Parallel Observing with VIRUS

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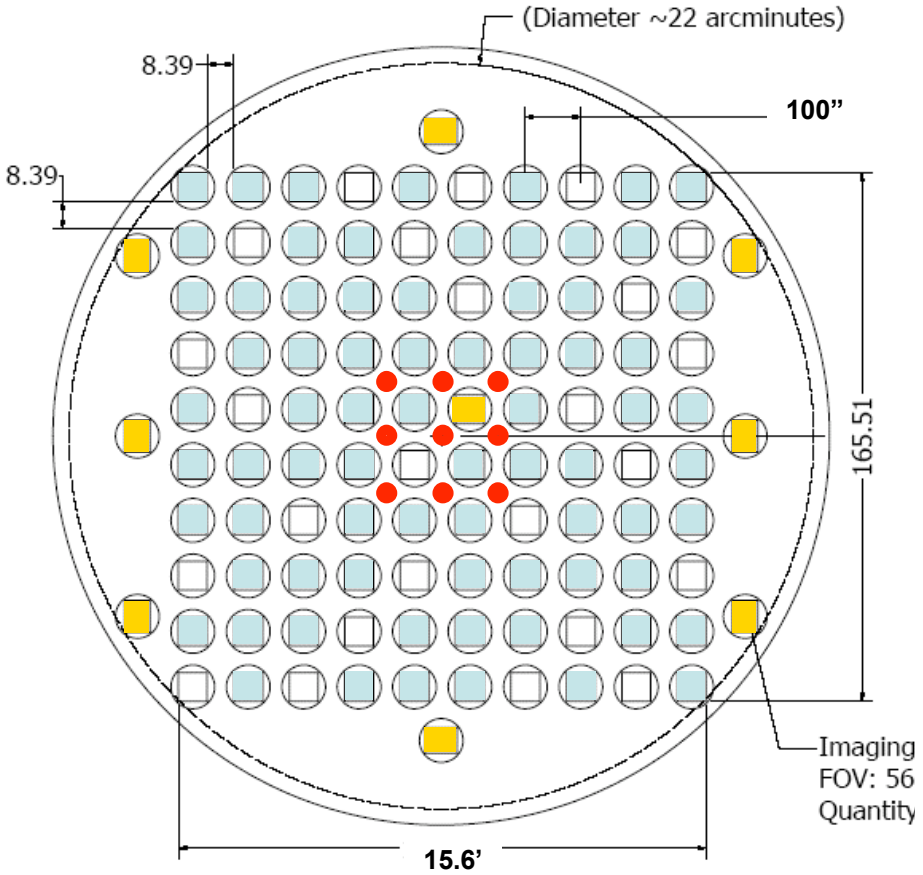
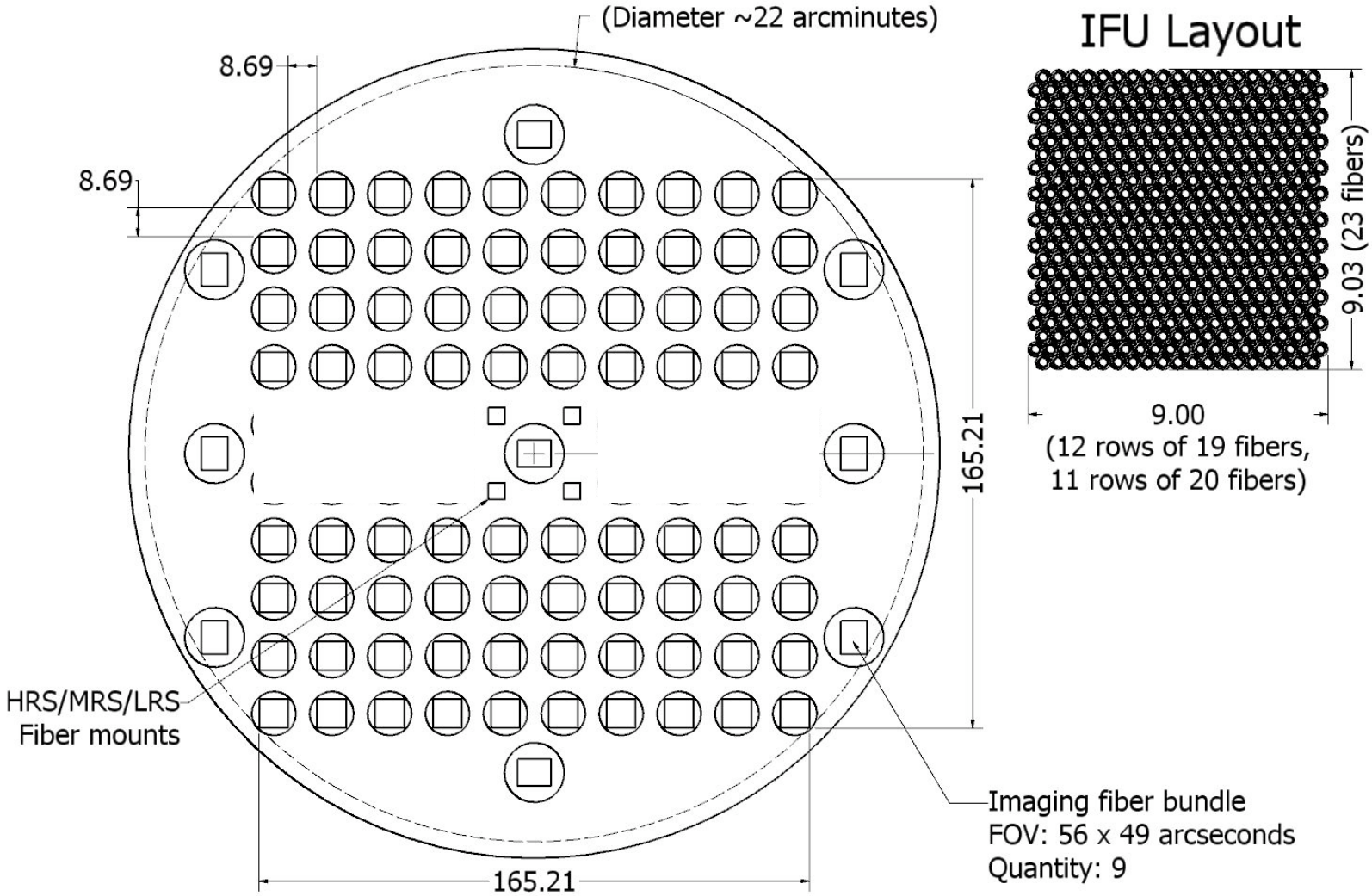
Parallel Mode

