The ALMA Observing Tool

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EUROPEAN ARC
ALMA Regional Centre

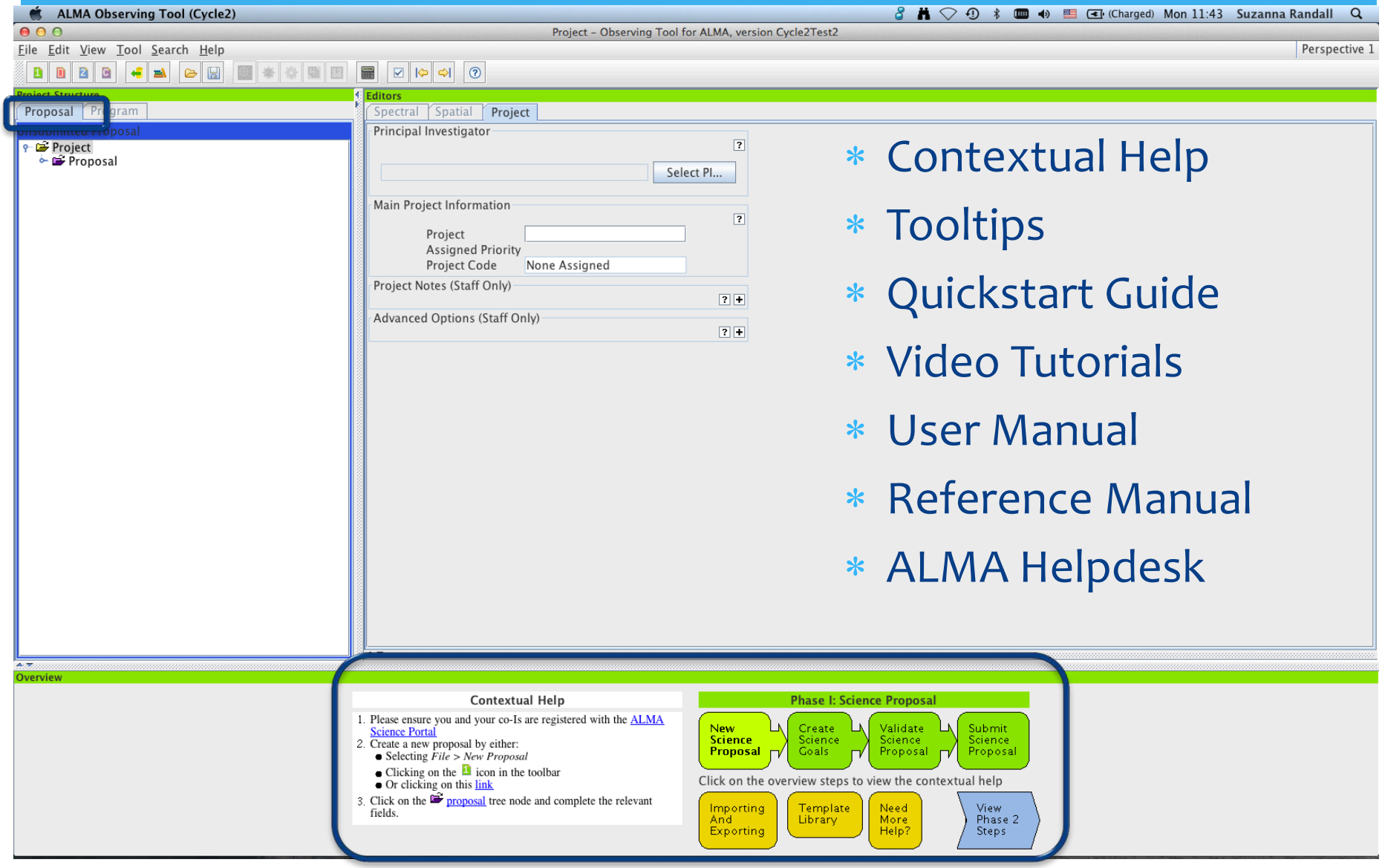
What is the ALMA OT?

* JAVA-based application, can be run on any OS that has a recent version of JAVA (currently JAVA 6 and 7 supported) installed
* Two flavours: web-start (recommended; updates done automatically) or tarball (more robust)
* The ALMA OT is the one-stop shop for
  - ✓ Preparing ALMA Observing Proposals (Phase I)
  - ✓ Submitting proposals to the ALMA archive
  - ✓ Generating Scheduling Blocks (Phase II)
  - ✓ Submitting Phase II material to the archive
* Designed to allow users without in-depth technical knowledge of sub-mm/interferometry concepts to prepare high-quality proposals

Phase I - Concepts

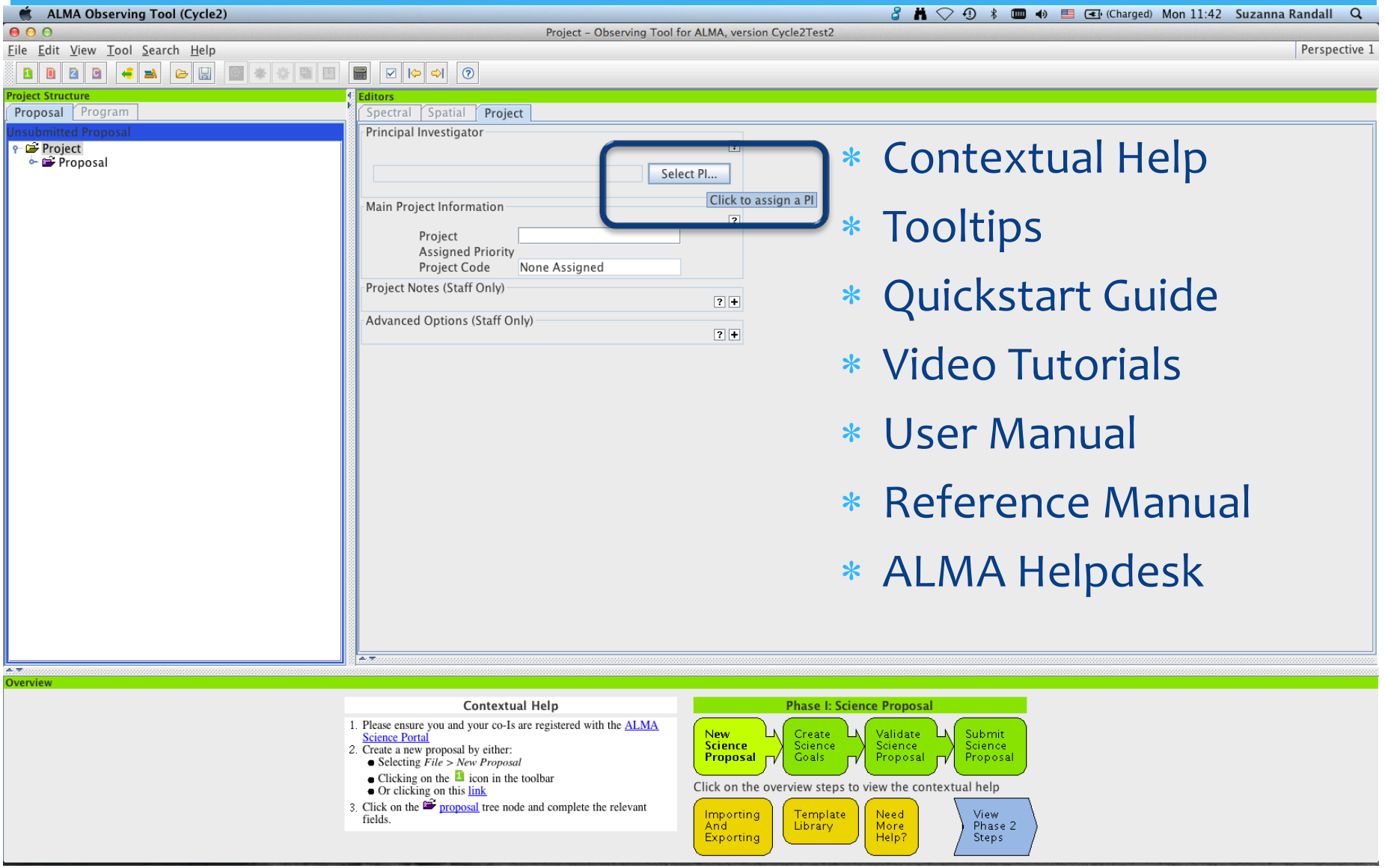
* OT software can be freely downloaded from the ALMA Science Portal. Then run locally, although intermittent internet connection required (e.g. database access, submission)
* PIs prepare ALMA proposals containing
  - ✓ General information (title, abstract, PI and co-Is etc)
  - ✓ Science Case (4 page PDF)
  - ✓ One or several Science Goals (SGs – contain technical information)
* All PIs and Co-Is must be registered with the ALMA Science Portal
* All proposals must pass a validation check before submission

Phase I – Getting started



- Contextual Help
- Tooltips
- Quickstart Guide
- Video Tutorials
- User Manual
- Reference Manual
- ALMA Helpdesk

Phase I – Getting started



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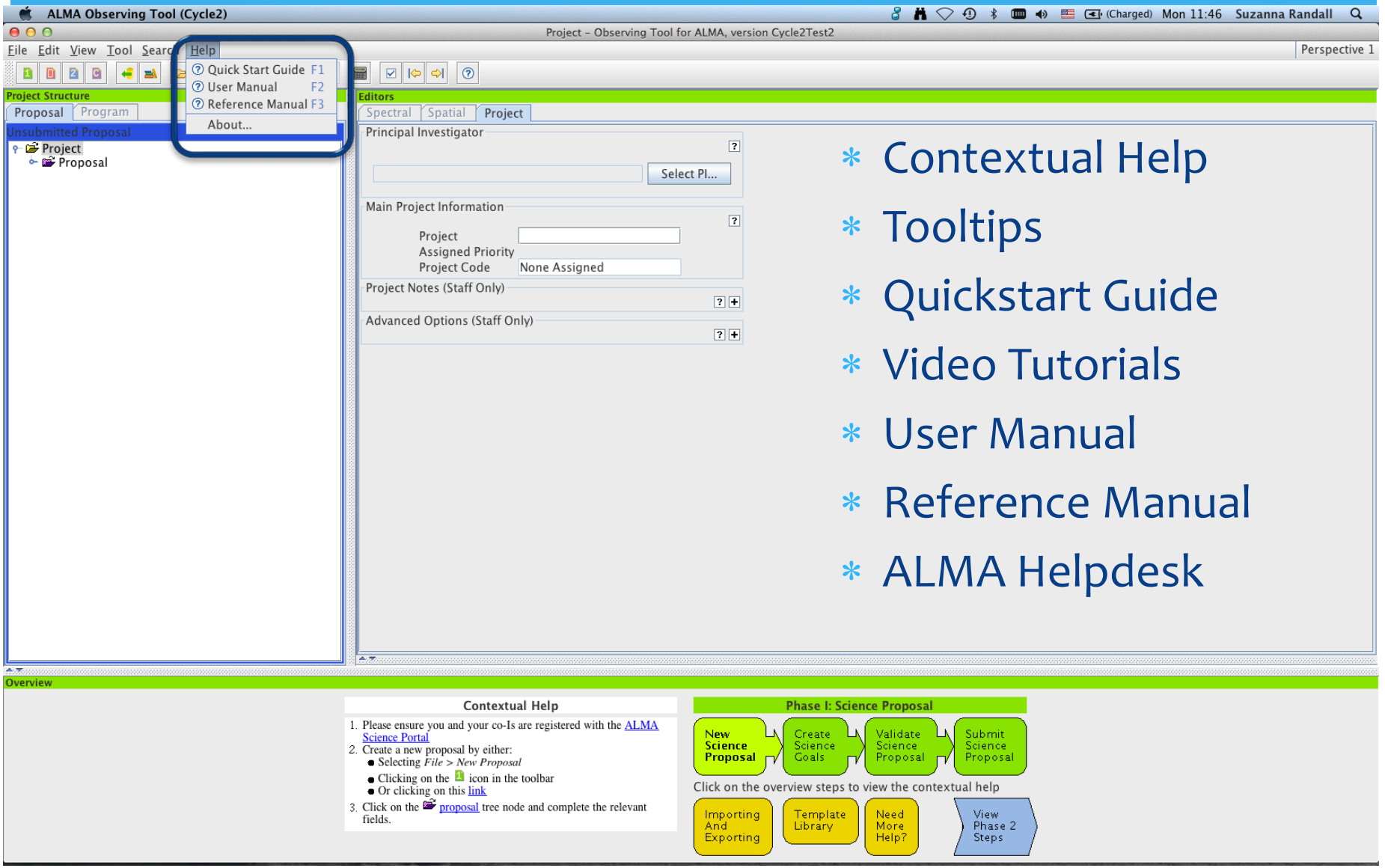

