The ALMA Observing Tool, experiences from Cycle 0

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Overview

1. ALMA and ALMA Observing Tool Introduction

2. Brief Cycle 0 Description

3. Cycle 0 Proposal Submission:
   - Setup
   - Deadline
   - Debrief

4. The Future

Acknowledgements

- David Clarke, Maurizio Chavan, Liz Humphreys, Harvey Liszt, Nuria Lorente, Suzanna Randall, Mark Rawlings, Joe Schwarz, Steve Scott, Heiko Sommer, Leonardo Testi, and many more.

- All our testers over the past several years, from ALMA Regional Centres (ARCs) and elsewhere.

- Correlator subsystem for their validator module
- Control subsystem for their tuning solutions module
- Archive for…the Archive, and some utilities
- Observatory Operations for User Repository

- Joint ALMA Observatory (JAO) Software team for machines, configurations, assistance

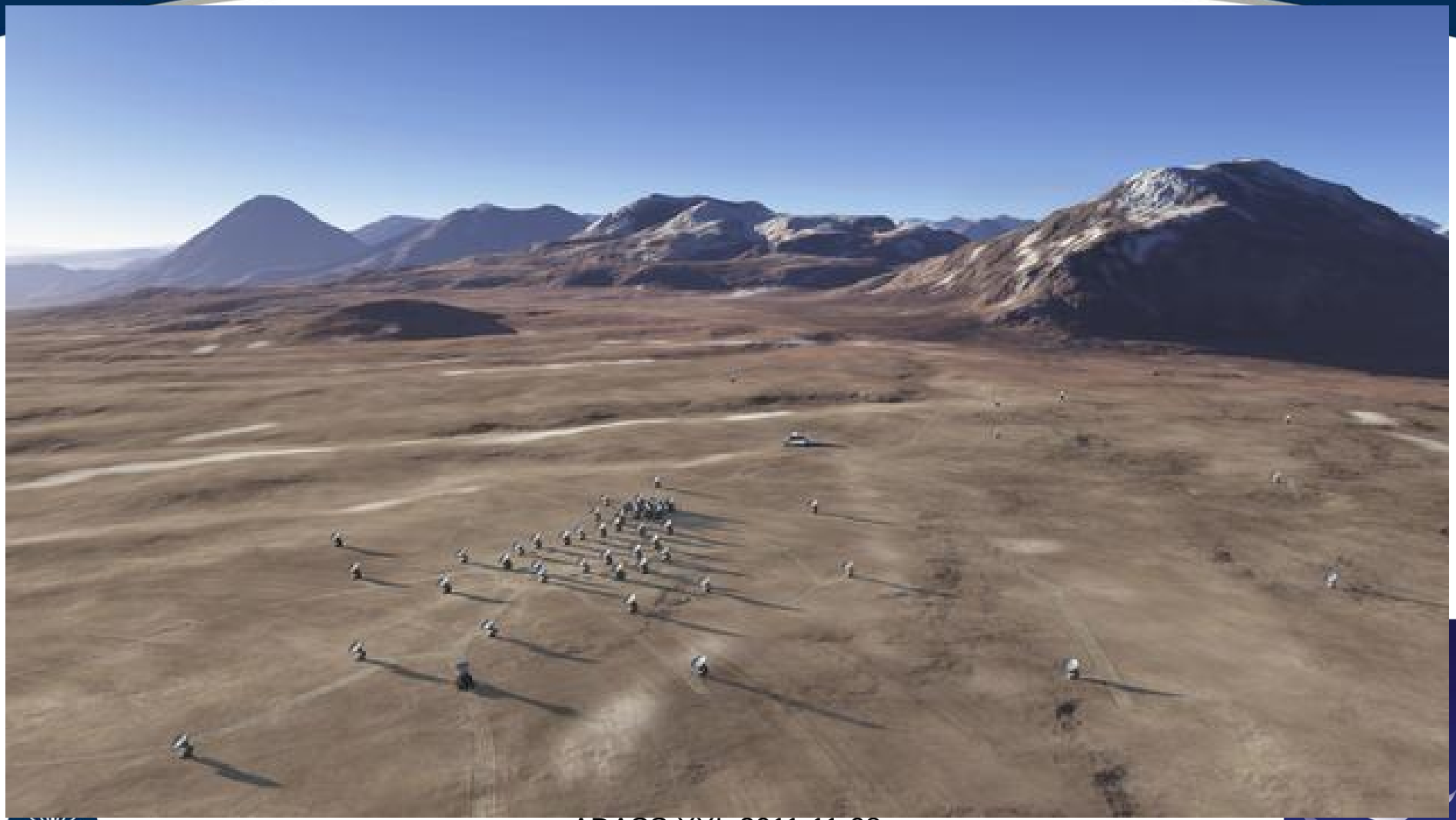
ALMA: What is it?

