



SUMMARY OF DESIRED LUVOIR OBSERVATION CAPABILITIES

Aki Roberge (NASA GSFC)

LUVOIR STDT Meeting 2

Greenbelt, MD

Aug 18, 2016

The science matrix – drawn from science docs

Science Matrix_v5.xlsx

Search in Sheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
High-Level Topic	Investigation	UV imaging	Far-far UV spec (912 A - 1150 A)	UV spec, low R ($R \sim 10^{1-2}$)	UV spec, medium R ($R \sim 10^{3-4}$)	UV spec, high R ($R \sim 10^{5-6}$)	UV spec, spatially resolved	UV spec, multiplex	Optical imaging, wide-field	Optical spec, low R	Optical spec, medium R	Optical spec, high R	Optical spec, multiplex	NIR imaging	NIR spec, low R	NIR spec, medium R	NIR spec, high R	NIR spec, multispec	High-contrast UV spec, low R, spatially resolved	High-contrast O/IR imaging	High-contrast O/IR imaging, w/ polarization	High-contrast optical spec, low R, spatially resolved	High-contrast NIR spec, low R, spatially resolved	Time-resolved obs		
1																										
2	Basic Exoplanet Parameters	Planet colors for confusion discrimination & Initial characterization																			X	X?				
3		Orbits																			X					
4		Planet masses via RV											X													X
5		Planet masses via astrometry								X																
6																										
7																										
8	Biosignatures	Detect H ₂ O via direct spectroscopy																								
9		Detect O ₂ , O ₃ , O ₄ via direct spectroscopy																		X				X	X	
10		Detect CO, CO ₂ via direct spectroscopy																						X	X	
11		Detect CH ₄ via direct spectroscopy																						X	X	
12		Detect CH ₄ via template matching																						X	X	
13		Ocean glint											X									X	X?			
14		Surface reflectivity biosignatures																				X	X?			
15	Seasonal variability																				X	X			X	
16																										
17																										
18	General Exoplanet Characterization	Measure system inclinations for known RV planets																			X			X		
19		Detect molecular and atomic atmospheric gases in directly imaged planets																			X		X	X		
20		Measure atmospheric column mass																			X?	X?				
21		Measure cloud and haze properties in directly imaged planets																			X	X	X?	X	X	X
22		Detect molecular and atomic atmospheric gases in known transiting planets					X						X					X								
23		Detect evaporating gas via transit spectroscopy					X																			
24		Phase curves																				X				X
25		Diurnal variations and surface albedo maps																				X	X?			X
26		Detect presence of large exomoons																				X?		X	X	X
27																										
28																										
29																										
30	Host Star Characterization	Input spectra for photochemical modeling				X							X													
31		Determine stellar flaring rate				X																			X	
32																										
33																										
34																										
35																										
36	Terrestrial Planet Formation	Measure bulk composition of planetary building blocks via resonantly scattered gas emission						X															X			
37		Measure bulk composition of planetary building blocks via absorption spectroscopy of edge-on disks					X							X												
38		Measure bulk composition of planetary building blocks via spectroscopy of transiting comets					X							X												
39		Measure bulk composition of planetary building blocks via spectroscopy of polluted white dwarfs					X							X												
40		Image dust structures in debris disks																								
41		Detect moon-forming impacts																				X?	X	X		
42																										

Exoplanets Cosmic Origins Solar System Stats

23 observation categories (so far)

UV imaging

Far-far UV spectroscopy (912 – 1150 Å)

UV spectroscopy, low R ($R \sim 10^{1-2}$)

UV spectroscopy, medium R ($R \sim 10^{3-4}$)

UV spectroscopy, high R ($R \sim 10^{5-6}$)