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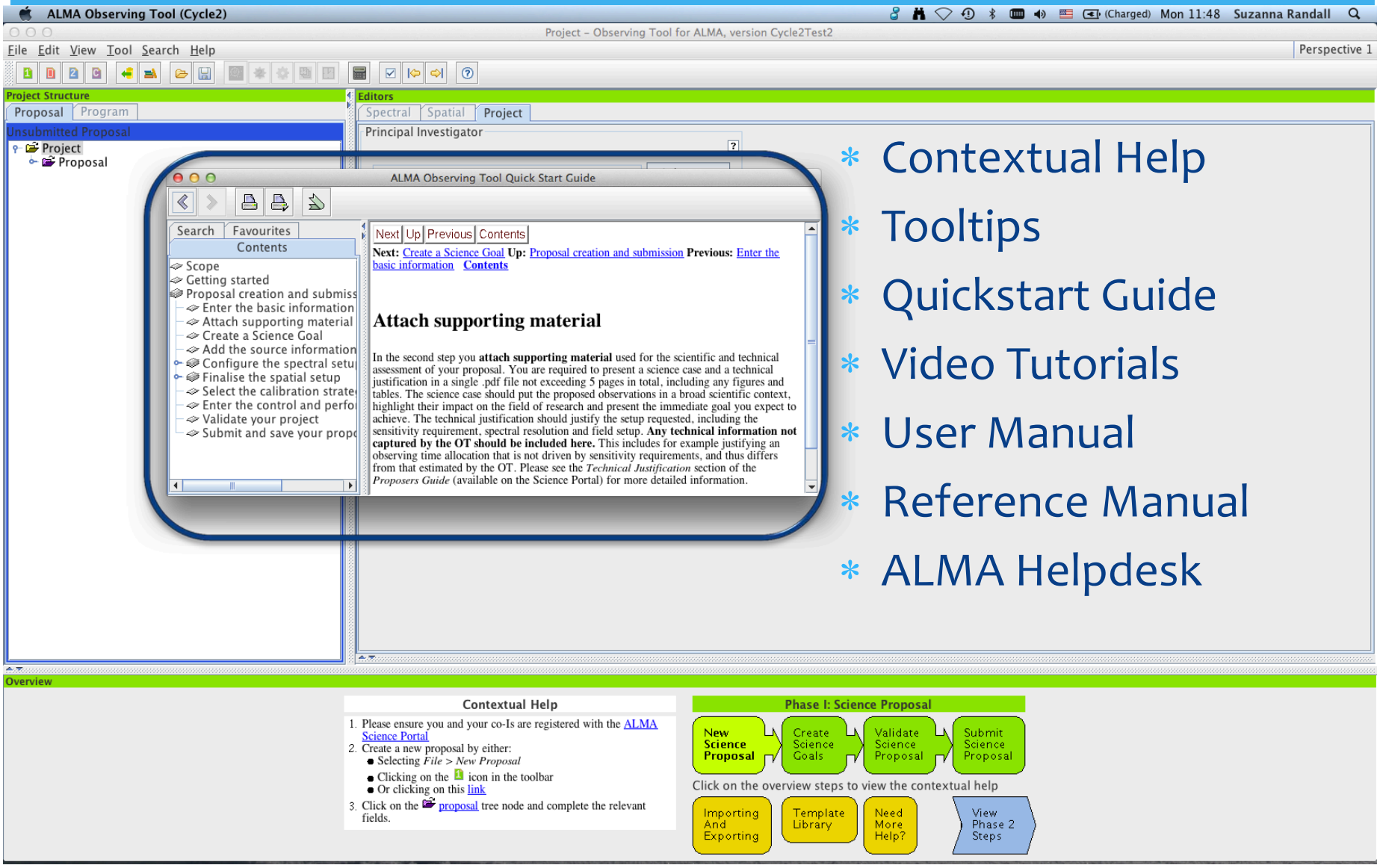

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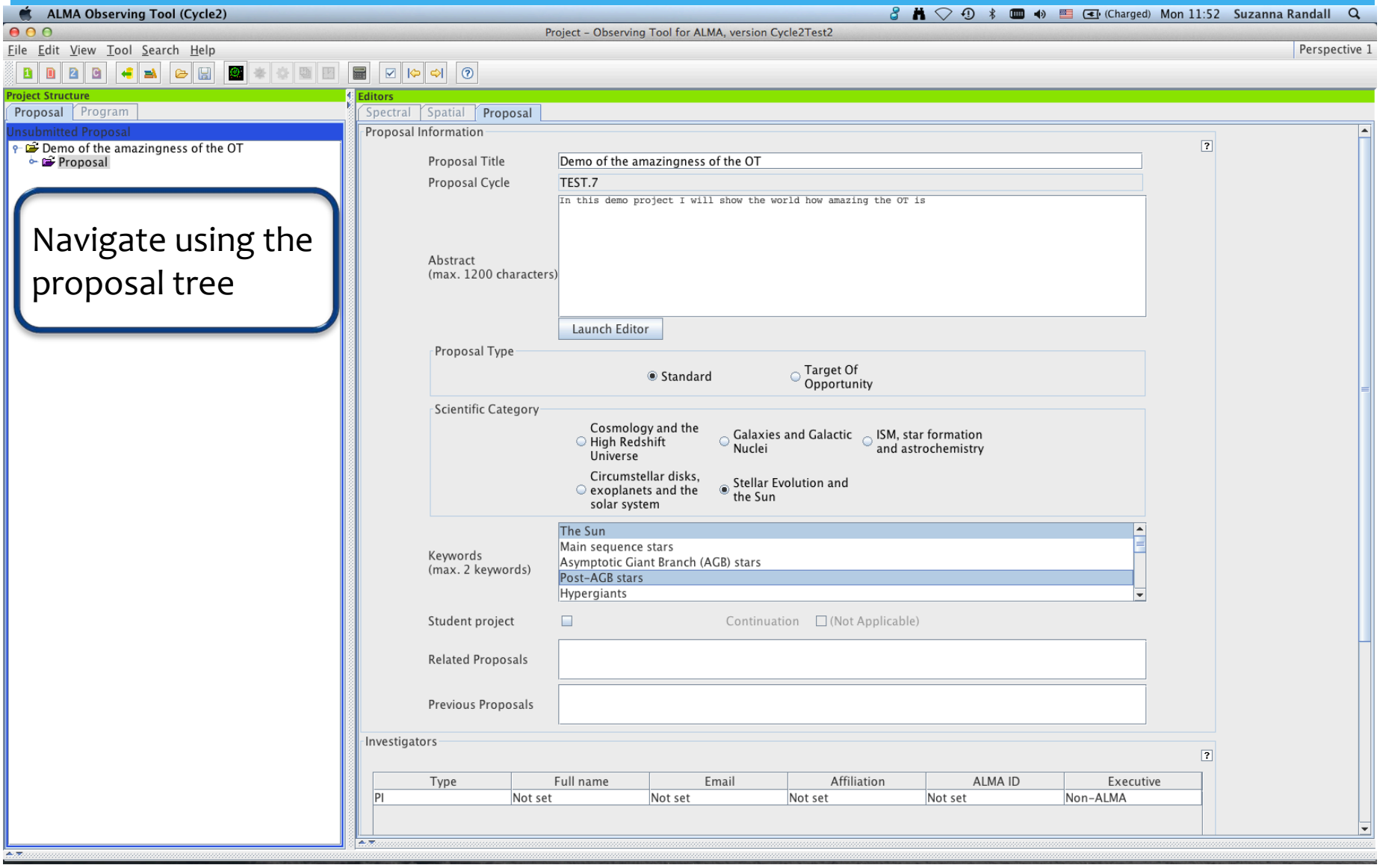
Phase I – General info



