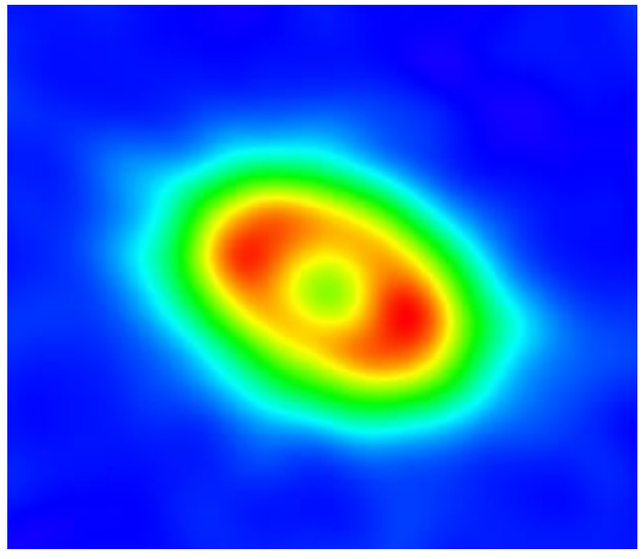
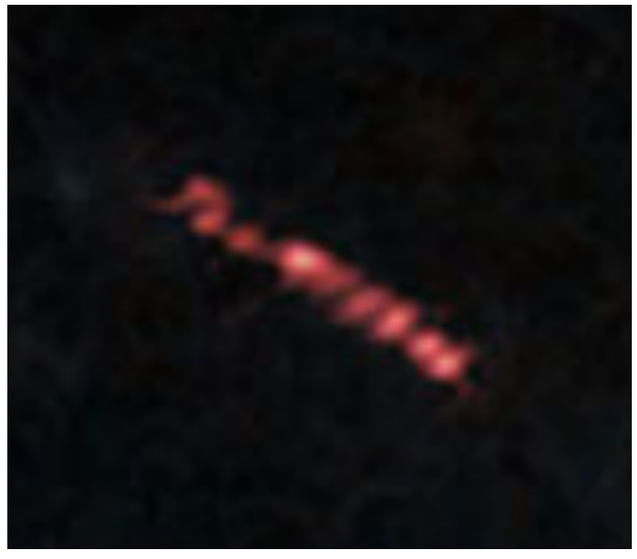
Science Prospects with the wSMA