UV spectroscopy, spatially resolved

UV spectroscopy, multi-object

Optical imaging, wide field

Optical spectroscopy, low R

Optical spectroscopy, medium R

Optical spectroscopy, high R

Optical spectroscopy, multi-object

NIR imaging

NIR spectroscopy, low R

NIR spectroscopy, medium R

NIR spectroscopy, high R

NIR spectroscopy, multi-object

High-contrast UV spectroscopy, low R, spatially resolved

High-contrast optical / NIR imaging

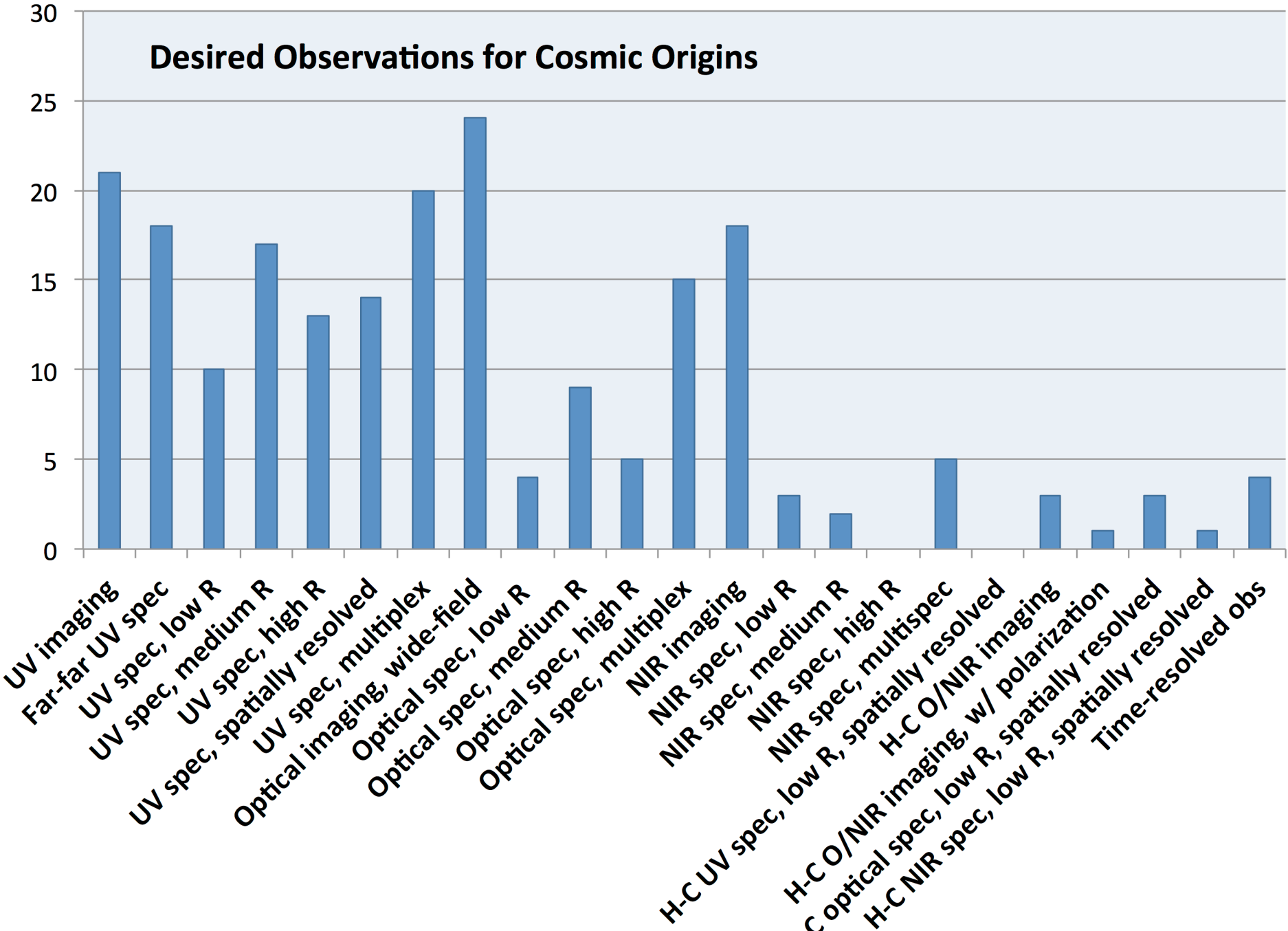
High-contrast optical / NIR imaging, w/ polarization

