

A search for water masers in the Magellanic Clouds (C973)

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AIMS

- Identify more strong masers in LMC & SMC
- Study relationship with HII regions and AGB stars
- Maser luminosity function
- Monitor variability
- Multi-epoch VLBI study of stable masers to measure PROPER MOTION ($1 \text{ marcsec yr}^{-1}$) and ANNUAL PARALLAX ($40 \mu\text{arcsec}$) of Magellanic Clouds

Observations

- $6_{16}-5_{23}$ water maser transition at 22.235 GHz
- Two epochs – Feb 2002 & Nov 2002
- Each epoch – 3 x 12-hr obs, spread over 6 days to allow for bad weather, nighttime
- Generally 1-2 hour angles, 2-5 mins integration
- 500 sources
- Typical elevations: 30-60 degrees

Observations (cont)

- Channelization: two types
 - 16 MHz 512 channels (search)
 - 8 MHz + 128 MHz (known sources)
- Mosaic mode to reduce overhead time for snapshots and make use of short coherence times during bad weather
- Phase cal every 10-15 mins

Feb 2002

- Night 1
 - Weather poor (overcast, some rain)
 - T_{sys} 150-200+ K (varied by 50-80 K)
 - High T_{sys} + high Opacity = unable to detect 2-10 Jy (peak) masers
 - CACAL on 1934-638 @ 16 MHz BW – poor choice
 - Detection limits: 0.4 km/s, 1-2 mins $>$ 1 Jy

Feb 2002

- Night 2 & 3
 - Better weather – clearer, $T_{\text{sys}} \sim 120$ K (varied from 80 – 160 K)
 - CACAL on 0537-441 (7 Jy) ☺
 - Phase stability good – coherence times of many 10's of mins or more at times
 - Good (new) detections @ 1-2+ Jy

Nov 2002

- All nights
 - CACAL on 1921-293 (12 Jy, assumed) ☺
 - Also: Mars observed each night
 - Weather good: T_{sys} 120K, 120K, 60-100K
 - Phase stability excellent: coherence times $> 1-2$ hours (!)
 - System: good performance, a few ACCs died
 - Good detections, 0.4 km/s channel rms ~ 0.2 Jy after 2-3 minutes

Calibration

- First epoch
 - CACAL: used 0537-441 (7 Jy), 1934-638 (~0.4 Jy)
 - 0454-810, 0100-760 phase cals
 - Mars observation included (not used yet)
- Second epoch
 - CACAL: Used 1921-293 (12 Jy) , also assumed it at 12 Jy to set flux scale (interp. VLA value)
 - 0454-810 (2.5 Jy), 0100-760 (0.75 Jy) phase cals
 - Mars observations included (3", 0.4 Jy)

