The North American ALMA Science Center

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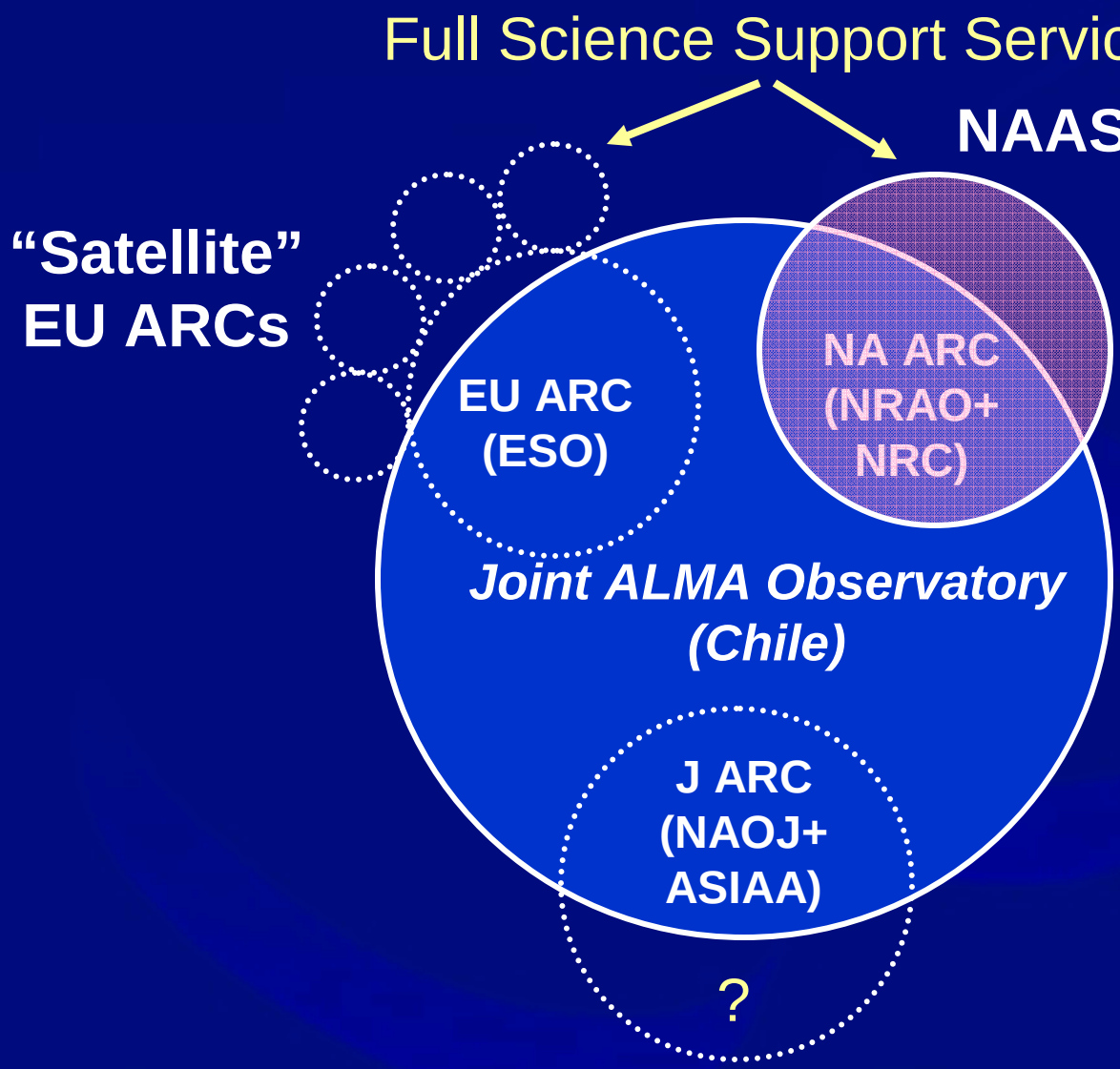
NRC·CNRC

ALMA: A Facility for All Astronomers

- The key premise of ALMA is that the best science will emerge from competitive use by the widest possible user community
  - ALMA should not be restricted to experts in mm/submm astronomy or even radio astronomy
- This goal requires comprehensive user support including:
  - Test, improve, distribute, and support use of user software
  - Help users push the envelope of ALMA capabilities
  - Contribute to (and learn from) Chilean ALMA operations
  - Foster development of new capabilities

To achieve this goal we have created the North American ALMA Science Center (NAASC)