High-contrast optical spectroscopy, low R, spatially resolved

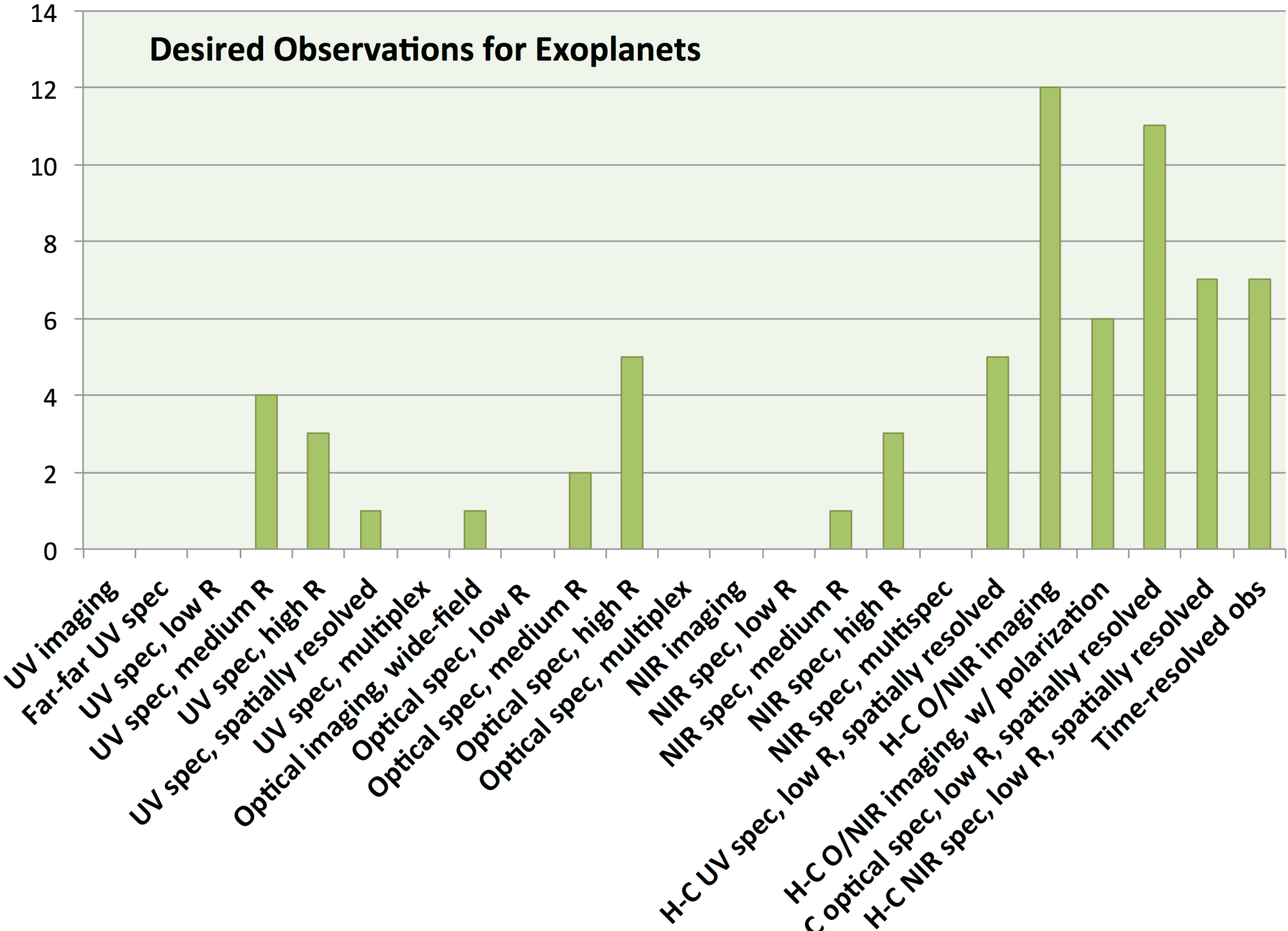
High-contrast NIR spectroscopy, low R, spatially resolved