- VIRUS can observe in parallel mode when HRS or MRS feeds are being used for the primary science exposure
- The HRS and MRS fiber feeds are located in front of the VIRUS shutter and do not dither with the VIRUS input
- Depending on the ultimate design of the new LRS, the feed may not be well-adapted to parallel mode
- The feed for the future LRS may use one of the VIRUS IFU positions
  - Which would present some problems for dithering and shuttering
  - Works for redeployed LRS or full multi-beam instrument
- Or LRS feed may be integrated with the acquisition camera to provide more capability
  - In that case most of the VIRUS IFUs would be obstructed and parallel observations with LRS would not be possible



A Virtual Virus Footprint

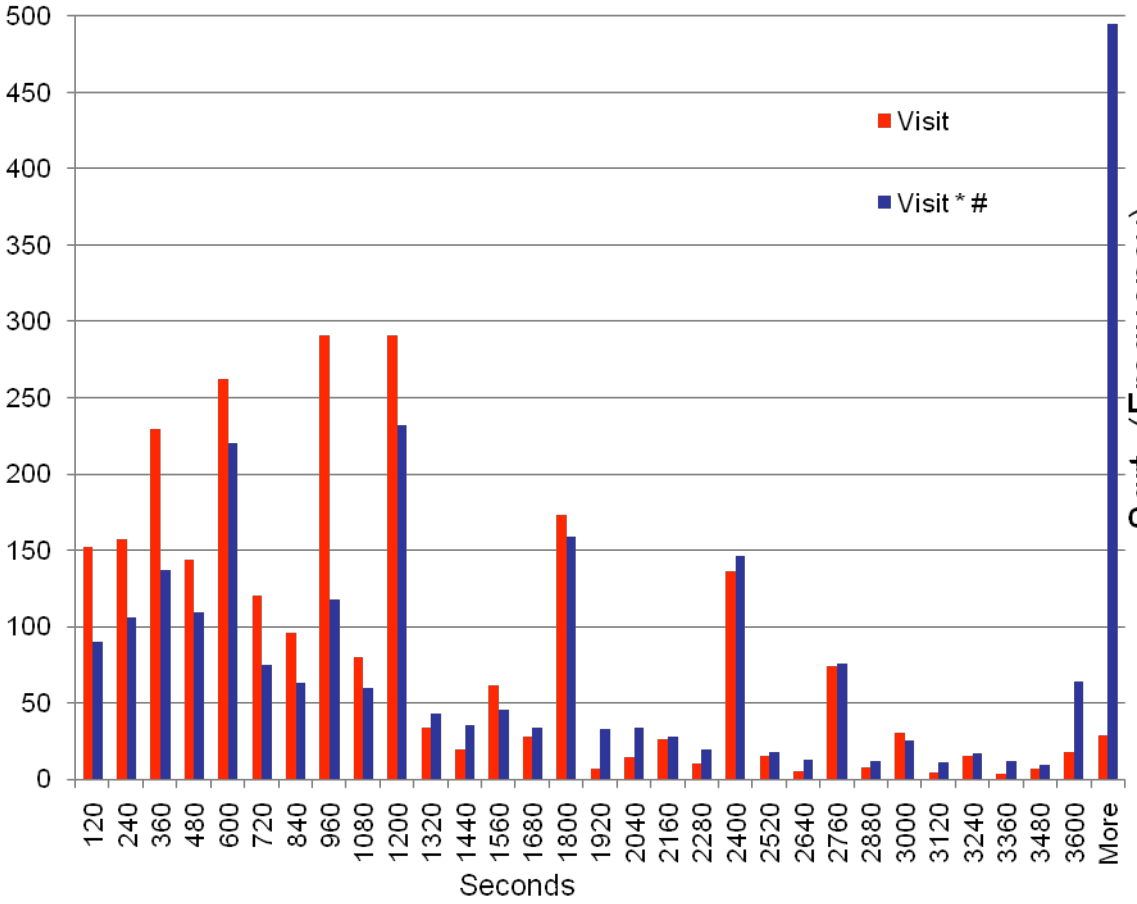


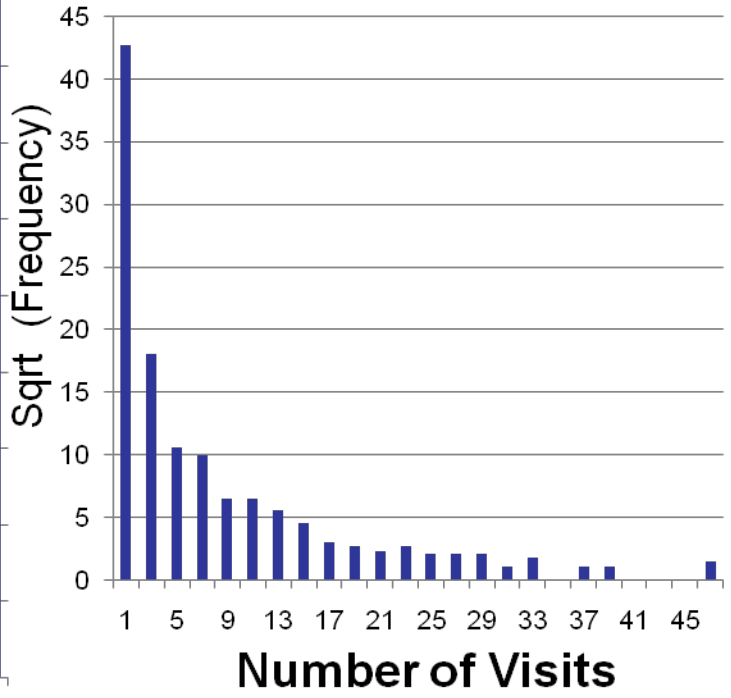
For this view of what might be we assume 80 IFU or 160 spectrographs in the config above.

Virtual Virus Summary

- 80 IFU = 160 spectrographs
- 448 fibers per IFU
- 35840 individual spectra per pointing
- Distance between fibers is 2.5” within an IFU
- Median seeing for LRS likely to be 1.5”
- Roughly 57 arcmin square per pointing

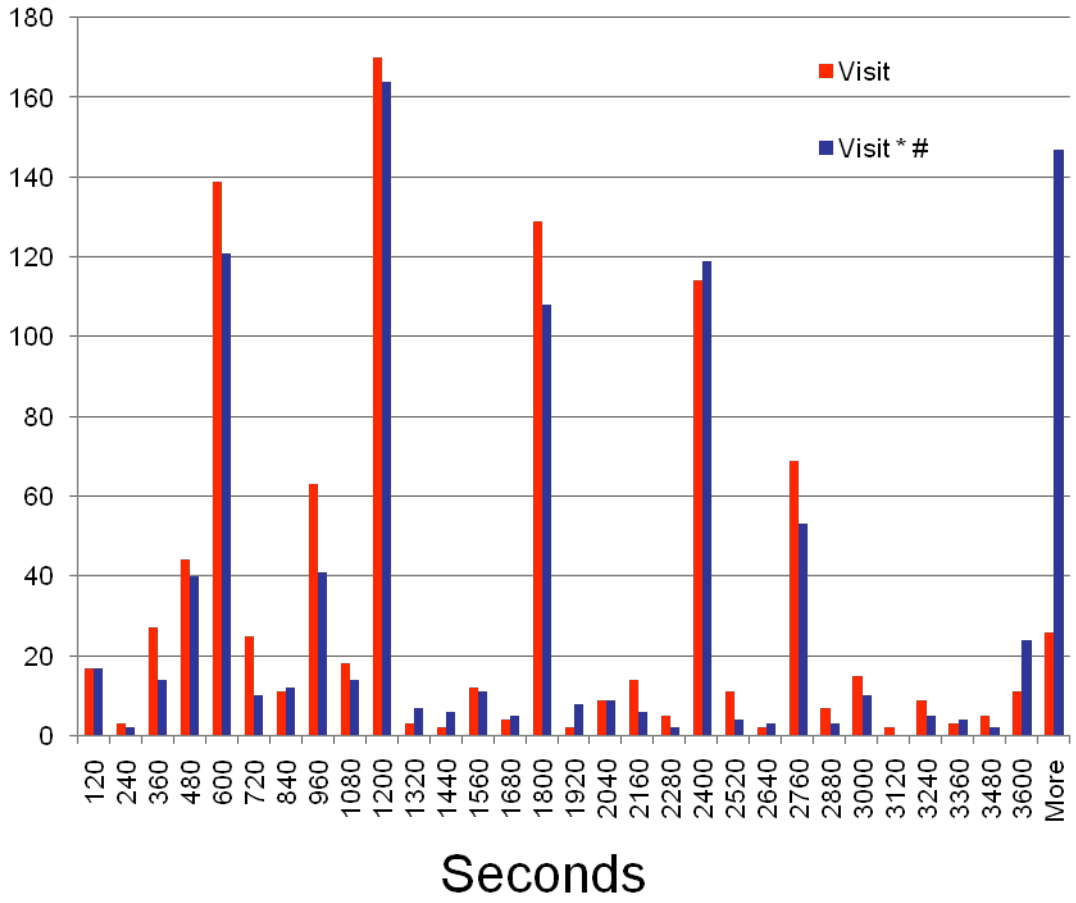
For 2007 and 2008 all tracks

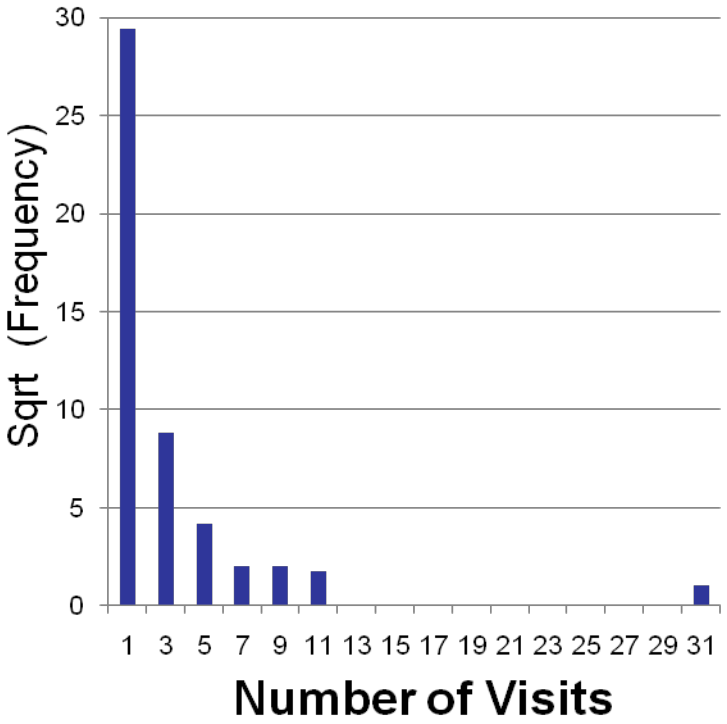




- 2538 different pointings (tracks) but multiple visits
- 7517 total visits (some to the same sources)

