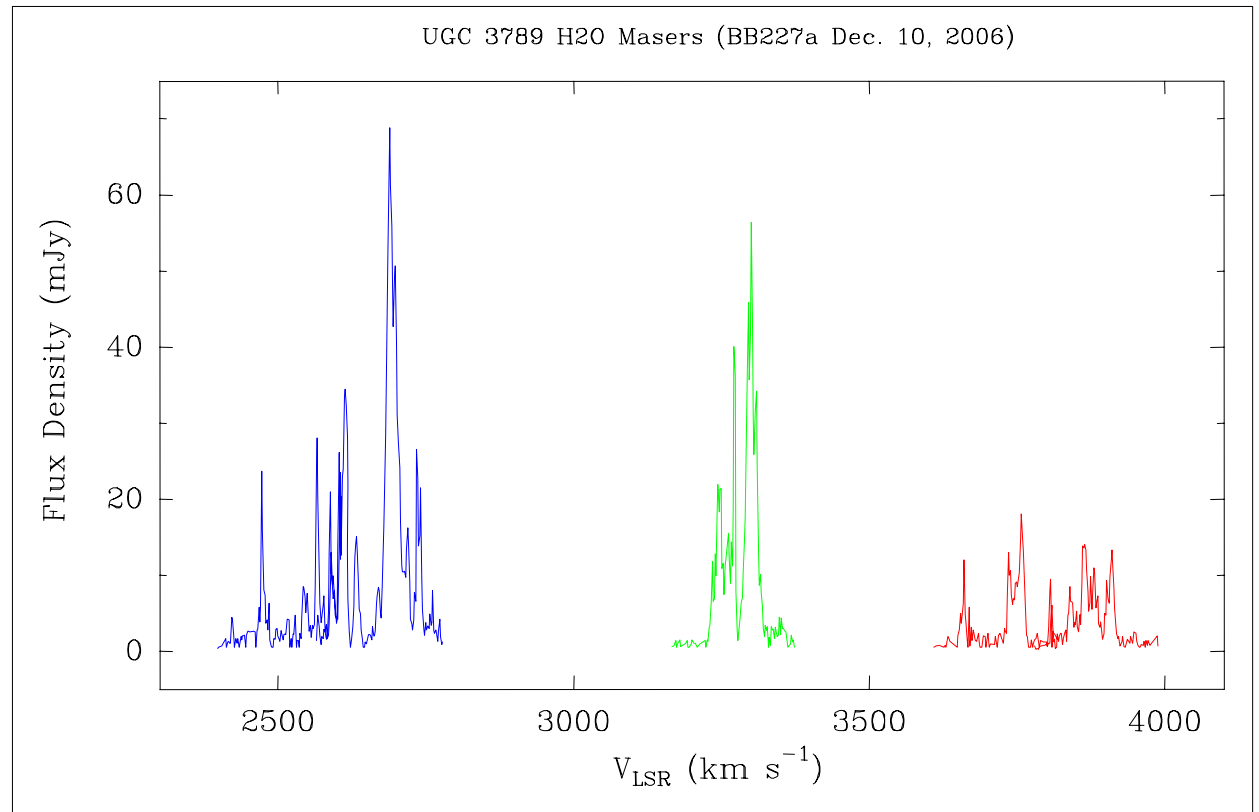


# Maser Cosmology Project

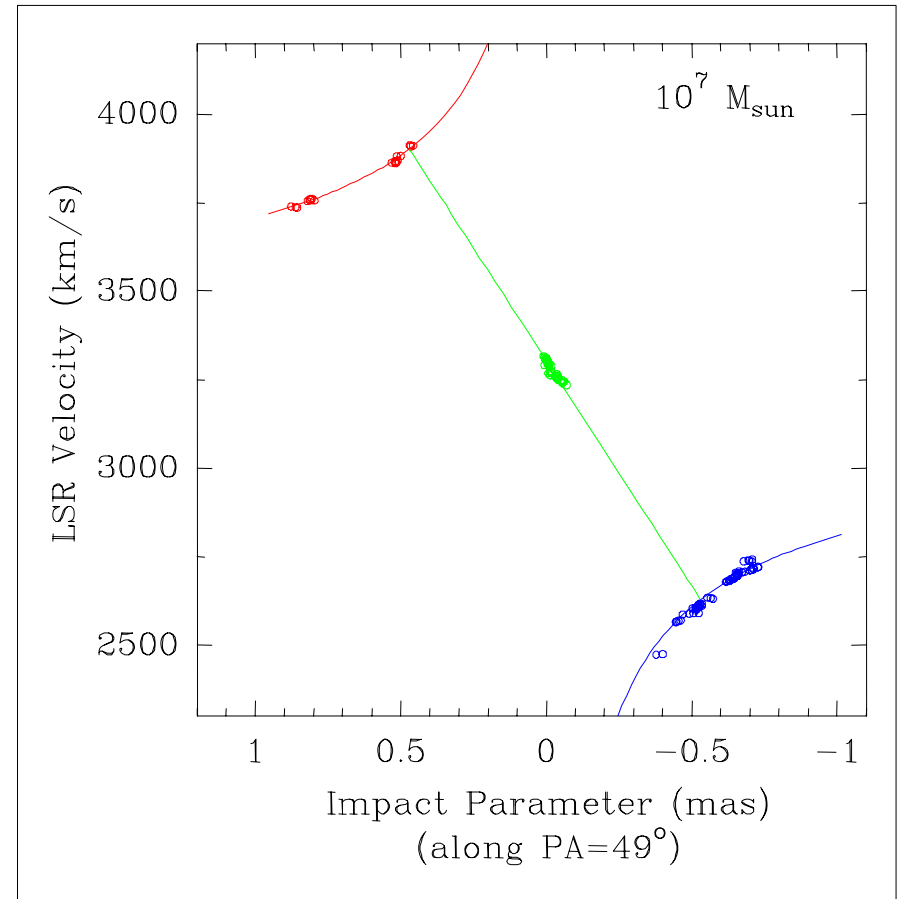
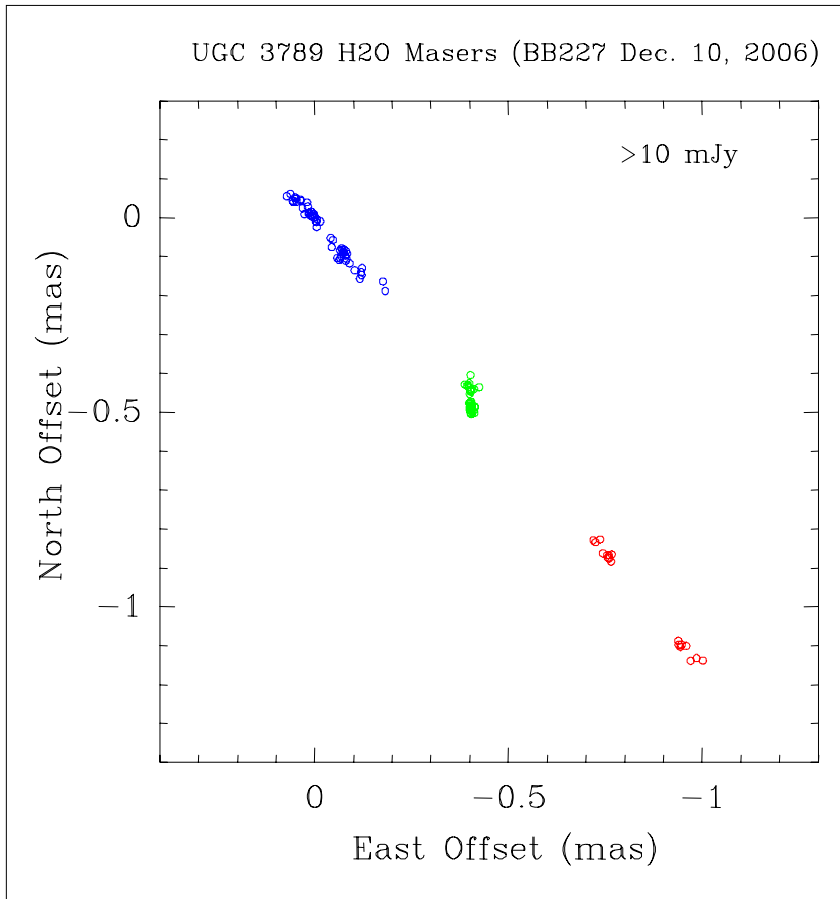
Braatz, Condon, Greenhill, Henkel, Lo & Reid

- Goal:  $H_0$  to  $< \pm 3\%$
- How: Geometric Distances to  $H_2O$  masers in Hubble Flow
- NGC 4258 (7%  $\rightarrow$  5%)
- UGC 3789
- + 5 - 8 more