ALMA Operations: Three ALMA Regional Centers - ARCs



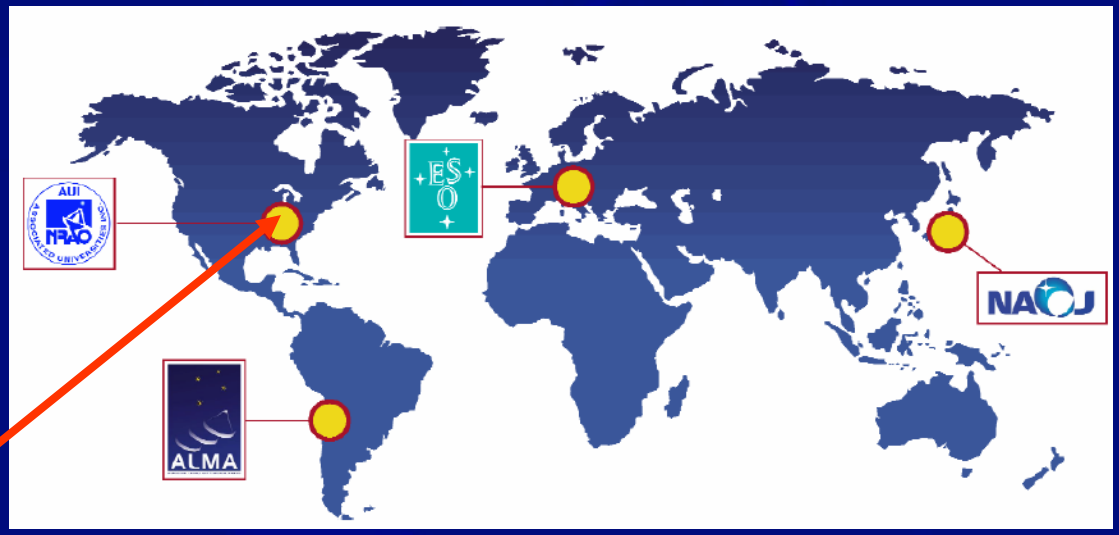
ARCs provide basic user interface, as well as basic archive, software, and hardware maintenance and development

Full Science Support is needed to provide advanced user support, algorithm development, student programs, EPO, grants

The Tri-Partner ALMA Project – Service community through ALMA Regional Centers (ARC)

The North American ARC is a partnership between the US and Canada (7.25%)

The NAASC is a combination of the NA ARC and US funded Full Science Support



One-stop shopping for NA astronomers

- Proposals
- Observing scripts
- Data archive and reduction

NAASC: North America ALMA Science Center, Charlottesville, VA

What Will the NA ARC do?

- NA User Support
  - User friendly web-based access
  - Helpdesk based problem resolution
- JAO Observational Support
  - Astronomer on Duty
  - Quality Assurance
  - Help with Commissioning and Science Verification (training)
- Maintenance and development of NA software deliverables like the pipeline and off-line data reduction package (CASA)
  - Pipeline will produce science-ready images for basic ALMA observing modes (off-line data reduction in early years)
- Maintenance and development of hardware delivered by NA
  - Band 3 (100 GHz) & 6 (230 GHz) Receivers

NAASC ARC: Portal for NA Astronomers

- Provide user friendly web-based documentation
  - Proposal tool (Phase I)
  - Observing tool (Phase II)
  - Post-processing and data analysis
- Review, evaluate, and exercise proposal tool, observing tool, and pipeline processing functionality
- Issue calls for NA proposals
- Assist JAO in the Proposal Review Process
- Verify and correct observing scheduling blocks
- Distribution of data and processed images
- Online Helpdesk for Phase I & II
- Online Helpdesk for post-processing questions

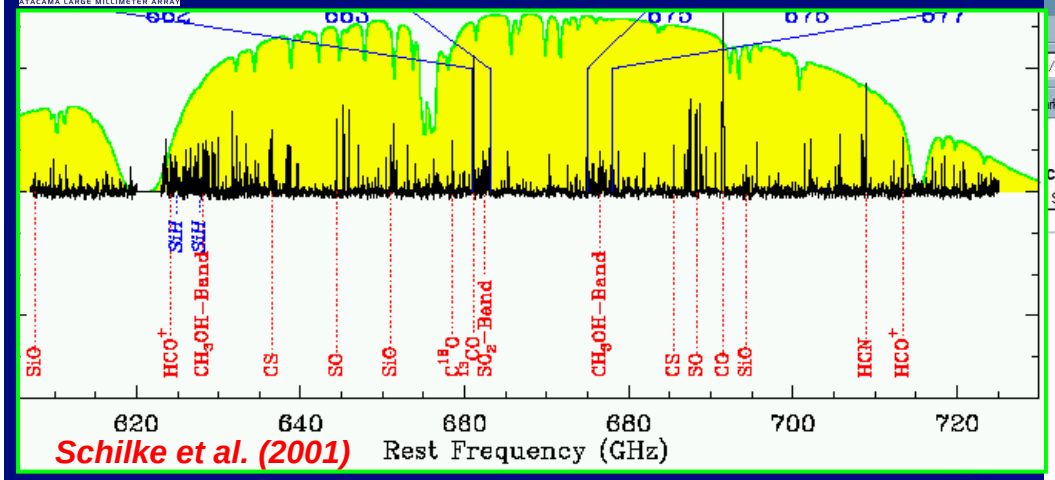
Is This Enough?

