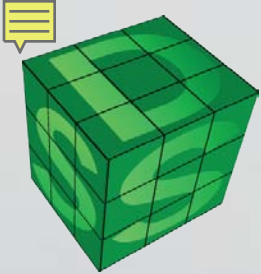
$$R = (\eta S P_{\alpha}^{\beta} P_v^{\gamma}) (I_{eff} I_{HA} I_z I_{tr} I_{st}) (f_{oos} f_{com} f_{sg} f_{tp}) (t_t t_n t_{le} t_{tb})$$

Performance Limits:
Observing Efficiency
Hour Angle
Zenith Angle
Tracking Error
Atmospheric Stability

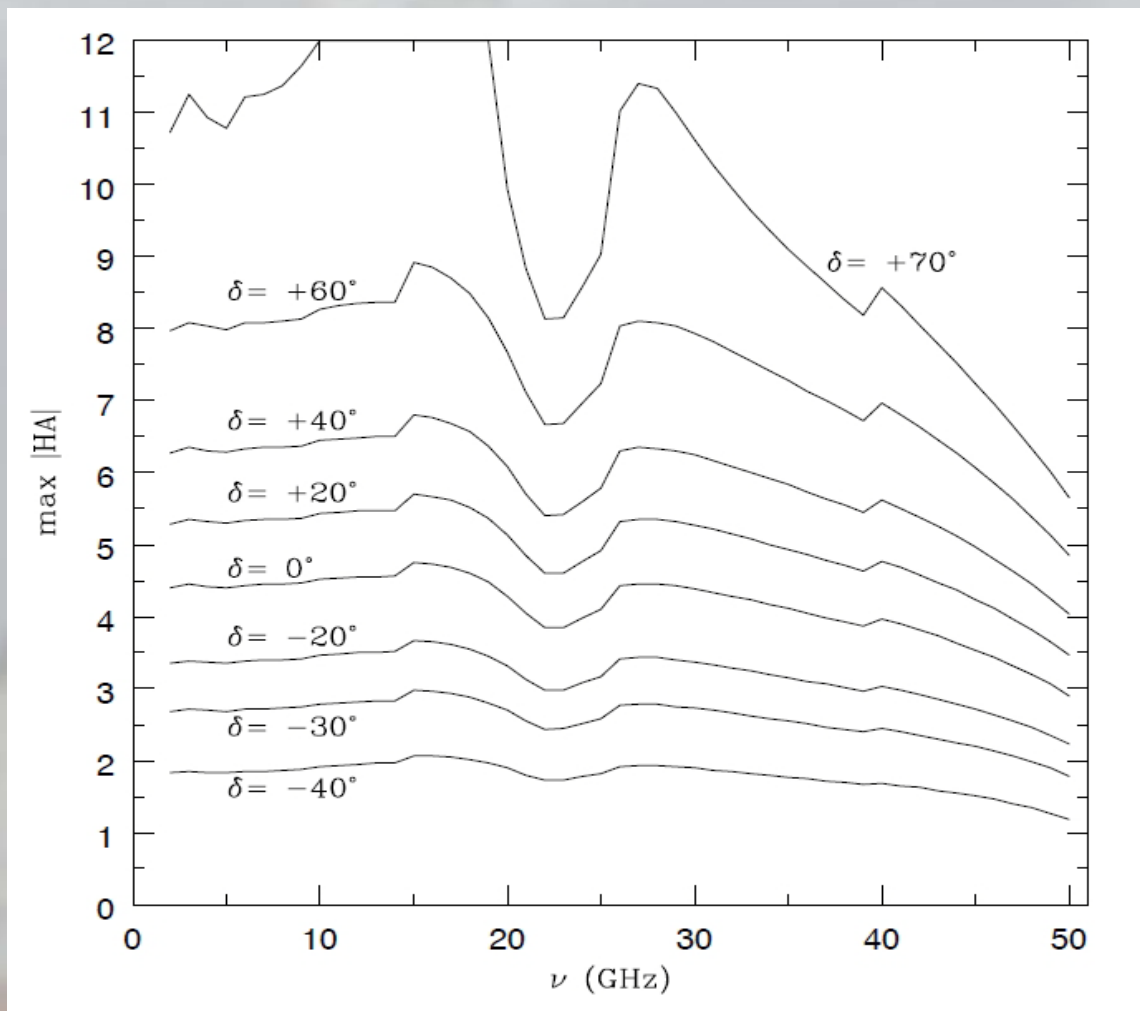


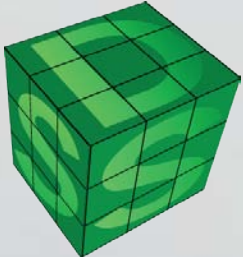
Observing Efficiency Limit





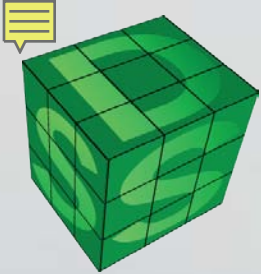
Hour Angle Limit



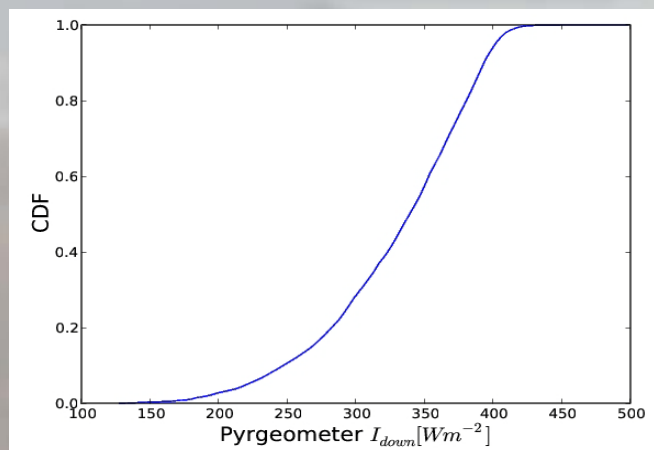
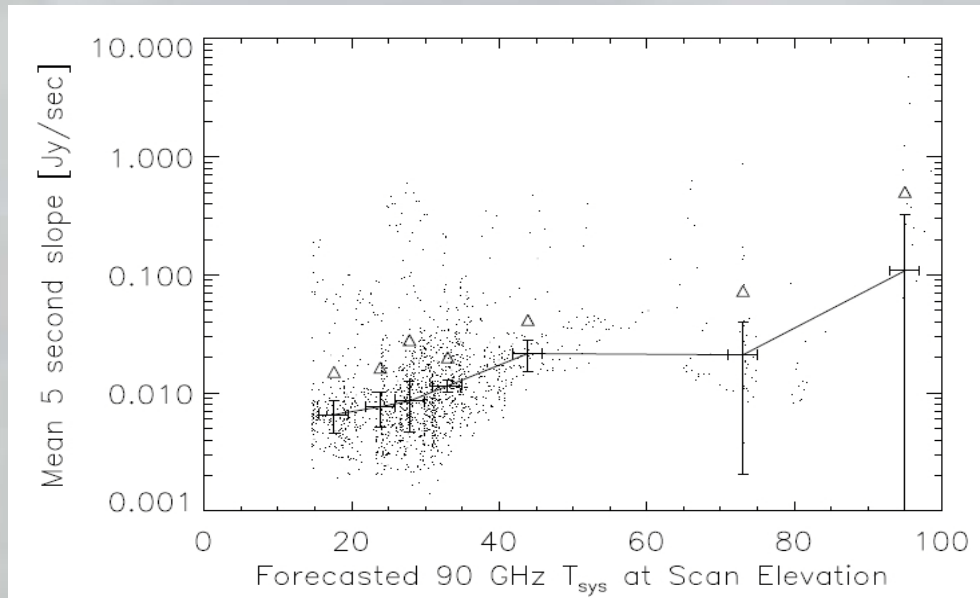
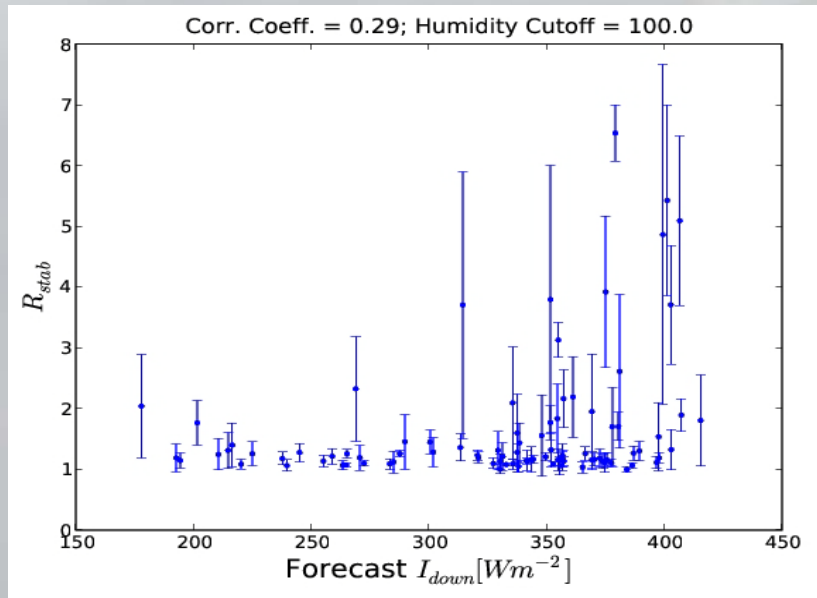