SMA: the key mm interferometry facility

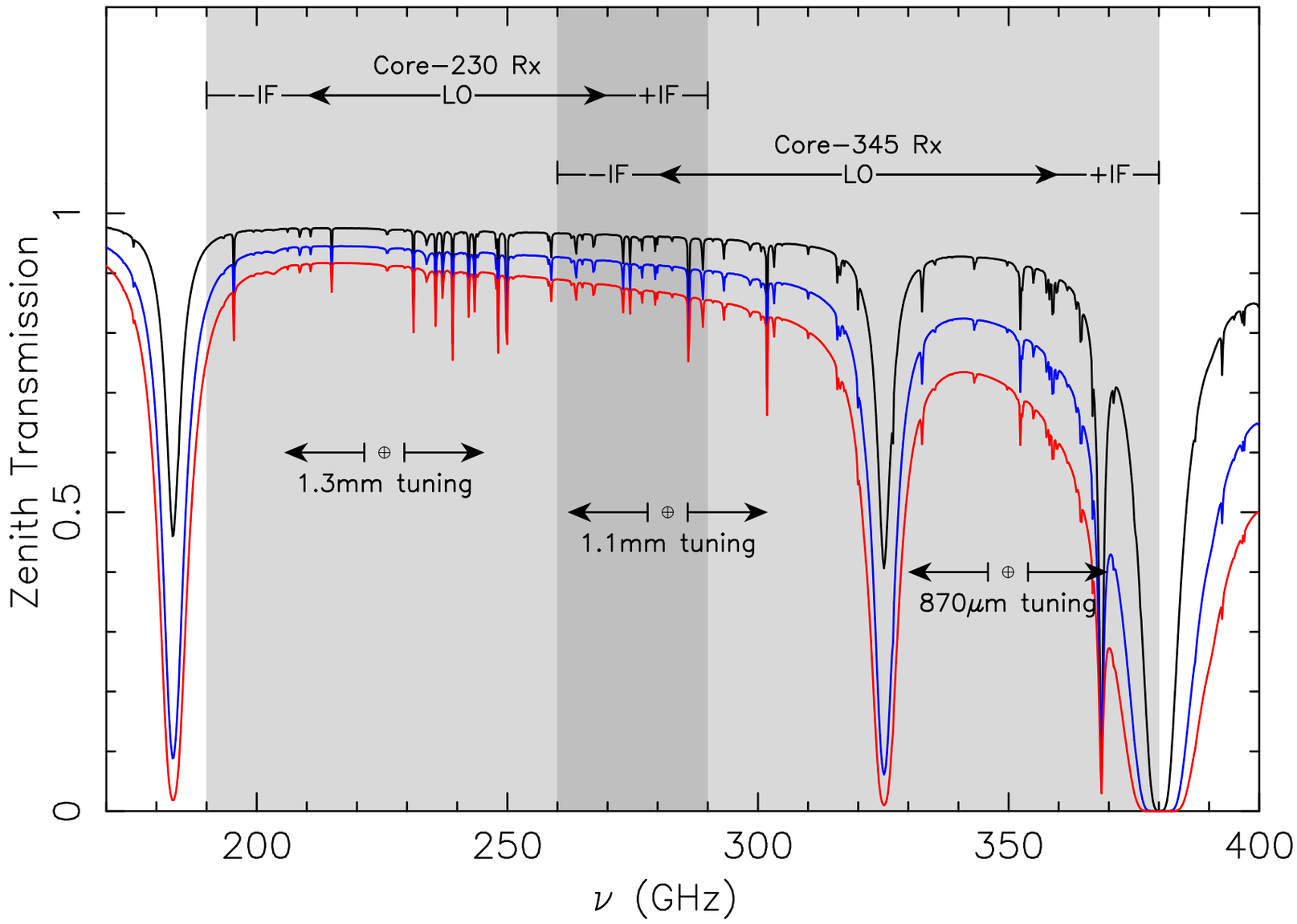
the SMA has genuinely transformed fields,
from planet formation to the high-redshift universe





700 publications; 21000 citations
(>1 paper/week; earn 5 cites/day!)

wSMA: 16x wider instantaneous bandwidth



continuum: 16x faster
(4x deeper)

spectral lines: 16x grasp
(4x fewer settings)

wSMA: practical scientific benefits

every measurement is an imaging spectral line survey

most efficient resolved spectral line mapping facility

nimble, flexible, more sensitive for time domain studies

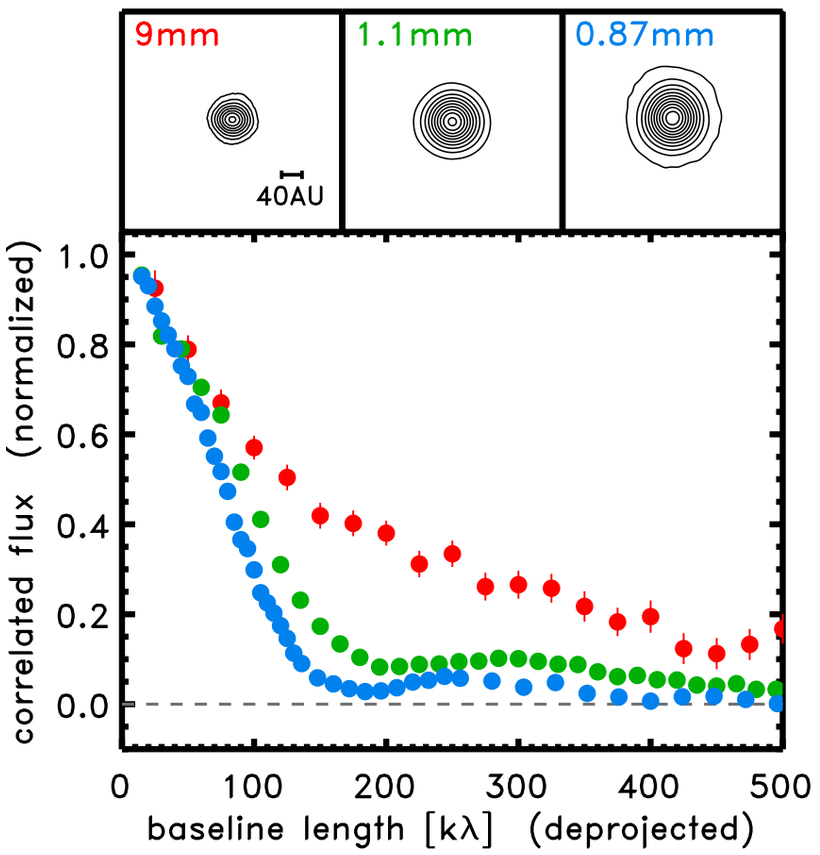
(and everything we do now is better and faster)

