Substructures in Compact Protoplanetary Disks

2018.1.00271.S

ABSTRACT

ALMA has shown in spectacular fashion that bright rings, gaps, and spirals are a common features of protoplanetary disks. While the origin of the structures remain highly debated, the ubiquity of substructures must be indicative of an important step in the planet formation process, either from the gravitational interaction of already-formed embedded planets, or from one step in the planet-formation process. Since the existing high resolution observations are biased toward the brightest, more luminous disks, an important question is whether such structures are prevalent in the more typical, compact and fainter systems. In this proposal, we request time with ALMA to image a carefully selected sample of disks that are fainter and smaller than 95% of the disks in the recently completed Large Program. The goal is to empirically establish the prevalence of substructure, or lack thereof, in faint, compact disks. Our sample consists of 9 sources that have radii between between 18 au and 46 au, and thus are far more typical of disk sizes and indeed more akin in size to our Solar System.

PI NAME:	John Carpenter			**SCIENCE CATEGORY:**	Circumstellar disks, exoplanets and the solar system
ESTIMATED 12M TIME:	**24.5 h**	**ESTIMATED ACA TIME:**	**0.0 h**	**ESTIMATED NON-STANDARD MODE TIME (12-M):**	**0.0 h**
CO-PI NAME(S): (Large & VLBI Proposals only)					
CO-INVESTIGATOR NAME(S):	Viviana Guzman; Sean Andrews; Myriam Benisty; Andrea Isella; Laura Perez; Jane Huang; David Wilner; Luca Ricci				
DUPLICATE OBSERVATION JUSTIFICATION:	No duplications were found in the archive or list of scheduled observations.				

REPRESENTATIVE SCIENCE GOALS (UP TO FIRST 30)

SCIENCE GOAL	POSITION	BAND	ANG.RES.(")	LAS.(")	ACA?	NON-STANDARD MODE
Long baselines cluster 1	ICRS 15:39:27.7660, -34:46:17.170	6	0.025 - 0.017	0.100	N	N
Long baselines cluster 2	ICRS 15:45:08.8710, -34:17:33.340	6	0.025 - 0.017	0.100	N	N
Long baselines cluster 3	ICRS 15:47:56.9440, -35:14:34.760	6	0.025 - 0.017	0.100	N	N
Long baselines cluster 4	ICRS 16:23:09.2400, -24:17:04.700	6	0.025 - 0.017	0.100	N	N
Long baselines cluster 5	ICRS 16:26:48.9800, -24:38:25.240	6	0.025 - 0.017	0.100	N	N
Long baselines cluster 6	ICRS 16:09:00.7610, -19:08:52.680	6	0.025 - 0.017	0.100	N	N
Long baselines cluster 7	ICRS 16:14:20.2990, -19:06:48.140	6	0.025 - 0.017	0.100	N	N
Short baselines cluster 1	ICRS 15:39:27.7660, -34:46:17.170	6	0.130	1.000	N	N
Short baselines cluster 2	ICRS 16:26:48.9800, -24:38:25.240	6	0.130	1.000	N	N
Total # Science Goals : 9						

SCHEDULING TIME CONSTRAINTS	NONE	**TIME ESTIMATES OVERRIDDEN ?**	No

Scientific justification

The spectacular ALMA image of the disk around HL Tau shattered pre-conceived notions about the formation of planetary systems (ALMA Partnership et al. 2015). The discovery of a series of concentric gaps in HL Tau out to a radius of 91 AU demonstrates that some disks are highly structured even at an age of <1 Myr. Other disks have now been observed at high or moderate resolution that also reveal gaps of various widths and depths (e.g., Fedele et al. 2018), spirals (Pérez et al. 2016), and asymmetries (van der Marel et al. 2013). In Cycle 4, our group was awarded an ALMA Large Program (2016.1.00484.L) to conduct the first comprehensive census of substructure in disks. While the data delivery was only completed in March 2018, the preliminary images clearly demonstrate that bright rings, gaps, and spirals are a common features of disks (see Figure 1) with a diversity of widths and depths.

