



2301 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

Cycle: 1, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
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Dr. Jon A. Holtzman (CoI)	New Mexico State University

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	2	NIRCam-PreImaging B RIGHT2, both modules	NIRCam Imaging	(200) PREIMAGING+BRICK13
	4	Plan_04	NIRSpec MultiObject Spectroscopy	(203) REVISED-CATALOG-11NOV2022
	6	bNatafSchiavonSelection_V5b	NIRSpec MultiObject Spectroscopy	(205) input_catalogue_v4B

ABSTRACT

Galaxy evolution models are strongly underpinned by anchoring constraints made locally in the Milky Way. In this proposal, we aim to perform a pilot study toward providing a secondary local anchor in the form of a detailed mapping in element abundances of the stellar populations of the Andromeda galaxy, M31. Primarily, we will use NIRSpec spectroscopy of giant stars to study element abundances in the old disk of M31, establishing whether it plays host to a dichotomy in the ratio of its alpha-element abundances relative to Iron. Such a feature is readily observed in the Milky Way, and thought to be indicative of an early and rapid assembly of its mass. These pilot observations towards larger spectroscopic surveys of

the M31 disk will allow us to discriminate between the myriad models which are now proposed for the origin of this feature in the Milky Way. This will place the first stake of true galactic archaeology in Andromeda, opening the door to more detailed future studies which will attempt to reconstruct the star formation history and more fully constrain the history of mass assembly in our nearest giant disk.

OBSERVING DESCRIPTION

This proposal will observe 229 red giants in the disk of M31, selected using HST WFC-3 photometry from the PHAT survey. We will use NIRSpec in multi-object spectroscopy mode to obtain medium resolution NIR spectra using the G140M/F100LP and G235M/F170LP grating/filter combinations. Targets are selected between F160W of 19.5 and 19.0 (Vega), which will allow us to obtain SNR of upward of 30-50 in the relevant regions of the spectra, where we intend to use molecular features to measure Carbon, Nitrogen and Oxygen abundances, as well as Metallicity.

Three target configurations will be observed adopting a 2 shutter slitlet nod pattern and 80 shutter dither in the dispersion direction, for a total of four exposures per grating/filter for each configuration. Each exposure will consist of one integration with 60 groups in NRSIRS2RAPID readout mode, for a total of 889s per exposure - totalling a roughly 1 hour integration per target.

Proposal 2301 - Targets - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PHAT-BRICK13	RA: 00 44 57.3890 (11.2391208d) Dec: +41 46 11.37 (41.76982d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				
(200)	PREIMAGING+BRICK13	RA: 00 44 59.6381 (11.2484921d) Dec: +41 45 46.22 (41.76284d) Equinox: J2000		
<i>Comments:</i> <i>Category=Star</i> <i>Description=[Population I stars, Population II stars, Population III stars, Red giants]</i>				
(203)	REVISED-CATALOG-11NOV2022	RA: 00 44 58.0089 (11.2417037d) Dec: +41 46 11.81 (41.76995d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				
(204)	input_catalogue_v3	RA: 00 44 58.4438 (11.2435158d) Dec: +41 45 49.59 (41.76378d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				
(205)	input_catalogue_v4B	RA: 00 44 58.7405 (11.2447521d) Dec: +41 45 46.02 (41.76278d) Equinox: J2000		
<i>Comments:</i> <i>Description=[]</i>				

Fixed Targets

Proposal 2301 - Observation 2 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

Wed Jul 19 19:05:36 GMT 2023

Observation	<p>Proposal 2301, Observation 2: NIRCam-PreImaging BRIGHT2, both modules</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	<p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Visit 2:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>									
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections			Miscellaneous		
	(200)	PREIMAGING+BRICK13	RA: 00 44 59.6381 (11.2484921d) Dec: +41 45 46.22 (41.76284d) Equinox: J2000							
	<p><i>Comments:</i> <i>Category=Star</i> <i>Description=[Population I stars, Population II stars, Population III stars, Red giants]</i></p>									
Template	Module		Subarray			Target Placement				
	ALL		FULL			Module Gap				
Dithers	#	Primary Dither Type		Primary Dithers	Subpixel Dither Type		Dither Size	Subpixel Positions		
	1	FULLBOX		8NIRSPEC	STANDARD			1		
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F115W	F250M	BRIGHT2	3	2	16	8	1116.624	
Special Requirements	<p>Group Visits within 53.0 Days Aperture PA Range 208 to 248 Degrees (V3 208.0713531 to 248.0713531) Visits Same PA</p>									