wSMA: practical observational benefits

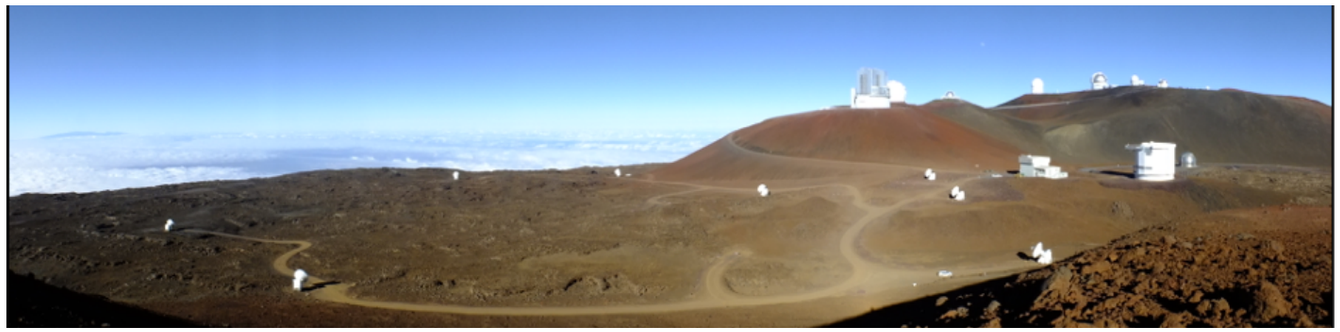
wide bandwidth improves image fidelity
(multifrequency synthesis; $\Delta\nu/\nu$~0.1-0.2)

better sensitivity especially
beneficial at longest baselines
(leveraging SMA resolution)

more robust phase transfer
(nearby calibrators)



wSMA *complements* ALMA



ALMA pressure >7:1

you can't do it all

(and the TAC knows it)

wSMA strengths:

- high-risk seed studies
- rapid response projects
- long-term, large surveys

- crucial mm VLBI station
- development (explicit)

