Modifications and Other Modes of VIRUS

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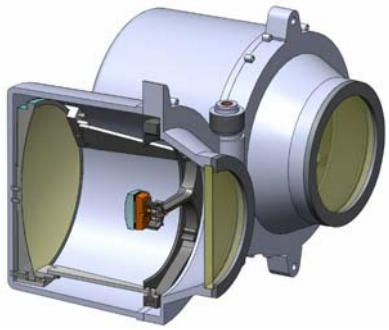
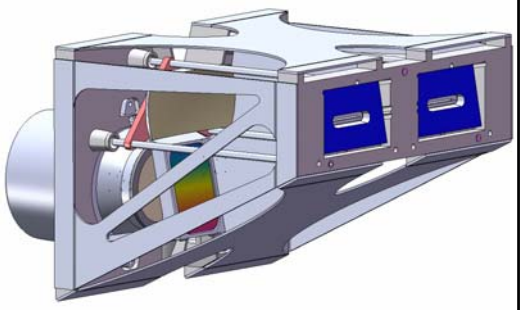
Scope

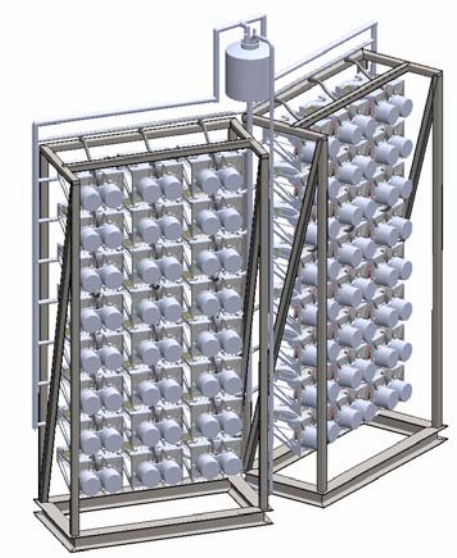
- Baseline Characteristics
- IFU layout
- Modifications involving change of the dispersers
- Other applications of VIRUS modules





VIRUS baseline characteristics

- VIRUS has been optimized for the DEX mode to ensure the maximum efficiency in executing the dark energy experiment
- Properties of DEX mode
  - 75 pairs of spectrographs
  - Each fed by a 448 fiber IFU with 1.5 arcsec diameter fibers
  - Dither pattern of 3 exposures fills 50x50 arcsec area per IFU
  - 350-550 nm coverage
  - R=700 (6.4A resolution element)
- Goal is to increase total number to 96 pairs



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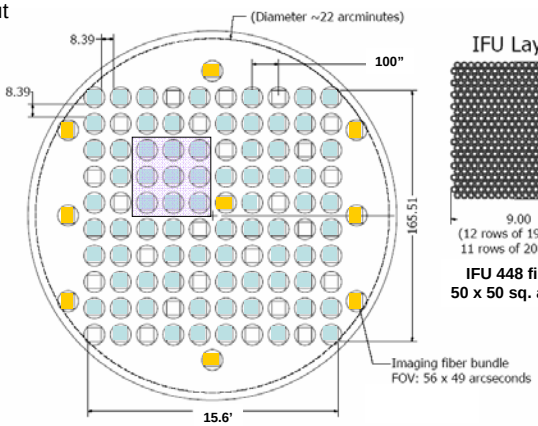
IFU layout on sky

- Proposed HETDEX Layout
- 75 IFUs random layout
- 150 spectrographs
- Contiguous 9 IFU block can allow full coverage of 17.4 sq. arcmin area
- Future reconfigurations can fill in a smaller total area contiguously, depending on the total number of spectrographs funded



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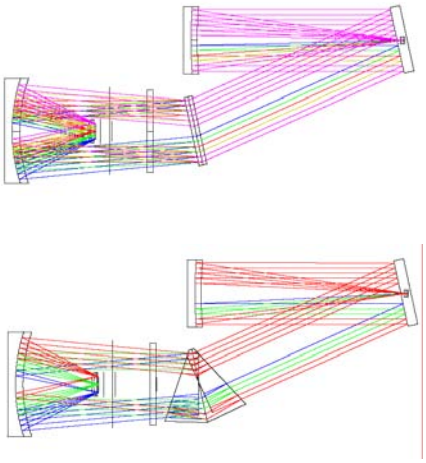
Modifications to VIRUS