- The **Atacama Large Millimeter/submillimeter Array (ALMA)**, an international partnership of **Europe, North America** and **East Asia** in cooperation with the Republic of Chile. It is **the largest astronomical project** in existence.
  - *The Sun never sets on the ALMA Project!*

- At least 50 12 metre antennas at 5000m, Llano de Chajnantor, Chile, acting as an interferometer
- Plus ALMA Compact Array - 12 7m dishes, 4 more 12m *Total Power* dishes
- Largest/most sensitive instrument in World at mm and submm wavelengths (10mm-350micron, 30-950 GHz).
- Study galaxy/star/planetary system formation in un-precedented detail: Up to 15km baselines, milli-arcsec resolution

ALMA in September 2011

ALMA in 2013



The Antennae: Hubble and ALMA

Hubble Image:
Blue stuff

CO 115 & 346 GHz

12 Antennas

The ALMA OT: multi-use

- Main Astronomer interface into ALMA
- Used for *Phase I* Proposals (Science Goals)
  - Provides validation & configured according to available capabilities
- Used for detailed *Phase II* Observing Preparation
  - Output is a series of Scheduling Blocks used to control observing (ALMA is dynamically scheduled)
- Java desktop client tool
  - Delivered to user via tarball or webstart
- Servlet (Tomcat) server front-end to the Archive
  - In Santiago (JAO)
  - Provides role-based authentication, ensures validation

Multi-customer

- Obviously for community investigators
  - From novices to experts

But also

- In use by JAO (& ARC) staff for verification and commissioning
- Used by staff to develop observing (now, and in operations)
- Provide proposal summary information to reviewers
- And of course output used by the downstream systems

