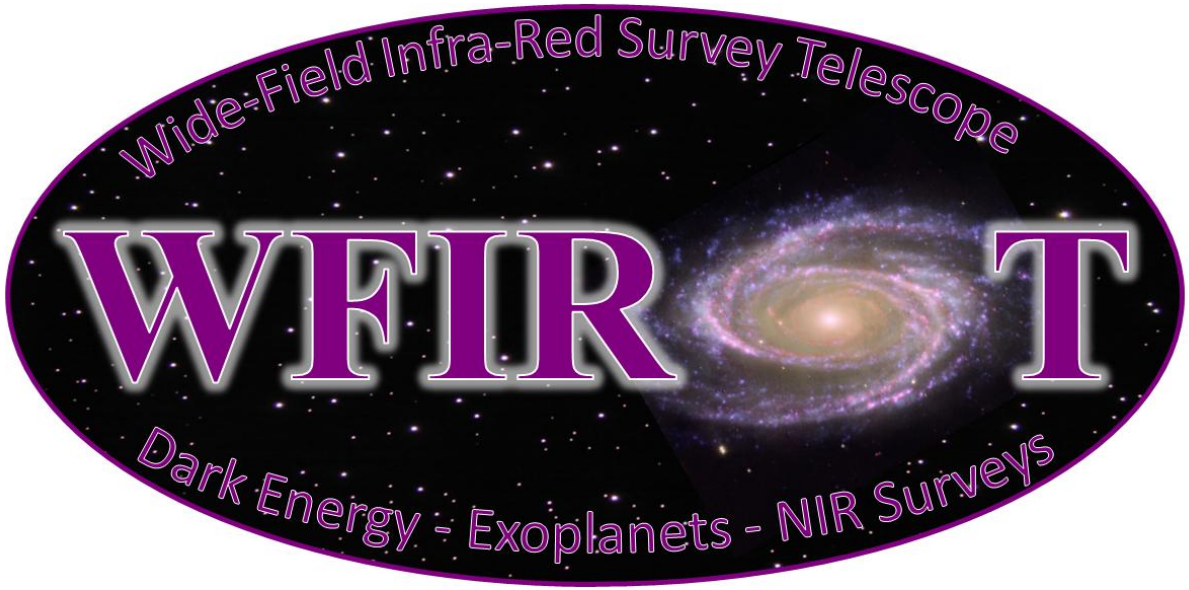

Science Requirements Document

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Science Requirements Document Status

- First draft circulated 7/23/2014
- What's in it:
  - Science background for context
  - Objectives from Level-1
  - Flowdown from objectives to high-level science requirements
  - Flowdown from high-level science requirements to observation requirements
- Where did it come from?
  - Mostly from prior SDT reports, some dating back to ISWG days
  - Restructured in form of a flowdown, rather than prior purpose of demonstrating what DRM would produce

SNIa Example – Science Requirements

- **SN 1:** The distance modulus μ(z) shall be measured over the redshift range $0.2 \leq z \leq 1.7$, with observational noise contributions to the uncertainty $\sigma_\mu \leq 0.02$ per $\Delta z = 0.1$ bin.
- **SN 2:** Observe >100 SNe-Ia per $\Delta z = 0.1$ bin for all bins for $0.2 < z < 1.7$. *[The discussion above implies that we should specify a larger number of SNe in the lower-z bins]*
- **SN 3:** Redshift error $\sigma_z \leq 0.005*(1 + z)$ per supernova
- **SN 4:** Relative instrumental bias ≤ 0.005 on photometric calibration across the wavelength range.
- **SN 5:** Select fields with low Galactic extinction, E(B-V) ≤ 0.02.

SNIa Example – Science Requirements

- **SN 7:** The fields employed for SN discovery must be monitored continuously with a sampling cadence ≤ 5 days
- **SN 8:** Follow-up observations of individual SNe must be scheduled with a sampling cadence ≤ 4*(1 + z) days, beginning two cadence steps prior to the peak of the light curve and continuing for five cadence steps past the peak. *[need further discussion above quantifying why these are the right number of steps. S/N per step or overall is derived from SN1 and is not a separate requirement, though perhaps it belongs as such in the next section]*
- **SN9:** Final follow-up observations of SN host galaxies must take place roughly a year or more after the SN discovery.