The origin of the substructures in disks remains controversial. While numerical simulations show that while the width and depths of many gaps are consistent with dynamically clearing from Jovian-mass planets (e.g, Isella et al. 2016), it remains a theoretical challenge to explain how such massive planets can form at ages $\lesssim$ 1-2 Myr, and especially at tens of astronomical units from the host star. Other mechanisms have been proposed to explain the appearance of gaps in disks, including magnetohydrodynamic effects (e.g., Pinilla et al. 2016), and chemical and size variations as dust particles drift toward the sublimation fronts of volatile ices ("snowlines") (e.g., Okuzumi et al. 2016).

Regardless of the correct physical origin(s), the ubiquity of substructures must be indicative of an important step in the planet formation process. More generally, a long standing puzzle in the evolution of disks is how millimeter-sized dust particles can persist in disks, as gas drag has long been recognized as an efficient mechanism to remove millimeter-size particles from disks on time scales far shorter than the disk lifetime (Weidenschilling 1977). Substructure in disks present an appealing solution to this problem if they represent local maximum in the gas pressure, which can "trap" dust to prevent further dust migration (Pinilla et al. 2012), and thereby promote the planet formation process.

The impressive ALMA results motivate the next surveys to understand how the presence of substructure extends over the full spectrum of disk and stellar properties. In particular, the high resolution studies to date have preferentially targeted the largest, most luminous disks. For example, the median disk in the Large Program survey has a 340 GHz flux density of $\sim$0.4 Jy and a radius of $\sim$80 au (see Figure 2). The vast majority of young disks are not only less luminous by about an order of magnitude (Ansdell et al. 2017), they are also more compact, with typical radii less $\lesssim$ 30 au (Pietu et al. 2014; Tripathi et al. 2017; Barenfeld et al. 2017; Tazzari et al. 2017).

Any evolutionary connection between the disks of various sizes remains unclear. The inward migration of millimeter-sized dust particles due to gas drag will make disks appear smaller over time. Evidence in support of this scenario is that the gas disk is often more extended than the dust disk, consistent with the dust migration hypothesis. Thus the small disk sizes may merely reflect the inability of setting up dust traps at larger radii. For example, in AS 209 (see zoom in Figure 3), the disk contains a nest of bright rings of radii of 15, 27, 43, 78, and 126 au with a concentration of dust centered on the host star. Thus the inner two rings would yield a flux and size comparable to many of the compact, faint disks that have been detected.

In this proposal, we request time with ALMA to image a carefully selected sample of disks that are fainter and smaller than 95% of the disks in the Large Program survey. The goal is to empirically establish the prevalence of substructure, or lack thereof, in faint, compact disks. Our proposed observations will achieve a spatial resolution of $\sim$3 au to detect substructures similar to those found in the inner regions of the bright disks imaged to date. Our sample consists of 9 sources that have radii between between 18 au and 46 au, and thus are far more typical of disk radii and indeed more akin in size to our Solar System.