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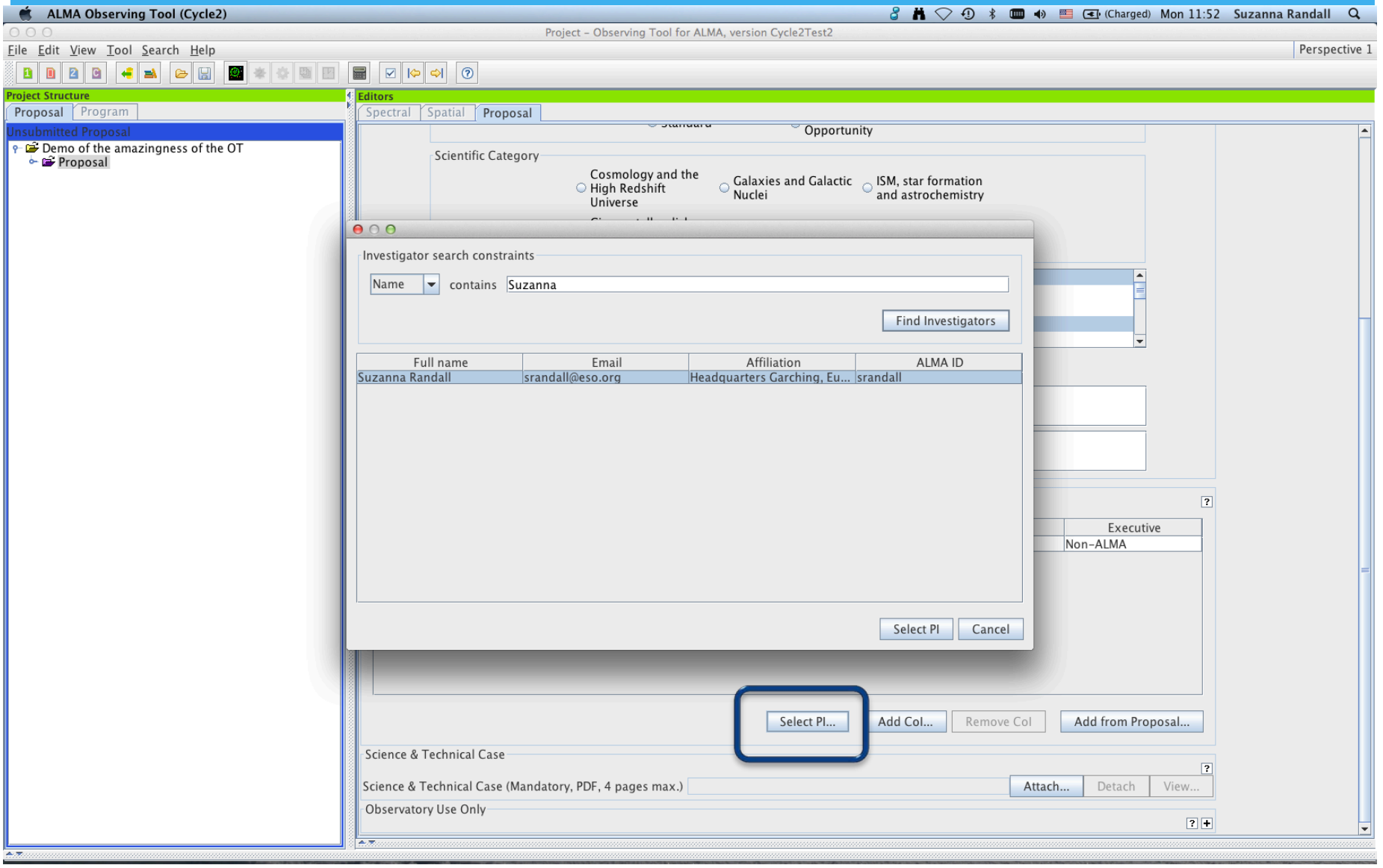
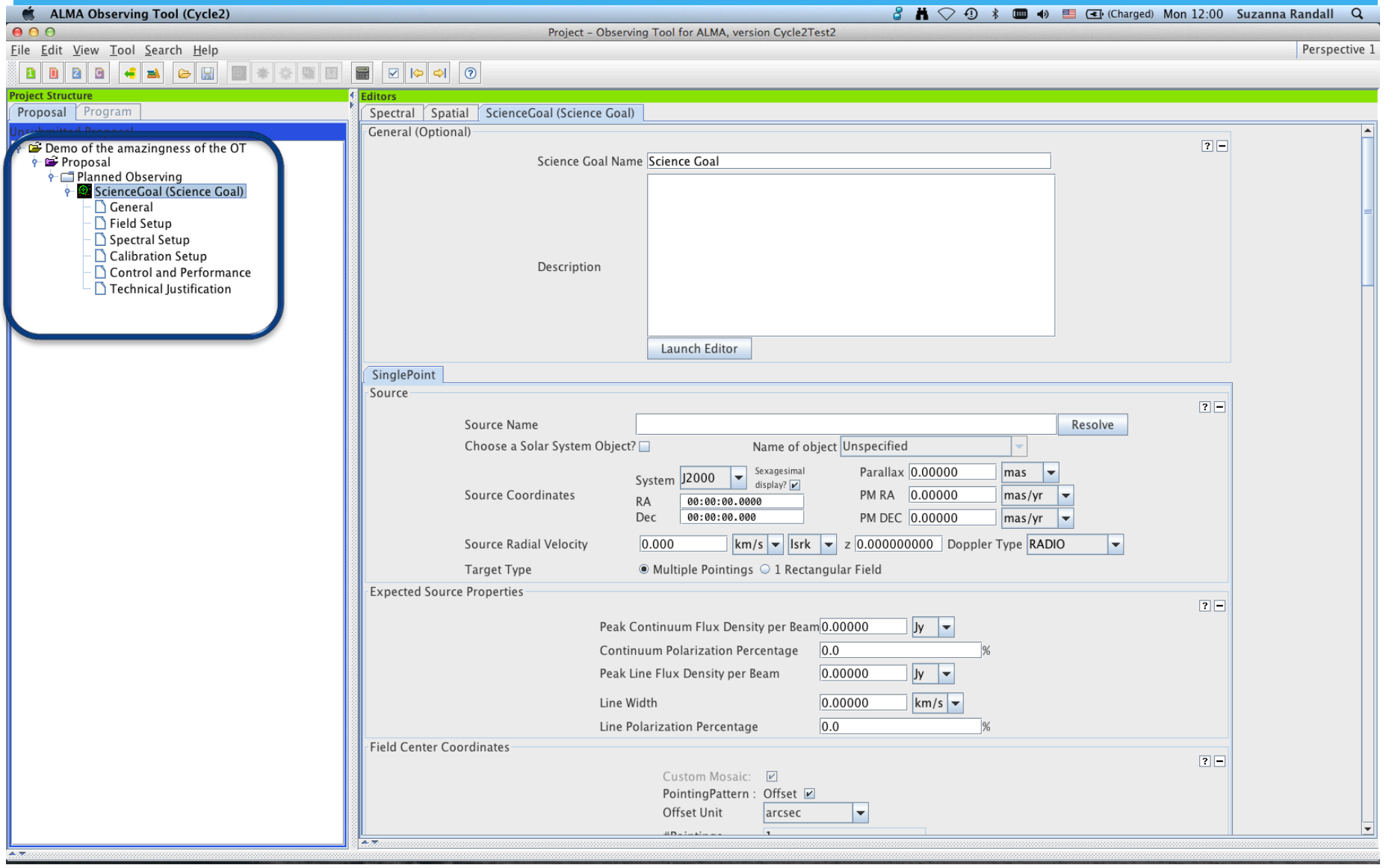


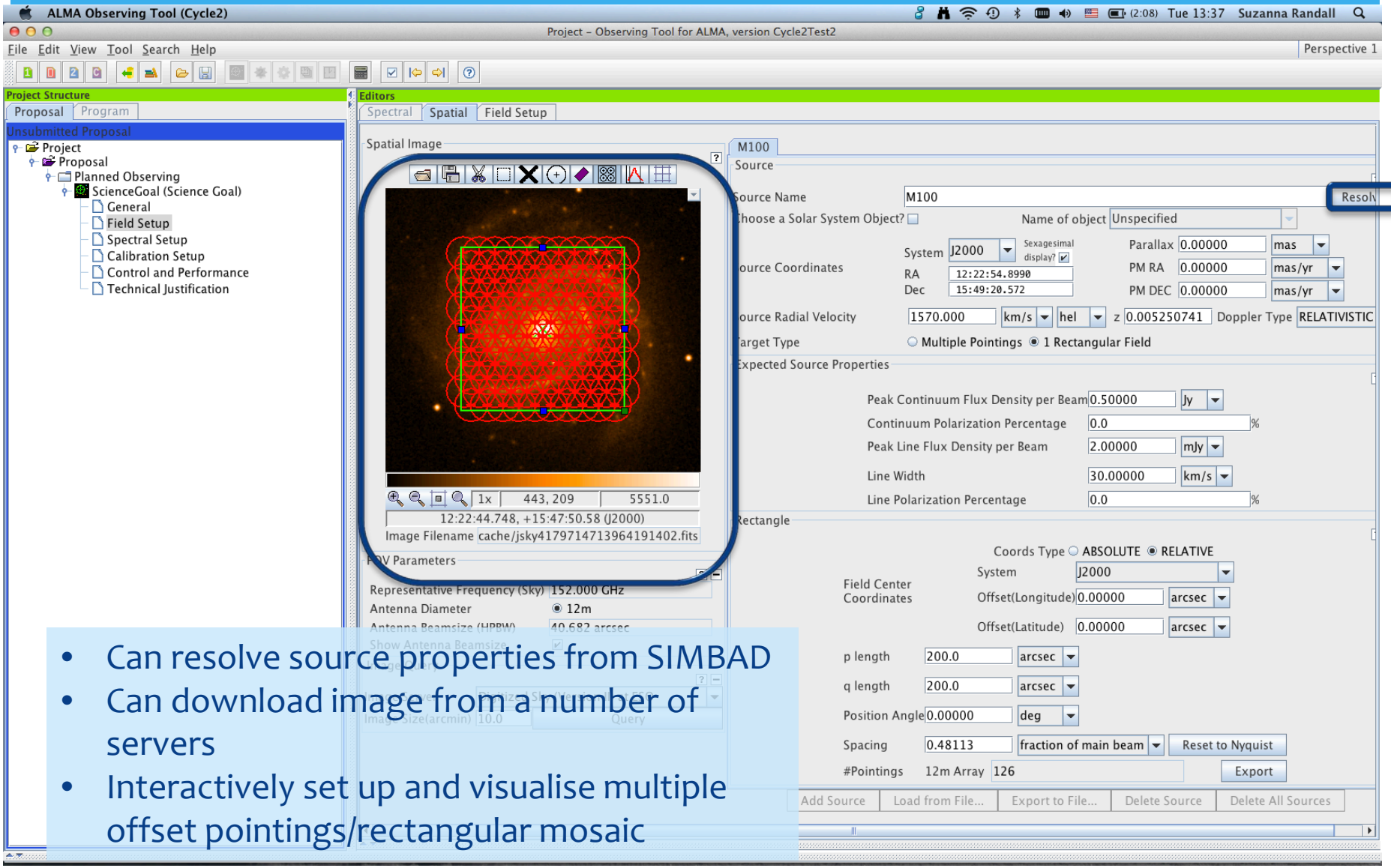
Phase I – Science Goal(s)

* A Science Goal defines the scientific requirements of an observation
  * Field setup (several point sources with offset pointings OR 1 mosaic)
  * One Spectral setup (frequencies, spectral resolution…)
  * Calibration requirements
  * One set of Control & Performance parameters (spatial resolution and LAS, sensitivity required, timing constraints…)
* The correlator setup, array configuration(s), time required to achieve requested sensitivity, observing sequence etc. are then all defined by the OT based on the user input
* Technical Justification to be included in each SG by PI

Phase I – Science Goal(s)