- Disperser swap is the primary option for modifying the VIRUS units
  - Reflective coatings limit wavelengths to 350<λ<700 nm
- Grisms allow different wavelength ranges and resolutions to be obtained
  - Tune with combination of fringe frequency on the VPH grating and immersing between prisms
- Maximum resolution is set by space for prism (30^o wedge angle) and index of glass



Maximum Resolution

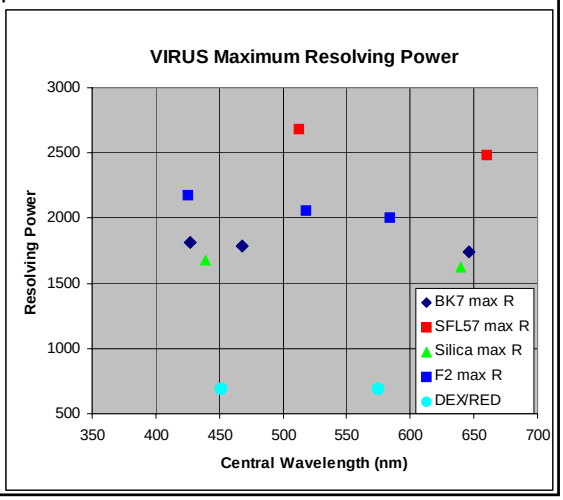
- Depending on the wavelength region, different glasses are available to create grisms
- Maximum is R~2500 except in the UV
- Roughly $\Delta\lambda \sim 310\ \lambda_c/R$

Table 1 – Example Grism Properties

Case	Prism material	Prism angle	Grating l/mm	Min wav (nm)	Max wav (nm)	Resolving power
DEX	Fused Silica	0	930	349	552	691
RED	Fused Silica	0	730	445	703	692
Case 1	Fused Silica	31	2090	399	480	1676
Case 2	Fused Silica	31	1420	578	700	1620
Case 3	BK7	31	2090	428	509	1785
Case 4	BK7	31	2300	391	464	1809
Case 5	BK7	31	1420	588	704	1740
Case 6	F2	31	2650	390	449	2192
Case 7	F2	31	2100	480	557	2059
Case 8	F2	31	1850	540	640	2005
Case 9	SF57	31	2610	482	542	2685
Case 10	SFL57	31	1865	618	700	2480

Maximum Resolution

- Depending on the wavelength region, different glasses are available to create grisms
- Maximum is R~2500 except in the UV
- Roughly $\Delta\lambda \sim 310\ \lambda_c/R$
- Interesting examples:
  - 480-540 nm at R~2700
  - 620-700 nm at R~2500
  - 390-450 nm at R~2200



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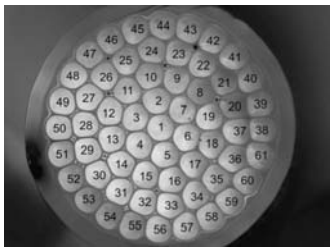
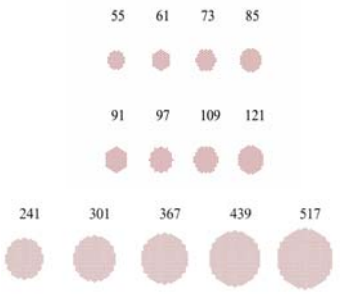
Other applications

- The VIRUS units are adaptable to other wavelength regions and different fiber inputs
- Different mirror coatings can give broad-band red-optimized capability
- Fiber core size as small as 125 μm can be used
  - 0.70" on sky; 3 pxl on chip
  - 400 fibers per spectrograph
- Contiguous coverage can be obtained with lenslet-coupled IFU
- or Hexabundles (Hawthorn+ 09) would provide a contiguous field without need for microlenses
  - 90% fill factor (better efficiency to lenslets)
  - Being deployed on VLT GIRAFFE
- These options most relevant to future LRS





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Summary and Costs

- DEX mode has 350-550 nm coverage with R~700
- Disperser swaps can enable observations of other wavelength regions at resolving powers up to R~2500
  - A red grating mode would cover 450-700 nm at R~700
- Cost is significant, but if a major new survey were enabled a complete reconfiguration would be possible
  - Cost of RED gratings for all 75 pairs of VIRUS would be ~$1M
  - Cost of highest dispersion grisms would be about $40k per spectrograph pair or ~$3M for 75 pairs
- A more limited reconfiguration may enable interesting science, however,
  - Such as a core of 9 contiguous IFUs at a cost of ~$360k