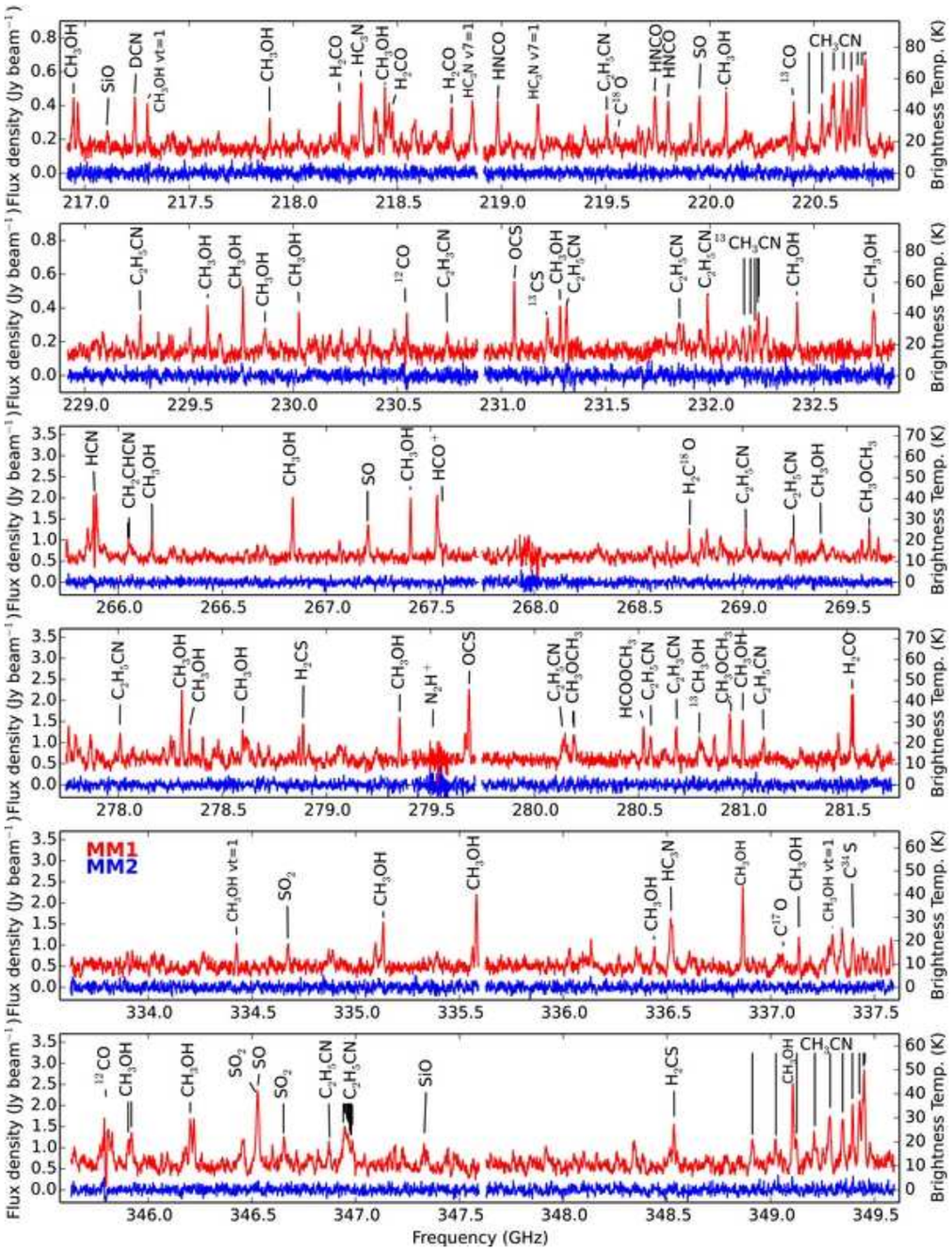
some examples of key wSMA science modes

spatially resolved spectral line surveys
(star formation, evolved stars, high-z galaxies)

time domain / transient / ToO science
(Sgr A* activity, comets, gamma-ray bursts)

bonus or miscellaneous modes
(mm VLBI / EHT, [CII] intensity mapping)

chemical evolution in star formation



example: 24 GHz in 3 settings

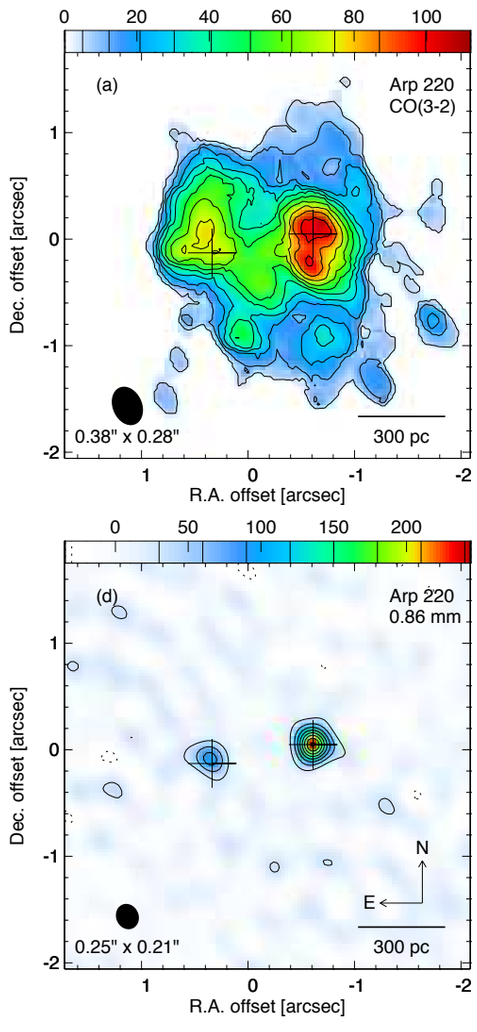
dramatic chemical changes precipitated by desorption