Data Reduction

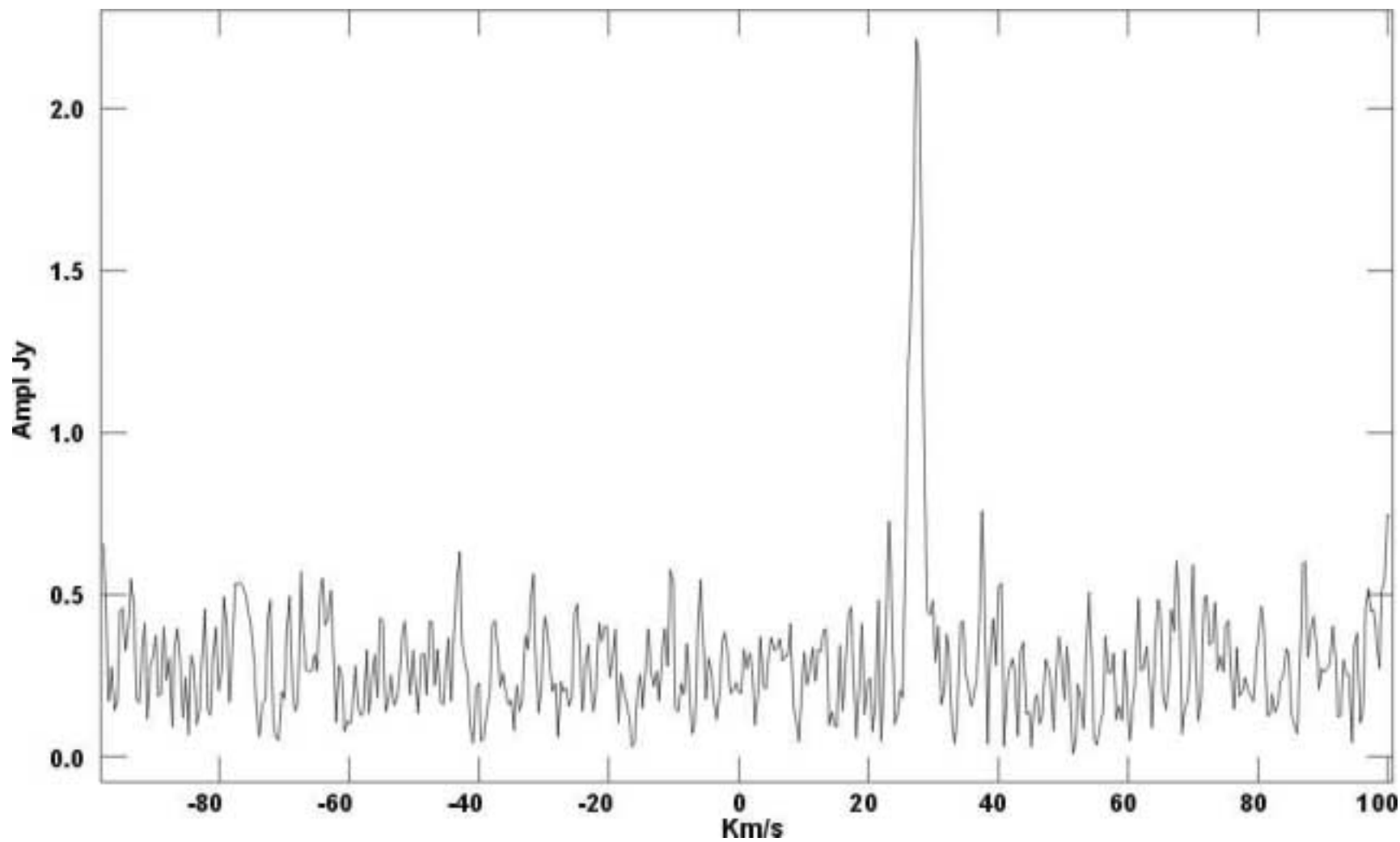
- During run – observed spectra on SPD in baseline average mode – most detections easily visible after 60 secs.
- Also: AIPS reduction (Beasley's preference).
- No task to implement Mars calibration available in AIPS (Beasley plans to write one...)

