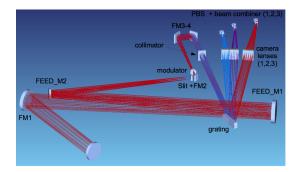
## Visible Spectro-Polarimeter (ViSP):

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The ViSP is a slit spectrograph that will provide precision measurements of the full state of polarization (intensity plus a full description of the linear and circular polarization states) simultaneously at diverse wavelengths in the visible spectrum. It stresses spectral flexibility, has multiline capability, and will fully resolve the profiles of lines over a wide range of wavelengths.

## Spatial Field of View and Resolution:

Optical:	$2 \times 2$ arcmin <sup>2</sup> (of the full 2.8 arcmin diameter round post-AO DKIST field of view)
Along slit:	0.0295/0.0236/0.0195 arcsec sampling for arm 1, 2, and 3, respectively (@ 617.3 nm)
Slit widths:	0.028 (diffraction limited at 900 nm), 0.041, 0.054, 0.107, 0.214 arcsec.
FOV height:	Camera arm 1: 75 arcsec, Camera arm 2: 60 arcsec, Camera arm 3: 50 arcsec (@ 617.3 nm)

Sampling along slit is critical at about 920 nm, 745 nm, and 620 nm, for arm 1, 2, and 3, respectively (e.g. 1.22 lambda / D = 1.22\*620e-9/4\*206264.81 / 2 = 0.0195")

The ViSP uses co-aligned images from VBI Blue for context

## Spectral Range and Resolution:

Range: 380 - 900 nm

with continuous spectral coverage over this range. Up to three spectral bands (about 1nm wide at 630 nm) can be observed simultaneously; any portion of the spectrum can be imaged individually on any of the 3 spectral arms.

Resolution: better than 3.5 pm (1.75 pm sampling) at 630 nm (R > 180000)

Example photospheric and chromospheric lines accessible:

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	Ca II K Ca II H Fe I H δ Ca I H γ Ti I Ba II Sr I H β Mg I b1 Mg I b2 Ea I	393.37 nm 396.85 nm 404.58 nm 410.17 nm 422.67 nm 434.05 nm 453.60 nm 455.40 nm 460.73 nm 486.13 nm 517.27 nm 518.36 nm	<pre>(photo/chromosphere) (photo/chromosphere) (photosphere) (E-field diagnostics) (PRD) (E-field diagnostics) (second solar spectrum) (second solar spectrum) (Hanle effect) (chromosphere) (photo/chromosphere) (photo/chromosphere)</pre>	<ol> <li>16.</li> <li>17.</li> <li>18.</li> <li>19.</li> <li>20.</li> <li>21.</li> <li>22.</li> <li>23.</li> <li>24.</li> <li>25.</li> <li>26.</li> <li>27.</li> <li>28.</li> </ol>	Na I D2 Na I D1 Fe I H α Ni I Ca I Fe I K I Na I Na I Ca II Ca II Ca II	589.00 nm 589.59 nm 617.33 nm 630.20 nm 656.28 nm 676.78 nm 714.82 nm 751.15 nm 769.90 nm 818.33 nm 819.48 nm 849.81 nm 854.21 nm	(photo/chromosphere; PRD) (photo/chromosphere; PRD) (HMI) (Hinode/SP) (chromosphere) (photosphere) (photosphere) (photosphere) (photo/chromosphere) (photo/chromosphere) (photo/chromosphere) (photo/chromosphere) (photo/chromosphere)
12.	Mg I b2	518.36 nm					
13.	Fe I	525.04 nm	(photosphere)	20.	Call	866.22 nm	(photo/chromosphere)
14.	Mn I	553.78 nm	(HFS)	100			
15.	He I	587.59 nm	(prominences; spicules)	30.	Mn I	874.10 nm	(HFS)

## **Temporal Cadence:**

10 sec per slit position (10 sec or shorter integration to reach  $10^{-3} I_{cont}$  polarimetric signal from 450 nm longward,  $2 \times 10^3 I_{cont}$  at 380 in 10 sec). The slit can be stepped between two adjacent positions in less than 200 ms.

10 minute reconfiguration for each spectral channel

# Polarimetric Capabilities and Accuracy:

Full Stokes vector polarimetry.

ViSP is a dual-beam polarimeter; the simultaneous, orthogonal states of polarization (I + U, Q, V, after polarization modulation) are imaged on the same camera, thus limiting the spectral coverage available in a single exposure.

## Photometric Capabilities (Precision):

Flat fields repeatable to the 2% level.

#### Instrument Modes Available:

Polarimetric mode: full Stokes; slit steps from one position to the next after integration

Intensity-only mode: *I* only; slit moves continuously during exposure. Some blurring of the image but substantially faster. Read-out rate of camera can be selected.

#### Example Modes of Operation:

It is important to note that the ViSP instrument is designed for operational flexibility to meet a range of research needs, both those currently known and well understood and many unknown or only poorly understood. The instrument thus aims to serve a wide range of exploratory science, and the use cases below are only examples.