Time-resolved observations

Desired Observations for Cosmic Origins

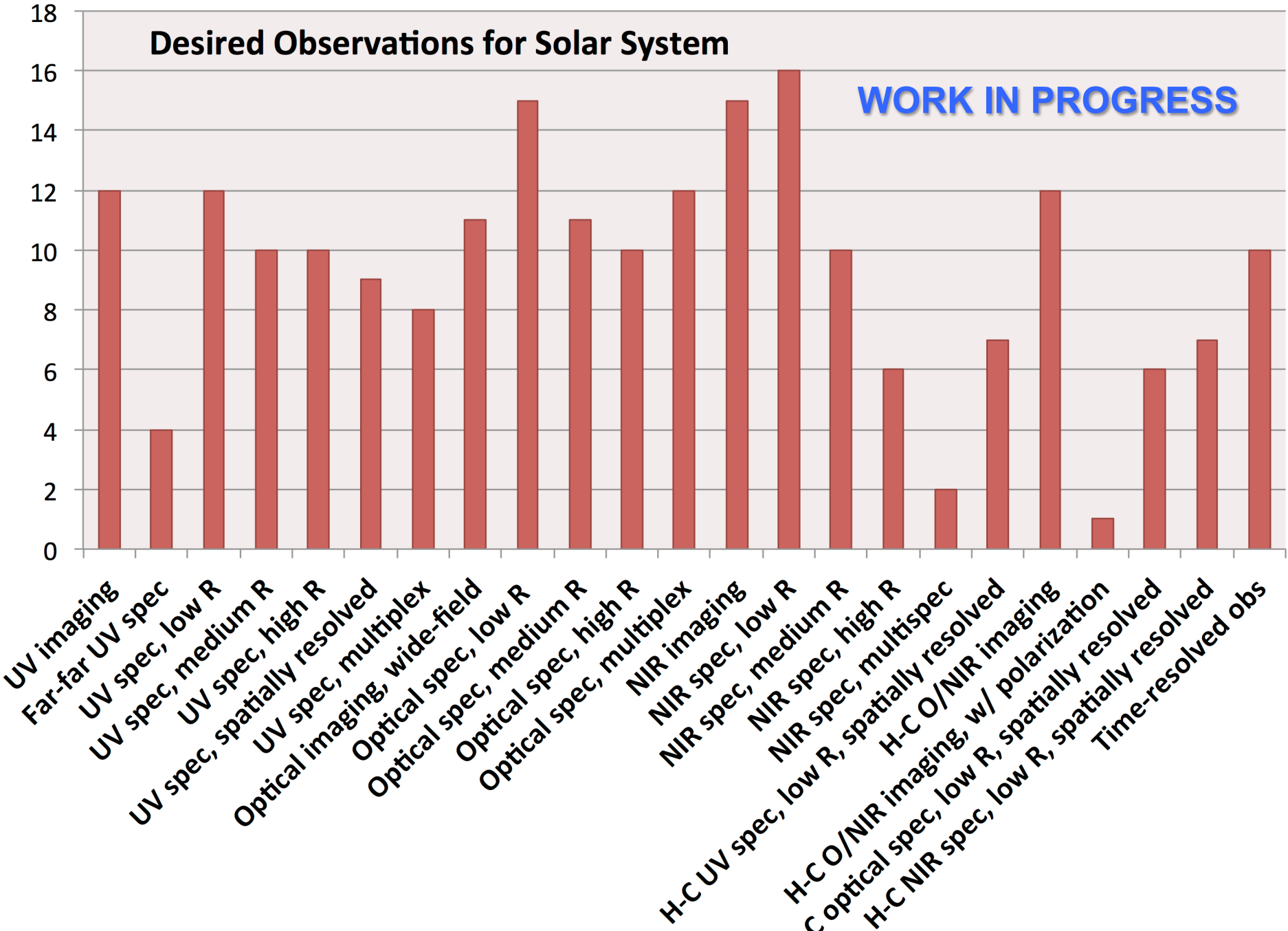


Desired Observations for Exoplanets



Desired Observations for Solar System

WORK IN PROGRESS



Additional considerations for Solar System

- ⦿ Solar exclusion angle < 48 degrees
- ⦿ UV-O spectro-polarimetry
- ⦿ UV-O imaging-polarimetry
- ⦿ Occulting disk
- ⦿ Ultra-wide FOV
- ⦿ Bright object capability (ND Filter)
- ⦿ Moving object tracking

Comments

- ⦿ All science themes span whole wavelength range
- ⦿ COR science weighted toward UV
- ⦿ EXO science weighted toward high-contrast optical / NIR
- ⦿ Solar System science spans whole range more evenly
 - But has special requirements, partly captured

Possible candidate instruments to start from

- ◎ UV imager & spectrograph
 - High resolution spectroscopy
 - Multi-object spectroscopy
- ◎ Optical / NIR high-contrast instrument
 - Imaging
 - Low resolution, spatially resolved spectroscopy
- ◎ Wide-field optical / NIR imager
- ◎ Multi-resolution optical / NIR spectrograph
 - High R for RV / template matching
 - Med R for transit spectroscopy, solar system

Some questions to consider in breakouts

- ⦿ Any instruments wrong or missing?
- ⦿ Any capabilities wrong or missing?
 - UV polarization capability?
 - For COR, multi-object or spatially resolved?
- ⦿ Are any of these capabilities covered by ground-based ELTs or other upcoming space mission?