



11234 - A Brief Revisit of the Crab

Cycle: 16, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
02	(1) CRAB-POSITION1	WFPC2	1	18-Jan-2008 04:52:59.0	yes
01	(2) CRAB-POSITION2	WFPC2	1	18-Jan-2008 04:53:03.0	yes

2 Total Orbits Used

ABSTRACT

We propose using WFPC2 to obtain continuum-dominated images of the Crab pulsar and environs closely duplicating archival exposures from 1994 and 1995. By matching the archival data we can realize ~ 3 mas precision astrometry with a minimum of systematic effects over a maximum (~ 13.5 y) baseline. This determines the Crab proper motion to better than 0.3 mas/yr (3 km/s) accuracy and measures its position angle to better than 1.5 degrees, i.e. reducing the errors of the best present (HST archive) measurement by a factor of three. Most importantly, this provide a nearly systematic-free result. This proper motion measurement would match the precision of the CXO-measured angular momentum vector. Comparison of these vectors is the foundation of an effort to understand the physical origin of the large momentum kick at pulsar birth.

OBSERVING DESCRIPTION

Although careful PSF fitting and distortion mapping make enormous improvements, WFPC2 astrometry is still limited by systematics for moderately bright stars. We can however, make proper motion measurements largely free of these systematics by accurately reproducing the position and orientation of archival exposures, achieving ~ 3 mas differential astrometry. We seek here to take advantage of the stable WFPC2 platform, duplicating Crab pulsar/nebula observations of 1995 and 1995. These observations are somewhat challenging to schedule, but offer a unique opportunity to make a measurement that is a fundamental constraint on models for the 'kicks' that give pulsars their high speeds. The observations must be made during cycle 16, before SM4.

Visit 1 is a duplication of WFPC2/F547M images taken on 1995-08-14 with the pulsar on the PC chip. Here we can achieve an exact match to the original roll angle for a wide range of dates -- we request dates from a 1 month window around the day-of-year of the original exposure to minimize any parallactic shift of foreground comparison stars. After duplicating the 2000s CR-split 7e-gain exposure of the original pointing, we use the remaining visibility to obtain an unsaturated 120s image of the pulsar, which allows improved PSF centroiding.

Visit 2 matches the earliest available image, 1994-03-09 with the pulsar on the WF2 chip. Here the target is only available for a limited period near the required roll angle, and with low (18min) orbit visibility. This observation is, however, very valuable as the larger WF image provides more reference stars on the single chip containing the pulsar (which gives the most stable astrometry). Although the PSF is more poorly sampled, the larger number of stars compensates and we can get an accurate astrometric frame-tie even with shorter exposures. We have requested a 260s/160s exposure pair at 15e-gain, where the second exposure avoids saturation for the pulsar. The combined exposure suffices to reach systematics-dominated astrometry for all but our faintest reference stars. Since this is a single orbit visit, the low visibility is not a serious efficiency hit, as HST is free to move after occultation.

The science goals can be partly achieved with visit 1 alone. However, a key aspect is to demonstrate the lack of systematics in the measured proper motion vector; comparison between the visit 1 and visit 2 observations is an important addition, showing independence of chip, orient and season. The program produces a small data set, but very careful analysis will be needed to exploit the full astrometric potential of these frames.

Visit	Proposal 11234, Visit 02, implementation Diagnostic Status: Warning Scientific Instruments: WFPC2 Special Requirements: ORIENT 104.0D TO 108.0 D; ON HOLD <i>On Hold Comments: checking gain</i>																				
Diagnostics	(Visit 02) Warning (OP): EXPOSURE TIME DECREASED FOR WFPC (Visit 02) Warning (OP): EXPOSURE TIME DECREASED FOR WFPC																				
Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>CRAB-POSITION1</td> <td>RA: 05 34 30.3400 (83.6264167d) Dec: +22 00 47.21 (22.01311d) Equinox: J2000</td> <td></td> <td>V=16.6+/-0.2</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	CRAB-POSITION1	RA: 05 34 30.3400 (83.6264167d) Dec: +22 00 47.21 (22.01311d) Equinox: J2000		V=16.6+/-0.2	Reference Frame: ICRS								
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Orbit Structure	<div style="display: flex; justify-content: space-between;"> <div> <p>Orbit 1</p> </div> <div> <p>Server Version: 20071214</p> </div> </div>																				

Proposal 11234 - Visit 01 - A Brief Revisit of the Crab

Fri Jan 18 09:53:06 GMT 2008

Visit		Proposal 11234, Visit 01, implementation								
		Diagnostic Status: No Diagnostics								
		Scientific Instruments: WFPC2								
		Special Requirements: ORIENT 266.0D TO 267.0 D; BETWEEN 01-AUG-2007:00:00:00 AND 28-AUG-2007:00:00:00								
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	CRAB-POSITION2	RA: 05 34 31.9500 (83.6331250d) Dec: +22 00 55.60 (22.01544d) Equinox: J2000		V=16.6+/-0.2	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(2) CRAB-POSITIO N2	WFPC2, IMAGE, PC1-FIX	F547M	ATD-GAIN=7			2000.0 Secs	
									[==>1000.0 Secs (Split 1)]	[1]
									[==>1000.0 Secs (Split 2)]	
	2		(2) CRAB-POSITIO N2	WFPC2, IMAGE, PC1-FIX	F547M	ATD-GAIN=7			120.0 Secs	
									[==>160.0 Secs]	[1]
Orbit Structure	<p>Orbit 1 Server Version: 20071214</p> <p>The diagram illustrates the timing of observations during Orbit 1. A horizontal axis represents time in seconds, ranging from 0 to 5500. A blue hatched bar indicates the period of visibility, starting at approximately 400 seconds and ending at approximately 3100 seconds. Key events are marked with arrows and labels: 'GS Acq' at 0s, 'Exp. 1, split 1' at ~400s, 'Exp. 1, split 2' at ~1600s, 'Exp. 2' at ~2800s, and 'Occultation' at ~3100s. Vertical lines labeled 'Overhead' indicate the time between exposures. A note specifies 'Unused Visibility = 32' seconds.</p>									