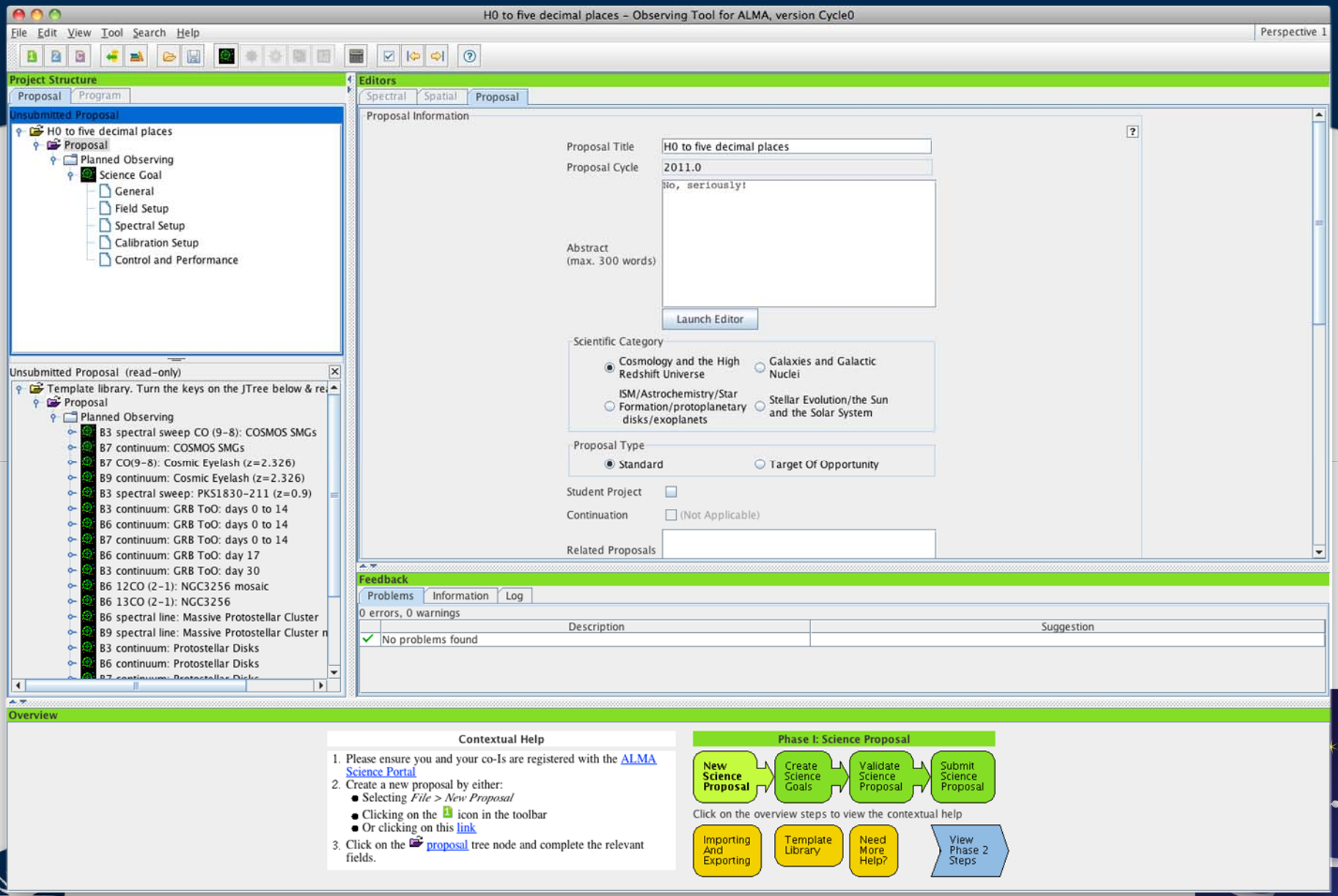
An Intelligent Tool

The tool *knows* what ALMA can do, so the user doesn't need to (almost):

- Sensitivity calculations, observing time estimates
- Suggests defaults
- Auto-generates SBs from Science Goals
  - According to various default strategies and policies
- Derives calibration strategies
- Derives correlator setups
- Validates to ensure the project can be executed
- Constrains to current cycle capabilities
  - Configurable, so other capabilities also available for commissioning