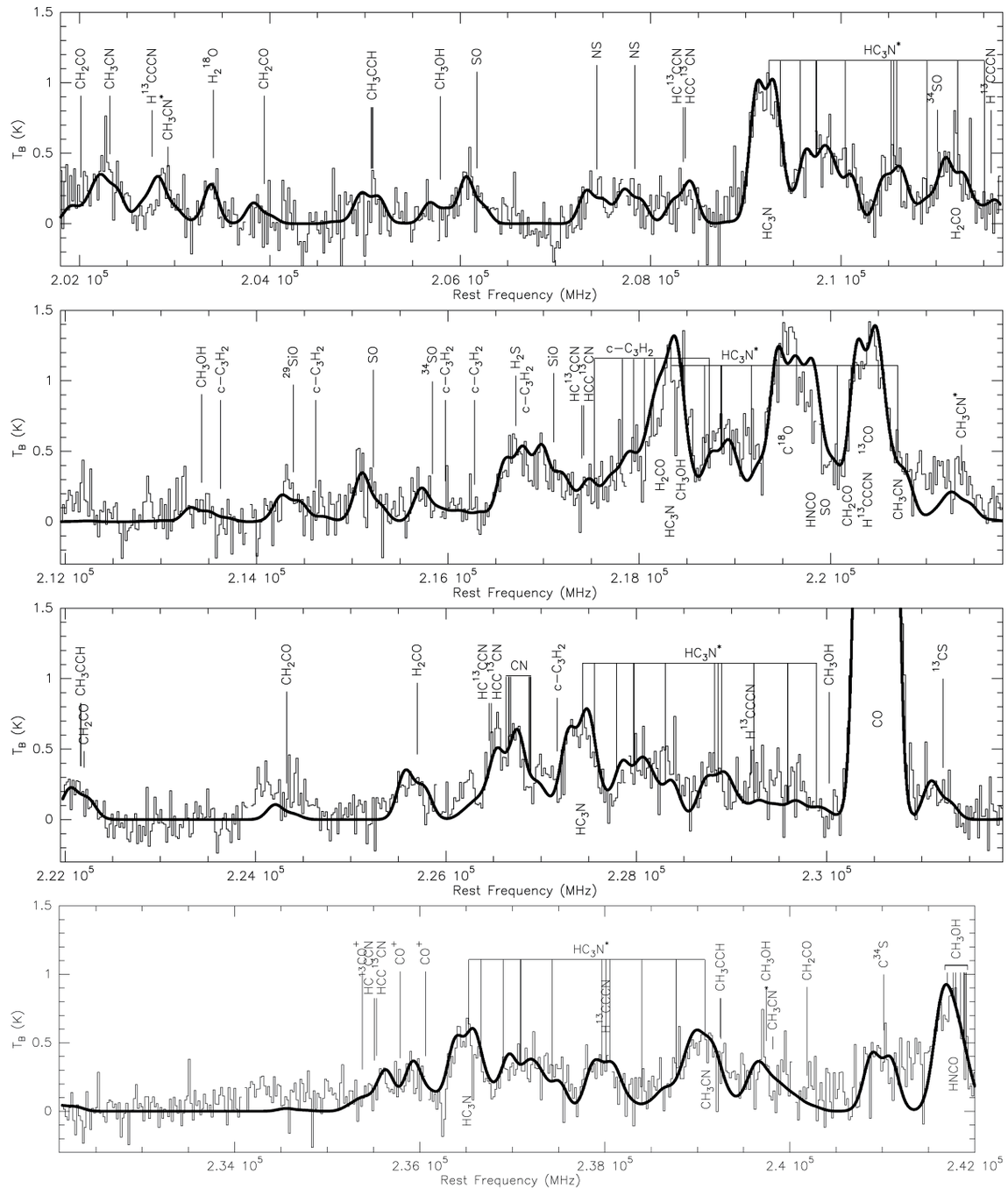
wSMA gets more than this in only one setting

can map entire SF regions (inventory; seed projects; etc)

chemical evolution in star formation

galactic scales too (starbursts/AGN)



