Hierarchy of observing objects

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`Initially proposed by Barry, and revised by R. Lucas`

PROPOSAL An observer submits a proposal to do an observation or set of observations. A proposal has uniquely associated with it:

- A proposal identification code
- A status (eg New, Being Observed, Partially Scheduled, Rejected, etc.)
- A title
- A list of requested bands
- A list of requested configurations
- A first author
- A contact person
- A staff contact person
- A synoptic referee rating

It has associated with it an author list, a time request list, and an optional source list.

Although there certainly are groups of proposals (and the submission tool should have a box to list associated or previous proposals), it is proposed to take no formal cognizance of them.

PROJECT proposal.project

When approving a proposal, the observing program committee creates a project. The project is observations of a source or group of sources taken from the proposal. Many proposals will have only a single project. For multiple project proposals, the projects will be scheduled as independent entities. (That is, one project may be scheduled and another not, depending on the time pressure at the particular LST.) The project refers back to the proposal through the proposal identification code. It has associated with it additional information.

- A project identification code
- A list of requested bands (possibly subset of those in proposal)
- A list of requested configurations (possibly subset of those in proposal)
- A scientific priority assigned by the observing program committee
- An optional source list (subset of that in proposal if that exists)

PROGRAM proposal.project.program

At the same time as the observing program committee creates the project, it creates a program. The program refers back to the proposal through the proposal and project identification codes. It has associated with it additional information.

- A program identification code
- A maximum time to be scheduled
- Optionally, an additional scientific priority increment (?)

The program includes at least one scheduling block and may include breakpoints.

BREAK POINT proposal.project.program.bp

The observer may wish (or be required) to have breakpoints in his program, to check on progress and be able to interact. If so, he creates a breakpoint, which refers back to the proposal through program, project, and proposal identification codes. It has associated with it additional information.

- A breakpoint identification code
- A condition required for the scheduling of any scheduling block of the program. This condition is a logical expression based on the execution status of any scheduling block in the program. It must be "true" if no scheduling block has been executed. It must be "false" before all scheduling blocks have reached their goals.

SCHEDULING BLOCK (SB) proposal.project.program.sb

When the observer is notified that his project is approved for phase 2, he makes a set of scheduling blocks. The division into scheduling blocks is under the observer's control, but for standard observing modes, a template is provided, and observers warned that deviating from spirit of the templates may result in a reduced likelihood of being scheduled. The SB refers back to the proposal through the proposal, project, program, identification code. It has associated with it additional information.

- An observing script to be executed.
- A maximum repeat count.
- A maximum single execution duration of the SB.
- A maximum total observing time to be spent using this SB.
- A main target direction, to be used by the scheduler to evaluate observing priority for the SB. All actual targets must lie within a limited area around this direction ($\sim$ 5 degrees, TBD).
- Observing scripts for preamble and postamble observations
- The sensitivity goal to be reached by repeated executions to be checked using the nominal radiometry formula, expressed in $T_{\rm A}^*$ units
- The maximum water content required for scheduling. Normally defaulted from frequency.
- The maximum seeing parameter required for scheduling. Normally defaulted from frequency and requested angular resolution.
- Conditions on the antenna positions: ranging from a required configuration name to a required angular resolution, i.e. a domain of the uv plane to be filled with reasonable uniformity (depending of the array configuration policy, TBD).
- An optional, observer assigned logical condition to be satisfied before scheduling. This is used for dependencies between SBs.
- An optional preferred LST range, and preference for rising sources, which may be used to increase the likelihood of contiguous UV tracks, over a system preference for high elevations.
- Status information, including at least:
  - The number of successful executions
  - The integration time, and theoretical rms for each execution
  - The total integration time, and current resulting theoretical rms
  - Whether the block goals are reached.

If a project or proposal source list exists, the sources in the SB should be checked to be either a member of that list or a calibrator.

Examples of SBs:

Strong source, low frequency, interferometry :

- One minute point source calibrator scan
- Nine minutes target scan

Strong source, high frequency, interferometry :

- Pointing scan
- Focus scan
- One minute point source calibrator scan
- Nine minutes target scan
- One minute point source calibrator scan
- Nine minutes target scan
- One minute point source calibrator scan
- Nine minutes target scan

Weak source, low frequency, interferometry :

  - Twenty seconds point source calibrator scan
  - Forty seconds target scan

Weak source, high frequency, interferometry :

  - Pointing scan
  - Focus scan
  - Twenty cycles of
    - Twenty seconds point source calibrator scan
    - Forty seconds target scan

Dual band, low frequency, interferometry :

  - Target, band 1, two minutes
  - Calibrator, band 1, 30 seconds
  - Calibrator, band 2, 20 seconds
  - Target, band 2, two minutes

Accurate polarization :

  - Pointing scan
  - Focus scan
  - Leakage calibrator scan, 1 minute
  - Thirty cycles of
    - Point calibrator 20 seconds
    - Target 40 seconds

Mosaicing, interferometry :

  - Pointing scan
  - Focus scan
  - Up to 30 mosaic points at 30 seconds each

Mosaicing, single dish, OTF :

  - Pointing scan
  - Focus scan
  - Off source point 1 minute
  - Scan 300 map points at 5s each
  - Off source point 1 minute
  - Scan 300 map points at 5s each

Preamble and postamble blocks have several possible functions. They may collect data for use in the data reduction phase:

- They may do a bandpass calibration on a strong calibrator.
- They may do a polarization leakage bootstrap if partial calibration or source polarization is known
- They may do a polarization orthogonal receiver phase difference determination

There is at least one case in which one would like a preamble SB to feed back information to the observing system: It may observe a list of calibrators, picking one or two which meet defined characteristics (mainly exceeding a minimum flux), using data fed back by the calibrator data reduction program. These may then be referred to symbolically in the following SBs.

OBSERVING SESSION The time continuous execution of one or more scheduling blocks in a program constitutes an observing session. In addition to the SBs it will include preamble and postamble observations attached to them.

The observing session is a key object for the data processing since data taken in a session will have some technical coherence (e.g. no receiver tuning inside a session) which allows calibrations to be shared for that data.

SCAN The scan is the lowest level object normally used by an observer. It is a sequence of observations that share a single goal. Many scans are a single observation; some, like the pointing and focus scans, involve a pattern of observations. Whether OTF mosaicing observations are considered a single scan or a scan per point is rather a matter of how you would like to define it.

OBSERVATION The observation is the minimal amount of data taking that can be commanded at the script language level. It is highly desirable that it should be a simple enough element so that the script language may be used to define the content of scans (at the staff member/expert level), as a means to develop and debug new observing modes. Ideally a single generic command could execute any observation as described by the observation descriptor. The observation descriptor features:

- a simple driving pattern for each antenna,
- a simple driving pattern for nutating subreflector
- a simple driving pattern for the array phase center
- a single receiver band
- a single position for any slow receiver calibration mechanical device (vane) or a simple switching pattern for any fast receiver calibration mechanical device (chopper)
- a single frequency or a simple frequency switching pattern
- a single correlator configuration