Proposal 2301 - Observation 4 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

Wed Jul 19 19:05:37 GMT 2023

Observation	<p>Proposal 2301, Observation 4: Plan_04</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec MultiObject Spectroscopy</p>																																
	Diagnostics	<p>(Plan_04 (Obs 4)) Warning (Form): Config c1 (#1) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c1 (#1) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c1 (#1) has 1 primary slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c1 (#2) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c1 (#2) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c1 (#2) has 1 primary slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c2 (#3) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c2 (#3) has 1 primary slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c2 (#4) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c2 (#4) has 1 primary slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c3 (#5) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c3 (#6) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c4 (#7) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c4 (#8) has 1 primary slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c5 (#10) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c5 (#10) has 1 primary slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c5 (#9) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c5 (#9) has 1 primary slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c6 (#11) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c6 (#12) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c7 (#13) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c7 (#13) has 1 filler slits affected by failed closed shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c7 (#14) has 1 filler slit traces affected by failed open shutters.</p> <p>(Plan_04 (Obs 4)) Warning (Form): Config c7 (#14) has 1 filler slits affected by failed closed shutters.</p> <p>(Visit 4:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
Fixed Targets		<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(203)</td> <td>REVISED-CATALOG-11NOV2022</td> <td>RA: 00 44 58.0089 (11.2417037d) Dec: +41 46 11.81 (41.76995d) Equinox: J2000</td> <td></td> <td></td> </tr> </tbody> </table> <p>Comments: Description=[]</p>											#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous	(203)	REVISED-CATALOG-11NOV2022	RA: 00 44 58.0089 (11.2417037d) Dec: +41 46 11.81 (41.76995d) Equinox: J2000													
	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous																												
(203)	REVISED-CATALOG-11NOV2022	RA: 00 44 58.0089 (11.2417037d) Dec: +41 46 11.81 (41.76995d) Equinox: J2000																															
Acquisition	<table border="1"> <thead> <tr> <th>#</th> <th>Reference Star Bin</th> <th>Target</th> <th>Filter</th> <th>MSA Configuration</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Filter: F110W; Readout: NRSRAPIDD6; 8 sources in 3 quads; [Reduced Accuracy]</td> <td>SAME</td> <td>F110W</td> <td>Auto Acq MSA Config</td> <td>NRSRAPIDD6</td> <td>3</td> <td>1</td> <td>4</td> <td>687.153</td> <td></td> </tr> </tbody> </table>											#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	1	Filter: F110W; Readout: NRSRAPIDD6; 8 sources in 3 quads; [Reduced Accuracy]	SAME	F110W	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	
	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID																						
1	Filter: F110W; Readout: NRSRAPIDD6; 8 sources in 3 quads; [Reduced Accuracy]	SAME	F110W	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153																								

Proposal 2301 - Observation 4 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

Template	TA Method	Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List	Spectral Overlap Map	Spectral Overlap Threshold
	MSATA	No	MSA Center	Primary (3222 sources)	Filler (6349 sources)	jwst-nirspec-mr	1.5

Reference Stars	Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
	1	40331	11.247356	41.790026	21.559727	1	85749	11.231915	41.756622	21.360931
	1	77035	11.205633	41.777289	21.38799	1	94035	11.210777	41.759678	21.612255
	1	83876	11.217611	41.765406	21.581434	1	100780	11.226839	41.745897	21.616976
	1	85285	11.240056	41.753066	21.36656	1	109315	11.222959	41.740425	21.607407

Proposal 2301 - Observation 4 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

