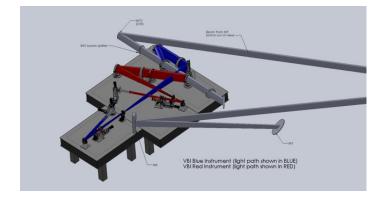
# Visible Broadband Imager (VBI):

(PI: Friedrich Wöger)



The VBI will provide high-quality imaging through filters with relatively narrow passbands. The transmission filter design stresses high cadence and short exposure times. Combining adaptive optics and real time speckle reconstructions the VBI will deliver images at the diffraction limit of the telescope.

# Spatial Field of View and Resolution:

Full Optical Field: 2 arcmin square (i.e. the full post-AO DKIST field of view)

The **physical** field of a single image is limited by the 4k x 4k detector. The full optical field of views is accessible by *field sampling*.

VBI channel Reference Wavelength	Physical FOV	Spatial Sampling	Resolution			
Blue	45 arcseconds	0.011 arcseconds/pixel	0.022 arcseconds			
430.5 nm			(diffraction limited)			
Red	69 arcseconds	0.017 arcseconds/pixel	0.034 arcseconds			
656.3 nm			(diffraction limited)			

# Spectral Range and Resolution:

VBI blue channel	VBI red channel					
CWL: 393.327 nm, FWHM: 0.101 nm (CaII K)	CWL: 656.282 nm, FWHM: 0.049 nm (H-alpha)					
CWL: 430.52 nm, FWHM: 0.437 nm (G-band)	CWL: 668.423 nm, FWHM: 0.442 nm (red continuum)					
CWL: 450.287 nm, FWHM: 0.41 nm (blue continuum)	CWL: 705.839 nm, FWHM: 0.578 nm (TiO)					
CWL: 486.139 nm, FWHM: 0.0464 nm (H-beta)	CWL: 789.186 nm, FWHM: 0.356 nm (Fe XI)					

Within each channel, images at multiple wavelengths are acquired in series.

# **Temporal Cadence:**

The VBI will, in its default mode of operation, acquire sets of images and use these sets to compute a single reconstructed image, discarding the original images.

#### **Reconstructed images:**

3.2 sec for images with same physical FOV (single or multiple  $\lambda$ ) (3 × 3 mosaic of the full optical FOV within 9 × (2.667 + 0.533) seconds = 28.8 seconds) (VBI red channel uses 2x2 tiling for full optical FOV mosaic)

#### Raw images:

0.033 sec for images with same physical FOV and single  $\lambda$ (3 × 3 mosaic of the full optical FOV within 9 × (0.033 + 0.533) seconds = 5.1 seconds)

0.566 sec for images with same physical FOV and multiple  $\lambda$ 

<u>Note</u>: Raw image data acquisition is constrained by DKIST Data Handling System limitations on data storage and transport, in particular when the VBI is used in combination with other instruments.

Typical maximum durations for raw image data acquisition are about 60 minutes, when running both channels simultaneously standalone.

### Polarimetric Capabilities and Accuracy:

None

### Photometric Capabilities (Precision):

Relative photometric precision: goal 1 x  $10^{-2}$  I<sub>0</sub>

#### Instrument Modes Available:

Unsynchronized and synchronized data acquisition with VBI red and blue channel:

- No synchronization between blue and red channel
- Loose synchronization: synchronization between blue and red channel at the beginning of an acquisition sequence consisting of multiple selected wavelengths
- Fixed synchronization: synchronization between blue and red channel at the beginning of acquisition at each wavelength in a sequence

Single physical FOV data acquisition, or partial or full optical FOV data acquisition via field sampling

Reconstructed or single unreconstructed images at any wavelength

Frame Selection / Region of Interest / Binning, for data volume reduction

# Example Modes of Operation:

1. Fixed Synchronization:

Blue Channel:

Ca II K Center FOV speckle	move	G band Center FOV speckle	move	H beta Center FOV speckle	move	blue cont. Center FOV speckle	move	Ca II K Center FOV speckle
Red Channel:								
H alpha Center FOV speckle	move	red cont. Center FOV speckle	move	H alpha Center FOV speckle	move	TiO Center FOV speckle	move	H alpha Center FOV speckle

#### 2. Lose Synchronization:

Blue Channel:

Ca II K Center FOV speckle	move	Ce	oand nter FOV eckle	move	Ce	beta enter FOV eeckle	move	blue cont. Center FOV speckle	move	Ca II K Center FOV speckle
Red Channel:										
v red cont. center FOV speckle		move	TiO Center FOV speckle		move	Syncl	hror	ization Wait		e red cont Center F speckle
(Halpha Center FOV single										H alpha Center FOV single

# 3. No Synchronization:

#### Blue Channel:

H beta Center FOV speckle	move	H beta Center FOV speckle	move	G band Center FOV speckle	move	H beta Center FOV speckle	move	H beta Center FOV speckle
Red Channel:								
H alp Full F single	ov	C	ed co ente peck	r FOV		H alpha Full FOV single		red con Center speck