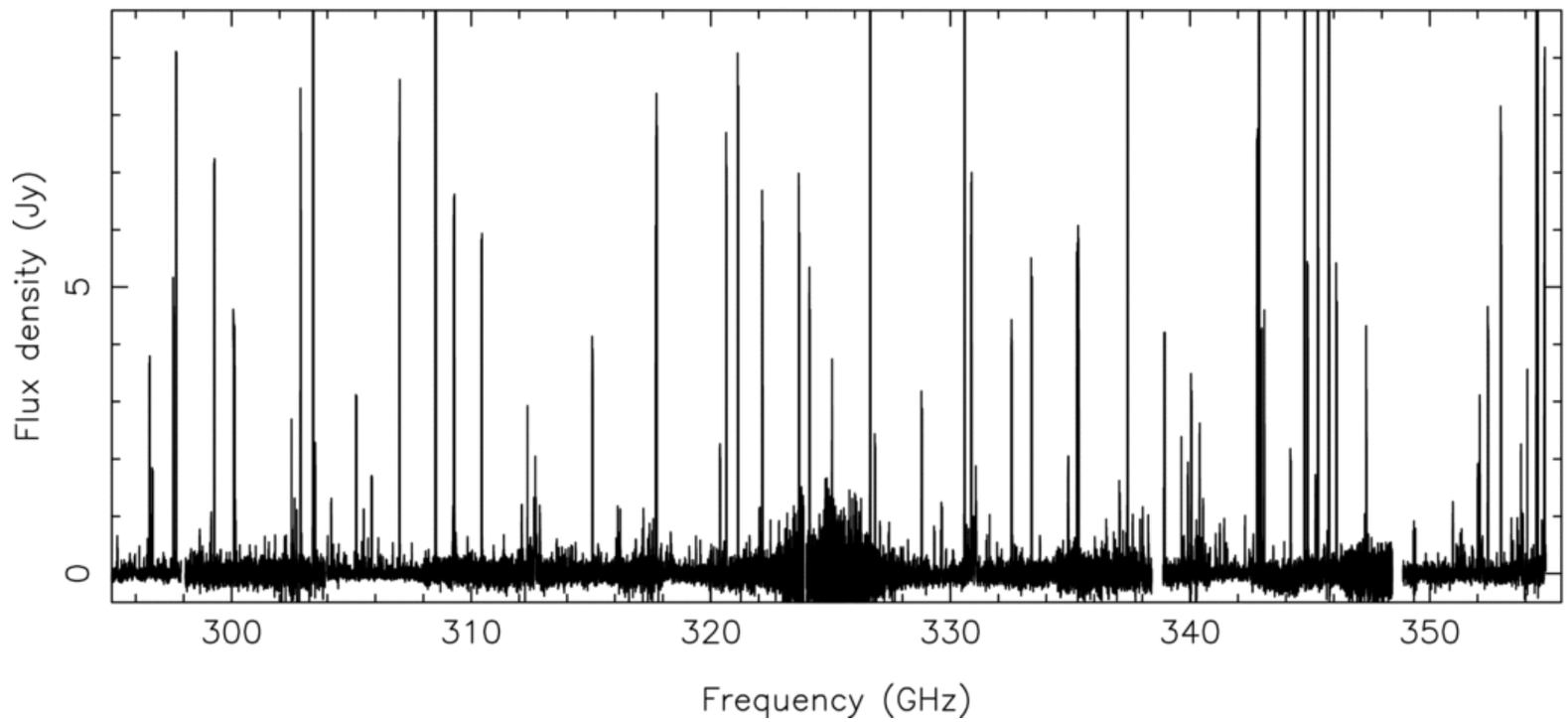


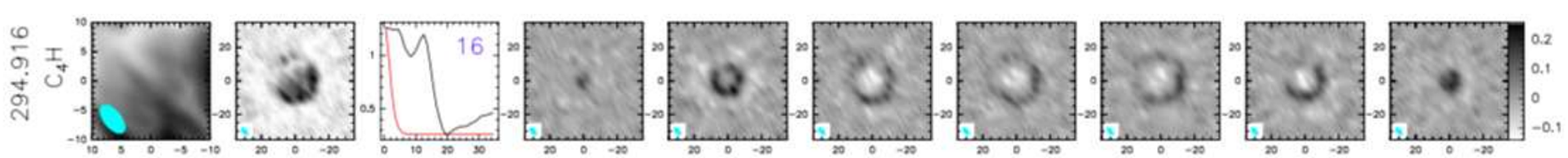
ISM enrichment from evolved stars