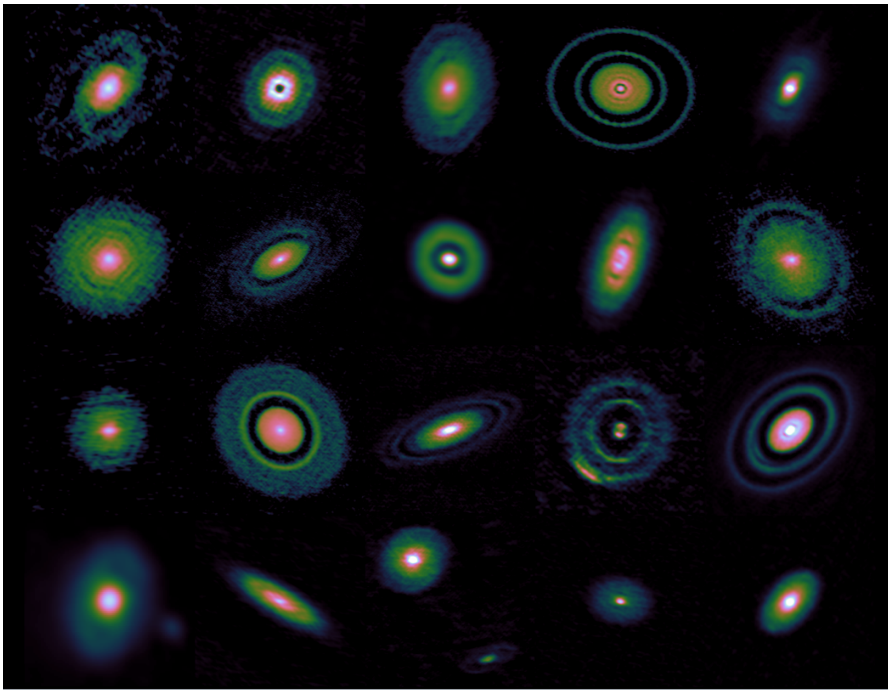

Figure 1: Preliminary ALMA images of the 1.3 mm dust continuum of 20 primordial disks in the Cycle 4 Large Program (2016.1.00324.L). These observations demonstrate that prevalence of bright rings, gaps, spirals, and asymmetries in bright, extended disks.

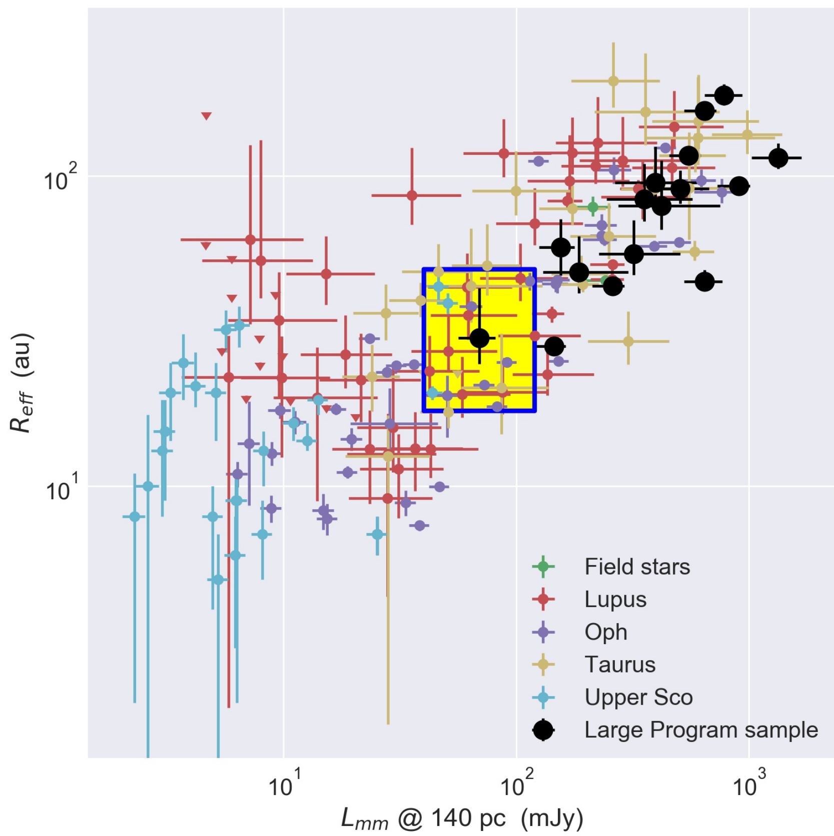

Figure 2: Correlation between effective disk radius (R_{eff}) and disk flux density at a distance of 140 pc for disks with well measured sizes (Tripathi et al. 2017; Barenfeld et al. 2016; Ansdell et al. 2017; Cox et al. 2017). The filled black circles indicate the sources that were the subject of the Cycle 4 Large Program. Our proposed sources, bounded by the yellow-shaded box, will target a complete sample of 9 sources that where the combined sizes and luminosities are smaller and fainter than 95% of the sources shown in Figure 1.