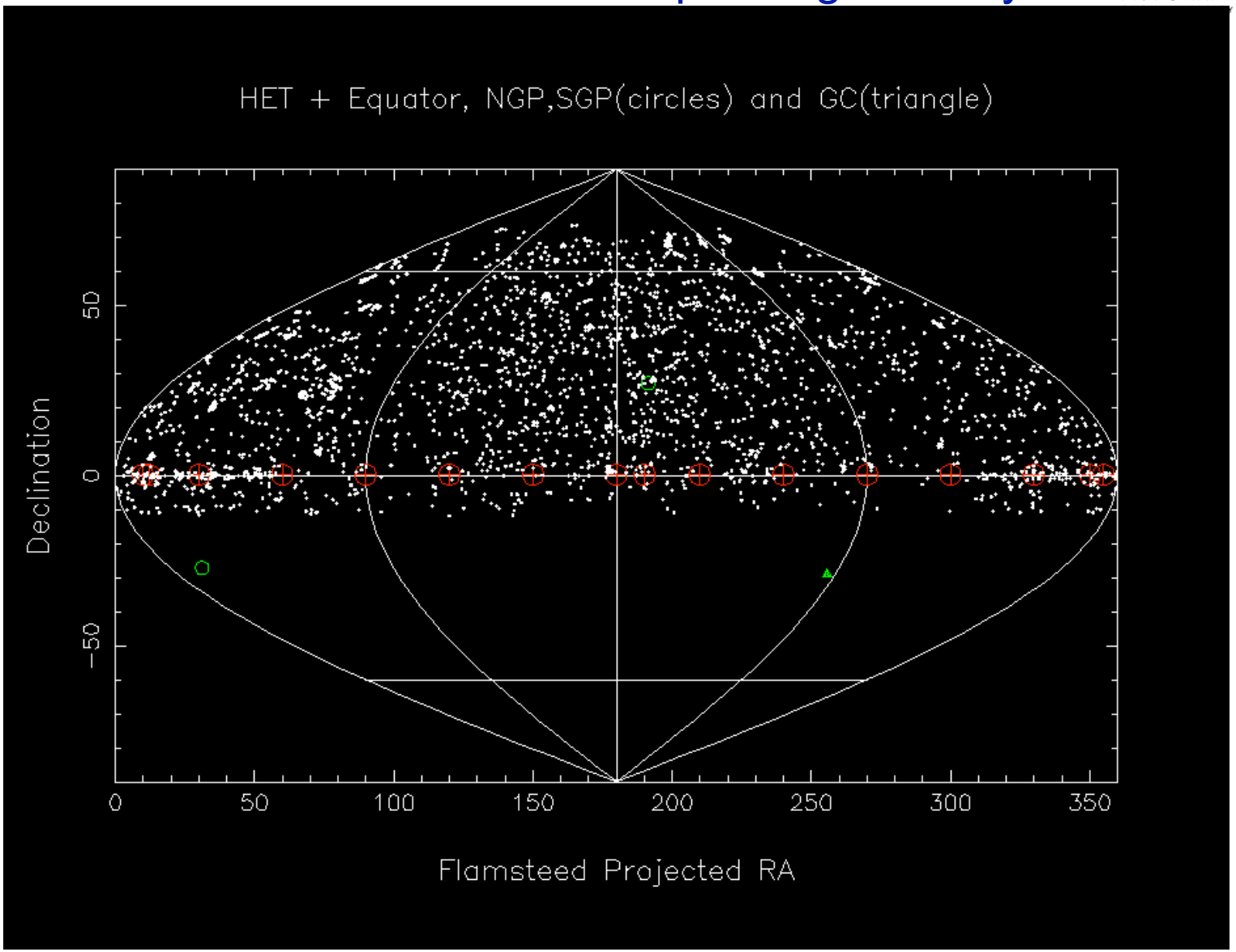
For 2007 and 2008 dark time tracks





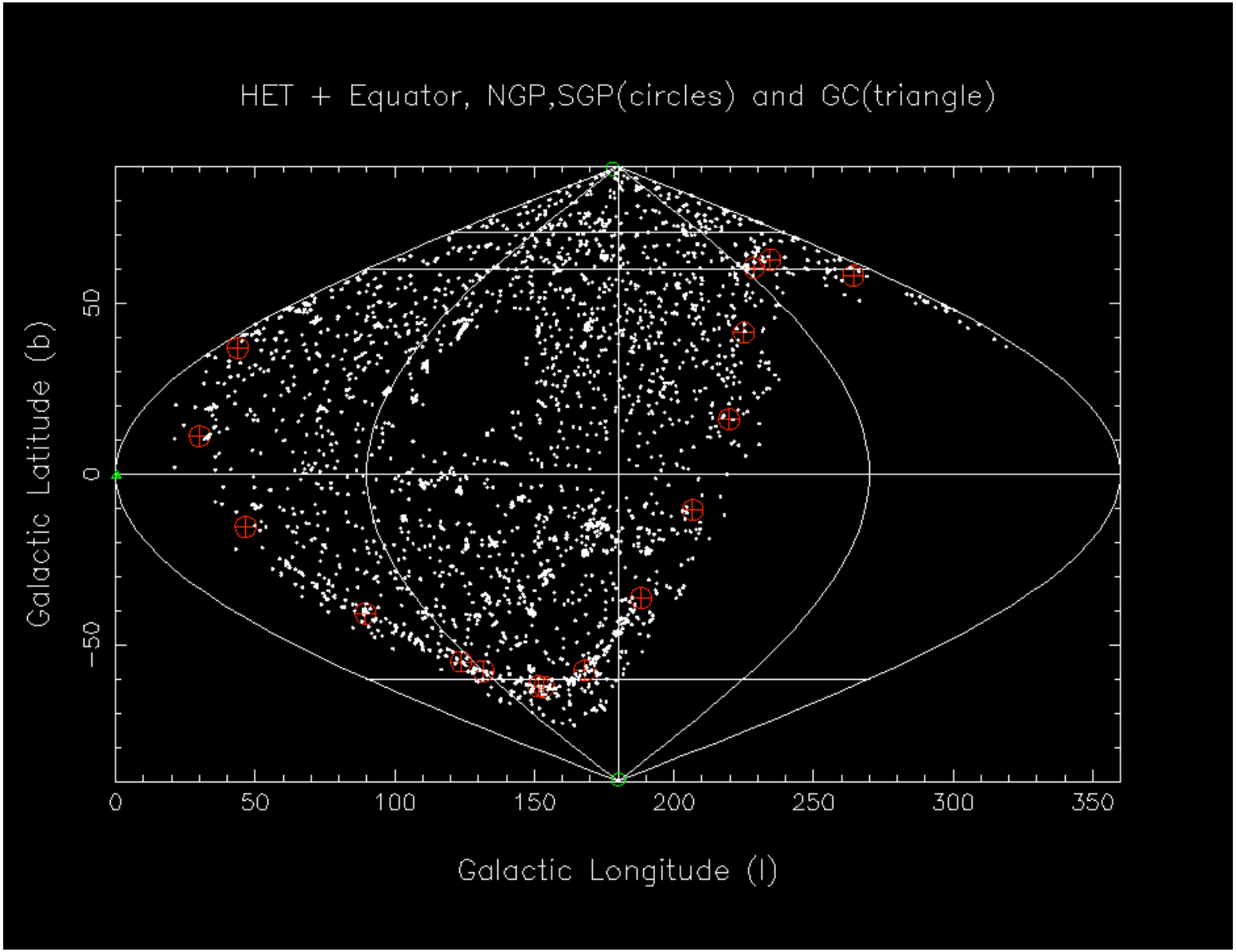
971 different pointings (tracks) with sky brightness constraint of Vsky > 20.0 but multiple visits