mass-loss rates; wind physics

chemistry —> dust mineralogy

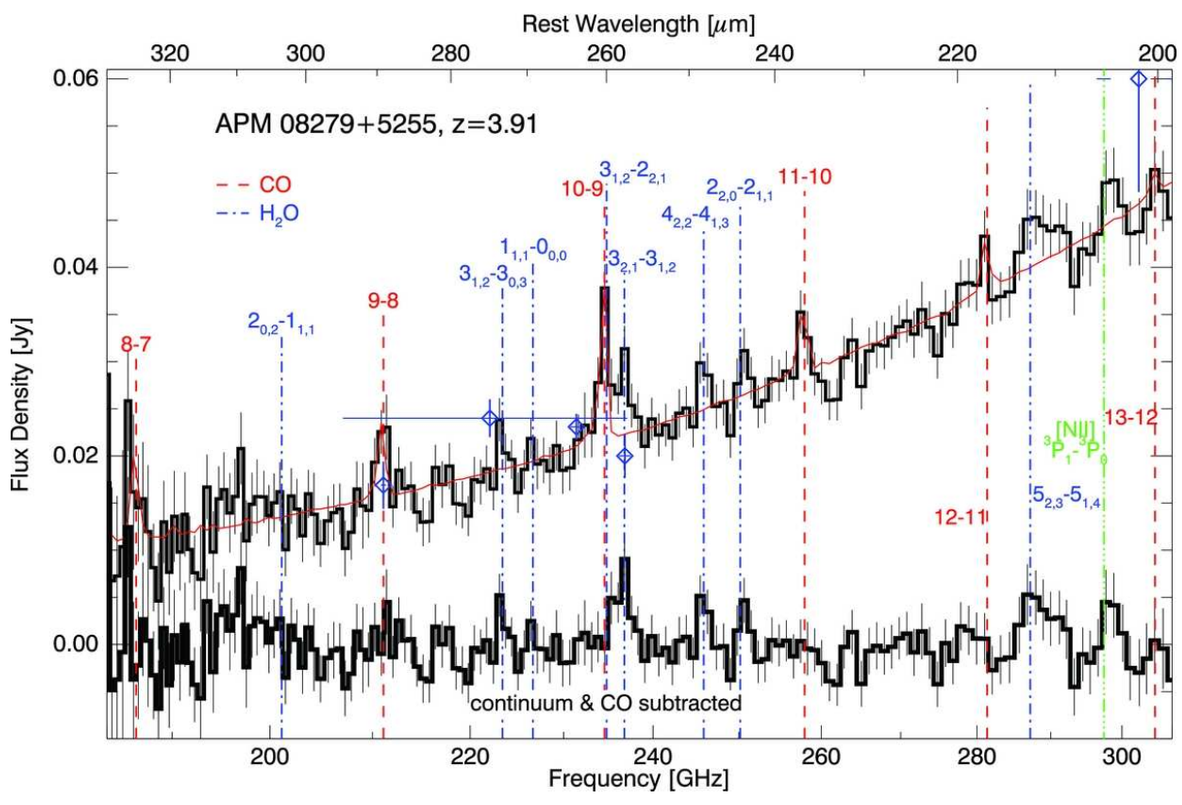
example: 64 GHz (13 tracks)
1 wSMA track

