**ALFALFA Year 1: Midterm Report**

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ALFALFA, the Arecibo Legacy Fast ALFA survey of extragalactic HI, initiated observations in February 2005. Among its scientific goals are those of delivering an unbiased view of the local, extragalactic Universe and providing a legacy tool for the astronomical community at large.

**Scheduling Status.** In the five months up to the end of June of 2005, about 400 hours of telescope time have been scheduled, of which 367 hours were succesfully used for observations, the rest lost to hardware and system failures or practical "overheads" (e.g. removal of ALFA cover). We have verified that, under normal circumstances, the ALFALFA strategy gives a science data to observing run duration efficiency of 97%. Scheduling of individual observing blocks is undertaken in a deliberate, stategic manner, reviewed almost daily based on data quality verification. The second pass of each area of sky is scheduled more than 2 months after the first (so that the heliocentric doppler shift can be exploited as a signal reality check). For reference, see the internal A2010 observing team website: *http://www.naic.edu/∼a2010/galaxy_a2010.html*.

The request submitted in October 2004 for the first survey year asked for 990 hours, or 66 observing sessions between 07.2 and 16.7 hrs, 21.7 to 03.2 hrs, LST. This request was motivated by the plan to complete mapping of 2 strips of "tiles", each 4° wide in Declination. Figure 1 shows the final status of the spring 2005 A2010 observations. As evident in the figure, the observations made so far cover the northern galactic cap, or the "Spring extragalactic sky" but with a large degree of unevenness. We hope that time allocations towards the end of 2005 and beginning of 2006 will allow us to complete coverage. At the current rate of time allocation, completion of the targeted tiles will not be possible.

**Team Constitution and Governance.** ALFALFA is an open group, which currently includes 48 members from 11 countries and 32 different institutions. Team expertise includes all areas deemed necessary for the succesful management of the survey and the achievement of its stated science goals. As stated in the observing proposal, the ALFALFA team has organized its governance by forming an Oversight Committee, which includes the P.I. (Riccardo Giovanelli), a member from a foreign institution (Noah Brosch), a graduate student (Brian Kent), a member of the NAIC staff (Emmanuel Momjian) and two other US–based scientists (Martha Haynes and Lyle Hoffman). A set of guidelines that will regulate the various projects' development, within and around ALFALFA, inclduing criteria for authorship, has been developed and posted. Several task groups have been formed, which contribute to the coordination of the observations, bookkeeping, software development, data processing, follow-up work, public access to the data, research involvement of students and public outreach. Particular attention to the protection of students' thesis projects has been given in the drafting of those guidelines.

**Team Activities.** While observing procedures have been carefully streamlined and documented — and observations can be and have been safely carried out remotely —, the team has given strong preference to the option of observing on site, while minimizing the use of AO team members for that purpose. In doing so, we have appreciated NAIC's support in waving our team's, especially students', lodging expenses. This practice ensures a more productive and higher rate of utilization of the scheduled telescope time, more effective communication with Observatory staff and shorter response times to equipment failures, more effective training of students and faster adaptation to Observatory dynamics. The role of "designated observer" has been utilized, which stimulates a heightened sense of responsibility for the quality of the survey data and has an invaluable impact on the training of students.

Software development is still under way, but all the fundamental pieces of data processing software are now operational. This development has taken place within the IDL environment at Cornell. The software has been exported to and is being succesfully used by other extragalactic HI teams, such as the NGC 2903 group. Processing of the data to the Level I, as defined in the ALFALFA proposal (noise, bandpass calibrated and baselined drift scans), has been carried out for all the data taken so far. Demonstrations of data processing at institutions other than Cornell, such as AO, Lafayette College and Union College, have been completely succesful, showing the easy exportability of the software.

A website is maintained, with mirror sites at Cornell (*http://www.egg.astro.cornell.edu/alfalfa*) and Arecibo (*http://www.naic.edu/∼a2010/galaxy_a2010.html*), where updated reports of future scheduling and observing plans, actual observations, sky coverage, technical memos, manuals, guidelines, science and other activities are regularly posted. Scientific results of the survey precursor observations are also posted: papers, data tables, catalogs and, for each source, cross–references to optical and other catalogs. We have made an effort to make our results available to the community and the public in a mode compatible with National Virtual Observatory standards. We have obtained NSF funding to develop the necessary software and 3 of our graduate students (Kent, Masters and Spekkens) have attended the 2004 Aspen NVO School. Kent will return for a second year to the 2005 NVO School. The presentation of the precursor observations data set at *http://www.egg.astro.cornell.edu/precursor*, as developed by team member B. Kent, is a preliminary demonstration of those efforts.

**Team Meetings.** In order to foster team participation, to maintain team coordination and proper dissemination of results and progress updates, several ALFALFA workshops have been held, namely:

1. 30 May 2005 at the Brera Observatory downtown Milan, Italy, which saw the participation of 15 team members from Italy, France and Spain and several other researchers interested in the project (taking advantage of RG's and MH's vacation in Europe);
2. June 23-24 at Cornell in Ithaca, NY, which saw the participation of 24 researchers;
3. July 6-7 at Union College in Schenectady, NY, with the participation of faculty from Union, Cornell, Lafayette, Wesleyan, Colgate, U. of Puerto Rico and St. Lawrence, 2 Cornell graduate students, and 14 undergraduates from Union, Cornell, Lafayette, Colgate and UPR. This meeting, which focussed on research experience for undergraduates and public outreach, was also attended by the Director of the AO Angel Ramos Visitor Center, Dr. José Alonso. The highlight of the meeting was an ALFALFA observing session of 90 minutes, carried out remotely by the students themselves and succcesfully processed and analyzed by them during the day which followed the observations. Before the meeting, the students had communicated by email to develop a proposal, submitted to NAIC, for how they would use the allocated time, and remain in communication as the data are processed and analyzed. See *http://caborojo.astro.cornell.edu/alfalfalog/ualfa*. It is hoped that the students will present a poster on their results at the Jan 2006 AAS meeting.

