



# Observing Application

Date : May, 12 2012  
Proposal ID : VLA/12A-477  
Legacy ID : AB1438  
PI : Michael Busch  
Type : Director's Discretionary  
Time - Target of  
Opportunity  
Category : Solar System, Stars,  
Planetary Systems  
Total Time : 4.5

## EVLA+VLBA Radar Speckle Tracking of Near-Earth Asteroids

### Abstract:

The Arecibo and Goldstone radars have provided unparalleled information on near-Earth asteroid shapes, sizes, and trajectories. However, they are often limited by unknown pole directions. We have applied radar speckle tracking to determine asteroid poles.

The reflections from a radar target's surface interfere with each other, producing a radar speckle pattern. As the target rotates, the speckles move in the same direction as the surface. Measuring the motion of the speckle pattern with several stations provides a measurement of the target's spin state.

For the last three years, we have used VLBA stations for speckle tracking. The most important speckle target in the next year is 4179 Toutatis in December 2012. The VLBA has allocated time for observing Toutatis, but we require EVLA antennas and the Pie-Town-and-Los-Alamos-to-EVLA baselines to measure Toutatis' full spin vector.

Observing asteroid radar echoes places unusual demands on WIDAR in both frequency and time resolution; the array must also track a moving target. In addition to six half-hour blocks for observing Toutatis, we request three blocks for earlier observations as tests.

### Authors:

Name	Institution	Email	Status
Michael Busch	University of California Los Angeles	michael.william.busch@gmail.com	
Bryan Butler	National Radio Astronomy Observatory	bbutler@nrao.edu	

Principal Investigator: Michael Busch  
Contact: Michael Busch  
Telephone: 6122699998  
Email: michael.william.busch@gmail.com

### Related proposals:

BB309

### Joint:

Not a Joint Proposal

### Observing type(s):

Solar System, Radar

## VLA Resources

Name	Conf.	Frontend & Backend	Setup
Radar Receive	Any	S Band 10 cm 2000 - 4000 MHz WIDAR RSRO	<p>Comments: Asteroid radar observations require high frequency and time resolution, near the limits of WIDAR. The array will also need to track moving sources. We will be testing these new modes, with the eventual goal of making radar observations with the EVLA routine.</p> <p>Michael Busch will be arriving in Socorro on September 1, satisfying the residency requirement.</p>

## Sources:

Name	Position		Velocity		Group
30 min block	Coordinate System	Equatorial	Convention	Radio	Toutatis
	Equinox	J2000			
	Right Ascension	00:00:00.0	Ref. Frame	LSRK	
		00:00:00.0			
	Declination	+00:00:00.0	Velocity	0.00	
	00:00:00.0				
30 min block	Coordinate System	Equatorial	Convention	Radio	New Discoveries
	Equinox	J2000			
	Right Ascension	00:00:00.0	Ref. Frame	LSRK	
		00:00:00.0			
	Declination	+00:00:00.0	Velocity	0.00	
	00:00:00.0				

## Sessions:

Name	Session Time (hours)	Repeat	Separation	LST minimum	LST maximum	Elevation Minimum
Toutatis	0.50	6	0 day	00:00:00	00:00:00	0
New Discoveries	0.50	3	0 day	00:00:00	00:00:00	0

## Session Constraints:

Name	Constraints	Comments
Toutatis	Must occur while Arecibo is transmitting. See Science Justification	
New Discoveries	Must occur while Arecibo or Goldstone is transmitting. See Science Justification	

## Session Source/Resource Pairs:

Session Name	Source	Resource	Time	Figure of Merit	Subarray
Toutatis	30 min block	Radar Receive	0.5 hour	1 mJy/bm	
New Discoveries	30 min block	Radar Receive	0.5 hour	1 mJy/bm	

Present for observation: yes

Staff support: None

Plan of Dissertation: no