Sample Selection

Figure 2 shows the correlation between the effective radius and the submillimeter luminosity for disks that have well measured disk sizes and submillimeter fluxes based on observations of disks in Taurus, Lupus, Ophiuchus, Upper Sco, and field stars (Tripathi et al. 2017; Barenfeld et al. 2016; Ansdell et al. 2017; Cox et al. 2017). The effective radius is defined as the radius containing 68% of the submillimeter luminosity, and the luminosity is the flux density at a distance of 140 pc. A general correlation is seen, spanning four different star formation regions and field stars, in that more luminous disks tend to have larger radii.

Based on these results, we carefully selected a complete sample of disks that would promise to provide high-quality images while achieving our scientific goals. The selection criteria are as follows:

- The stellar distance is less than 150 pc to optimize the spatial resolution and sensitivity to spatial structure.
- Disks have effective radii < 50 AU and submillimeter luminosity between 40 and 120 mJy at 345 GHz for a distance of 140 pc, which is smaller and fainter than 95% of the disks previously imaged at high spatial resolution.
- The source have effective radii > 17 AU, such that there will be at least 10 independent linear resolution elements across the disk diameter to well-resolve any disk structure.
- The disk shows no evidence of significant substructure from a previous high angular resolution submillimeter observations at $\sim 0.2''$ resolution.
- The stars transits at night during the scheduled long baseline observations in Cycle 6 to maximize the opportunity to obtain high-quality data in the best weather conditions. This criterion effectively selects sources in Lupus, Ophiuchus, and Upper Sco.
- The source has an inclination $\lesssim 60°$ to select more face-on disks to better reveal disk structure.
- The host stars have spectral types between G and M, to select a stellar sample that coincides with stellar masses of previous disk observations.

Table 1 summarizes the complete list of nine sources that satisfy the selection criteria.

Table 1: Proposed Sources

Name	**RA (J2000)**	**Dec (J2000)**	**Spectral Type**	**S_ν (mJy)**	**Reff (au)**	**Region**
Sz 65	15:39:27.75	−34:46:17.56	K7	104	31	Lupus
2MASS J15450887-3417333	15:45:08.85	−34:17:33.81	M5.5	76	20	Lupus
Sz 73	15:47:56.92	−35:14:35.15	K7	54	36	Lupus
2MASS J16090075-1908526	16:09:00.75	−19:08:52.68	K9	51	39	USco
2MASS J16142029-1906481	16:14:20.29	−19:06:48.14	M0	44	29	USco
IRAS 16201-2410	16:23:09.22	−24:17:05.36	G0	114	46	Oph
WL 18	16:26:48.98	−24:38:25.24	M3.5	51	20	Oph
WL 10	16:27:09.10	−24:34:08.71	K9	91	25	Oph
YLW 47	16:27:38.31	−24:36:59.00	M0	83	18	Oph

The columns are (1) the source name, (2) right ascension, (3) declination, (4) spectral type, (5) integrated flux density at a frequency of 340 GHz, (6) effective radius that encloses 68% of the total flux density, and (7) name of the star-forming region.

