IDS Report
1 Oct 2004 SWG meeting

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Recent activities

- Most have been described before:
  - LAT multiwavelength document (Thompson committee)
  - *NuSTAR* (SMEX would provide coordinated X-ray obs w/ *GLAST*) concept study report, site visit, upcoming downselect meeting
  - New grad, Bulent Kiziltan, has joined to work on pulsar timing prioritization/planning

An Intro to P-ALFA

- Two key pulsar advances in *GLAST* era:
  - Improved sensitivity of *GLAST* itself
  - Substantial increase in known pulsar population
    - Parkes Multibeam Survey
      - ~700 new pulsars, many young
    - Arecibo drift surveys
      - Scores of pulsars, biased towards older population & millisecond pulsars

The advantage of 21-cm

- Most surveys at 430 MHz
  - Pulsars are strong
  - Beams are big
  - But sky is bright and dispersion limits distance
- Parkes survey was at 1400 MHz
  - 13 beams simultaneously
  - Long dwell (2100s per pointing)
  - BIG advantages in Galactic plane (where the youngest pulsars are)

Arecibo ALFA system

- 7 beams at 1400 MHz
- 10 times raw sensitivity of Parkes beams
- New, very broadband (300 MHz) spectrometer (soon)
- 268s dwell times
- 1.8 times as deep (4 times for msec psrs)
- 6 times the volume (50 times for msec psrs)