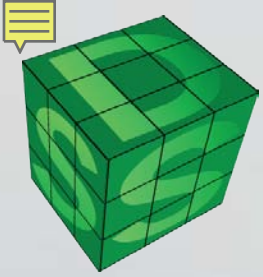
Tracking Error Limit

$$f = \sigma_{\text{tr}} / \theta = 0.20 \text{ (10\% flux errors)}$$



Atmospheric Stability Limit





Packing (Open Sessions)

Problem: a thief with a bag of capacity N , faced with a number (M) of possible goodies each having a different weight (cost) and value, how do you pack your bag to maximize your take?

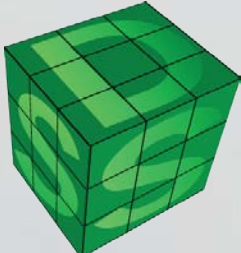
Brute Force: order ($M!$)

Knapsack Algorithm: order ($M*N$)

N = number of quarter hours to schedule

M = number of potential sessions

Overhead = 15 min.



Scheduler Page

Scheduler - Mozilla Firefox

File Edit View History Bookmarks Tools Help

GBT11B-010 Scheduler

trent.gb.nrao.edu:8005/nubbles/war/Nubbles.html

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Project Explorer | User Explorer | Session Explorer | Window Calendar | **Session Page** | **Schedule** | Time Accounting | Project Page | Receiver Schedule

Controls

Semester: Enabled Not Complete

Calendar Control

Start Date: 2012-03-06
 Days: 3 Scores: [] Get Scores
 TZ: UTC

Schedule Control (Current Average Score: 3.41 Unscheduled Time: 01:00)

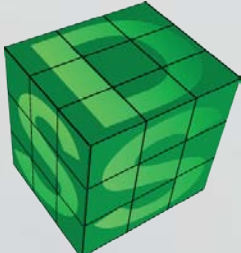
Schedule Restore Schedule Factors Publish Email

Period Explorer (most recent forecast at 2012-03-06 10:34:00 UTC)

Session (Project) VP	T	S	Day	T...	LST	Dur...	Hist Sc...	Curr S...	Rcvrs	N...
GBT11B-051-02 (GBT11B-051) 5970	O	S	2012-03-05	21:15	02:49:44	5.25	1.51	1.51	L	0
GBT11B-246-03 (GBT11B-246) 6385	...	S	2012-03-06	02:30	08:05:35	0.5	0	1.34	L	0
GBT12A-388-02 (GBT12A-388) 6328	O	S	2012-03-06	03:00	08:35:40	10	0	0	342	0
Maintenance day (Maintenance) 666	E	S	2012-03-06	13:00	18:37:19	8.5	0	0		0
GBT12A-114-12 (GBT12A-114) 6260	O	S	2012-03-06	21:30	03:08:43	6.5	2.08	2.14	X	0
GBT11B-001-16 (GBT11B-001) 5886	O	S	2012-03-07	04:00	09:39:47	4.5	18.7	18.7	MBA	0
GBT11B-068-03 (GBT11B-068) 5770	O	S	2012-03-07	08:30	14:10:31	3	15.9	15.6	MBA	0
GBT11B-010-03 (GBT11B-010) 5628	O	S	2012-03-07	11:30	17:11:01	5	9.10	9.08	X	0
GBT12A-114-12 (GBT12A-114) 6260	O	S	2012-03-07	16:30	22:11:50	4	2.08	2.08	X	0
GBT11B-051-02 (GBT11B-051) 5970	O	S	2012-03-07	20:30	02:12:28	5.75	1.50	1.48	L	0