- ALMA will provide calibrated data and images for **basic observing modes**
  - ➢ This service will not be available until the start of full operations in late 2012
- Only basic post-processing user support in the form of an electronic helpdesk is provided for in the ALMA Operations Plan
  - ➢ The needs of the most technically and scientifically challenging observing programs will not be met by the pipeline processing
  - ➢ ALMA will appeal to a much broader range of astronomers than traditional radio observatories, these investigators will require additional help

Advanced User Support

- F-2-F expert assistance with observation preparation and post-processing
- Research/develop new approaches/algorithms for calibration, imaging, and scientific analysis tools
- Continually Improve data analysis documentation
- Organizing observing and data reduction tutorials
- Advanced simulation capabilities to help users better plan their observations
- Support special observing projects: Legacy type projects or other large programs
- Maintain spectral line database and develop more sophisticated spectral line analysis and visualization routines

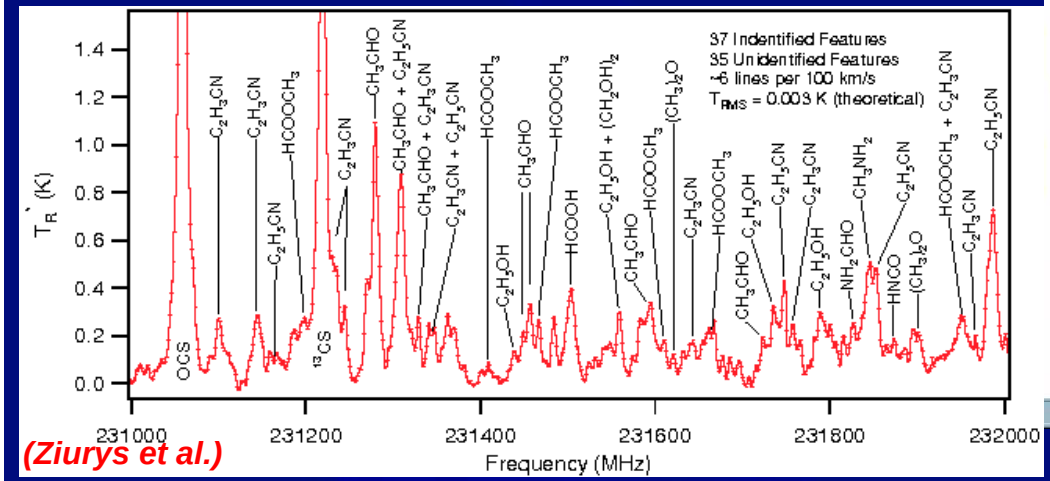
Spectral Line catalogs and tools needed to deal with tremendous spectral complexity



Schilke et al. (2001)

Lines visible in Band 9 (CSO)

1 GHz



(Ziurys et al.)

SgrB2(N) spectrum using Band 6 mixer at the SMT

splatalogue
database for astronomical spectroscopy

Currently a transition-resolved compilation of the JPL, CDMS and Lovas/NIST lists
Searching 3688088 lines in 656 chemical species