SNIa Example – Survey Requirements

- **SN 10**: The field of regard of the observatory must include regions within 20° of the ecliptic poles.
- **SN 11:** The wide field instrument must provide three filters, approximately Y, J, H, for SN discovery.
- **SN 12:** Spectrophotometric data shall be provided by an Integral field unit (IFU) spectrometer, with spectral resolution $\lambda/\Delta\lambda$ ~100 per 2-pixel resolution element, a bandpass spanning at least 0.6-2.0μm, and spatial resolution of 0.15 arcsecond or better.
- **SN 13:** The IFU spectra should provide S/N ≥ 10 per pixel for redshift/typing, and S/N ≥ 15 per synthetic filter band for points near lightcurve maximum in each band at each redshift. *[this presumably can be derived from requirement SN1 – need text to support this. Also need to specify number and spacing of samples relative to light curve peak]*

SNIa Example – Survey Requirements

- **SN 14:** Dither with 30 mas accuracy *[this is presently unsupported by anything. Perhaps move this to the calibration section to follow.]*
- **SN 15:** There is a programmatic requirement, based on the time allocations recommended in NWNH, that the total observing time needed to execute the baseline SNIa program be less than 6 months.

Science Requirements Document Status

- What's not in it yet:
  - Many intermediate steps in flowdown
  - Observatory performance requirements
    - Flowdown from observation requirements
    - *Partial draft of this section is what I circulated last Dec.*
  - Reference information
  - Traceability matrices
  - Calibration requirements flowdown
  - Everything that appears highlighted in yellow in the text
  - Etc.

Desired inputs

- Every section has numerous requests in form of highlighted yellow text.
  - ~equal requests for material at top, middle of flowdown
  - Examples:
- *[Insert section here describing quantitatively how the different measures of cosmic expansion can be combined to constrain cosmological parameters. This is where the link is made between the 'sub-percent precision' quoted in objectives 1 and 2 and the translation into the requirements on redshift range & accuracy and distance precsion for SNIa (i.e. give the source of σμ ≤ 0.02 per Δz=0.1 bin), redshift range, sampling density, effective volume for BAO, etc.]*
- *[insert discussion of why S/N>7 is required – use simulations to demonstrate the number of false positive detections vs S/N. This also feeds into the spectral resolution budget above.]*

Desired inputs

- Much of the requested material may already exist in some form, but some may require new or revisited analysis.
- The yet-to-be-written Observatory Performance section will need inputs from simulation efforts just now getting under way

Organizing efforts - 1

- The SRD is organized around the science themes called out in NWNH.
  - Simplifies traceability
  - Works functionally, as requirements tend to be quite distinct
- Propose working groups with similar structure:
  - Microlensing
  - Type Ia Supernovae
  - Galaxy Redshift Survey
  - Weak Lensing
  - Exoplanet/Disk direct imaging and spectroscopy
    - Not sure if exoplanets and disks should have combined or separate groups

Organizing efforts - 2

- Cross-cutting working groups
  - Calibration
    - What is needed?
    - How to do it – (1):
      - Dedicated observations
      - Self-calibration observing scenarios
      - What on-board hardware?
    - How to do it – (2):
      - How will it be implemented in data reduction pipelines?
  - Photometric redshifts, spectral typing, etc.
    - Some demands are unique to specific programs, but many issues are common, especially for GOs.

Organizing efforts - 3

- Each working group should have a lead SDT member
- Dedicated point of contact in Study Office
  - Coordinate inputs
  - Update the SRD
  - Generate traceability matricies
  - Etc.

Schedule

- Want SRD finalized by late Fall 2015.
- Notional schedule for receiving inputs:
  - Top of flowdown for each program ('Science Requirements' sections): Sept/Oct 2014
  - Middle of flowdown for each program ('Survey Implementation'): Dec 2014 / Jan 2015
  - Bottom of flowdown ('Observatory Performance') – includes results from simulations: July/August 2015