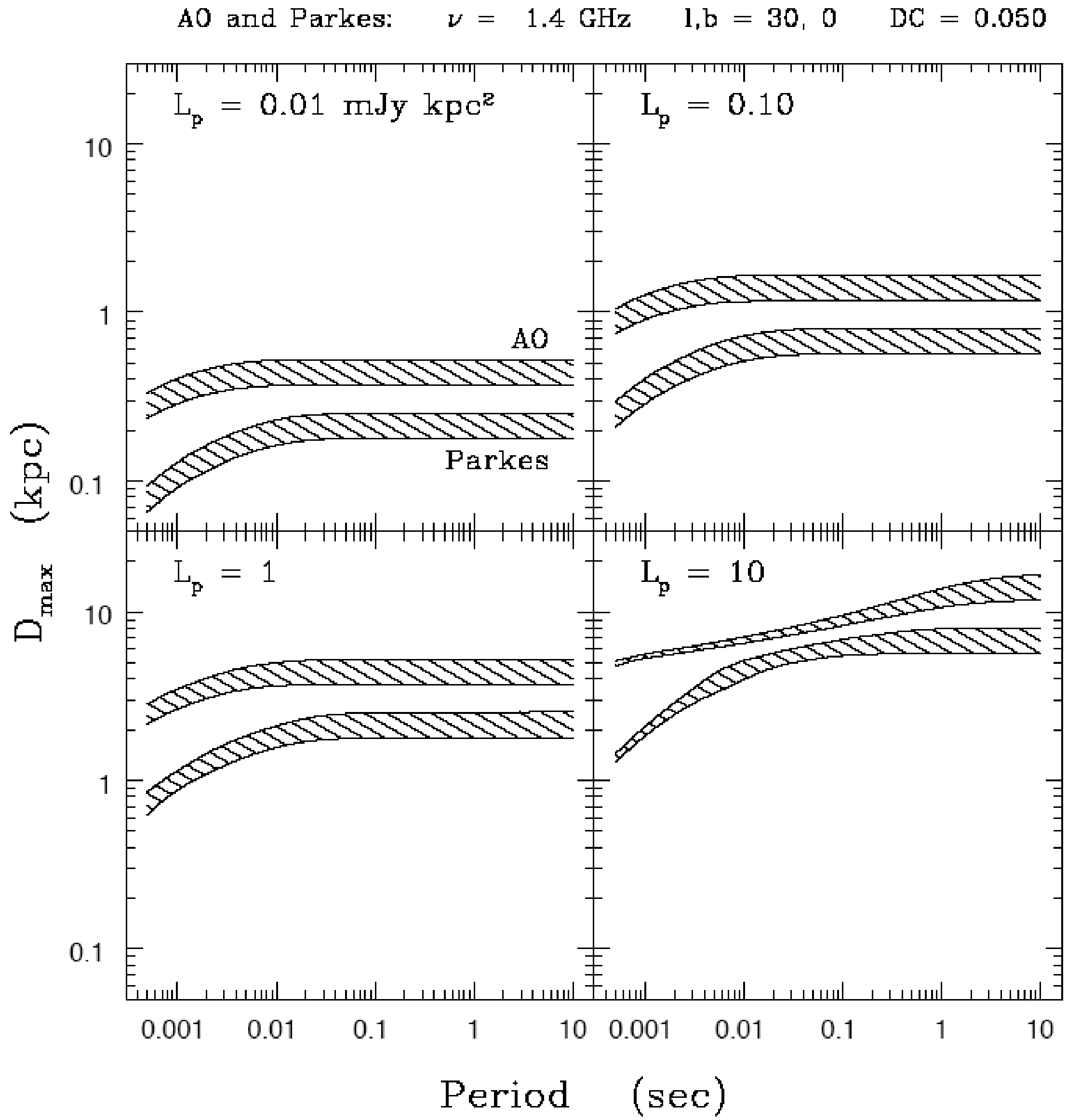

FIG. 1.— Maximum detection distance ($D_{\rm max}$) vs. spin period for the direction $\ell, b = 30^\circ, 0^\circ$ (at the edge of the declination limit for Arecibo). The four frames correspond to different values of the 'pseudo-luminosity' $L_{\rm p}$, which is the period-averaged flux density $\times D^2$. The distribution of $L_{\rm p}$ for pulsars is broad, covering several orders of magnitude, because the emission is beamed. The top and bottom boundaries of each shaded region are for full- and half-gain, respectively. The telescope parameters are as in Table 1 using ALFA II parameters for Arecibo. Propagation effects, which limit $D_{\rm max}$ at large distances are calculated using the electron density model NE2001 (Cordes & Lazio 2002). For distances $\gtrsim$ 5 kpc, $D_{\rm max}$ is affected by pulse broadening from scattering.

Test observations

- This summer, had 19 hrs in Galactic center, 17 in Galactic anticenter, with shorter dwell
- Rediscovered 19 pulsars (~all that were known in area)
- 6 new pulsars (one is 69 msec!) in first pass processing
- Final analysis will be 2-4 times deeper