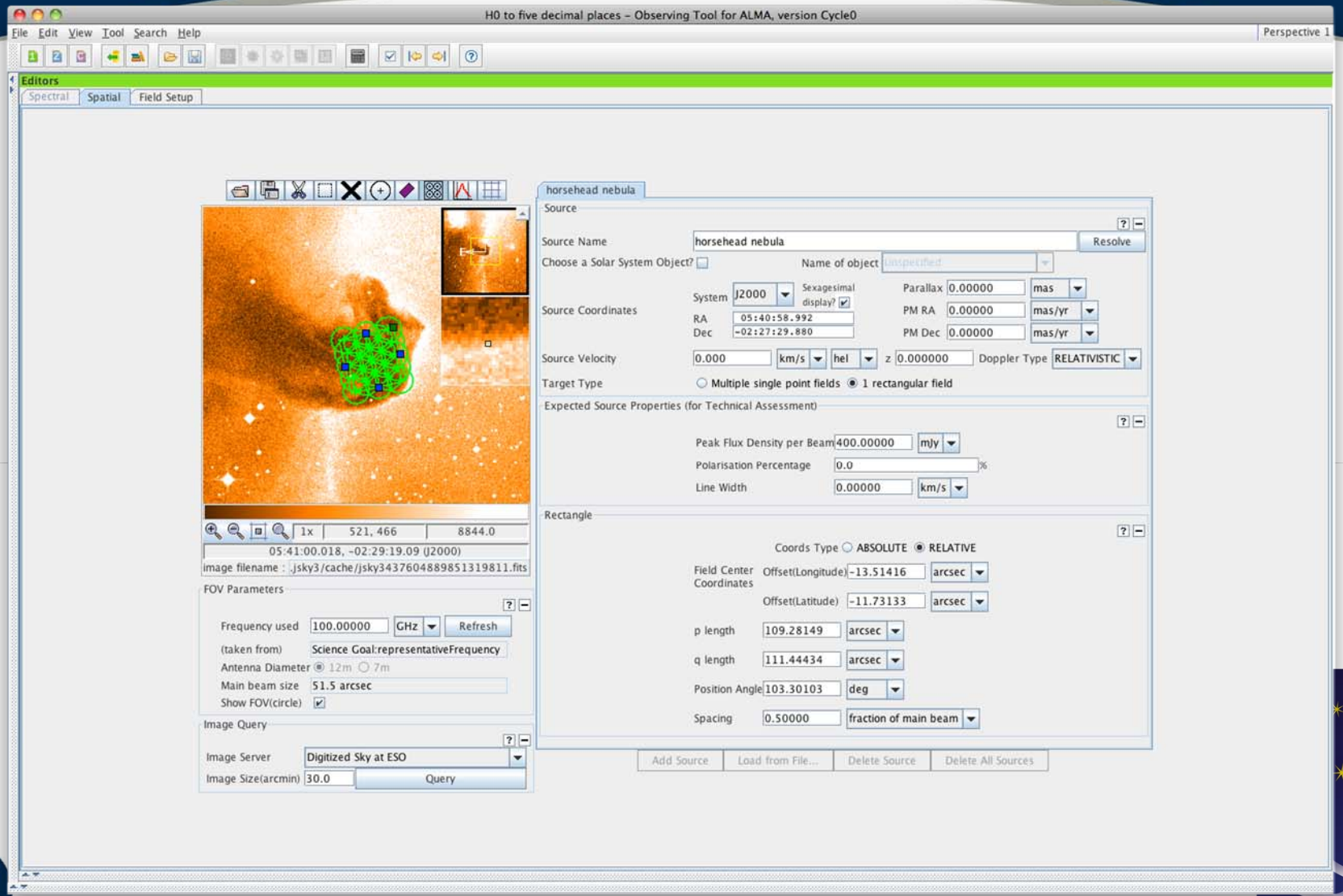
Server software Too

- Tomcat-based submission-service
  - Front-end to Archive subsystem and Oracle DB
  - Authenticates
  - Ensures validation
  - Initiates Project lifecycle
- Investigator searching & retrieval service
  - Using user-database