Distribution of pointings on Sky

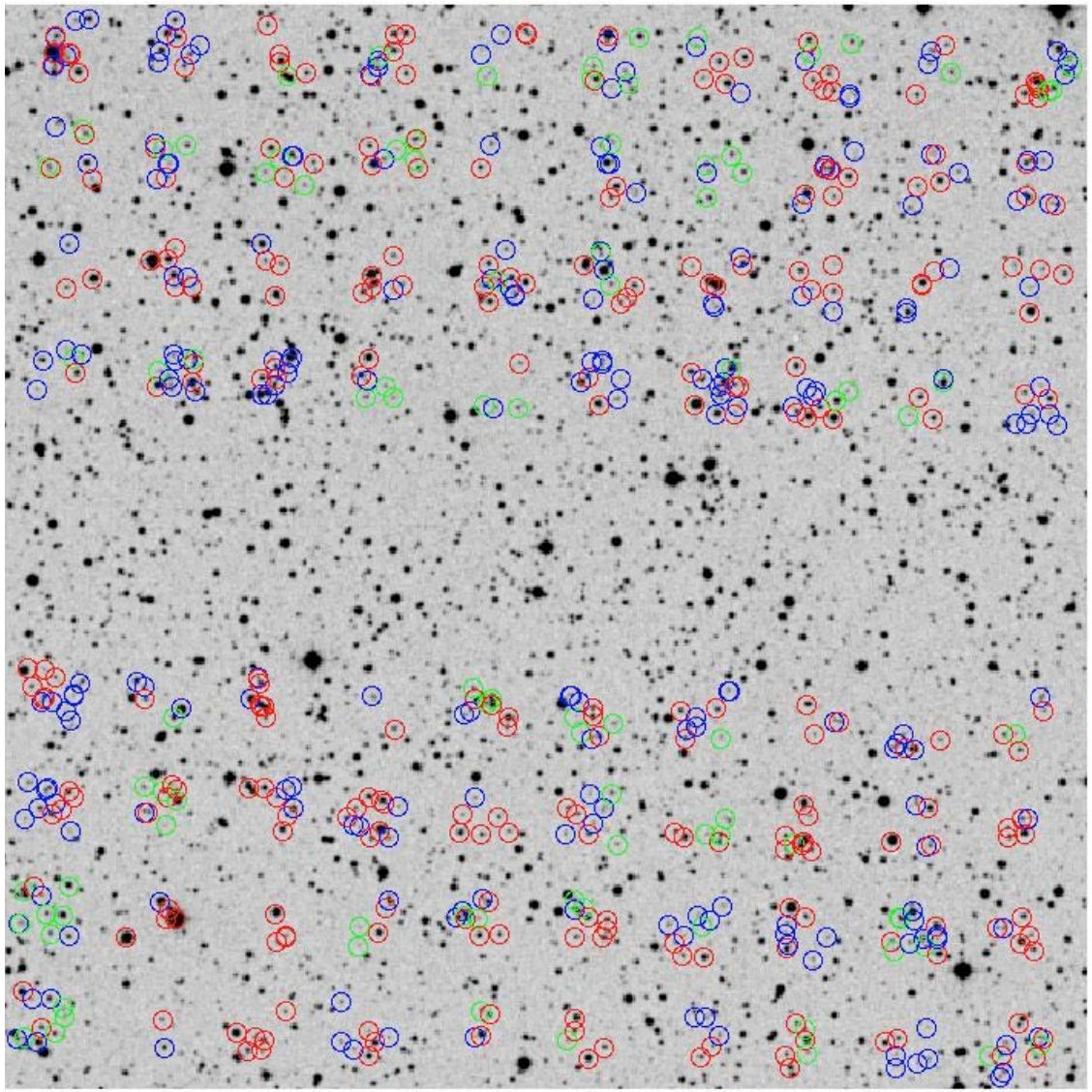


Total of 40 square degrees covered

Distribution of pointings on Sky



A typical Virus parallel field



Red = stars

Blue = galaxies

Green = ID??

For 2007 and 2008 all targets in all tracks

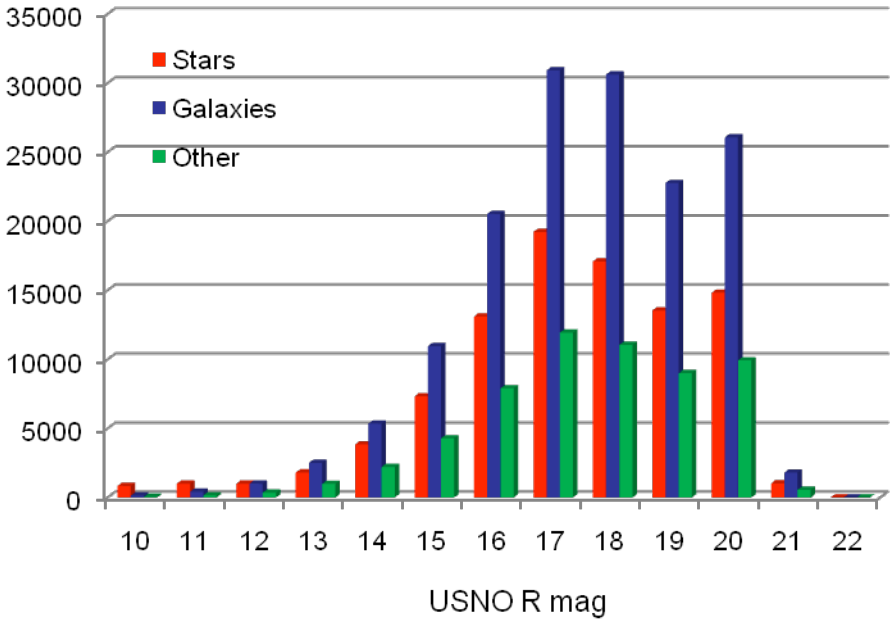
Using the USNO catalog to find targets that would have fallen in on fibers in the 2007 and 2008 observing seasons. We assume that targets are observed in a sky brightness greater than the target constraint. This limits the target magnitude to $V < V_{sky} + 0.5$; this is not realistic but gives a worst case scenario and a lower limit to the number of targets detected.