#	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
1	1 (G140M/F100LP)	c1	3 Shutter Slitlet	11.239659458333 332 Degrees 41.767508611111 11 Degrees	228.36119291091 782			3	3	1181.7
2	2 (G235M/F170LP)	c1	3 Shutter Slitlet	11.239659458333 332 Degrees 41.767508611111 11 Degrees	228.36119291091 782			3	3	1356.767
3	1 (G140M/F100LP)	c2	3 Shutter Slitlet	11.244955583333 333 Degrees 41.763066666666 67 Degrees	228.36473013354 842			3	3	1181.7
4	2 (G235M/F170LP)	c2	3 Shutter Slitlet	11.244955583333 333 Degrees 41.763066666666 67 Degrees	228.36473013354 842			3	3	1356.767
5	1 (G140M/F100LP)	c3	3 Shutter Slitlet	11.237943083333 333 Degrees 41.765813055555 554 Degrees	228.36005307401 71			3	3	1181.7
6	2 (G235M/F170LP)	c3	3 Shutter Slitlet	11.237943083333 333 Degrees 41.765813055555 554 Degrees	228.36005307401 71			3	3	1356.767
7	1 (G140M/F100LP)	c4	3 Shutter Slitlet	11.243239166666 665 Degrees 41.761371388888 89 Degrees	228.36359026766 624			3	3	1181.7
8	2 (G235M/F170LP)	c4	3 Shutter Slitlet	11.243239166666 665 Degrees 41.761371388888 89 Degrees	228.36359026766 624			3	3	1356.767
9	1 (G140M/F100LP)	c5	3 Shutter Slitlet	11.2397525 Degrees 41.763667777777 776 Degrees	228.36126286645 936			3	3	1181.7
10	2 (G235M/F170LP)	c5	3 Shutter Slitlet	11.2397525 Degrees 41.763667777777 776 Degrees	228.36126286645 936			3	3	1356.767
11	1 (G140M/F100LP)	c6	3 Shutter Slitlet	11.245048291666 667 Degrees 41.759225833333 33 Degrees	228.36479986597 61			3	3	1181.7
12	2 (G235M/F170LP)	c6	3 Shutter Slitlet	11.245048291666 667 Degrees 41.759225833333 33 Degrees	228.36479986597 61			3	3	1356.767
13	1 (G140M/F100LP)	c7	3 Shutter Slitlet	11.243927583333 333 Degrees 41.766436111111 11 Degrees	228.36403833726 658			3	3	1181.7
14	2 (G235M/F170LP)	c7	3 Shutter Slitlet	11.243927583333 333 Degrees 41.766436111111 11 Degrees	228.36403833726 658			3	3	1356.767

Proposal 2301 - Observation 4 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

#	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
15	1 (G140M/F100LP)	c8	3 Shutter Slitlet	11.249223333333 331 Degrees 41.761994166666 67 Degrees	228.36757531020 9			3	3	1181.7
16	2 (G235M/F170LP)	c8	3 Shutter Slitlet	11.249223333333 331 Degrees 41.761994166666 67 Degrees	228.36757531020 9			3	3	1356.767
Special Requirements	MSA Scheduled Aperture PA 228.3625 to 228.3625 Degrees (V3 89.78798 to 89.78798)									

Proposal 2301 - Observation 6 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

Wed Jul 19 19:05:37 GMT 2023

Observation	Proposal 2301, Observation 6: bNatafSchiavonSelection_V5b Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy										
	(Visit 6:1) Warning (Form): Data Excess over lower threshold (Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(205)	input_catalogue_v4B	RA: 00 44 58.7405 (11.2447521d) Dec: +41 45 46.02 (41.76278d) Equinox: J2000								
<i>Comments:</i> Description=[]											
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	Filter: F110W; Readout: NRSRAPID; 8 sources in 3 quads; [Reduced Accuracy]	SAME	F110W	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	
Template	TA Method	Obtain Confirmation Images		Science Aperture	Primary Candidate List	Filler Candidate List	Spectral Overlap Map	Spectral Overlap Threshold			
	MSATA	No		MSA Center	Primary5 (3762 sources)	Filler5 (11959 sources)	jwst-nirspec-mr	1.5			
Reference Stars	Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude	
	1	358887	11.249850	41.753115	20.42599868774414	1	668833	11.213871	41.745950	20.416000366210938	
	1	358948	11.230910	41.777368	20.44099998474121	1	668856	11.247697	41.737914	20.43400001525879	
	1	415937	11.209413	41.780903	20.44199943542480	1	668857	11.251913	41.748323	20.444000244140625	
	1	668656	11.213658	41.743441	20.42899894714355	1	669014	11.244010	41.736343	20.447000503540045	

Proposal 2301 - Observation 6 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