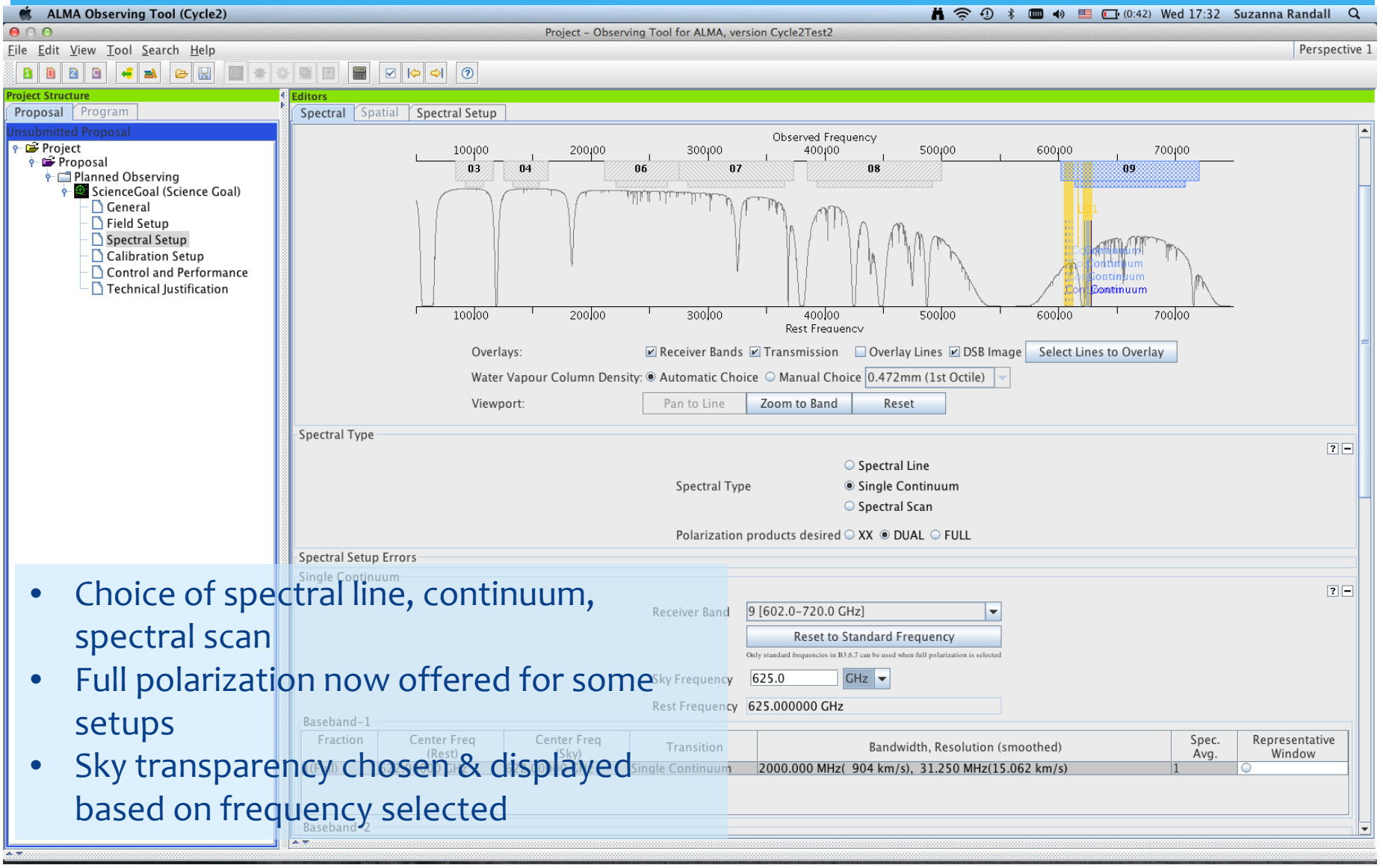


Phase I – Field Setup



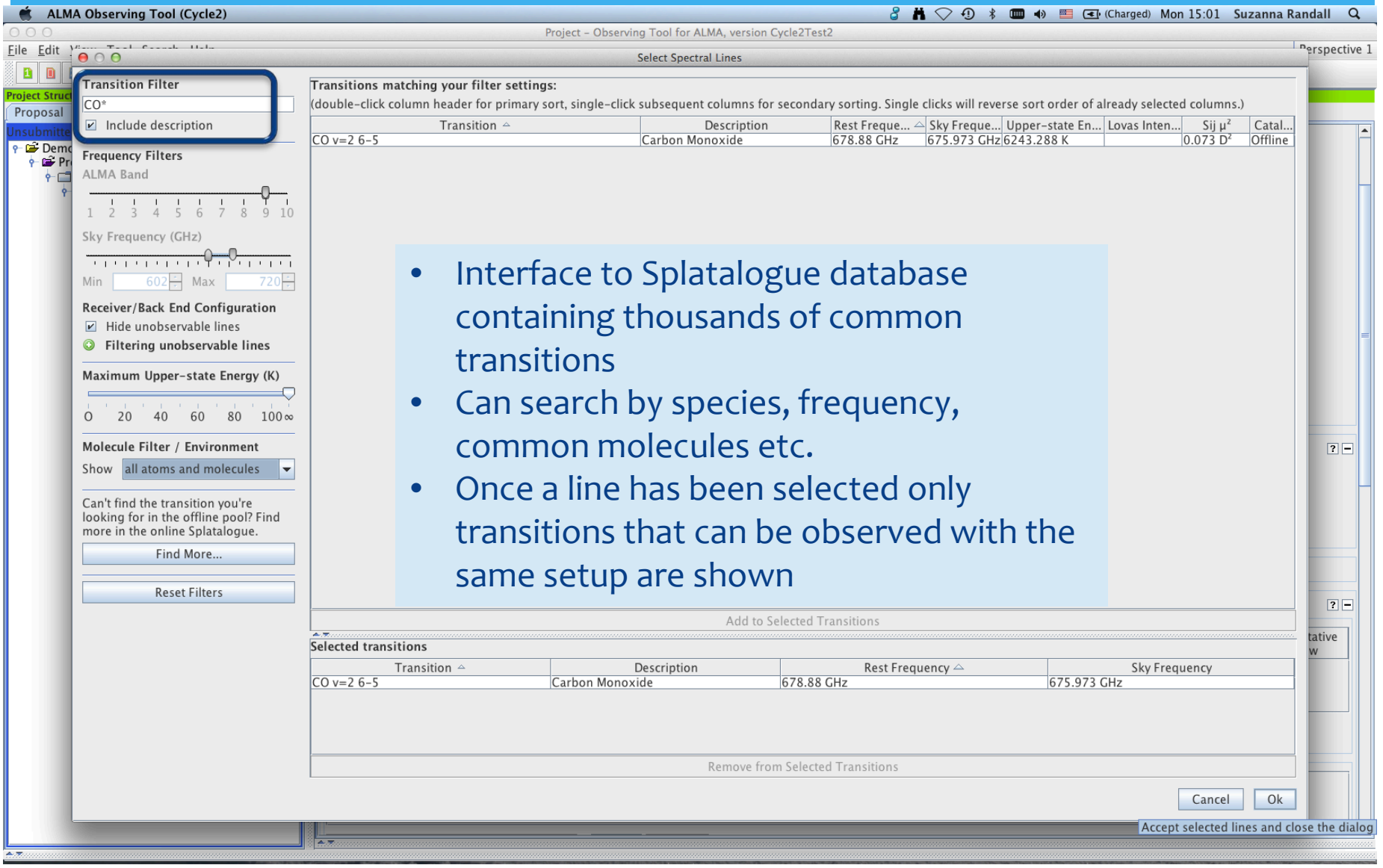
- Can resolve source properties from SIMBAD
- Can download image from a number of servers
- Interactively set up and visualise multiple offset pointings/rectangular mosaic

Phase I – Spectral Setup



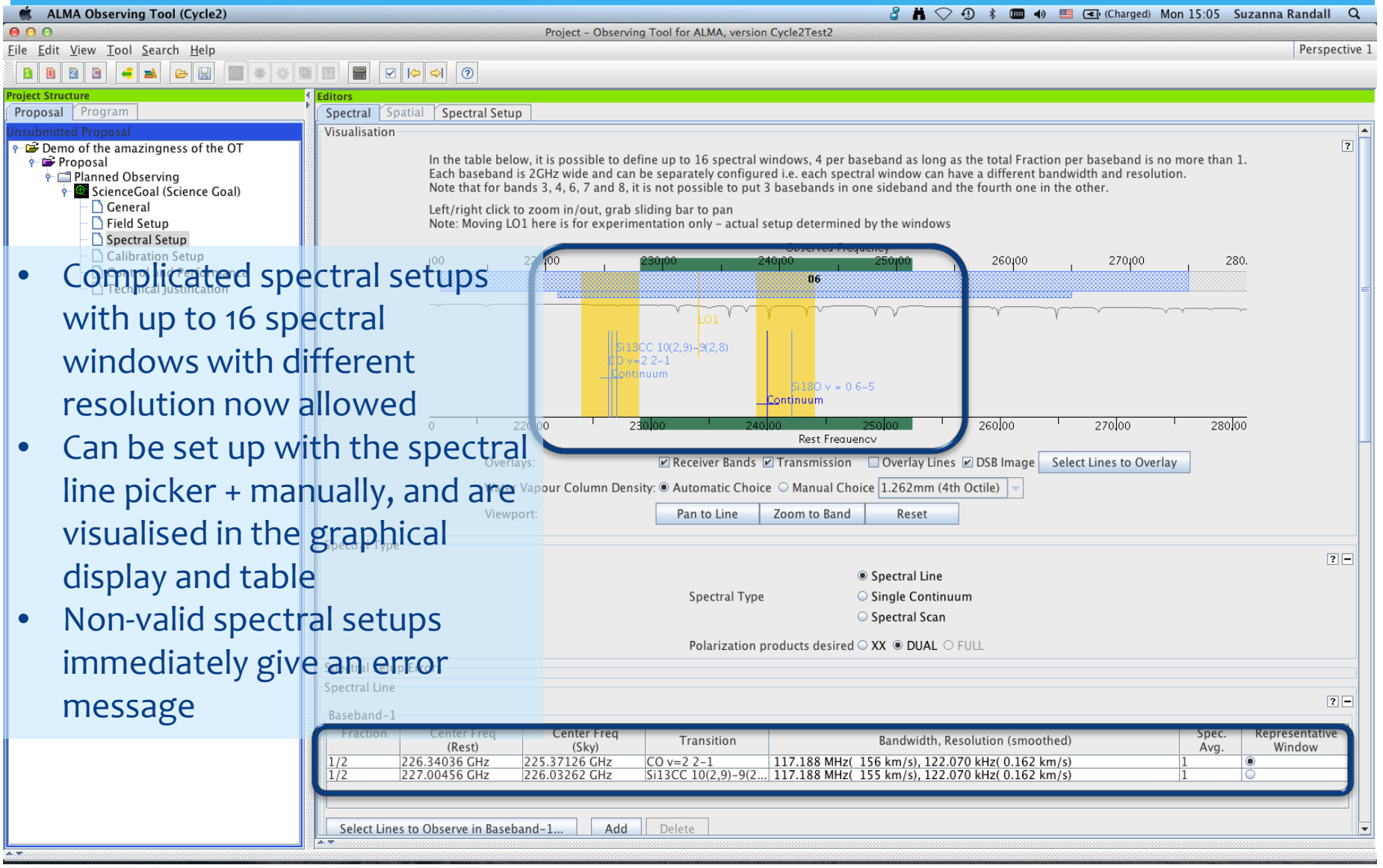
- Choice of spectral line, continuum, spectral scan
- Full polarization now offered for some setups
- Sky transparency chosen & displayed based on frequency selected