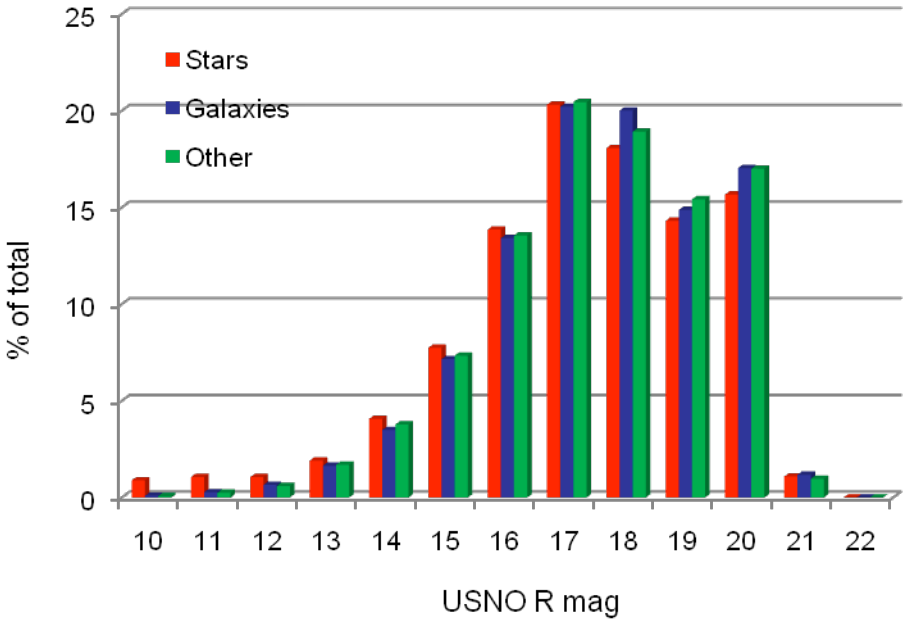
94616 observed stars

153062 observed galaxies

58382 observed targets with no ID

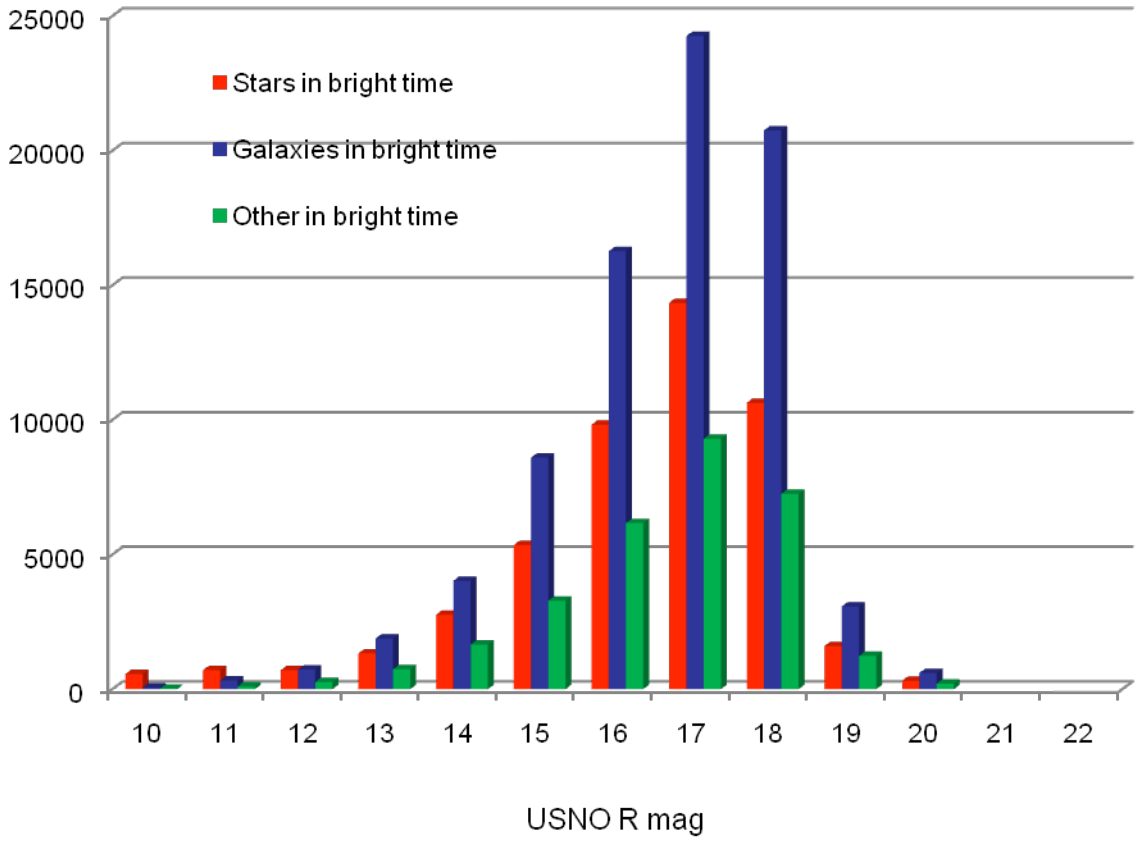
Histogram of the Parallel Field Targets





The distribution percentage is likely a function of the completeness of the USNO catalog.

Histogram of the Bright Time (V_{sky} <20) Parallel Field Targets



During two years of bright time we would collect at least:
48,104 stars, 80,477 galaxies, 30,193 other

Comparison to other Surveys

Two Years of VIRUS Parallel Survey:

153,062 galaxies, 94,616 stars, 58,382 other

2dF Galaxy Redshift Survey:

232,155 galaxies, 125 quasars, 12,311 stars

Sloan Loan Legacy Survey:

930,000 galaxies, 120,000 quasars, and 225,000 stars

SEGUE:

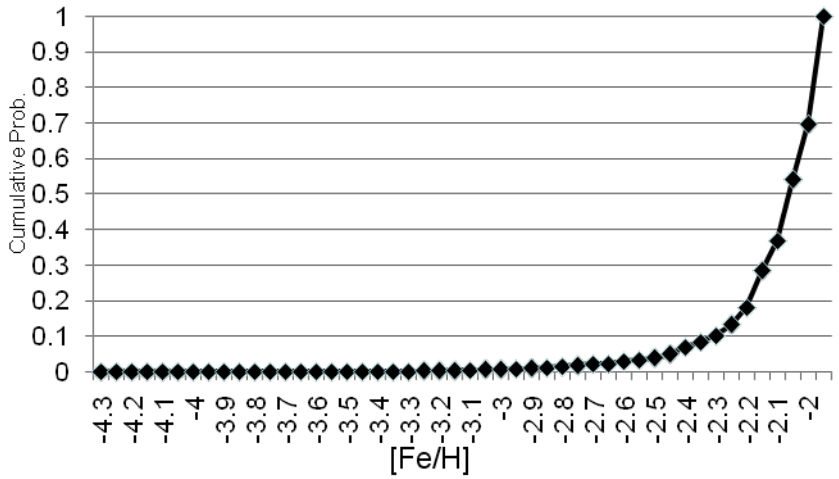
240,000 stars brighter than 18.

RAVE:

1,000,000 stars brighter than 15.