Found 95 DNC lines, showing 1 - 95

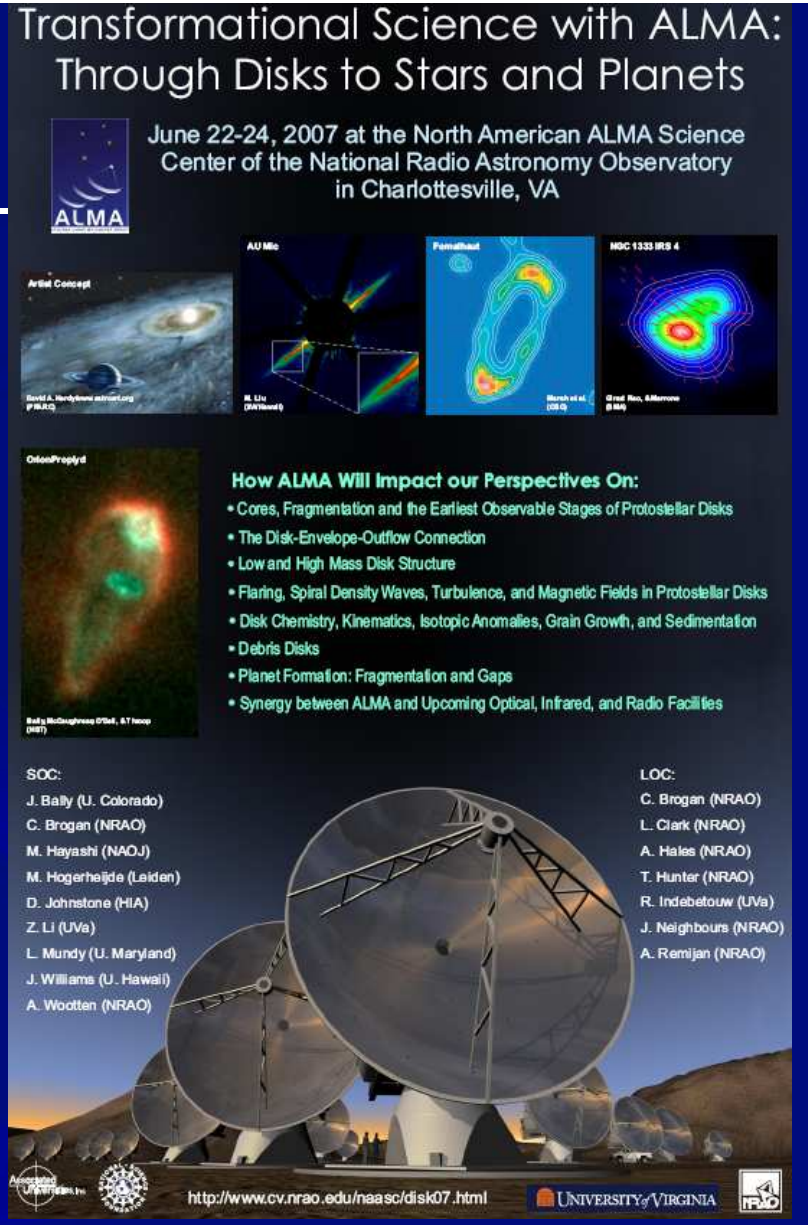
	Frequency (MHz)	Uncertainty (MHz)	LineList	E_L (cm^{-1})	Transition	
1	76305.71700		Lovas/NIST		J=1-0	ALMA BAND 2
2	76305.72700	0.009	JPL	0	J=1-0	ALMA BAND 2
3	76305.72700	0.03	CDMS	0	J=1-0	ALMA BAND 2
4	152609.77000		Lovas/NIST		J=2-1	ALMA BAND 4
5	152609.77400	0.009	JPL	2.5453	J=2-1	ALMA BAND 4
6	152609.77400	0.03	CDMS	2.5453	J=2-1	ALMA BAND 4
7	228910.48900	0.009	JPL	7.6358	J=3-2	ALMA BAND 6
8	228910.48900	0.03	CDMS	7.6358	J=3-2	ALMA BAND 6
9	228910.49200		Lovas/NIST		J=3-2	ALMA BAND 6
10	305206.21900	0.009	JPL	15.2714	J=4-3	ALMA BAND 7
11	305206.21900	0.03	CDMS	15.2714	J=4-3	ALMA BAND 7
12	381495.27390	0.0237	JPL	25.452	J=5-4	
13	381495.39040	0.0111	CDMS	25.452	J=5-4	
14	457775.99960	0.0499	JPL	38.1773	J=6-5	ALMA BAND 8
15	457776.26640	0.0115	CDMS	38.1773	J=6-5	ALMA BAND 8
16	534046.72750	0.0885	JPL	53.4471	J=7-6	
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
18	610305.79150	0.1414	JPL	71.261	J=8-7	ALMA BAND 9
19	610306.58860	0.0099	CDMS	71.261	J=8-7	ALMA BAND 9
20	686551.52520	0.2105	JPL	91.6186	J=9-8	ALMA BAND 9
21	686552.72700	0.011	CDMS	91.6186	J=9-8	ALMA BAND 9
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
23	762783.99400	0.02	CDMS	114.5196	J=10-9	
24	838996.33680	0.4053	JPL	139.9632	J=11-10	ALMA BAND 10
25	838998.73600	0.015	CDMS	139.9633	J=11-10	ALMA BAND 10
26	915192.08200	0.5351	JPL	167.9491	J=12-11	ALMA BAND 10
27	915195.28800	0.03	CDMS	167.9493	J=12-11	ALMA BAND 10