The Spectral Line Picker



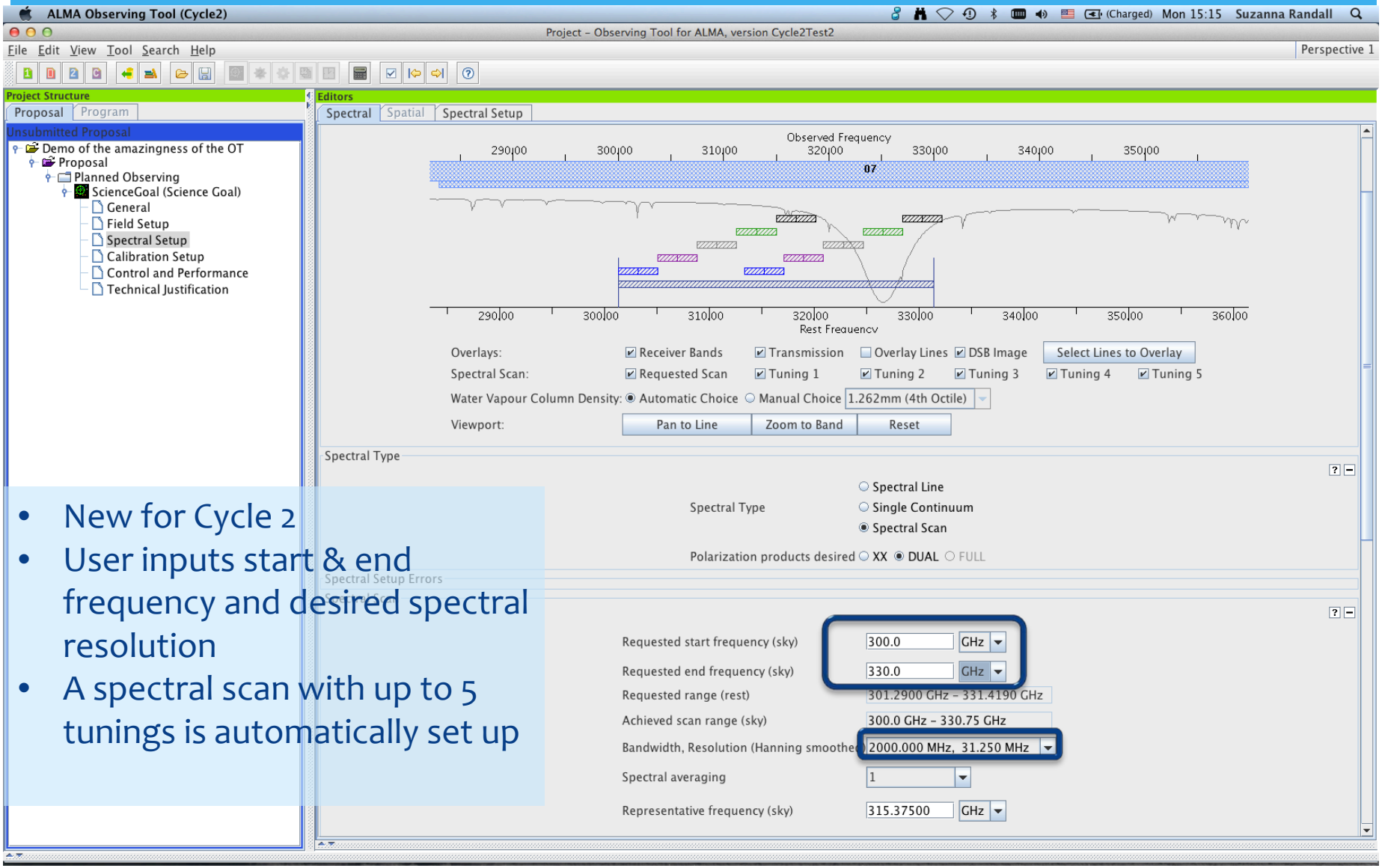
- Interface to Splatalogue database containing thousands of common transitions
- Can search by species, frequency, common molecules etc.
- Once a line has been selected only transitions that can be observed with the same setup are shown

Spectral Setup – Spectral Line



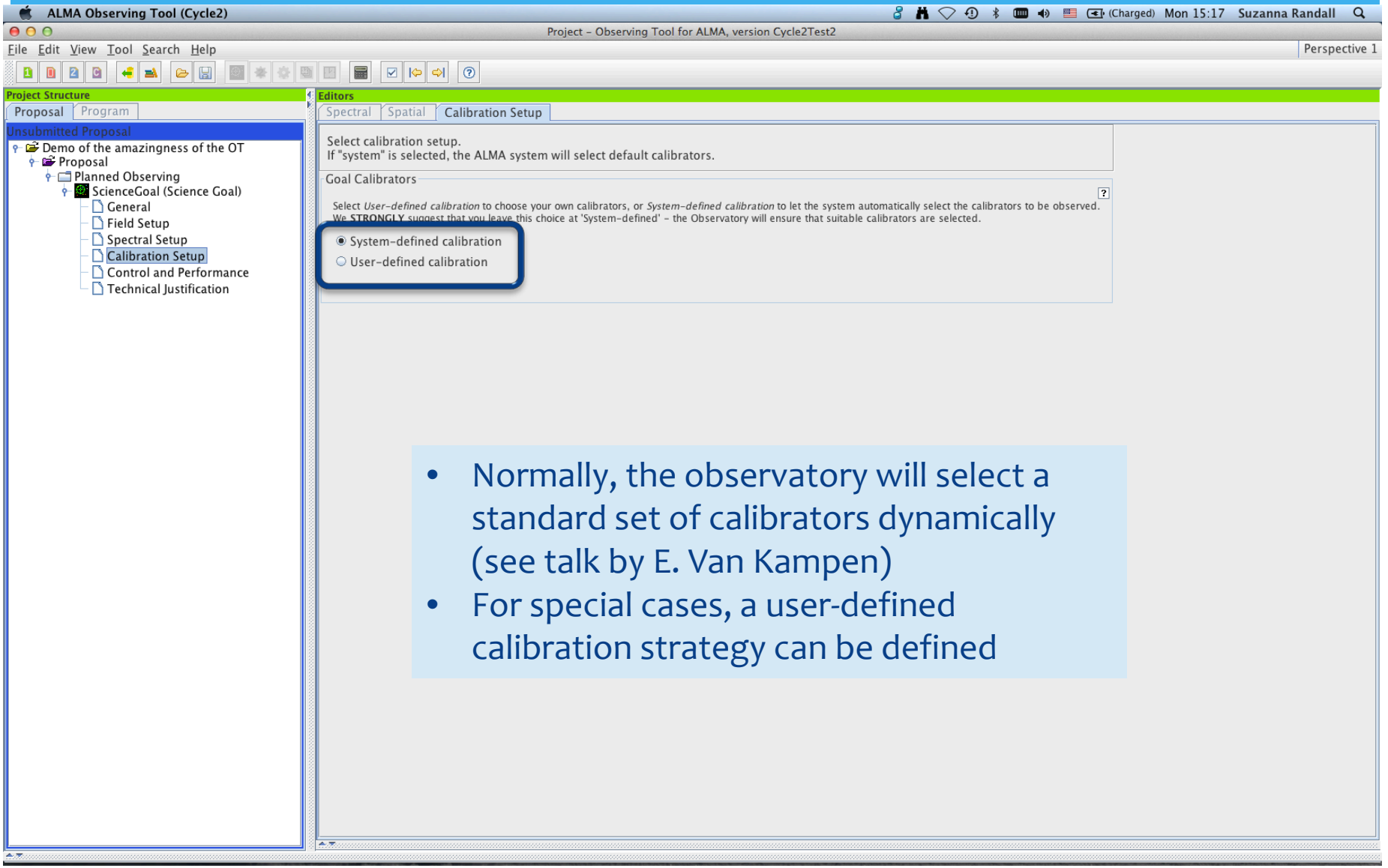
- Complicated spectral setups with up to 16 spectral windows with different resolution now allowed
- Can be set up with the spectral line picker + manually, and are visualised in the graphical display and table
- Non-valid spectral setups immediately give an error message

Spectral Setup – Spectral Scan



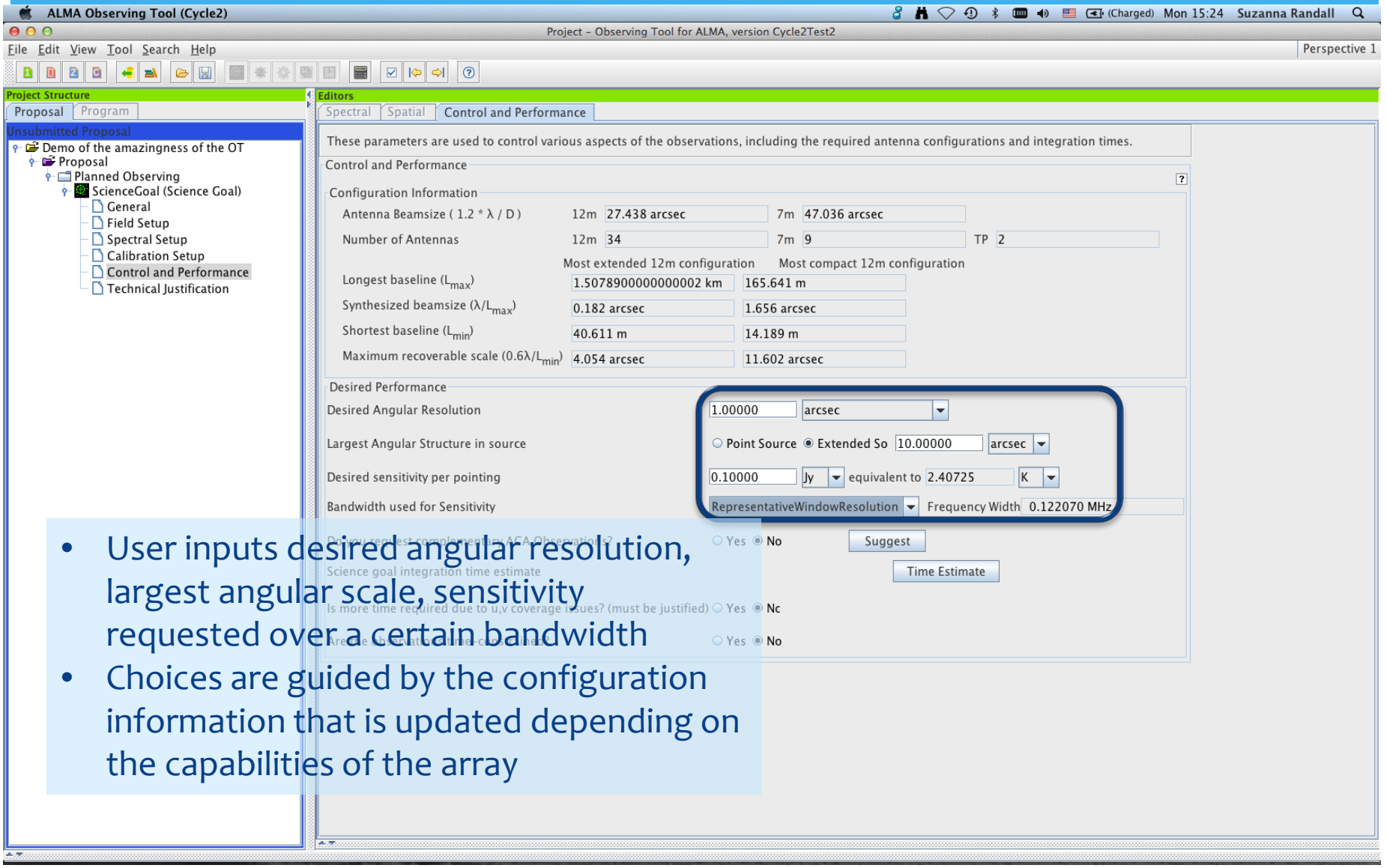
- New for Cycle 2
- User inputs start & end frequency and desired spectral resolution
- A spectral scan with up to 5 tunings is automatically set up