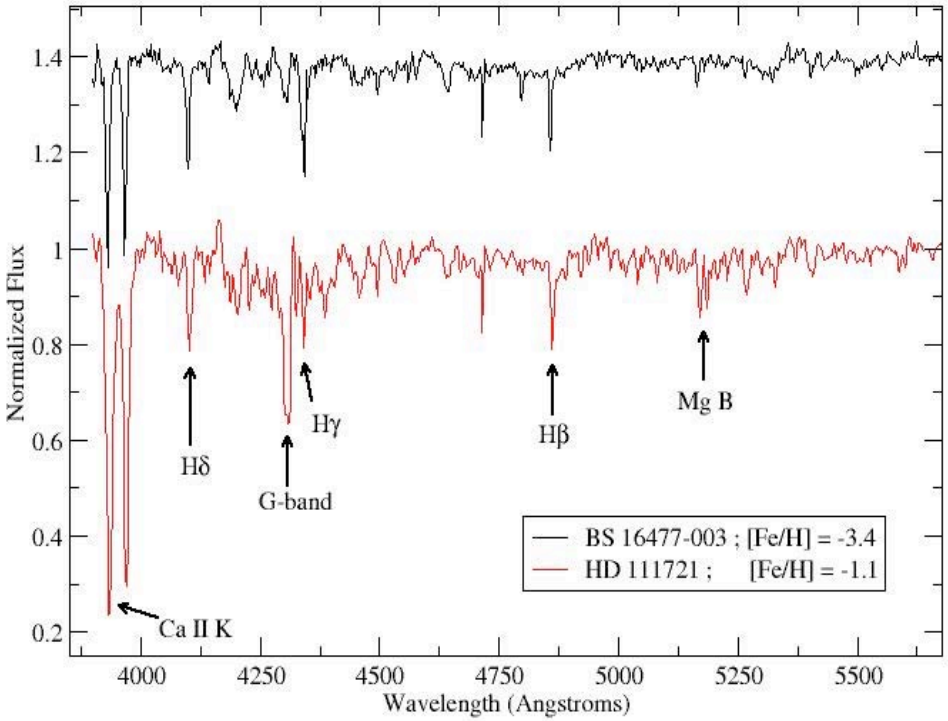
Comments on Science Projects
Very Metal-Poor (VMP, [Fe/H] < -2) stars

In Beers et al. 2005 and Schorck et al. 2008 from the Segue and Hamburg/ESO survey:
0.1% of solar neighboorhood is VMP (For fainter stars out of the plane of the MW this % rises)
9% of VMP stars are EMP (less than [Fe/H] < -3)
0.1% of VMP stars are UMP (less than [Fe/H] <= -4)



I will assume ~5% of our stellar sample is VMP.
For our 2 year sample of 94,616 observed stars we will have
4730 VMP stars, 425 EMP stars, and 5 UMP stars.
Note: only 4 UMP stars currently known.

Spectra from Virus-p Wilhelm et al. 2008



Comments on Science Projects
Transient Events

Roughly 0.8 square degrees per dark run yields many transient events

From Rodney 2009 AAS 213, 438.03: Pan-STARRS SN Rates per dark run

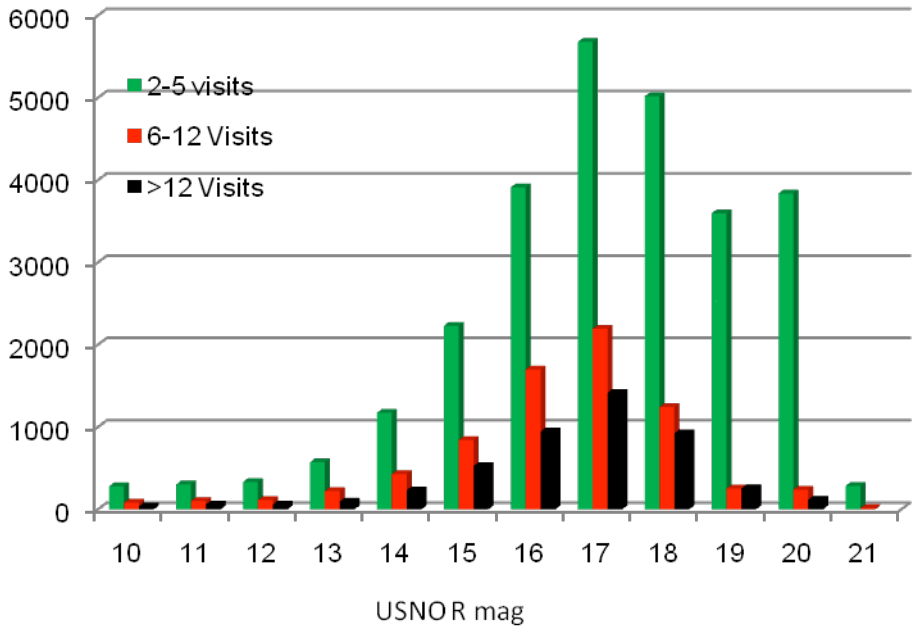
Redshift

Mag.	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	sum
19.5		0.1									0.1
20		0.1	0.2								0.3
20.5		0.1	0.3	0.2	0.1						0.7
21		0.1	0.4	0.5	0.4	0.1					1.4
21.5		0.1	0.4	0.7	1.0	0.6	0.3	0.1			3.0
22			0.3	0.7	1.4	1.4	1.6	0.9	0.5	0.1	6.9

We might expect a couple of SN per dark run mostly between 21-22.

Comments on Science Projects
Stellar binaries and Variables

With a velocity precision of 20-24 km/s (see Wilhelm et al. 2008) we could find short period binaries, RR Lyrae, and Cepheids.



For example, from Rucinski 2007 contact binaries make up about 1/500 of the general population. Thus, in our sample of stars with more than 5 measurements we might expect to find 24 of these objects.

Searching through the VIRUS database

The tools we developed for this thought experiment could be used before or after future observations:

- The tool could be used to predict what interesting objects will be found in Virus parallel science fields.
- The tool could be used with your favorite catalog of objects to look for targets VIRUS has observed.

Summary of Virus Parallel

- This is a powerful mode
- We are doing our best to incorporate it into the design of the Prime Focus Instrument Package
  - HRS and MRS single fiber feeds are ok
  - LRS IFU feed may be problematic but we're working on that in conjunction with the conceptual design of the future LRS
- Parallel Science is not completely "for free"
  - HETDEX software scope does not include support of this mode, although the elements of the basic pipeline will be directly applicable
  - Operationally, the RAs will need a few additional planning tools to manage the mode
  - There is time for people in this room to contribute to the effort and implement the parallel mode