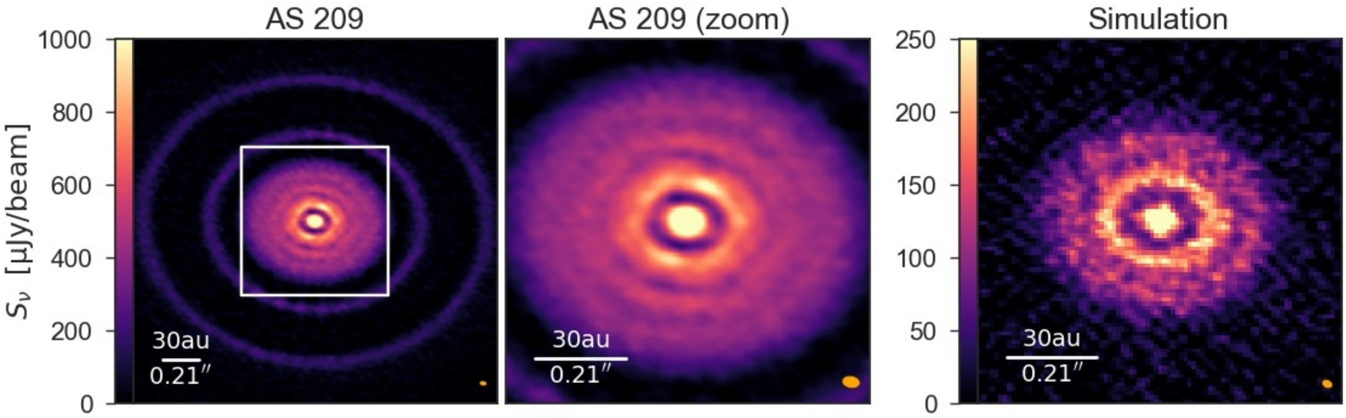

Figure 3: *Left:* ALMA Cycle 4 image of the circumstellar disk around AS 209, and a zoom of the inner portion of the disk (*middle*) to highlight the substructure within the inner 30 au in radius. The disk consists of a series of six concentric bright rings that extend from a radius 15 au to 126 au. *Right:* Simulated CASA image of a disk that contains only the two inner rings found in AS 209 at radius of 15 and 27 au, but with the total flux density at 240 GHz scaled to 31 mJy, which is the median flux density in our sample. The simulation was obtained with the configurations in the proposed observations.

Proposed Observations

We propose to image the dust continuum for all 9 disks listed in Table 1 using the extended configurations C43-9 or C43-10. While the sources were selected using a flux criteria in Band 7 since most moderate-resolution surveys have been conducted in that band, we propose for the Band 6 continuum to allow direct comparison to the results from the Large Program.

Either configurations C43-9 (0.025″) or C43-10 (0.017″) is suitable to for this program to provide a spatial resolution of 2.4-3.5 au. This will provide a minimum of 10 independent linear resolution elements across the diameter of the disk, to yield between 73 and 1035 independent pixels across the face of the disk given the range of R_{eff} in the sample (see Table 1). The sensitivity was set to match that of the Large Program so that comparable structures in the inner disk can be detected. As recommended by the ALMA Proposer's Guide, we also request observations in C43-6 to recover larger angular scales with a recommended time multiplier of 0.21.

Figure 3 shows a simulated CASA image using our proposed configurations and integration times of a faint, compact disk. The synthetic disk contains two rings that have the same radii (15 and 27 au) and width as observed in AS 209, but were reduced in surface brightness by a factor of two to agree with the median flux density of sources in our sample. The CASA simulation demonstrates that our observing strategy will be able to detect substructures in the inner regions of faint disks, if present.

References

ALMA Partnership et al. 2015, ApJ, 808L
Ansdell, M., et al. 2017, AJ, 153, 240
Barenfeld, S., et al. 2016, ApJ, 827, 142
Barenfeld, S., et al. 2017, ApJ, 851, 85
Cox, E., et al. 2017, ApJ, 851, 83
Fedele, D., et al. 2017, A&Ap, 610, 24
Isella, A., et al. 2016, PRL, 117, 251101
Okuzumi, S., et al. 2016, ApJ, 821, 82
Pérez et al. 2016, Science, 353, 1519
Piétu, V., et al. 2014, A&Ap, 564, 95
Pinilla, P., et al. 2012, A&Ap, 538, 114
Pinilla, P., et al. 2016, A&Ap, 596, 81
Tazzari, M., et al. 2017, A&Ap, 606, 88
Tripathi, A., et al. 2017, ApJ, 845, 44
Weidenschilling, S. J. 1977, MNRAS, 180, 57