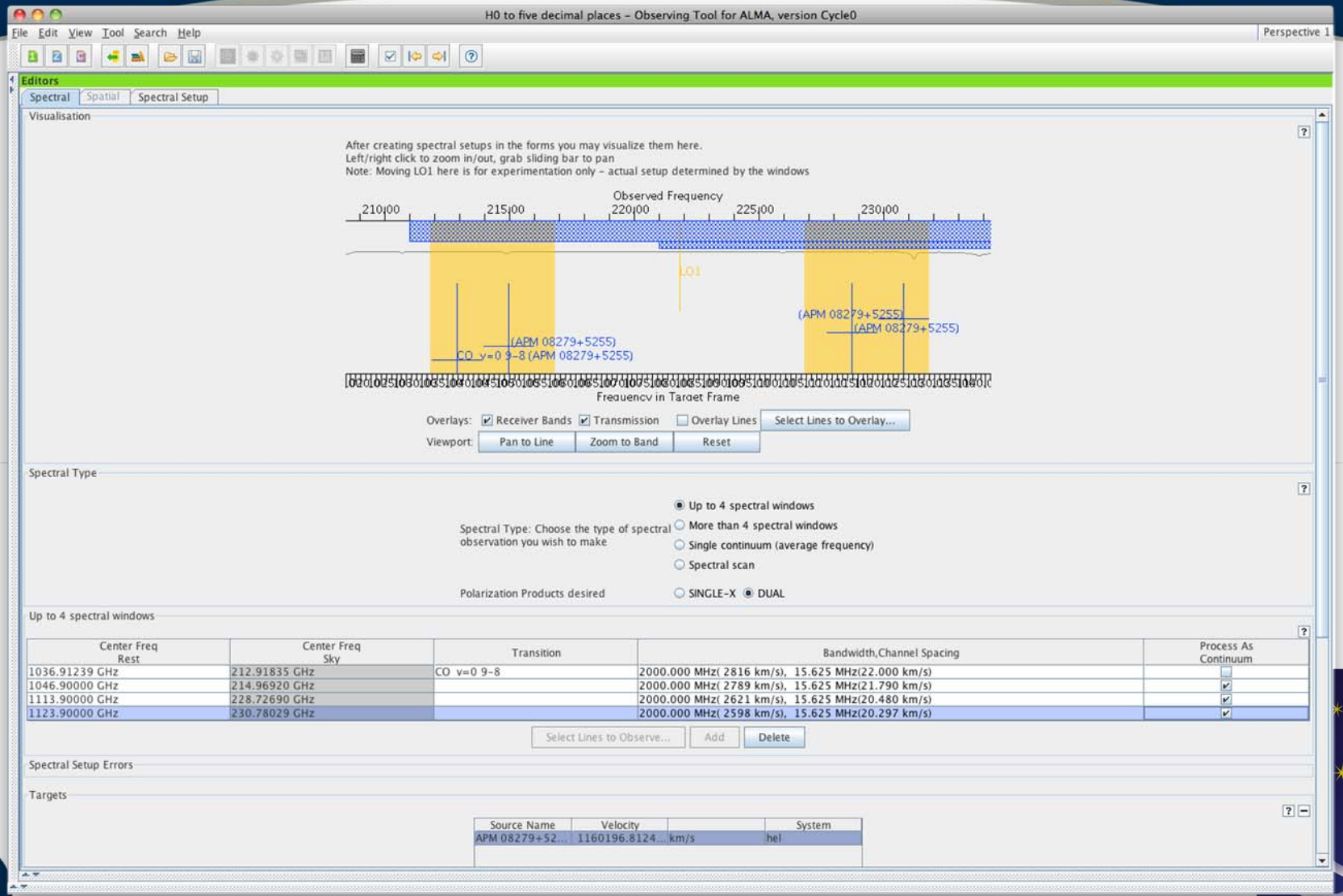
ALMA
ATACAMA LARGE MILLIMETER ARRA

Spatial Visual Editor



ALMA
ATACAMA LARGE MILLIMETER ARRAY

Spectral Visual Editor



ALMA
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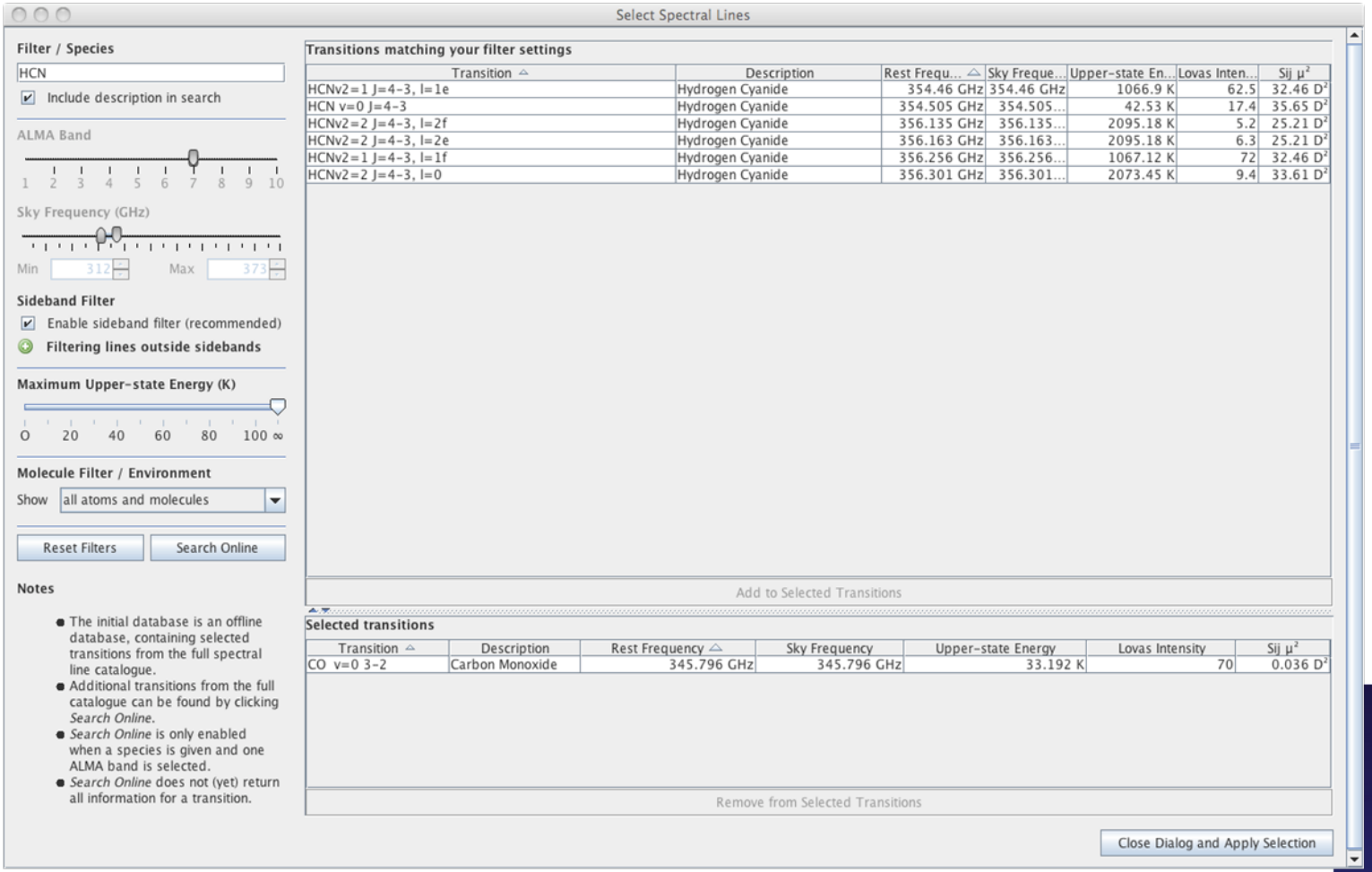
Spectral Line Picker