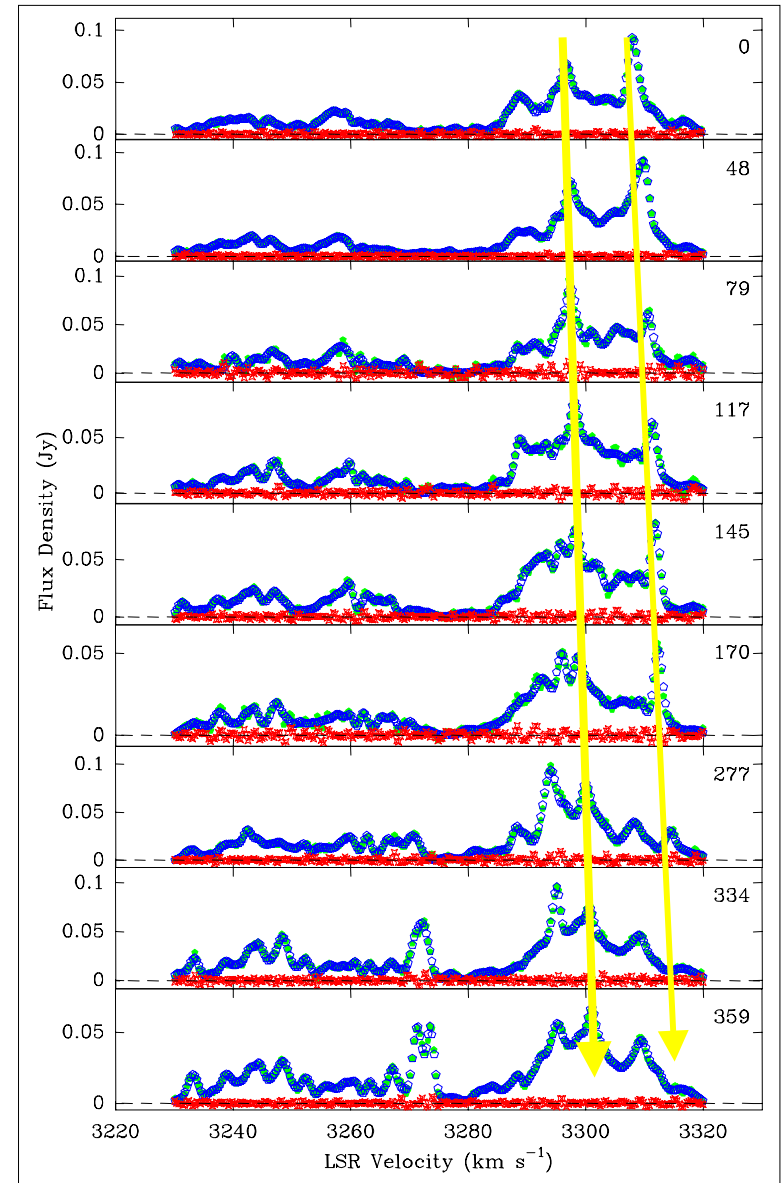
# “Maser Cosmology Project”

Braatz, Condon, Greenhill, Henkel, Lo & Reid



# UGC 3789

- Accelerations  $\sim 3.5$  km/s/year
- $D = V_2 / A \theta$ 
  - $V \sim 625$  km/s
  - $\theta \sim 0.52$  mas
  - $A \sim 3.5$  km/s/year
  - $\therefore D \sim 48$  Mpc or  $H_0 \sim 71$  km/s/Mpc
- $\sigma_D \sim 10\%$  expected with detailed model



# A Key SKA Science Driver

- $H_0$  via  $H_2O$  masers to 1% accuracy

$\sigma_V \sim 200$  km/s, so need  $V = 20,000$  km/s

Currently can get to  $\sim 3,000$  km/s (UGC 3789)

Need x7 in distance  $\Rightarrow$  x50 in sensitivity ... ie SKA

# Major Astronomical Discoveries

## Not Planned

Hubble expansion

CMB

Quasars (SMBHs)

Pulsars

Masers

Cosmic “web”

Dark Matter

SNR Ia/Dark Energy

## Planned

Extra-solar planets

CMB fluctuations

# Decadal Review “Realities”

- Look beyond decade (few projects built in decade proposed)
- Costs established (if costs double, lose decadal recommendation)
- Operations costs critical (over 20 years, ops costs nearly 2x construct.)

Senior Review recommended: cuts for largest telescope (Arecibo) and highest resolution telescope (VLBA) to save “operations” funds

- ALMA demonstrated success before another “World Array”
- Clear concept / “Transformational” science

# Site Issues

- Low/Mid Freqs: performance dominated by interference
- High Freqs:  $\text{H}_2\text{O}$  / phase stability more important

A single site may not be best

- Northern & Southern sites highly desirable  
(unless only care about deep fields or example sources)

# SKA-high: a “modest” proposal

- “Successor to EVLA”: Shri Kulkarni’s Array (=S.K.A.)
- Add antennas to all VLA pads, collecting area at VLBA sites, and fill in (u,v)-gaps at 100’s km spacings

“50-100 m” antenna clusters @ 72 + 10 + 8 “pads”~ SKA  
get much better imaging at all scales

- Keep operations costs nearly constant
  - no need to re-configure arrays
  - little new infrastructure
  - cuts lifetime (20 yr) costs by 2/3<sup>rd</sup>s
- Could be scaled to fit total budget



# Affordability

- SKA-mid ~1.5GEuros

SKA-high ~1.5GEuros (?) ...currently not a realistic option

May need to consider smaller jump in collecting area

- Should we scale-back SKA-mid to allow SKH-high, or decouple the two (as in SKA Discussion Document)?