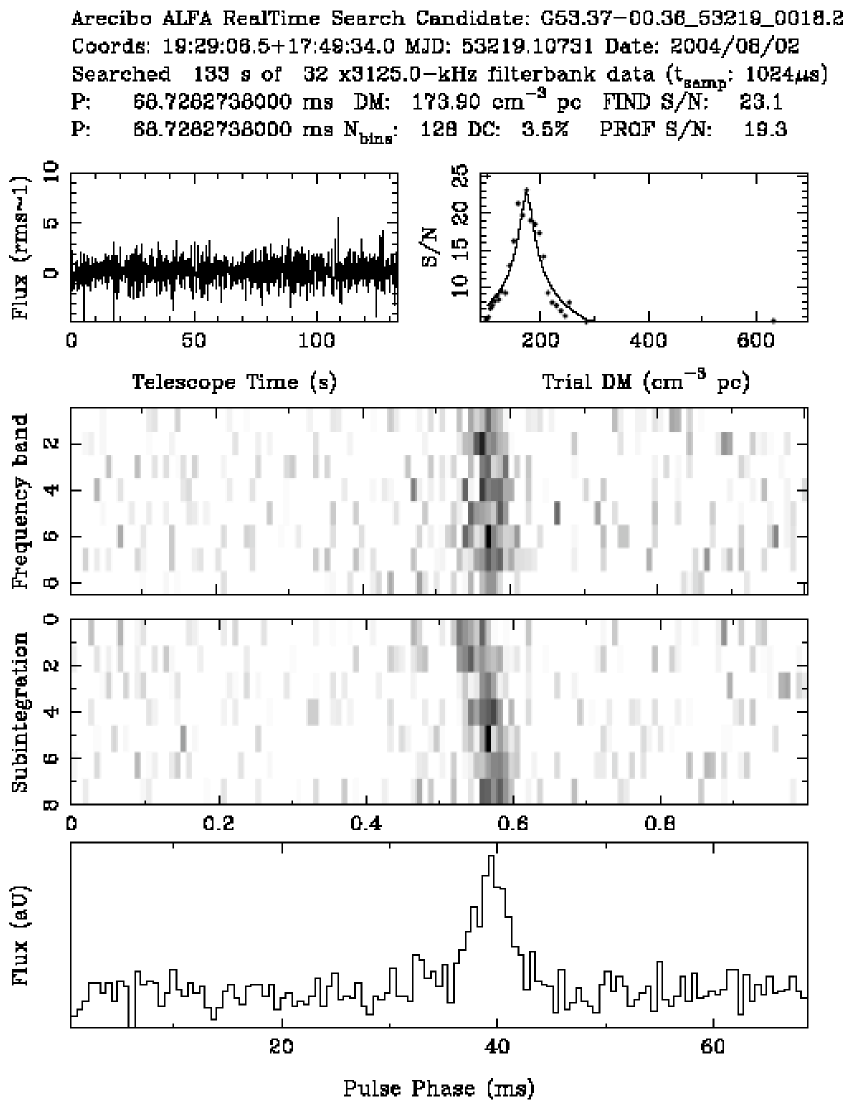

FIG. 5.— Summary page that shows the first detection from the precursor survey. A page like this is produced for each candidate signal that emerges from the periodicity analysis. Top left: dedispersed time series. Top right: amplitude of identified signal vs. DM. Second from top: grey-scale plot of signal-averaged flux density vs. frequency band, showing that the signal is broadband. Second from bottom: grey scale plot of signal-averaged flux density vs. subintegration (i.e. time) showing that the signal is peristent. Bottom: pulse profile using all the data.

Plan

- Proposal is for ~140 hrs/trimester for five years
- This is about 1/3 of Galactic center time at Arecibo!
- Expectation (with large unknowns about source population) is roughly 1000 new pulsars

