

DensePak Users Manual

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Abstract

DensePak is a fiber optic bundle used for integral field spectroscopy at the WIYN Telescope. The bundle forms an array of 91 fibers arranged in a seven fiber by thirteen fiber rectangle. DensePak attaches to the telescope at the WIYN port using the Indiana WIFOE head adapter and feeds into the WIYN Bench Spectrograph which is optimized for fiber optics and can provide low, moderate, and high dispersion spectra.

Instrument Description

DensePak was built from a decommissioned Hydra cable that contains "red" optimized fibers with 300 micron diameters. The fiber cable attaches to the "WIYN" Nasmyth port of the telescope utilizing the Indiana adapter head for their fiber-fed echelle spectrograph (WIFOE). Figure 1 is a photograph of the DensePak head assembly. The DensePak head assembly contains a anti-reflective coated quartz window with the fiber array coupled using an index matching gel. The WIFOE head assembly contains a pellicle for simultaneous viewing of the fiber array (which can be back illuminated) along with the target object. An ICCD is used for viewing objects down to a magnitude of 16. The fiber cable feeds the Bench spectrograph that is used with the Hydra multi-object spectrograph and allows many spectrograph configurations. Refer to the Hydra Manual for details on the spectrograph options.

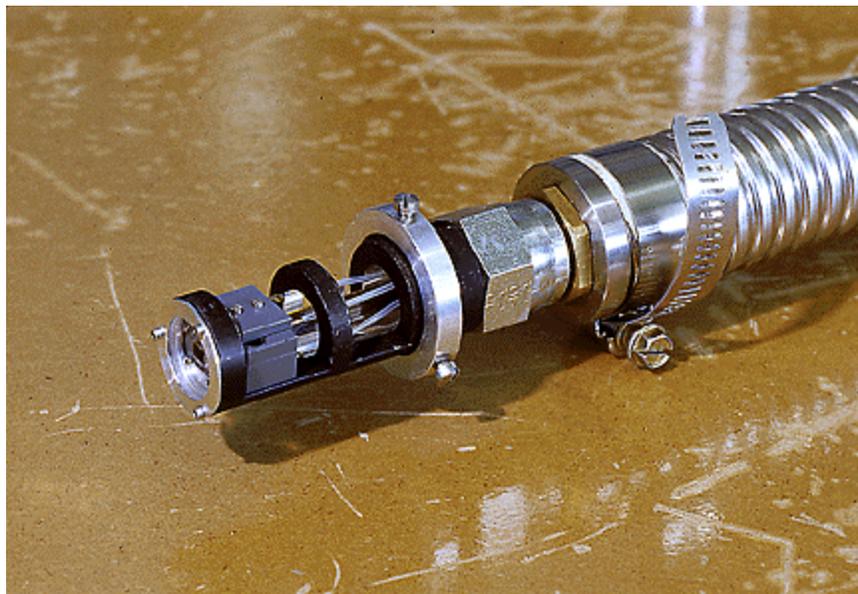


Figure 1: DensePak Head Assembly

Array Characteristics:

- Number of Fibers : 91
- Layout: 7 fiber x 13 fiber rectangle
- Fiber Diameter: 300 microns = 3 arcseconds
- Fiber-to-Fiber Spacing: 400 microns = 4 arcseconds
- Overall Dimensions: 30 arcseconds x 45 arcseconds
- Spectral Window: 3700• to 1.1 μm (several fibers have poor transmission below 4500• , see "Fiber Mapping" section for details)

Sky Fibers:

- Number of Fibers: 4
- Layout: Evenly spaced about 60 arcseconds from array center (see Figure 3 for exact spacing)
- Fiber Diameter: 300 microns = 3 arcseconds

Note: Measurements are currently being done to more precisely determine the relative fiber-to-fiber positions in the array, as well as the sky fiber positions.

