



**Atacama
Large
Millimeter
Array**

The ALMA Design Reference Science Plan

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Science IPT

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DRSP goal

- To provide a prototype suite of high-priority ALMA projects that could be carried out in ~ 3 yr of full ALMA operations
=> quantitative reference for:
 - Science operations plan
 - Imaging simulations
 - Software design
 - Any other application within ALMA project



Some immediate applications

- Cross-check ALMA specifications against ‘real experiments’
- First look at time distribution for
 - Configurations
 - Frequencies
 - Level of difficulty
- Start developing observing strategies
- Derive use-cases and data rates for computing IPT; template for proposal form
- Assess science loss in case some specs not being met



Side benefits

- Learning experience for community on how to use ALMA and what it can/cannot do in practice
- Updated ALMA science case
- Some 'fun' for Science IPT members



How the DRSP was made

- Start from ALMA science case for ESO council proposal 2000 => translate each chapter into one or more observing programs
- Identify Science IPT members as leaders for various topics; add ASAC, ESAC, ANASAC members where needed
- Leaders free to involve other experts from the community
- Spontaneous, unsolicited contributions from community (no open call was made)



Warning/disclaimer

- Scientific goals for ALMA will likely evolve between 2003 and 2012
- DRSP does not form the basis for any definition or claims on key, large or legacy-type programs or teams
- DRSP only considers baseline ALMA with Band 3, 6, 7 and 9, but option of ACA is included
- Time estimates do not yet include overheads



DRSP status

- Started planning late April; outline + teams complete early July
- >100 DRSP's received by mid-August, involving ~80 astronomers
- Final missing parts received last week
- Review by ASAC members completed this week; comments being included
- First delivery of DRSP by October 20



Example of DRSP

1.5.2: Name -- Circumnuclear Starburst Rings: From Gas to Stars
Authors: E. Schinnerer

2. Science goal: We will perform a high-resolution imaging (5-10pc) study of individual GMC complexes in a sample of nearby (D ~ 17 kpc) spiral galaxies containing circumnuclear starburst rings. These rings have typical diameters of about 1 kpc and are the sites of massive star clusters similar to those observed in merging systems. Comparison to high-resolution optical and NIR imaging data as well as radio continuum data will allow us to study the process of star formation from the gas phase via HII regions to 'fossil' star clusters. This comprehensive data set will allow us to access the process of star formation in an environment with short dynamical timescales. This study has also direct consequences for possible feeding mechanisms of nuclear BH or star clusters.

3. Number of sources: 10

4. Coordinates:

4.1. Virgo cluster targets plus others

4.2. Moving target: no

4.3. Time critical: no

5. Spatial scales:

5.1. Angular resolution: 0.05"

5.2. Range of spatial scales/FOV: 0.05" to 15"

5.3. Single dish: no

5.4. ACA: no

5.5. Subarrays: no

6. Frequencies:

6.1. Receiver band: Band 6 -- 220 GHz in Configuration ABCD

6.2. Lines and Frequencies: CO(2-1) @ 230 GHz

6.3. Spectral Resolution (km/s): 2-3 km/s

6.4. Bandwidth or spectral coverage: 800 km/s

7. Continuum flux density:

7.1. Typical value:

7.2. Continuum peak value: < 0.5 mJy/beam at 230 GHz

7.3. Required continuum rms:

7.4. Dynamic range in image:

8. Line intensity:

8.1. Typical value: <= 60 mJy/beam at 230 GHz

8.2. Required rms per channel: 0.6 mJy/beam

8.3. Spectral dynamic range: 100

9. Polarization: no

10. Integration time per setting: including calibration
1 track (+/- 1hr) at 230 x 10 sources x 4 configurations

11. Total integration time for program: 80 hr



Where to find the DRSP

- Current version of DRSP on secure Website at:
 - <http://www.strw.leidenuniv.nl/~joergens/alma/index.shtml>
 - User: alma; password: bingo64
- DRSP to be made open to the community once approved by ALMA Board
- September version used for statistics



Some initial statistics

Number of programs requesting capability

	Largest FOV	Mosaic	Single Dish	ACA	Pol
Galaxies	900''	11/42	12/42	10/42	6/42
Star formation	3600''	11/40	22/40	21/40	6/40
Stars	>60''	4/11	4/11	4/11	4/11
Solar System	1800''	8/26	13/26	13/26	7/26

Warning: all statistics based on September DRSP version: to be updated



Statistics Receiver Bands

% of time

	Band 3	Band 6	Band 7	Band 9	Total
Galaxies	22	30	32	16	100
Star formation	25	28	39	8	100
Stars	24	31	38	7	100
Solar system	4	38	51	7	100
Total	20	31	37	11	100



Continuum-only programs

% of time all programs

	Band 3	Band 6	Band 7	Band 9	Total
Galaxies	39	15	84	98	55
Star formation	18	1	22	2	14
Stars	25	27	47	45	35
Solar system	55	3	57	79	38
Total	30	8	53	69	36



Some initial conclusions

- Overall distribution over receiver bands reasonably consistent with weather statistics
- Fraction of continuum-only programs varies per receiver band and theme: Band 6 predominantly line; Band 7 and 9 large fraction continuum
- Fraction of proposals which require total power continuum of order 10%
- Fraction of proposals which require baselines of at least 1 km 50-60% (with peak around 0.1-0.2" => 1-2 km)