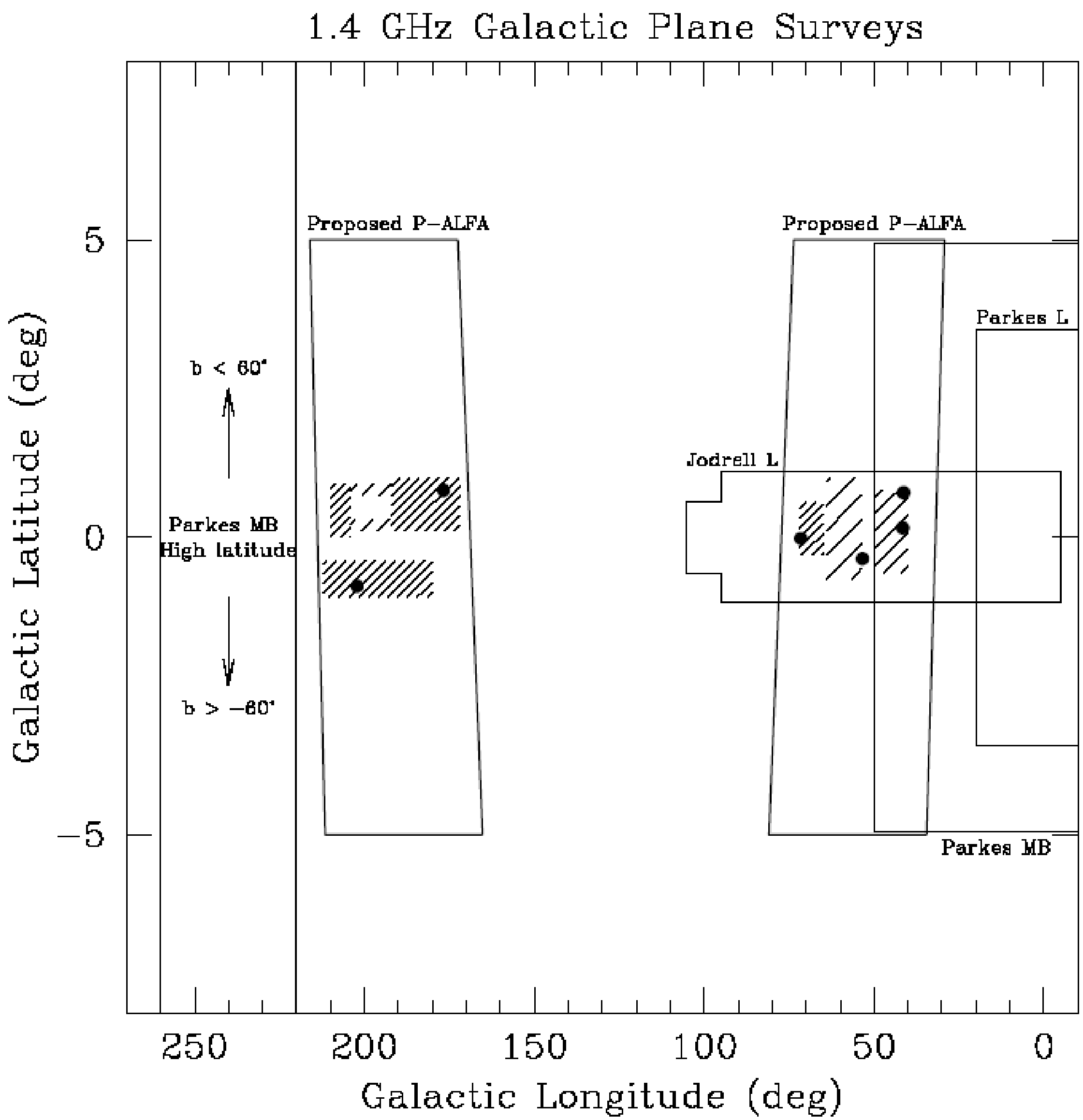

FIG. 2.— The regions of the Galactic plane proposed for PALFA surveys. taking into account declination limits and restricting $|b| \leq 5°$. For reference, we show the boundaries of other prominent L-band surveys that have been made in or near these regions, including the Parkes MB survey and single-pixel surveys with Parkes and Jodrell Bank. A shallower Parkes MB survey for millisecond pulsars extended to Galactic longitude 220°. Arecibo surveys at 0.43 GHz have covered our proposed search areas, but to distances $D_{\max}$ much smaller than we can reach owing to the limiting effects of interstellar dispersion and scattering.