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SG : 1 of 2   Long baselines cluster 1   Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111.134 km/s, 7.5 GHz	246.775000 GHz	16.915 µJy, 543.4 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.5 h	0.9 h	0.0 h	7.9 "	1	offset	23.6 "	3410.9 s	105.7 GB	17.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.5 km/s	40.225 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.677 km/s	0

1 Target

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-Sz_65	15:39:27, -34:46:17	0.00 km/s,lsrk,RADIO

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 mJy	0.5	2 km/s	1.98 mJy, 137.4 K	0.0002	0.0%	0.0
Continuum	330.00 uJy	19.5				0.0%	0.0

Dynamic range (cont flux/line rms): 0.2

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	246.775000	16.91 µJy, 1.2 K	16.47 uJy - 17.24 uJy

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 1 of 2 Long baselines cluster 2 Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111.123 km/s, 7.5 GHz	246.775000 GHz	16.995 µJy, 546 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.5 h	0.9 h	0.0 h	7.9 "	1	offset	23.6 "	3374.6 s	104.9 GB	17.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.5 km/s	40.225 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.677 km/s	0

1 Target

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-2MASS_J15450...	15:45:08, -34:17:33	0.00 km/s,lsrk,RADIO

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 Jy	503.3	2 km/s	1.99 mJy, 138 K	0.0002	0.0%	0.0
Continuum	570.00 uJy	33.5				0.0%	0.0

Dynamic range (cont flux/line rms): 0.3

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	246.775000	17 µJy, 1.2 K	16.55 uJy - 17.32 uJy

Sensitivity Comments

Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 1 of 2 Long baselines cluster 3 Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111.129 km/s, 7.5 GHz	246.775000 GHz	16.925 µJy, 543.7 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.5 h	0.9 h	0.0 h	7.9 "	1	offset	23.6 "	3410.9 s	105.7 GB	17.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.5 km/s	40.225 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.677 km/s	0

1 Target

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-Sz_73	15:47:56, -35:14:34	0.00 km/s,lsrk,RADIO

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 mJy	0.5	2 km/s	1.98 mJy, 137.5 K	0.0002	0.0%	0.0
Continuum	130.00 uJy	7.7				0.0%	0.0

Dynamic range (cont flux/line rms): 0.1

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	246.775000	16.93 µJy, 1.2 K	16.48 uJy - 17.25 uJy

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 1 of 2 Long baselines cluster 4 Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111 km/s, 7.5 GHz	246.775000 GHz	16.973 µJy, 545.2 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.4 h	0.9 h	0.0 h	7.9 "	1	offset	23.6 "	3338.3 s	103.9 GB	17.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.4 km/s	40.224 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.676 km/s	0

1 Target

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-IRAS_16201-24...	16:23:09, -24:17:04	0.00 km/s,lsrk,RADIO

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 mJy	0.5	2 km/s	1.98 mJy, 137.8 K	0.0002	0.0%	0.0
Continuum	16.00 mJy	942.7				0.0%	0.0

Dynamic range (cont flux/line rms): 8.1

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	246.775000	16.97 µJy, 1.2 K	16.53 uJy - 17.30 uJy

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 1 of 2 Long baselines cluster 5 Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111 km/s, 7.5 GHz	246.775000 GHz	16.974 µJy, 545.3 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
6.7 h	2.8 h	0.0 h	7.9 "	3	offset	23.6 "	3338.1 s	291.5 GB	18.0 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.4 km/s	40.224 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.676 km/s	0

3 Targets

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-WL_18	16:26:48, -24:38:25	0.00 km/s,lsrk,RADIO
2	2-WL_10	16:27:09, -24:34:08	0.00 km/s,lsrk,RADIO
3	3-YLW_47	16:27:38, -24:36:58	0.00 km/s,lsrk,RADIO

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 mJy	0.5	2 km/s	1.98 mJy, 137.9 K	0.0002	0.0%	0.0
Continuum	330.00 uJy	19.4				0.0%	0.0

Dynamic range (cont flux/line rms): 0.4

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1,2,3	246.775000	16.97 µJy, 1.2 K	16.53 uJy - 17.30 uJy

