Optical modeling of VISAR and PDV probes

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GRIN (Gradient Index) VISAR/PDV probe collection system for UNICORN

GRINS LENS 2.7mm dia.
Resolution: center, 40LP/mm
(0.9r 23 LP/mm)

6 mm dia. x 10mm fl.
ACH. Lenses Melles
Griot # 01LA0001

12 mm dia. x 25mm fl.
ACH. Lenses Melles
Griot # 01LA0019

1/2” dia. 2x18 array ± 25.4 µm

24.5 mm
19.3 mm
292 mm
68.5 mm
6.3 mm
38.7 mm

12.7°

292 mm

Rev:03/01/06
Mike Shinas
DX-3, LANL
Optical modeling of VISAR and PDV probes

Vision – Service - Partnership

UNICORN fiber array

VISAR fibers (36)

PDV fibers (6)

Only the colored fibers are ray traced.
Option 1

**VISAR @ 532 nm,**
100 μm fiber diameter,
only 0.02 NA light

**PDV @ 1550 nm,**
9 μm fiber diameter,
only 0.02 NA light

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**current UNICORN VISAR/PDV probes**

19.35 mm height

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**UNICORN_V7.len**

Positions: 1-2  RMM  26-Mar-06
Option 1

VISAR @ 532 nm,
100 µm fiber diameter,
only 0.02 NA light

25 mm doublet lens,
MG LAO019

10 mm doublet lens,
MG LAO001

Intermediate image is inside GRIN lens

PDV @ 1550 nm,
9 µm fiber diameter,
only 0.02 NA light

UNICORN_V7.len

Positions: 1-2  RMM  26-Mar-06
Option 1

VISAR @ 532 nm,
100 µm fiber diameter,
only 0.02 NA light

PDV @ 1550 nm,
9 µm fiber diameter,
only 0.02 NA light

current UNICORN VISAR/PDV probes

UNICORN_V7.len

Positions: 1-2  RMM  26-Mar-06
Option 1

VISAR @ 532 nm,
100 µm fiber diameter,
only 0.02 NA light

current UNICORN VISAR/PDV probes

upper VISAR probe

2 pitch GRIN rod lens has 4 image planes

19.35 mm height

(exaggerated scale)
Option 1

current UNICORN VISAR/PDV probes

upper PDV probe

19.35 mm height

PDV @ 1550 nm,
9 µm fiber diameter,
only 0.02 NA light

(exaggerated scale)
Option 1
VISAR @ 532 nm, 100 μm fiber diameter, only 0.02 NA light

ray tracing a fan of 11 rays

lower VISAR probe

upper VISAR probe

(exaggerated scale)

X: 3.50 MM
Y: 0.50 MM

UNICORN_V7.len

Position: 1 RMM 26-Mar-06
Optical modeling of VISAR and PDV probes

Option 1
PDV @ 1550 nm, 9 µm fiber diameter, only 0.02 NA light

Half of the rays from outer field probes are lost.

ray tracing a fan of 11 rays
Changing the air gap between the doublet lenses changes the magnification at the target, which is not good. 19.35 mm is the desired image height.
Option 2

VISAR @ 532 nm,
100 µm fiber diameter,
only 0.02 NA light

PDV @ 1550 nm,
9 µm fiber diameter,
only 0.02 NA light

new proposed UNICORN VISAR/PDV probe
new proposed UNICORN VISAR/PDV probe

25 mm doublet lens, MG LAO0019

10 mm doublet lens, MG LAO001

10.6 mm 29 mm 5.7 mm

Option 2

VISAR @ 532 nm, 100 $\mu$m fiber diameter, only 0.02 NA light

PDV @ 1550 nm, 9 $\mu$m fiber diameter, only 0.02 NA light

UNICORN_V8.len

Positions: 1-2 RMM 27-Mar-06
New proposed UNICORN VISAR/PDV probe

Option 2

VISAR @ 532 nm, 100 µm fiber diameter, only 0.02 NA light

PDV @ 1550 nm, 9 µm fiber diameter, only 0.02 NA light

0.11 NA from PDV fibers

0.22 NA from VISAR fibers

telecentric light from fibers

25 mm doublet lens, MG LAO001

10 mm doublet lens, MG LAO001

10.6 mm

29 mm

5.7 mm

UNICORN_V8.len

Positions: 1-2 RMM 27-Mar-06
**Option 2**

**VISAR @ 532 nm**, 100 µm fiber diameter, only 0.02 NA light

**PDV @ 1550 nm**, 9 µm fiber diameter, only 0.02 NA light

Shows how much of the 0.11 NA light from the PDV fiber is actually used.

Shows that VISAR fibers easily accept light from target.

UNICORN_V8.len

Positions: 1-2  RMM  27-Mar-06
Option 2

VISAR @ 532 nm,
100 µm fiber diameter,
only 0.02 NA light

PDV @ 1550 nm,
9 µm fiber diameter,
only 0.02 NA light

new proposed UNICORN VISAR/PDV probe

UNICORN_V8.len

Positions: 1-2
RMM 27-Mar-06
Option 2
VISAR @ 532 nm,
100 µm fiber diameter,
only 0.02 NA light

upper VISAR probe

new proposed UNICORN VISAR/PDV probe

(exaggerated scale)
new proposed UNICORN VISAR/PDV probe

Option 2

PDV @ 1550 nm,
9 \( \mu \)m fiber diameter,
only 0.02 NA light

18.11 mm height

UNICORN_V8.len
Option 2

VISAR @ 532 nm, 100 µm fiber diameter, only 0.02 NA light

new proposed UNICORN VISAR/PDV probe

lower VISAR probe

ray tracing a fan of 11 rays

upper VISAR probe

(exaggerated scale)  

UNICORN_V8.len  

Position: 1  RMM 27-Mar-06
Optical modeling of VISAR and PDV probes

Option 2
PDV @ 1550 nm,
9 µm fiber diameter,
only 0.02 NA light

new proposed UNICORN VISAR/PDV probe

None of the rays from outer field probes are lost.

lower PDV probe

middle PDV probe

upper PDV probe

ray tracing a fan of 11 rays

(exaggerated scale) X:3.50  MM
                    Y:0.50  MM

UNICORN_V8.len
Maximizing the ray bundle of light passing through the rod lens allows for an NA of 0.0368. But the image spot size is not controlled very well. Image height has also been reduced.

PDV @ 1550 nm,
9 μm fiber diameter,
only 0.0368 NA light

(exaggerated scale)
Optical modeling of VISAR and PDV probes

Vision – Service - Partnership

PDV @ 1550 nm, 9 µm fiber diameter, only 0.0368 NA light

None of the rays from outer field probes are lost.

Option 2
new proposed UNICORN VISAR/PDV probe

(Exaggerated scale)

ray tracing a fan of 11 rays

lower PDV probe

middle PDV probe

upper PDV probe

Position: 2  RMM 29-Mar-06
Circle diameter is 23.41 mm.
Design specification for outer PDV spot is $Y = 19.35 \text{ mm}$, $X = 13.18 \text{ mm}$