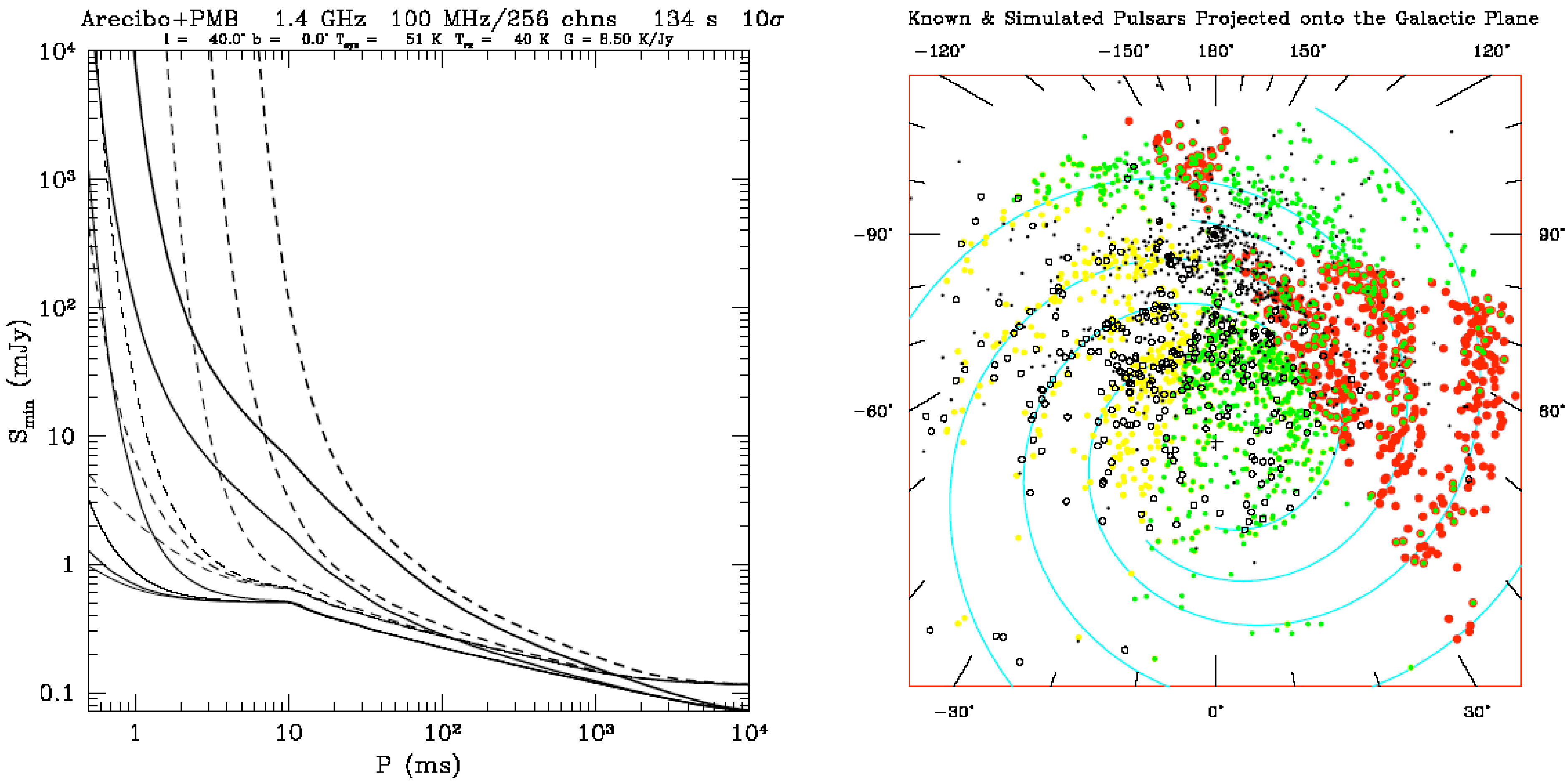

FIG. 4.— *Left:* Minimum detectable flux density vs. P for different values of DM. Solid lines: for full-resolution PALFA data using the WAPP systems and dwell time of 134s, as described in the text. Dashed lines: for the Parkes multibeam survey, which used 96 channels across 288 MHz and 250 μs sampling for a dwell time of 2100 s. For each set of curves, DM values from the lowest to the highest curve are 1, 10, 50, 200, 500 and 1000 pc cm^{-3}. The breakpoint at $P \sim 10$ ms for the solid curves occurs appears because we assume that the intrinsic pulse duty cycle scales as $P^{-1/2}$ with a maximum of 0.3, which occurs at this period. Above 10 ms, the number of harmonics contributing to detections increases from 1 to 32 (the maximum searched) as the duty cycle gets smaller. *Right:* Projection of simulated and real pulsars onto the Galactic plane. Curved lines represent spiral arms. The simulation is a realistic model of the population and of specific surveys, producing the correct

Follow-up

- All new pulsars must be timed to determine p-dot, E-dot, and detect binary motion
- It takes about a year of observations to separate position from p-dot
- It is roughly 2.6 hours/pulsar, or ~2600 hours!
- This doesn’t include longer term monitoring