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 1 of 2 Long baselines cluster 6 Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111.088 km/s, 7.5 GHz	246.775000 GHz	16.986 µJy, 545.7 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.4 h	0.9 h	0.0 h	7.9 "	1	offset	23.6 "	3338.3 s	103.9 GB	17.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.5 km/s	40.225 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.677 km/s	0

1 Target

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-2MASS_J16090...	16:09:00, -19:08:52	-7.30 km/s,hel,RELATIVISTIC

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 mJy	0.5	2 km/s	1.99 mJy, 138 K	0.0002	0.0%	0.0
Continuum	100.00 uJy	5.9				0.0%	0.0

Dynamic range (cont flux/line rms): 0.1

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	246.781009	16.99 µJy, 1.2 K	16.55 uJy - 17.31 uJy

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 1 of 2 Long baselines cluster 7 Band 6

Long baselines observations in C43-9 or C43-10 achieve a spatial resolution of 2.4-3.5 au.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.0250" - 0.0170"	0.1"	17 µJy, 546.1 mK-1.2 K	9111.104 km/s, 7.5 GHz	246.775000 GHz	16.987 µJy, 545.7 mK-1.2 K	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-9,C4...	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.4 h	0.9 h	0.0 h	7.9 "	1	offset	23.6 "	3338.3 s	103.9 GB	17.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.5 km/s	40.225 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.677 km/s	0

1 Target

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-2MASS_J16142...	16:14:20, -19:06:48	-6.77 km/s,hel,RELATIVISTIC

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	1.00 mJy	0.5	2 km/s	1.99 mJy, 138 K	0.0002	0.0%	0.0
Continuum	160.00 uJy	9.4				0.0%	0.0

Dynamic range (cont flux/line rms): 0.1

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1	246.780573	16.99 µJy, 1.2 K	16.55 uJy - 17.31 uJy

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The RMS was set to recover equivalent substructures as observed in the Cycle 4 Large Program 2016.1.00484.L, which achieved an rms of 17 microJy in the continuum. The simulations shown in Figure 3 demonstrate this can be used to achieve the goals.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We require the highest spatial resolution to measure the disk substructure uch that C43-9 or C43-10 were suitable. We used the achieve angular resolution (0.017-0.025 arcsec) to impose a minium disk radius of of 0.025 arcsec * 140 parsec * 10 * 0.5 = 17.5 au in selecting the sample.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 2 of 2 Short baselines cluster 1 Band 6

Observations in C43-6 to obtain compact observations and recover the larger angular scales.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.1300"	1.0"	38 µJy, 45.1 mK	9111.134 km/s, 7.5 GHz	246.775000 GHz	37.46 µJy, 44.5 mK	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-6)	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
1.0 h	0.6 h	0.0 h	7.9 "	3	offset	23.6 "	695.4 s	32.2 GB	10.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.5 km/s	40.225 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.677 km/s	0

3 Targets

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-Sz_65	15:39:27, -34:46:17	0.00 km/s,lsrk,RADIO
2	2-2MASS_J15450...	15:45:08, -34:17:33	0.00 km/s,lsrk,RADIO
3	3-Sz_73	15:47:56, -35:14:34	0.00 km/s,lsrk,RADIO

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	100.00 mJy	22.8	2 km/s	4.38 mJy, 5.2 K	0.0002	0.0%	0.0
Continuum	3.50 mJy	93.4				0.0%	0.0

Dynamic range (cont flux/line rms): 3.5

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1,2,3	246.775000	37.48 µJy, 44.5 mK	36.49 uJy - 38.21 uJy

Sensitivity Comments

Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The Proposer's Guide recommends a time multiplier of 0.21 for Configuration C43-6 to complement the C43-9 observations requested in the first science goal. Given the typical on-source integration of 58 minutes in C43-9 or C43-10, we set the sensitivity limit to obtain 12 minute integrations per source in C43-6.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

The angular resolution is set according the recommendations in the Proposer's Guide to select C43-6, which is needed to recover the larger angular scales.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.