Calendar (Pending Fixed Open Default Windowed Non-Default Windowed Elective)

2012	Tue, Mar 6	Wed, Mar 7	Thu, Mar 8
0:00	GBT11B-051-02 (Day 2)	GBT12A-114-12 (Day 2)	GBT11B-051-02 (Day 2)
1:00			
2:00			Subreflector Circle point
3:00	GBT11B-246-03 GBT12A-388-02		
4:00		GBT11B-001-16	
5:00			Receiver Checkout - 800
6:00			RFI Checkout - 800
7:00			GBT12A-031-01
8:00		GBT11B-068-03	
9:00			
10:00			



Schedule

GBT Schedule - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Getting Started in ... x EVLA high frequen... x EVLA baselines for... x List NRAO Archive... x NRAO: Secure Login x NRAO Observatio... x The VLA Calibrator... x GBT Schedule

nrao.edu https://dss.gb.nrao.edu/schedule/public

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GBT Schedule

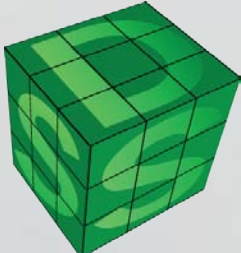
Wednesday March 14, 2012 08:19 EDT

Start: Days: Time Zone:

[Historical Schedules](#) | [Printer Friendly Schedule](#)

** The project ID links in the below schedule will bring the user to the appropriate page in the [DSS](#) (login required)**

2012-03-06 (ET)	Type	Project ID	Project Title	PI	Friend	Rcvrs	Frequency (GHz)
+00:00 - 08:00	A	GBT12A-388	Continuing the GBT All-Sky 350-MHz Pulsar Survey	Ransom	Demorest	342	0.29 - 0.40
08:00 - 16:30	M	Maintenance	Maintenance day- Add: 800 , Remove: 342	Chestnut	Minter	800, L, S, C, X, Ka, MBA, KFPA, W	
16:30 - 23:00	A	GBT12A-114	Constraining Stellar and Galactic Chemical Evolution with 3-Helium Abundances	Bania	Balser	X	8.00 - 10.00
23:00 - 00:00+	A	GBT11B-001	MUSTANG Imaging of the CLASH Cluster Sample II: Completion of the Sample	Mroczkowski	Mason	MBA	80.00 - 100.00
2012-03-07 (ET)	Type	Project ID	Project Title	PI	Friend	Rcvrs	Frequency (GHz)
+00:00 - 03:30	A	GBT11B-001	MUSTANG Imaging of the CLASH Cluster Sample II: Completion of the Sample	Mroczkowski	Mason	MBA	80.00 - 100.00
03:30 - 06:30	A	GBT11B-068	High resolution MUSTANG SZ imaging of New Planck Galaxy Clusters	Scaife	Mason	MBA	80.00 - 100.00
06:30 - 11:30	A	GBT11B-010	Probing Metallicity Throughout the Milky Way Disk	Balser	Balser	X	8.00 - 10.00
11:30 - 15:30	A	GBT12A-114	Constraining Stellar and Galactic Chemical Evolution with 3-Helium Abundances	Bania	Balser	X	8.00 - 10.00
15:30 - 21:15	A	GBT11B-051	HI Mapping of the M31-M33 Stream	Wolfe	Lockman	L	1.15 - 1.73
21:15 - 23:15	T	TGBT12A_508	Subreflector Circle point	Prestage	Prestage	Ka	
23:15 - 00:00+	T	TGBT10A_500	Receiver Checkout - 800	Minter	Minter	800	
2012-03-08 (ET)	Type	Project ID	Project Title	PI	Friend	Rcvrs	Frequency (GHz)
+00:00 - 00:15	T	TGBT10A_500	Receiver Checkout - 800	Minter	Minter	800	
00:15 - 01:45	T	TGBT09C_527	RFI Checkout - 800	Minter	Minter	800	
01:45 - 11:00	A	GBT12A-031	Deep searches for young pulsars in two globular clusters	Lorimer	Demorest	800	0.68 - 0.92