Phase I – Calibration Setup



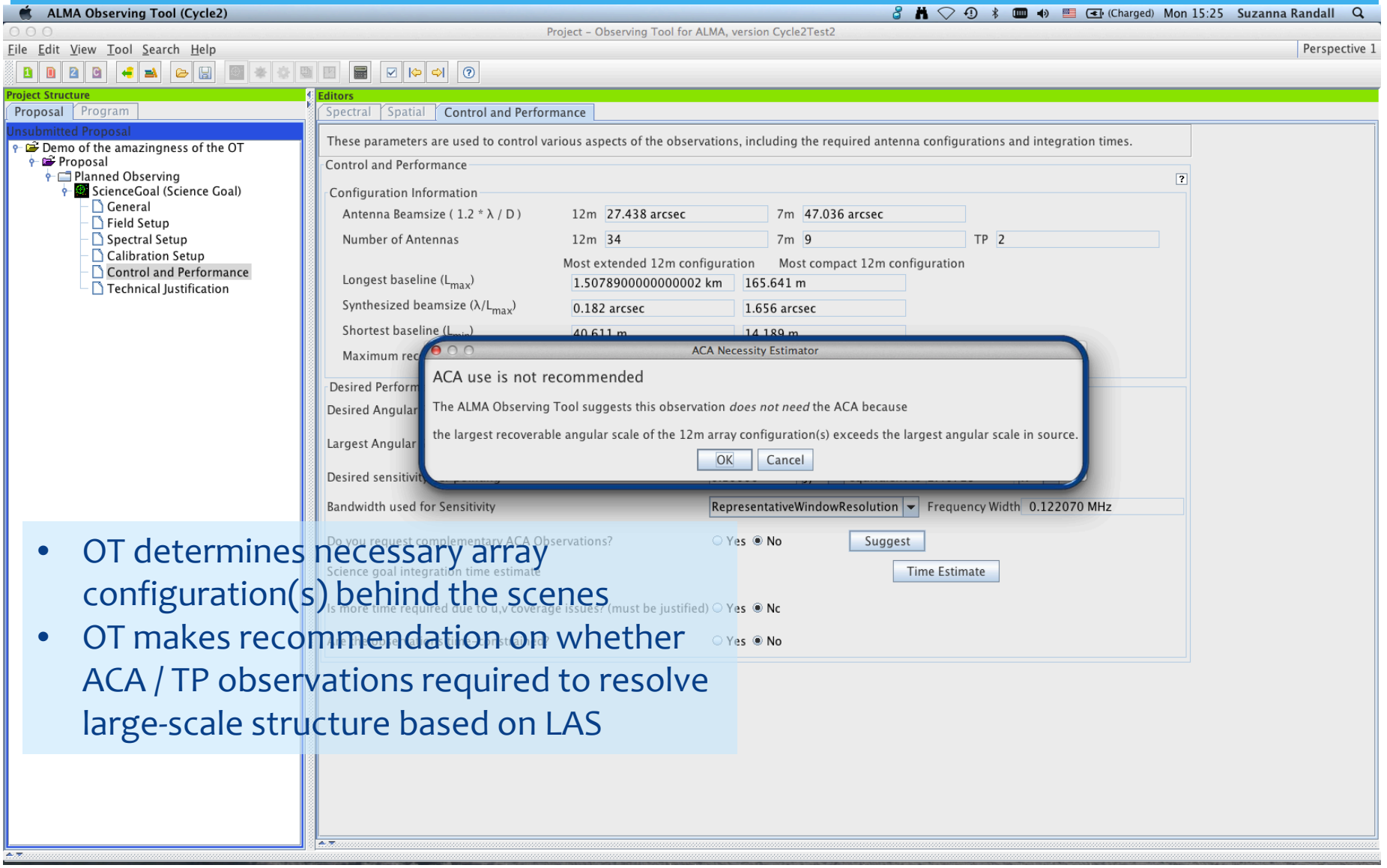
- Normally, the observatory will select a standard set of calibrators dynamically (see talk by E. Van Kampen)
- For special cases, a user-defined calibration strategy can be defined

Phase I – Control & Performance



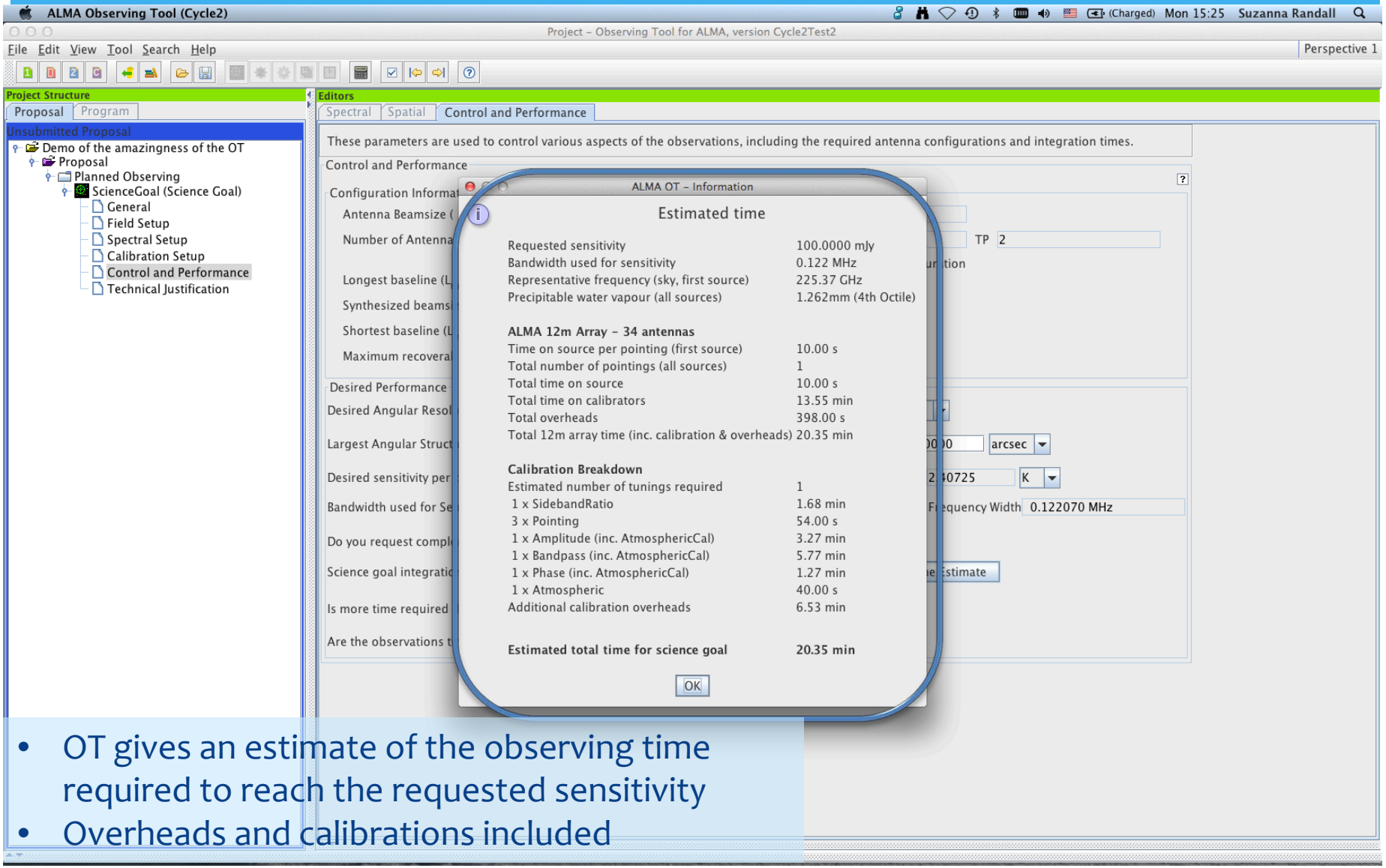
- User inputs desired angular resolution, largest angular scale, sensitivity requested over a certain bandwidth
- Choices are guided by the configuration information that is updated depending on the capabilities of the array

Phase I – Control & Performance



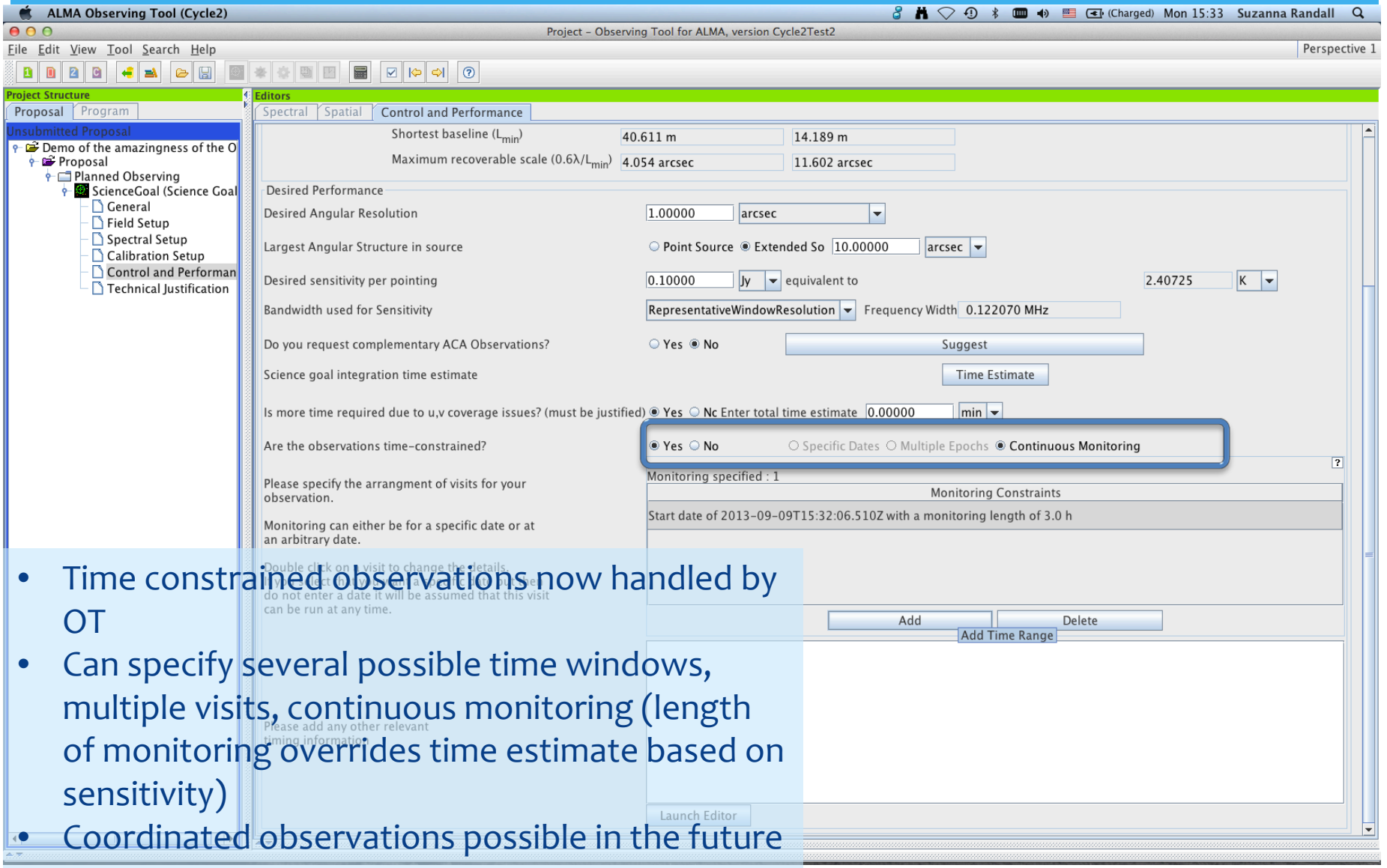
- OT determines necessary array configuration(s) behind the scenes
- OT makes recommendation on whether ACA / TP observations required to resolve large-scale structure based on LAS