#	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
1	1 (G140M/F100LP)	c1	2 Shutter Slitlet	11.234974708333 333 Degrees 41.760466944444 445 Degrees	9.5985857606203 86	0.125		2	2	875.333
2	1 (G140M/F100LP)	c1	2 Shutter Slitlet	11.234974708333 333 Degrees 41.760466944444 445 Degrees	9.5986020827132 03	-0.125		2	2	875.333
3	2 (G235M/F170LP)	c1	2 Shutter Slitlet	11.234974708333 333 Degrees 41.760466944444 445 Degrees	9.5986020827132 03	-0.125		2	2	875.333
4	2 (G235M/F170LP)	c1	2 Shutter Slitlet	11.234974708333 333 Degrees 41.760466944444 445 Degrees	9.5985857606203 86	0.125		2	2	875.333
5	1 (G140M/F100LP)	c2	2 Shutter Slitlet	11.227117583333 332 Degrees 41.761458055555 56 Degrees	9.5933623247891 56	0.125		2	2	875.333
6	1 (G140M/F100LP)	c2	2 Shutter Slitlet	11.227117583333 332 Degrees 41.761458055555 56 Degrees	9.5933786477041 17	-0.125		2	2	875.333
7	2 (G235M/F170LP)	c2	2 Shutter Slitlet	11.227117583333 332 Degrees 41.761458055555 56 Degrees	9.5933786477041 17	-0.125		2	2	875.333
8	2 (G235M/F170LP)	c2	2 Shutter Slitlet	11.227117583333 332 Degrees 41.761458055555 56 Degrees	9.5933623247891 56	0.125		2	2	875.333
9	1 (G140M/F100LP)	c3	2 Shutter Slitlet	11.235957625 Degrees 41.761469722222 22 Degrees	9.5992410064773 44	0.125		2	2	875.333
10	1 (G140M/F100LP)	c3	2 Shutter Slitlet	11.235957625 Degrees 41.761469722222 22 Degrees	9.5992573291145 02	-0.125		2	2	875.333
11	2 (G235M/F170LP)	c3	2 Shutter Slitlet	11.235957625 Degrees 41.761469722222 22 Degrees	9.5992573291145 02	-0.125		2	2	875.333
12	2 (G235M/F170LP)	c3	2 Shutter Slitlet	11.235957625 Degrees 41.761469722222 22 Degrees	9.5992410064773 44	0.125		2	2	875.333
13	1 (G140M/F100LP)	c4	2 Shutter Slitlet	11.228100374999 999 Degrees 41.762460833333 336 Degrees	9.5940174065836 96	0.125		2	2	875.333
14	2 (G235M/F170LP)	c4	2 Shutter Slitlet	11.228100374999 999 Degrees 41.762460833333 336 Degrees	9.5940337300430 25	-0.125		2	2	875.333

Proposal 2301 - Observation 6 - Unearthing the fossilized Andromeda galaxy: a spectroscopic pilot survey of M31 giants

#	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
15	2 (G235M/F170LP)	c4	2 Shutter Slitlet	11.228100374999 999 Degrees 41.762460833333 336 Degrees	9.5940337300430 25	-0.125		2	2	875.333
16	2 (G235M/F170LP)	c4	2 Shutter Slitlet	11.228100374999 999 Degrees 41.762460833333 336 Degrees	9.5940174065836 96	0.125		2	2	875.333
17	1 (G140M/F100LP)	c5	2 Shutter Slitlet	11.234825041666 666 Degrees 41.761471944444 445 Degrees	9.5984878166520 44	0.125		2	2	875.333
18	1 (G140M/F100LP)	c5	2 Shutter Slitlet	11.234825041666 666 Degrees 41.761471944444 445 Degrees	9.5985041393269 15	-0.125		2	2	875.333
19	2 (G235M/F170LP)	c5	2 Shutter Slitlet	11.234825041666 666 Degrees 41.761471944444 445 Degrees	9.5985041393269 15	-0.125		2	2	875.333
20	2 (G235M/F170LP)	c5	2 Shutter Slitlet	11.234825041666 666 Degrees 41.761471944444 445 Degrees	9.5984878166520 44	0.125		2	2	875.333
21	1 (G140M/F100LP)	c6	2 Shutter Slitlet	11.226967749999 998 Degrees 41.762462777777 78 Degrees	9.5932642250950 18	0.125		2	2	875.333
22	1 (G140M/F100LP)	c6	2 Shutter Slitlet	11.226967749999 998 Degrees 41.762462777777 78 Degrees	9.5932805485919 27	-0.125		2	2	875.333
23	2 (G235M/F170LP)	c6	2 Shutter Slitlet	11.226967749999 998 Degrees 41.762462777777 78 Degrees	9.5932805485919 27	-0.125		2	2	875.333
24	2 (G235M/F170LP)	c6	2 Shutter Slitlet	11.226967749999 998 Degrees 41.762462777777 78 Degrees	9.5932642250950 18	0.125		2	2	875.333
Special Requirements	MSA Scheduled Aperture PA 9.6051 to 9.6051 Degrees (V3 231.03055 to 231.03055)									