User Home Page

Profile - Dana Balsler - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Profile - Dana Balsler

Profile - Dana Balsler <https://dss.gb.nrao.edu/profile> Google

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Dana Balsler ICAL

Active Projects

Project ID	Title
GBT11B-010	Probing Metallicity Throughout the Milky Way Disk
GBT12A-114	Constraining Stellar and Galactic Chemical Evolution with 3-Helium Abundances

Assigned as Friend

Project ID	Required	Title
GBT11B-010		Probing Metallicity Throughout the Milky Way Disk
GBT12A-114		Constraining Stellar and Galactic Chemical Evolution with 3-Helium Abundances

Upcoming Observations

- GBT12A-114
 - GBT12A-114-12: Tue, Mar 06 21:30 UTC for 6:30 hrs
 - GBT12A-114-12: Wed, Mar 07 16:30 UTC for 4:00 hrs
- GBT11B-010
 - GBT11B-010-03: Wed, Mar 07 11:30 UTC for 5:00 hrs

Dynamic Contact Information

Home Phone: 434-589-6874

[edit](#)

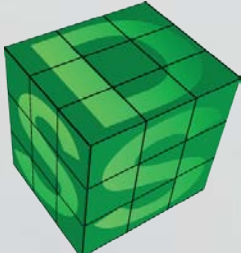
Static Contact Information

To update, edit your profile at [my.nrao.edu](#).

Email(s)
dbalsler@nrao.edu (Other)

Phone(s)
434-266-0243 (Work)

Upcoming Reservations



User Project Page

GBT11B-010 - Mozilla Firefox

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GBT11B-010

nrao.edu https://dss.gb.nrao.edu/project/GBT11B-010

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DYNAMIC SCHEDULING SYSTEM

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GBT11B-010

Probing Metallicity Throughout the Milky Way Disk

Project Sessions

Name	Coordinates	Freq	Rcvr	Time billed	Min/Max Dur.	Type	Gr	Enabled	Other Parameters
GBT11B-010-01	RA: 18:22:12.0 Dec: -13:50:24.0	9.0	X	14.0 / 14.0	1.25 - 6.0	continuum	A	<input type="checkbox"/>	Irradiance Threshold: 300.0
GBT11B-010-02	RA: 18:46:48.0 Dec: -02:01:48.0	9.0	X	0 / 0.0	3.0 - 5.0	spectral line	A	<input type="checkbox"/>	
GBT11B-010-03	RA: 18:22:12.0 Dec: -13:50:24.0	9.0	X	21.25 / 41.0	3.0 - 5.0	continuum	A	<input checked="" type="checkbox"/>	Irradiance Threshold: 300.0

Project Calendar (UTC)

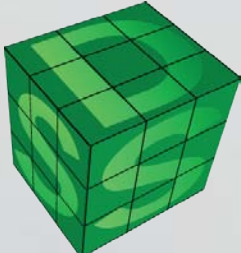
** Any days shaded in gray in the calendar indicate that the project cannot be scheduled on that day (click on day for details). **

observations, blackouts, reservations, windows, semester boundary

March 2012

today

Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	1	2	3
5:00 Dana Balse: Tech	9:00 Observing GBT11B-010-03	5:00 Dana Balse: Solis		5:00 Dana Balse: HTC		
4	5	6	7	8	9	10
11:30 Observing GBT11B-010-03	5:00 Dana Balse: Shu		11:30 Observing GBT11B-010-03	5:00 Dana Balse: HTC		5:00 Dana Balse: eRRL (Socorro)



Fini