Phase I – Control & Performance



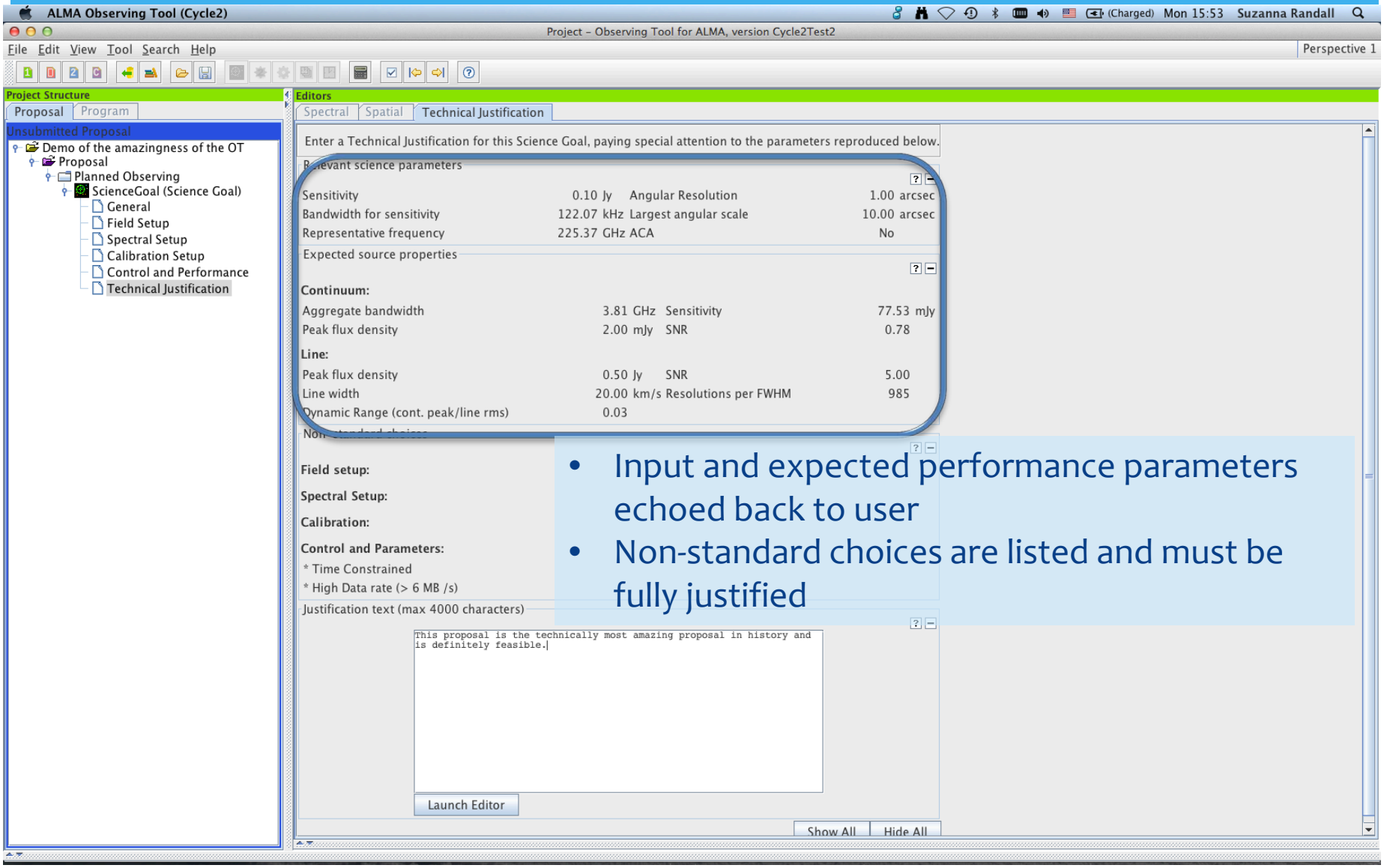
- OT gives an estimate of the observing time required to reach the requested sensitivity
- Overheads and calibrations included

Phase I – Control & Performance



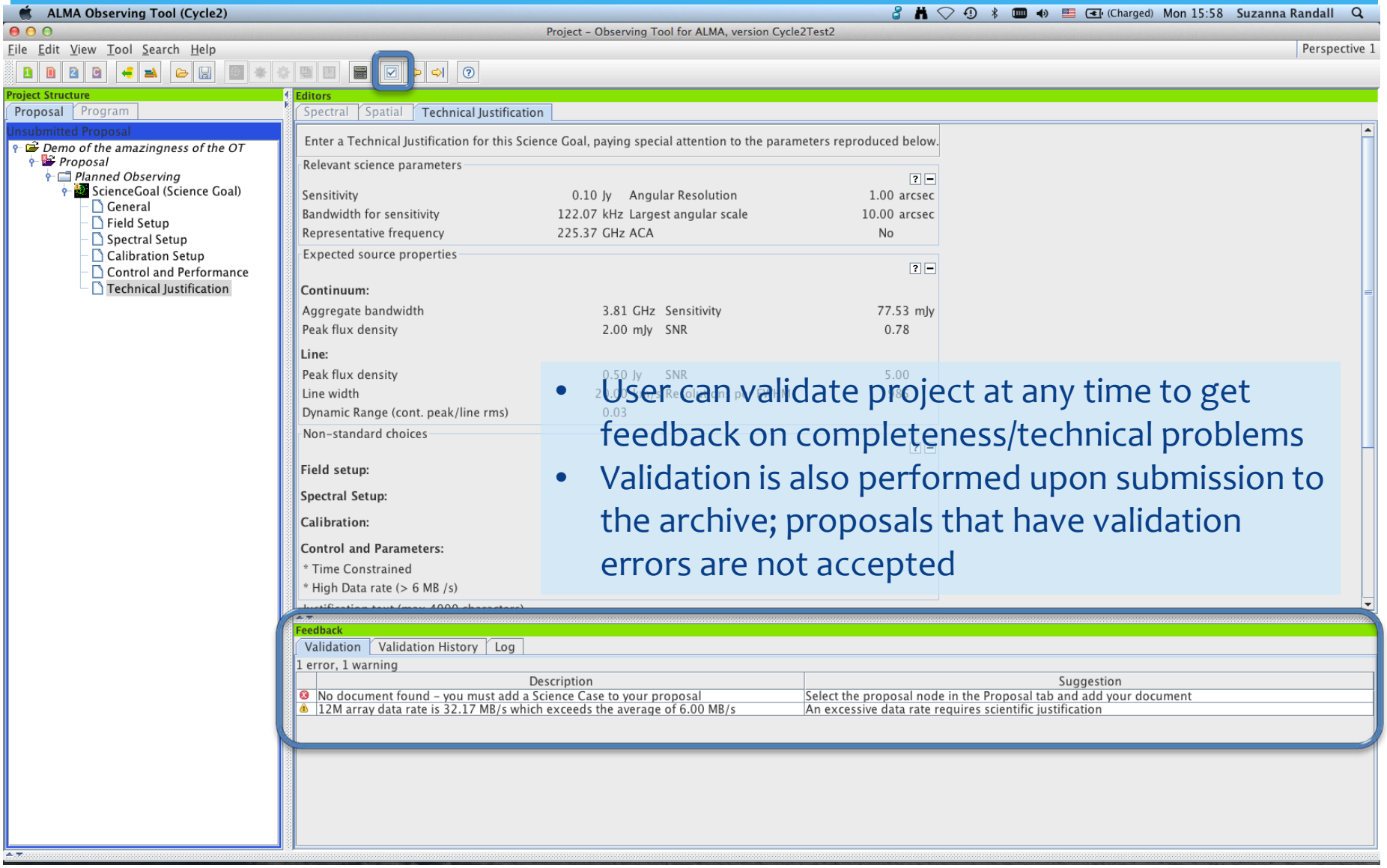
- Time constrained observations now handled by OT
- Can specify several possible time windows, multiple visits, continuous monitoring (length of monitoring overrides time estimate based on sensitivity)
- Coordinated observations possible in the future

Phase I – Technical Justification



- Input and expected performance parameters echoed back to user
- Non-standard choices are listed and must be fully justified

Phase I – Validation & Submission



- User can validate project at any time to get feedback on completeness/technical problems
- Validation is also performed upon submission to the archive; proposals that have validation errors are not accepted