Use Cases:

1. Common use profile example - study of prominences

Example #1:	Prominences			
SPATIAL COVERAGE A	AND RESOLUTION			
Slit Width		0.0406" (matched to 650 nm)		
Spatial Sampling		0.0406" slit step size		
Steps		500		
Total Field of View	20.3" x 77.8"	20.3" x 61.0"	20.3" x 49.4"	
X Spatial Resolution	0.082"	0.082"	0.083"	
SPECTRAL INFO:	Band #1	Band #2	Band #3	
Wavelength:	Ca II 396.85 nm	He I 587.59 nm	Ca II 854.21 nm	
Y Spatial Binning	1	1	2	
Y Spatial Resolution	0.061″	0.048''	0.077″	
Bandwidth:	0.807 nm	1.224 nm	1.629 nm	
Spectral Sampling	0.907 pm/pixel	1.375 pm/pixel	1.830 pm/pixel	
Spectral Binning	1	1	1	
Spectral Resolution	218000	213000	234000	
TIMING SUMMARY			•	
Integration Time		10 s		
Map Duration	1:25:00			
Repeats	1			
Total Duration	1:25:00			
DATA RATES				
Data Rate	22.8 MB/s			
Data Volume	114 GB (does not include calibration data)			

2. Chromospheric studies. Shown are two wavelength configurations for a large map (example 2) and n	epeated
small high cadence maps (example 3)	

Example #2:	Chromosphere, Large Map				
SPATIAL COVERAGE AND RESOLUTION					
Slit Width		0.0406" (matched to 650 nm)			
Spatial Sampling		0.0406" slit step size			
Steps		1000			
Total Field of View	40.6" x 75.7"	40.6" x 60.7"	40.6" x 49.4"		
X Spatial Resolution	0.082"	0.082"	0.083"		
SPECTRAL INFO:	Band #1	Band #2	Band #3		
Wavelength:	H I 656.28 nm	Fe I 630.2 nm	Ca II 854.21 nm		
Y Spatial Binning	1	1	2		
Y Spatial Resolution	0.059"	0.049"	0.077"		
Bandwidth:	0.935 nm	1.029 nm	1.750 nm		
Spectral Sampling	1.051 pm/pixel	1.157 pm/pixel	1.967 pm/pixel		
Spectral Binning	1	1	1		
Spectral Resolution	311000	271000	217000		
TIMING SUMMARY					
Integration Time		4 s			
Map Duration	1:10:00				
Repeats	1				
Total Duration	1:25:00				
DATA RATES					
Data Rate	57 MB/s				
Data Volume	228 GB (does not include calibration data)				

Example #3:	Chromosphere, Small Repeating Maps				
SPATIAL COVERAGE AND RESOLUTION					
Slit Width		0.1062" (matched to 2×850 nm	1)		
Spatial Sampling		0.1062" slit step size			
Steps		50			
Total Field of View	5.35" x 75.7"	5.35" x 62.3"	5.35" x 49.4"		
X Spatial Resolution	0.215"	0.215"	0.215"		
SPECTRAL INFO:	Band #1	Band #2	Band #3		
Wavelength:	H I 656.28 nm	Ca II 396.85 nm	Ca II 854.21 nm		
Y Spatial Binning	1	1	2		
Y Spatial Resolution	0.059"	0.049"	0.077"		
Bandwidth:	0.935 nm	0.748 nm	1.750 nm		
Spectral Sampling	1.051 pm/pixel	0.841 pm/pixel	1.967 pm/pixel		
Spectral Binning	1	1	1		
Spectral Resolution	311000	234000	217000		
TIMING SUMMARY					
Integration Time		0.5 s			
Map Duration	0:00:36				
Repeats	100				
Total Duration	1:03:00				
DATA RATES					
Data Rate	456 MB/s				
Data Volume	1139 GB (does not include calibration data)				

3.	Intensity only	experiment -	fast dynamics	of photosphere	and chromosphere
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Example #4:	Chromosphere, Intensity only					
SPATIAL COVERAGE A	ND RESOLUTION					
Slit Width		0.0406" (matched to 650 nm)				
Spatial Sampling		2.030″/s				
Map Width		120''				
Total Field of View	120" x 76.7"	120" x 61.8"	120'' x 49.4''			
X Spatial Resolution	0.082"	0.082"	0.083"			
SPECTRAL INFO:	Band #1	Band #2	Band #3			
Wavelength:	Mg I 517.27 nm	Ba II 455.40 nm	Ca II 854.21 nm			
Y Spatial Binning	1	1	1			
Y Spatial Resolution	0.060″	0.048″	0.054"			
Bandwidth:	0.931 nm	0.860 nm	1.678 nm			
Spectral Sampling	1.046 pm/pixel	0.967 pm / pixel	1.885 pm/pixel			
Spectral Binning	1	1	1			
Spectral Resolution	246000 234000		227000			
TIMING SUMMARY	TIMING SUMMARY					
Exposure Time	20 ms					
Map Duration	0:00:59					
Repeats	1					
Total Duration	0:00:59					
DATA RATES						
Data Rate	1367 MB/s					
Data Volume	80.9 GB (does not include calibration data)					

## ViSP Detectors:

The ViSP utilizes the Andor Zyla 5.5 cameras, with a detector format of 2560 (spatial)  $\times$  890 (spectral) px<sup>2</sup>, for each of the two (2) beams with orthogonal polarization states. The camera is 16 bits, and so each detector produces 9.114 MB of data per "full" frame (assuming a ROIx reduced from the native 2160 px of the detector down to 2×890 px).