ALMA
ATACAMA LARGE MILLIMETER ARRAY

Cycle 0

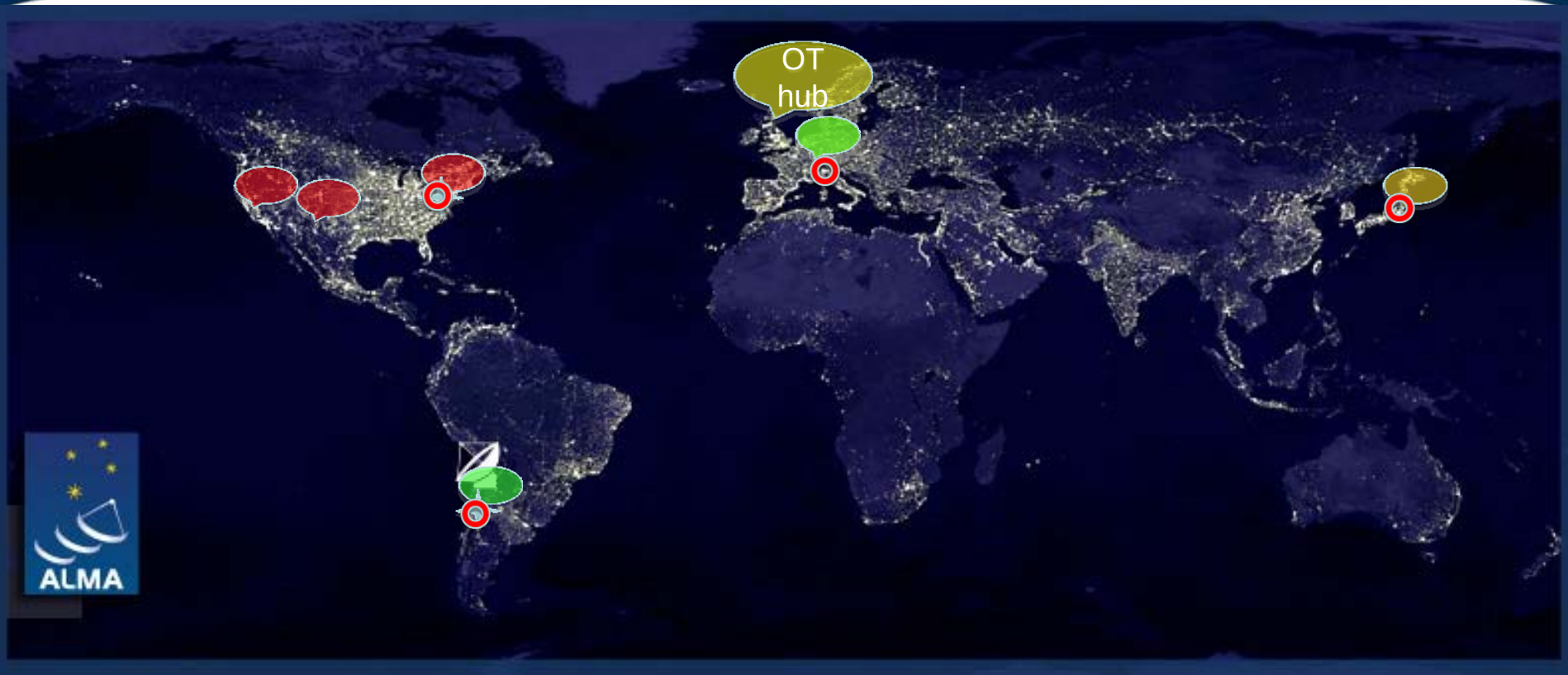
ALMA Officially opened its doors to the community during 2011 with its Cycle 0:

- 16 12m antennas
- 4 receiver bands
- Limited correlator modes
- Limited observing modes
- To be executed in parallel with continuing construction, verification and commissioning
- Approximately 500-700 hours of observing allotted over 9 months
- About 100 proposals expected to be executed
- “Best Efforts” basis, commissioning prioritized

Cycle 0 Proposal System Setup

- Build OT deployments, tarball and webstart
  - Good configuration management required
  - Good communications with ARCs to establish deployment process
  - OT Deployed (29th March) at each of the 3 ARCs (Also Chile and a backup for EA as the earthquake and related problems were still causing power disruption)
- 30th March Call for Proposals announced
- April-May configure and deploy server in Santiago
  - Joint Obsprep/ObOps/Archive/JAO Computing effort
- 1st June Archive opened for submissions…

Cycle 0 Setup



- [illegible] calibrator catalog

Cycle 0 Deadline

- 1st June Archive opened for submissions…
  - 3 received by 15th June.
- 30th June, 15:00 UT, deadline.
- Over 900 unique proposals received, plus several thousand *resubmissions* (allowed by observatory policy)
- Last two hours ~1350 submission attempts
  - ~ 240 new submissions, rest were resubmissions
- Server seized up with about 45 minutes left
  - So deadline extended by 1.25 hours
- More than 9:1 over-subscription rate
- A great success!

Cycle 0 Debrief

- Why did the server fail?
  - Number of submissions / minute well within limits established by stress testing
  - But level of queries was unexpected and not well tested
- Answer *slightly* surprising:
  - Oracle DB collapsed under weight of queries from users
  - Response time falls, connections left open, propagates, exceed allowed simultaneous connections -> errors to users
  - Xpath, so not tremendously efficient. But still why? Oracle *can* handle this
  - Hardware not the final system, and in retrospect under-powered for this level of querying
- More power in place for Cycle 1
- And of course we are looking to improve system response to this and the user's experience

Cycle 0 Debrief: Other lessons

Few surprises:

- Last minute changes undesirable, but they happen
- Communication is hard in a project this size
- Few big OT issues – confusion over resolution/largest structures
- Never under-estimate the imagination of users
  - OT Constrains to capabilities available in Cycle 0
  - (although fully powered “under the hood”)
  - But still users found ways to express their science goals that are … challenging

And what's next?

The fun never stops:

- In September Cycle 0 Observing Preparation (Phase II) began, using the OT
- Auto-generation of SBs, in particular default calibration setups
- Still much manual work – that's another story
- 30th September Observing began