2018.1.00271.S

SG : 2 of 2   Short baselines cluster 2   Band 6

Observations in C43-6 to obtain compact observations and recover the larger angular scales.

Science Goal Parameters

Ang.Res.	LAS	Requested RMS	RMS Bandwidth	Rep.Freq.	Cont. RMS	Cont. Bandwidth	Poln.Prod.	Non-standard mode
0.1300"	1.0"	38 µJy, 45.1 mK	9111 km/s, 7.5 GHz	246.775000 GHz	36.408 µJy, 43.3 mK	7.500 GHz	XX,YY	No

Use of 12m Array (43 antennas)

t_total(all configs)	t_science(C43-6)	t_total()	Imaged area	#12m pointing	12m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate
2.1 h	1.1 h	0.0 h	7.9 "	6	offset	23.6 "	725.6 s	66.5 GB	10.8 MB/s

Use of ACA 7m Array (10 antennas) and TP Array

t_total(ACA)	t_total(7m)	t_total(TP)	Imaged area	#7m pointing	7m Mosaic spacing	HPBW	t_per_point	Data Vol	Avg. Data Rate

Spectral Setup : Spectral Line

BB	Center Freq Rest GHz	spw name	Eff #Ch p.p.	Bandwidth	Resolution	Vel. Bandwidth	Vel. Res.	Res. El. per FWHM
1	231.000000	CO v=0 2-1	3840	1875.00 MHz	976.563 kHz	2433.3 km/s	1.267 km/s	2
2	232.900000	Continuum	128	1875.00 MHz	31.250 MHz	2413.4 km/s	40.224 km/s	0
3	246.775000	Continuum	128	1875.00 MHz	31.250 MHz	2277.8 km/s	37.963 km/s	0
4	248.650000	Continuum	128	1875.00 MHz	31.250 MHz	2260.6 km/s	37.676 km/s	0

6 Targets

No.	Target	Ra,Dec (ICRS)	V,def,frame --OR--z
1	1-WL_18	16:26:48, -24:38:25	0.00 km/s,lsrk,RADIO
2	2-IRAS_16201-24...	16:23:09, -24:17:04	0.00 km/s,lsrk,RADIO
3	3-WL_10	16:27:09, -24:34:08	0.00 km/s,lsrk,RADIO
4	4-YLW_47	16:27:38, -24:36:58	0.00 km/s,lsrk,RADIO
5	5-2MASS_J16142...	16:14:20, -19:06:48	-6.77 km/s,hel,RELATIVISTIC
6	6-2MASS_J16090...	16:09:00, -19:08:52	-7.30 km/s,hel,RELATIVISTIC

Expected Source Properties

	Peak Flux	SNR	Linewidth	RMS (over 1/3 linewidth)	linewidth / bandwidth used for sensitivity	Pol.	Pol. SNR
Line	100.00 mJy	23.5	2 km/s	4.26 mJy, 5.1 K	0.0002	0.0%	0.0
Continuum	2.70 mJy	74.2				0.0%	0.0

Dynamic range (cont flux/line rms): 4.9

1 Tuning

Tuning	Target	Rep. Freq. Sky GHz	RMS (Rep. Freq.)	RMS Achieved
1	1,2,3,4,5,6	246.775000	36.41 µJy, 43.3 mK	35.45 uJy - 37.10 uJy

Sensitivity Comments

Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

The Proposer's Guide recommends a time multiplier of 0.21 for Configuration C43-6 to complement the C43-9 observations requested in the first science goal. Given the typical on-source integration of 58 minutes in C43-9 or C43-10, we set the sensitivity limit to obtain 12 minute integrations per source in C43-6.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

The angular resolution is set according the recommendations in the Proposer's Guide to select C43-6, which is needed to recover the larger angular scales.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

The correlator is optimized for continuum observations. One of the windows is set for CO 2-1 observations in FDM mode to measure the CO extent. However, the sensitivity requirements are set solely for the continuum.