Unified spectral line database (to be used in observing tool)

Training & Science with the Community

- ALMA user community development and involvement
  - Scientific Workshops – venues to explore future directions for ALMA
    - ➢ 1st annual NAASC Workshop "From Z-machines to ALMA"
    - ➢ You are at the 2nd
  - Visiting Scientists
  - mm astronomy courses and summer schools
  - Promote ALMA at astronomy meetings

- Help train the next generation
  - 1 ALMA post-doc per year (for 3 yrs)
  - 2 pre-docs per year
  - Proportional support of NRAO Jansky Fellowship program (4 per 3 years)



Full Science Support in Perspective: What does it Cost?

In 2015:

Full Science Support = $3.1 M

NAASC cost to NSF = $27.2 M (~$15M goes to Chilean Operations)

Full Science Support = 11%

**We also advocate a dedicated ALMA grants program of $6 M

- The key premise of ALMA is that the best science will emerge from competitive use by the widest possible user community

- **Without full science support, the majority of US astronomers will not be able to realize the full potential of ALMA and will not be scientifically competitive**
- **ALMA is the largest ground-based project ever undertaken by US astronomy – the additional cost to maximize this $0.5B investment is minimal by comparison**

NAASC Staffing Plan

~ 12 Engineering

~ 20 Computing/software

~ 5 Archive support

~ 16 Scientific Staff

~ 5 Post-doc/Students

~ 5 EPO

~ 5 Chilean Affairs

~ 3 Management/Administrative

= ~70

- Begin NAASC Ramp up 2008; completed ~2012
- Includes ARC and full science support
- *NAASC Director: Chris Carilli*
- *NA ARC Manager: John Hibbard*
- *C. Brogan first new scientific staff*

Comparison (excluding spacecraft functions)

- *Chandra* ~150
- *HST* ~350
- *Spitzer* ~120

The ALMA North American Science Advisory Committee ANASAC:

Direct NA Community Input into ALMA - Get in Touch!

Andrew Baker, Rutgers U. (2008)

John Bally, U. Colorado (2008) – John.Bally@Colorado.EDU

Andrew Blain, Caltech (2007)

Todd Clancy, SSI (2009)

Xiaohui Fan, U. Arizona (2007)

Jacqueline van Gorkom (2009)

Terry Herter, Cornell (2009)

Paul Ho, CfA / ASIAA (2008)

Kelsey Johnson, U. Virginia (2009)

Doug Johnstone, NRC/HIA Canada (2007)

Lee Mundy, U. Maryland (2007)

Alycia Weinberger, OCIW-DTM (2009)

Jonathan Williams, U. Hawaii (2008) **Chair**

Christine Wilson, McMaster U. (2007)

Mel Wright, U.C.-Berkeley (2008)

Getting the Time…

- Phase I: Proposals are submitted using ALMA Observing Tool
  - NAASC issues calls, provides documentation, proposal preparation and submission help, as well as coordinating refereeing process
- Proposed to ALMA Board that a Single International Review Committee award ALMA time
  - Process suggested to be similar to *Spitzer*
  - Details are under study.
- Phase II: Successful PIs submit observing program using the Observing Tool
  - NAASC helps with observation planning and verifies observing schedule

Getting the Data…

- Queue based dynamic scheduling
  - Programs are composed of 30-60 min scheduling blocks
- Raw data passed through multi-tiered quality assurance
  - Combination of on-site duty astronomer, NAASC staff, and automated checks
- Data proceeds to pipeline and archiving
  - Data available from NAASC within ~2 weeks (TBD)
  - Pipeline products (images and calibrated u-v data), raw data, and off-line data processing software made available to PIs by the NAASC
    - Pipeline available after end of construction
  - Helpdesk available
  - Expert hands-on data reduction help IF we get full science support funding

ALMA News

European ALMA News (www.eso.org),
ALMA/NA Biweekly Calendar (www.cv.nrao.edu/~awootten/mmaimcal/ALMACalendars.html)

www.alma.info

The Atacama Large Millimeter Array (ALMA) is an international astronomy facility. ALMA is a partnership between Europe, North America and Japan, in cooperation with the Republic of Chile. ALMA is funded in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC), in Europe by the European Southern Observatory (ESO) and Spain. ALMA construction and operations are led on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI), on behalf of Europe by ESO, and on behalf of Japan by the National Astronomical Observatory of Japan.