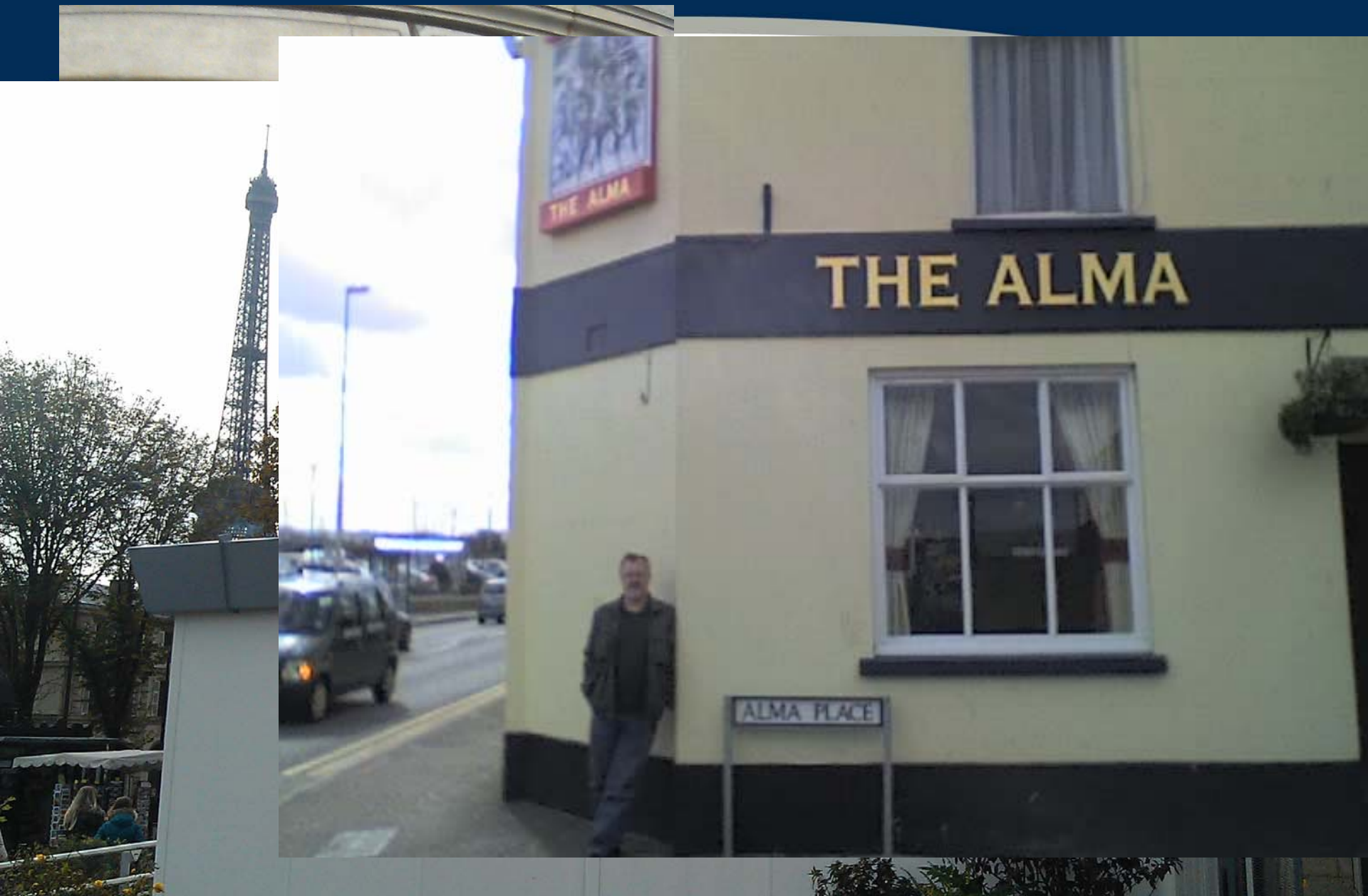
Cycle 1 and beyond

- February 2012, Cycle 1 Call for Proposals
  - More antennas, more observing modes,…
- Cycle N
  - ACA Integration
  - All correlator modes
  - More spectral modes
  - Double sideband receivers…
  - Simultaneous arrays, subarrays
  - We must keep them all simple

ALMA Papers in this Conference

- O21 Nuria Lorente: Visibility Isn't Everything: Managing Meta and Auxiliary Data in ALMA Observations.
- P024 David Clarke: ALMA Scheduling - It's Dynamic!
- P029 Lindsey Davis: Translating ALMA User Science Goals into Pipeline Processing Requests
- P089 Alisdair Manning: The ALMA Science Archive: Data Flow
- P104 Fernando Morales: Entity-relationship Model for ALMA.
- P114 Dirk Petry: Analysing ALMA data with CASA
- P130 Nemesio Rodriguez-Fernandez: Imaging On-the-fly ALMA observations
- P133 Juan de Dios Santander Vela: The ALMA Science Archive: Implementation
- P137 Marcus Schilling: Human Computer Interaction in the ALMA Control Room
- P147 Felix Stoehr: The ALMA Science Archive: Design
- P152 Alexis Tejeda: ALMA Telescope Calibration Subsystem computing performance
- P165 Mauricio Zambrano: Business Intelligence applied to the ALMA Software Integration process

British-French Alma Connection



Questions?

www.almaobservatory.org

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC) and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI) and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.