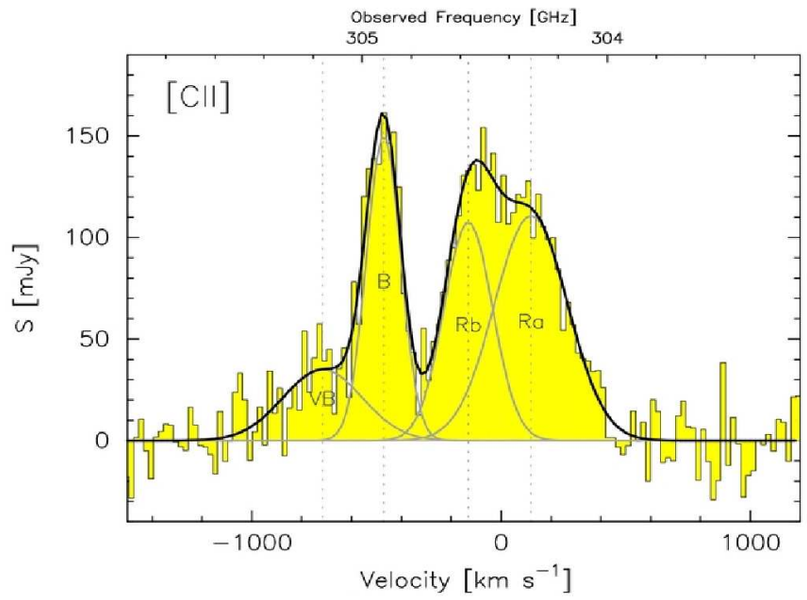




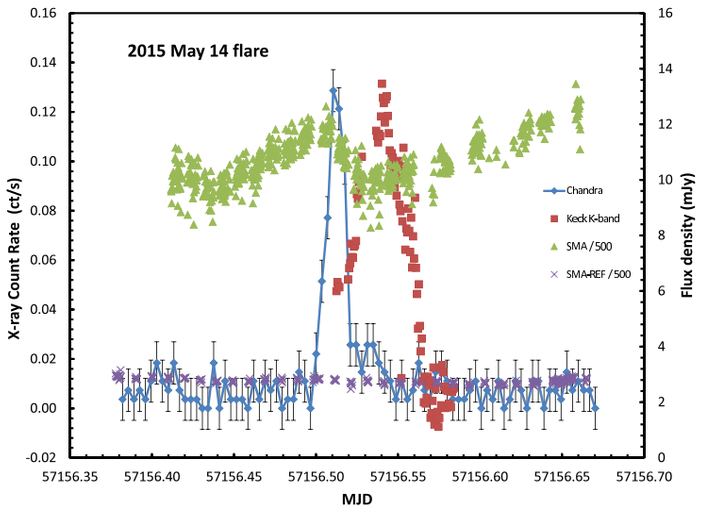
star formation in high redshift galaxies

lensed starbursts; multi-line studies
(CO, H_2O, fine structure lines, etc; reservoirs and UV heating from star formation)





time domain / transients

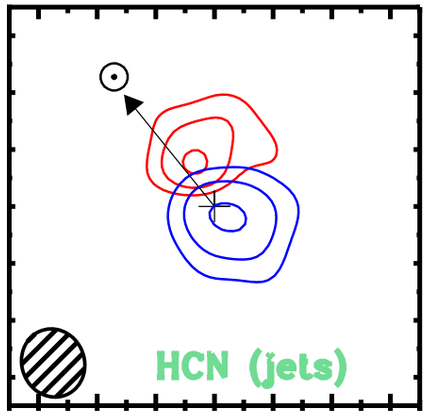


Sgr A*

simultaneous multi-freq Faraday measurements

time variability of accretion rate

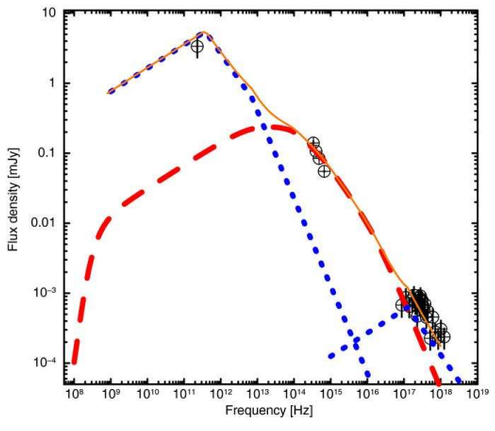
(crucial for mm VLBI interpretations)



comets

separate coma and jet contributions (spatially and through spectral line ratios)

short time variability of outgassing (in jets)



gamma-ray burst afterglows

reverse shock synchrotron emission; B-field, Γ

requires very rapid ToO (~minutes)

in principle, can see them at z~10 or more

other exciting wSMA modes

[CII] intensity mapping

line emission from “normal” galaxies at high redshift (3.5-10)

inferred statistically: fluctuations around mean line strength

blind surveys over large volumes; robust cross-calibration

millimeter VLBI (and EHT)

imaging supermassive black holes at event horizon scales

SWARM, etc. designed from ground up to do this well

only long E-W baseline; reliable weather (non-imaging)

Science with the wideband Submillimeter Array:
A Strategy for the Decade 2017–2027

ed. D. Wilner *contributing authors:* E. Keto, G. Bower, M. Gurwell,
G. Keating, N. Patel, G. Petitpas, C. Qi, TK Sridharan, Y. Urata,
K. Young, Q. Zhang, J.-H. Zhao

Version 1.7, December 1, 2016

Figure 1: *The eight 6-meter antennas of the Submillimeter Array on Maunakea, Hawaii (credit N. Patel).*

much more info in the wSMA white paper!