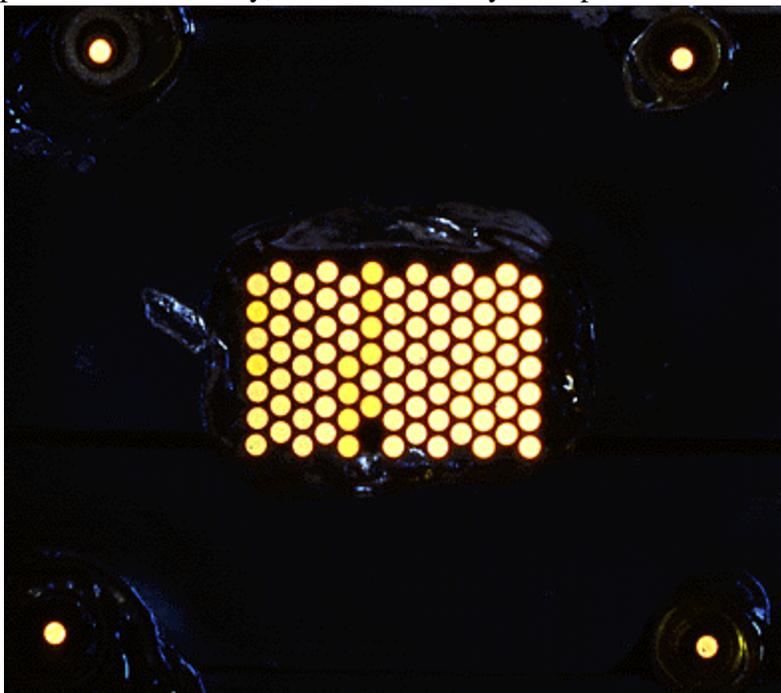


Figure 2: Close-up photograph of Densepak array and sky fibers

Fiber Mapping:

The DensePak fibers are numbered according to their slit position at the spectrograph. The raw images of spectra are oriented with fiber 1 appearing on the right and fiber 97 on the left of the CCD images. Figure 3 details the mapping of the fiber numbers in the array. Note, this diagram is oriented as DensePak appears when viewing it with the acquisition TV with North up and East to the left (see "Instrument Use" section for viewing instructions). Approximate dimensions of the array and sky fibers WRT field center (fiber 42) are shown in figure 3.

Notes about fibers:

Fibers 23, 28 are not used in the array

Fibers 36, 40, 46, 59, 93 have failed since the assembly of the array

Fiber 42 corresponds to field center

Fibers 2, 4, 36-43, 45 have poor blue transmission

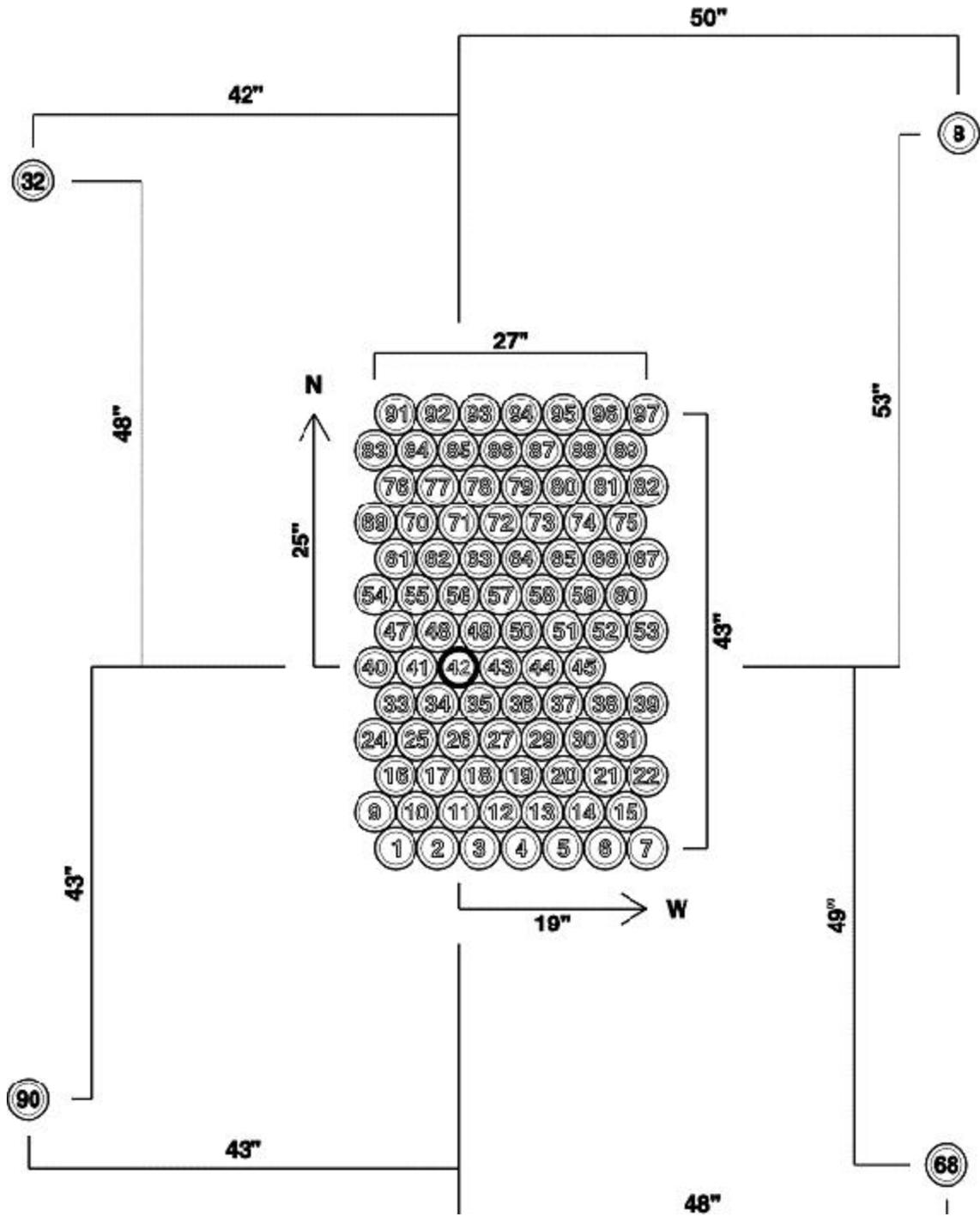


Figure 3: Mapping of Fibers and Relative Positions

Notes to Figure 3:

Column 1 center to column 14 center = 27"

Row 1 center to Row 13 center = 43"

All other dimensions are referenced to field center (fiber 42)

Configuring the Spectrograph

The spectrograph is configured using the procedures detailed in the [Hydra Users Manual](#).

The DensePak cable is installed on the spectrograph and the "DensePak" cable should be selected on the Bench Setup GUI so that the correct fiber size is used in the FWHM calculations.

A neutral density filter (N1) should be installed in the filter holder for use when back illuminating the array.

Instrument Use

Controlling the WIFOE head

Startup the WIFOE GUI using the background menu on Pearl or Vanilla. Select the desired button for WIFOE control. The GUI can also be started from an XTERM window on Pearl by typing `/usr/local/gui/tclsrc/scripts/wifoe/startwifoe`.

The WIFOE can also be controlled using a command line interface (CLI). On Pearl, start and XTERM window and type `~jsj/bin/wifoe -notk` to start communication. At the prompt you can issue the following commands (note, these are the same commands issued by the GUI described above):

wifoe init (initialize the wheel, find the home positions)

wifoe set 3 (move pellicle into the beam for viewing DensePak and object)

wifoe set 4 (move to clear position for exposing)

wifoe reboot (use only to reload the motor controller sequences if the above commands fail)

Observing with DensePak

Note: The focus offset for DensePak is approximately -450 microns from initial wavefront (or Imager) focus.

To view the DensePak and/or object:

- To view the target object on the acquisition TV,

Select channel 6 on the video distribution switcher

Move the pellicle into the beam and adjust the gain of the Fprobe controller

Make sure that the guide probes are clear of the DensePak FOV

- If you wish to view the fiber array in addition to the target object, Insert the Fiber Back Illuminator (FBI) using the Bench GUI

Insert the ND filter using the Bench GUI

Adjust the intensity of the FBI on the Bench GUI

Note: It may be necessary to remove any interference filters used on the Bench spectrograph to allow light from the FBI through.

Taking Calibrations:

Remove guide probe if on-axis

Insert the WIYN port Instrument Adapter Subsystem (IAS) feed slide. Note, there is no need to move off of the target position.

Select desired comparison lamps in IAS (quartz, ThAr, CuAr, sodium)

Set WIFOE to "clear" position

Assure that the ND filter is out and the desired Bench filters are inserted

Expose

Remove feed slide and turn off lamps when done

Observing an Object:

Align the target object on the array as desired (see "On-Sky Orientation")

Select a guide star using the Gprobe, start guiding

Remove the FBI

Remove the ND filter (insert interference filter if necessary)

Turn off the Fprobe gain

Select the pellicle out position of WIFOE

Expose once above operations have completed

On-Sky Orientation:

Instrument rotator position offset = +1d will align the major axis of DensePak with N-S. On the acquisition TV, North is up and East is to the left.

You can align DensePak with the position angle of your object by setting the instrument rotator (NIR) to the proper offset. A positive rotator offset will move N towards W on the TV. For example, if your object has a PA=30 degrees, then setting the NIR to 31 degrees (30 d PA + 1 d offset = 31 d) will align the major axis of your object with the major axis of DensePak.

If the NIR is near an unwrap condition (i.e. approaching +/- 180d) you can set the NIR to the position angle minus 179d to align along the major axis in the other direction.