Misc. info

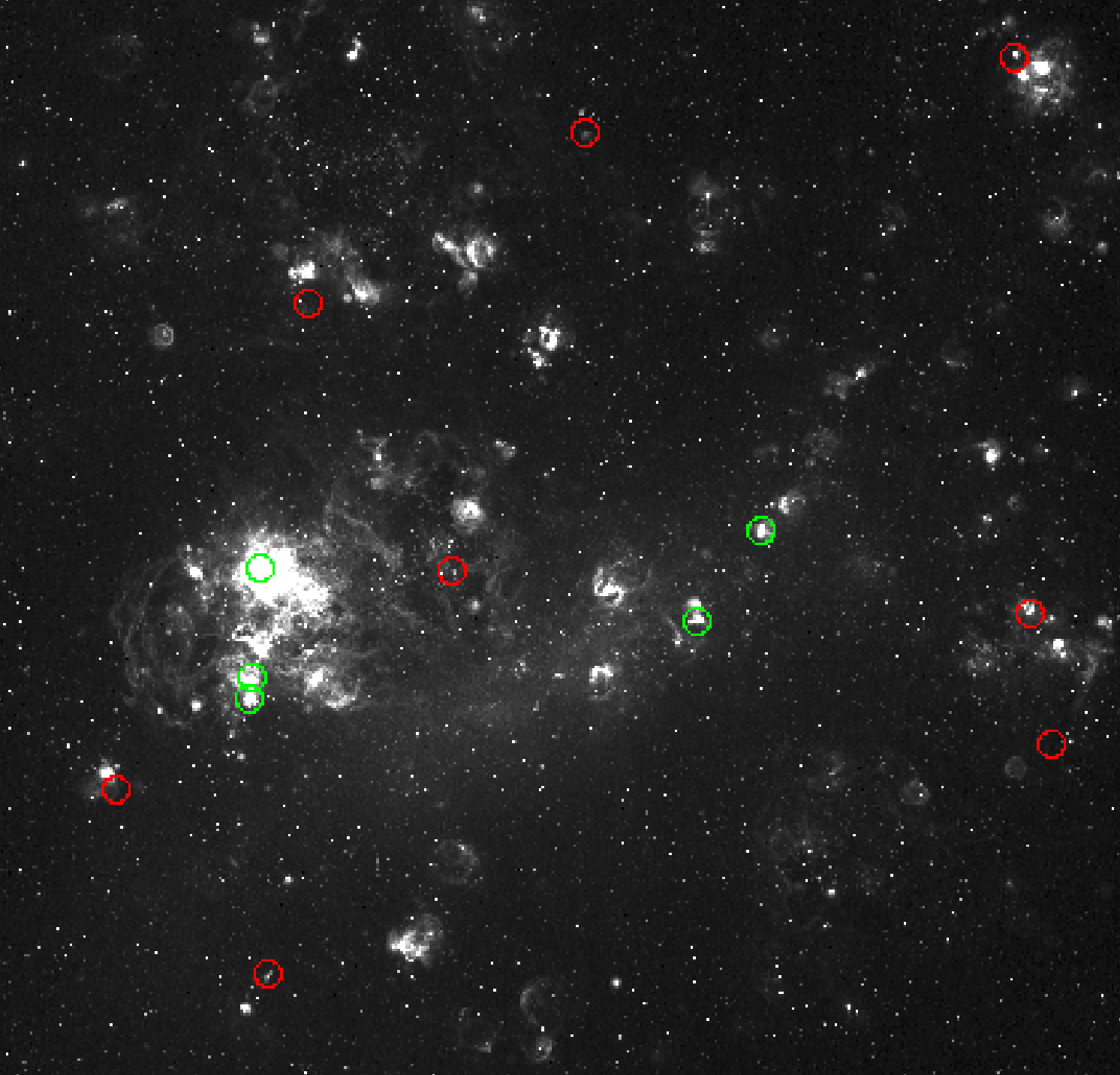
- Tsys increase with elevation obvious – below 30 degrees poor (Tsys > 150 K)
- Dawn effect – phase stability ruined about 1-2 hours after dawn (C1116).
- Mosaic mode – occasional mislabeling of source names seen in dataset (i.e. when changing mosaic files?).
- SYSC option in ATLOD doesn't work for 12mm data (?) (or is it for mosaic data?)

Results

- Nine new detections (8 in LMC, 1 in SMC)
- 7 IRAS or MSX-selected HII regions and 2 O-rich AGB stars
- 30+ spectral features
- Flux densities $> 0.5-1$ Jy
- 2% detection rate



Typical detection: Epoch 2, night 3



○ Previous
Parkes
detections

(Scalise & Braz
1982; Whiteoak
et al. 1983;
Whiteoak &
Gardner 1986)

○ New
ATCA
detections

22 GHz water
masers in
LMC

Tony Beasley's wish list:

- Easy “Dip” routine to determine tau (exists?), allow you to quantify atmos. part of Tsys
- Mosaic mode where RA/DECs of grid points specified (rather than degree offsets.. boring)
- Monitoring of 1921-293 (+ others) vs. Mars et al. for simple flux calibration, CACAL
- Good cal list (underway..)