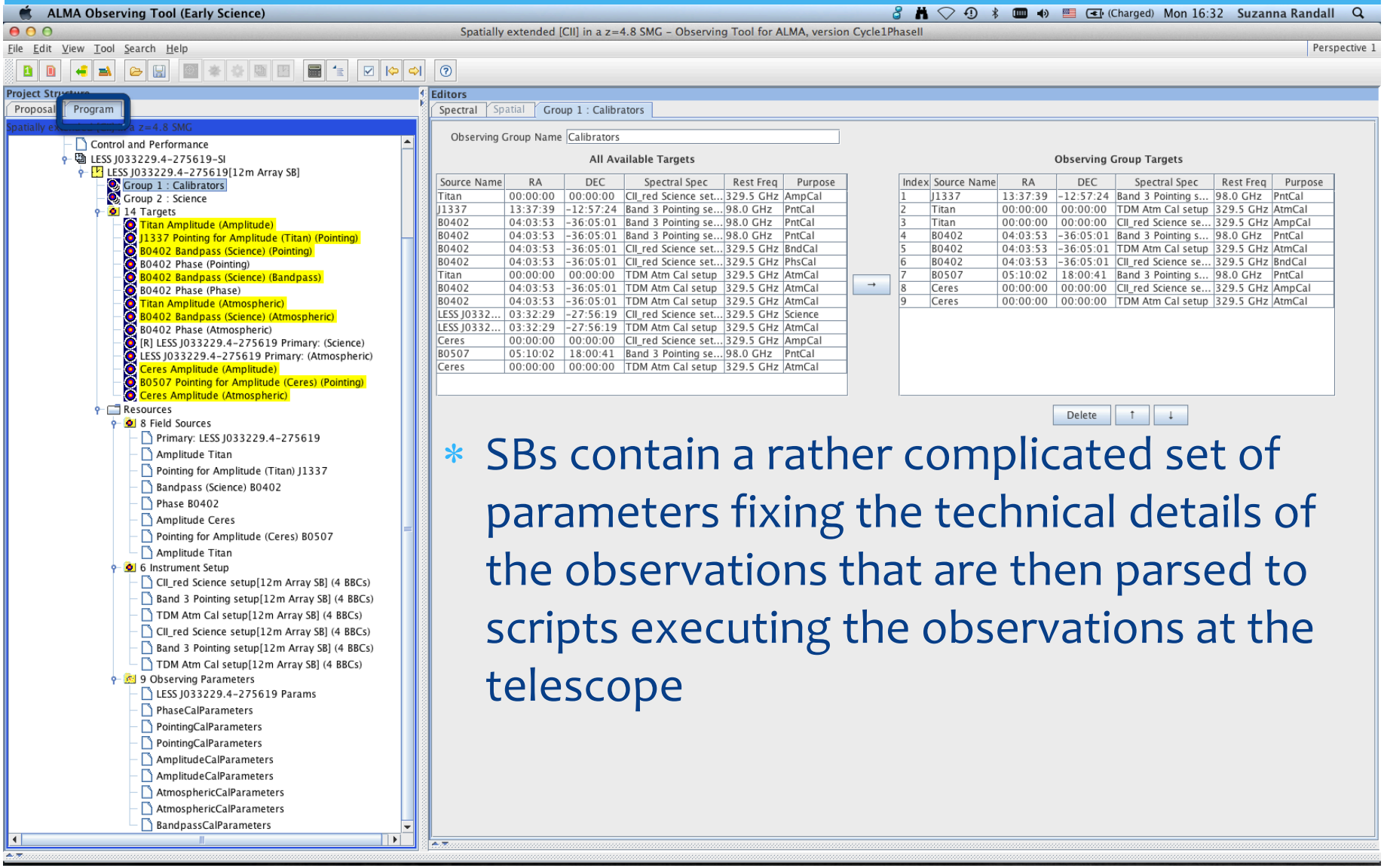
Beyond Phase I

* Re-submission of projects possible up until the deadline
* All projects submitted by the deadline are ranked based on their scientific merit
* From Cycle 2 the ranking will follow the ABCD grades as in place for ESO proposals
* Technical feasibility is evaluated – if not technically feasible, the proposal is rejected
* Proposals judged likely to be executed pass to Phase II – they then appear in the Program tab of the OT
* Scheduling Blocks (SBs) are generated semi-automatically by a member of staff using the OT, and are then approved (often after iteration & fine-tuning) by the PI
* After PI approval, the Phase II SBs are submitted to the archive by ALMA staff and set to Ready in the Project Tracker software

Phase II – Scheduling Blocks

* For each Science Goal an ObsUnitSet containing one or more SBs is created simply by pressing a button, then some checks & tweaks are done manually
* Normally one SB per array (12-m, ACA, TP)
* An SB is the smallest executable unit and contains all the technical details of the science observations as well as associated calibrations
* SBs normally run for 1-1.5 hours and are executed repeatedly until the time on source (calculated by OT based on sensitivity or specified by user for monitoring) has been reached

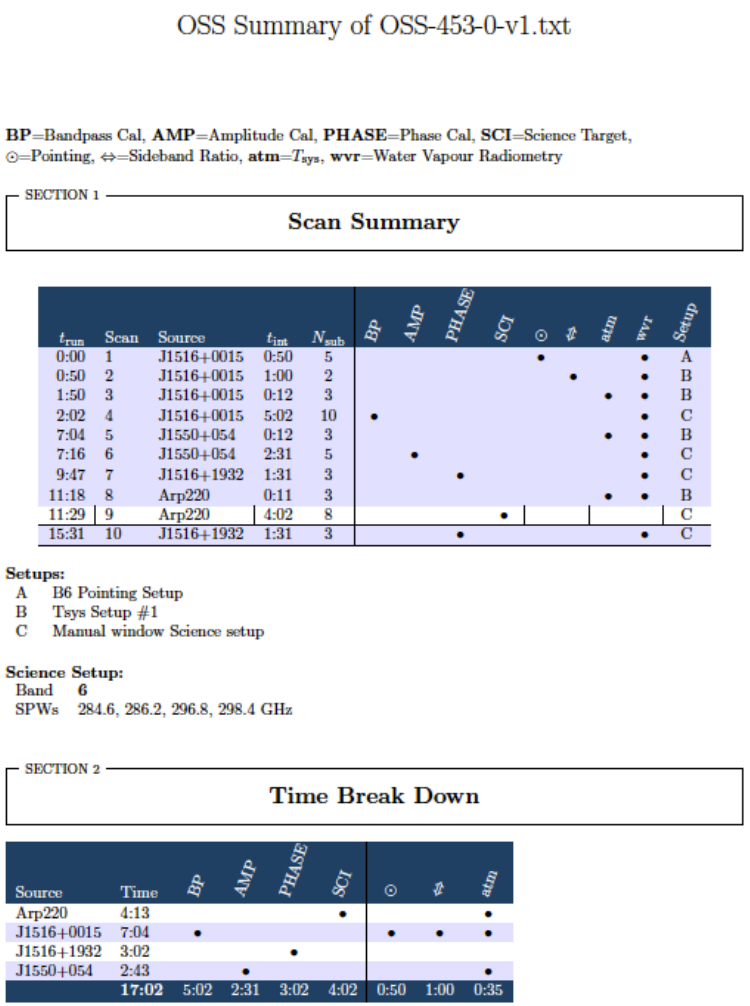
Phase II – Scheduling Blocks



* SBs contain a rather complicated set of parameters fixing the technical details of the observations that are then parsed to scripts executing the observations at the telescope

The Observing Script Simulator

* The presentation of SBs in the OT can be confusing to novice users; in particular the observing sequence and potential calibrators cannot be easily understood
* The Observing Script Simulator simulates what will happen at the telescope assuming a given execution date
* For each SB, it outputs the scan sequence and a time-break-down



OSS Summary of OSS-453-0-v1.txt

BP=Bandpass Cal, **AMP**=Amplitude Cal, **PHASE**=Phase Cal, **SCI**=Science Target, ⊙=Pointing, ⇔=Sideband Ratio, **atm**=T_{sys}, **wvr**=Water Vapour Radiometry

SECTION 1

Scan Summary

t_{run}	Scan	Source	t_{int}	N_{sub}	BP	AMP	PHASE	SCI	⊙	⇔	atm	wvr	Setup
0:00	1	J1516+0015	0:50	5					•			•	A
0:50	2	J1516+0015	1:00	2						•		•	B
1:50	3	J1516+0015	0:12	3							•	•	B
2:02	4	J1516+0015	5:02	10	•							•	C
7:04	5	J1550+054	0:12	3							•	•	B
7:16	6	J1550+054	2:31	5		•						•	C
9:47	7	J1516+1932	1:31	3			•					•	C
11:18	8	Arp220	0:11	3							•	•	B
11:29	9	Arp220	4:02	8				•					C
15:31	10	J1516+1932	1:31	3			•					•	C

Setups:
A B6 Pointing Setup
B Tsys Setup #1
C Manual window Science setup

Science Setup:
Band 6
SPWs 284.6, 286.2, 296.8, 298.4 GHz

SECTION 2

Time Break Down

Source	Time	BP	AMP	PHASE	SCI	⊙	⇔	atm
Arp220	4:13				•			•
J1516+0015	7:04	•				•	•	•
J1516+1932	3:02			•				
J1550+054	2:43		•					•
	17:02	5:02	2:31	3:02	4:02	0:50	1:00	0:35

The Observing Script Simulator

* The OSS also queries the ALMA calibrator data base and shows which calibrators are likely to be selected at run-time
* In the future, the OSS will be incorporated into the OT to make things more user-friendly
* Eventually, PIs will be able to create, submit and set to Ready their own SBs

SECTION 3

Calibrator Query

3.1 Bandpass Calibrator

The OSS performs a search of possible bandpass calibrators within 45.0 deg from the science target. A SNR of 50.0 per channel must be reached within 3.0 to 15.0 min, which conforms to a limiting flux density of 718 mJy (90 mJy if smoothing to 64ch in FDM). The minimum elevation is set to 56.0 deg.

The OSS query returned the following targets (the final choice is marked in bold):

Source	Ang.Sep.	Flux Density	Ref.Frequency
J1512-0905	33.0°	1.8 Jy	284.6 GHz
J1516+0015	23.7°	0.53 Jy	284.6 GHz
J1513-1012	34.1°	0.52 Jy	284.6 GHz

3.2 Phase Calibrator

The OSS performs a search of possible phase calibrators within 15.0 deg from the science target. A SNR of 15.0 over the full bandwidth must be reached within 0.5 to 2.0 min, which conforms to a limiting flux density of 18.4 mJy.

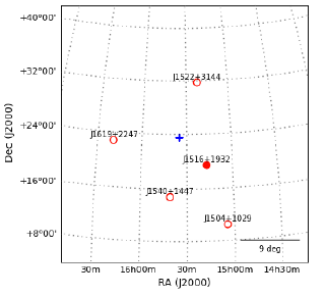
The OSS query returned the following targets (the final choice is marked in bold):

Source	Ang.Sep.	Flux Density	Ref.Frequency
J1516+1932	5.8°	0.45 Jy	284.6 GHz
J1540+1447	8.8°	0.4 Jy	284.6 GHz
J1504+1029	14.9°	0.36 Jy	284.6 GHz
J1619+2247	10.2°	0.12 Jy	284.6 GHz
J1522+3144	8.7°	0.1 Jy	284.6 GHz

3.3 Amplitude Calibrator

source	size	baselines*
Pallas	0.2″	3 / 6
Ceres	0.5″	1 / 6
Titan	0.8″	1 / 6
Callisto	1.2″	1 / 6
Ganymede	1.3″	1 / 6
Neptune	2.2″	1 / 6
Uranus	3.3″	1 / 6
Mars	3.9″	1 / 6
Venus	9.7″	0 / 6
Jupiter	34.9″	0 / 6

* fraction of baselines that are short enough to not resolve out the source



No suitable Solar System Object found. Choosing Grid Source **J1550+054** instead.

Conclusion

* The OT is constantly evolving – many new capabilities still to come
* A huge effort was made to make this tool as self-explanatory and user-friendly as possible
* There is extensive documentation available
* Any suggestions for improvement / comments are welcome!