**Science Results.** The observations carried out between August 2004 and January 2005, as part of the shared–risk survey precursor effort, have been fully processed and analyzed. Two papers have been submitted for publication to the Astronomical Journal in May 2005, and are currently in the refereeing process. The two papers are:

- *The Arecibo Legacy Fast ALFA Survey: I. Science Goals, Survey Design and Strategy* and
- *The Arecibo Legacy Fast ALFA Survey: II Results of Precursor Observations.*

Copies of the papers will be made public at the completion of the refereeing process, presumably by late Summer. The precursor observations were mainly used to 'shake down' the system. However, a fraction of the telescope time yielded science grade data. Those data allowed the detection of 166 extragalactic HI sources. Of those, 62 coincide with previously known HI sources, while optical redshifts were available for an additional 18 galaxies; thus, 52% of the redshifts reported were previously unknown. Of the 166 sources, 51 are previously unidentified objects. For comparison with the HIPASS survey, at the sensitivity levels of that survey, *only about half dozen of the 166 detected precursor observation sources would have been detected by HIPASS, had it surveyed the same region as our precursor observations covered.* Three of these objects had HI masses less than $10^7$ $M_\odot$.

In the data obtained in February–March 2005, a new exciting source was found in the general region of the Virgo cluster: an assembly of several HI clouds with no optical counterpart. The total HI mass is quite large, approaching $10^9$ $M_\odot$, exceeding the masses of the neighboring optically identified galaxies. We have confirmed the reality of the detection at Arecibo, and through the "rapid response" procedure enacted at

NRAO, we have applied for and obtained VLA C–configuration time to follow up on our discovery. VLA observations were made on July 11 and are being reduced.

Our team has also produced a number of technical memos, which have been posted at the AO ALFA website, as well as in the ALFALFA website, illustrating various aspects, concerns and results of our share of the commissioning effort. The Cornell Ph.D. theses of K.L. Masters (July 2005) and C.M. Springob (Aug 2005) contain substantial work of direct relevance to ALFALFA, including software tools for the derivation of HI mass functions, local flow field models and survey simulations.

**Utilization of Observatory Resources.** ALFALFA has aimed to minimize the need for Observatory support. Once the data taking observing modes were developed and tested, no further software development was required of Observatory staff. All the data processing and bookkeeping software has been developed at Cornell. Four members of the AO staff are also part of the ALFALFA team: Mikael Lerner and Phil Perillat have provided very valuable assistance in implementing the desired features in the observing mode, as well as in understanding the characteristics of ALFA and as consulting sources for our data processing development. As full members of the science team, Barbara Catinella and Emmanuel Momjian have participated in the observations, in the development and maintenance of web tools and as members of team working groups but their involvement in observations has been less than that of a number of team members. During observations, an ALFALFA "designated observer" is always either at the Control Room or observing remotely. In particular, the burden of data quality is always on an ALFALFA team member who is also conducting the observations in real time; we have not requested absentee or service observing. The raw data of ALFALFA is maintained in storage at AO; the data rate is about 1 GB per observing hour. We have made requests from the Computer Division for use of high end workstations whenever observing at AO, in order to meet the moderately high demands of processing software. All processed data is maintained in storage at Cornell.

**Recommendations for the Future.**

1. We appreciate the efforts of AO in allocating substantial amounts of telescope time for this project. We wish to underscore that an effort of the magnitude required to make ALFALFA a success requires high coordination between the Observartory scheduling team and the observing team. Given the observing mode adopted, which reinforces the limitations of the telescope as a transit device, filling in gaps in the sky coverage created by the vagaries of the start time of each observing session, is a difficult task. That task can be helped with "look-ahead" scheduling, so that the observing team can plan for optimal allocation of observing time. This is particularly important with the scheduling of the second pass of the survey, which is ideally made at a difference of $\sim 1/4$ or $3/4$ in seasonal phase. We strongly recommend that an effort be made to accomodate this scheduling request.

2. Given the sky coverage of the survey, separated by galactic caps, the most intense observing seasons are January to May for the northern cap, centered at LST of $12^h$, and August to December for the southern cap, centered at LST of $0^h$. A "natural low" in the observing thus takes place in the Summer months. Our initial proposal was submitted on October 1st, 2004, for an observing cycle starting in February. We would propose that the cycle be shifted by 4 months, and that the new proposal for continuation of the survey be submitted by Feb 1, 2006, and yearly continuation requests be submitted each year following that date. This would allow a seamless scheduling of the all–important northern cap time centered at $12^h$ LST. This proposal would require that the currently approved proposal be extended in a "continuing resolution" mode through June 1st, 2006, rather than to February 1st of that year, and that time allocation for the February–to–June period continue to be allocated at the same sustained rate as in 2005. Were this adjustment granted, the project would resume at the survey yearly cycle stated by NAIC.

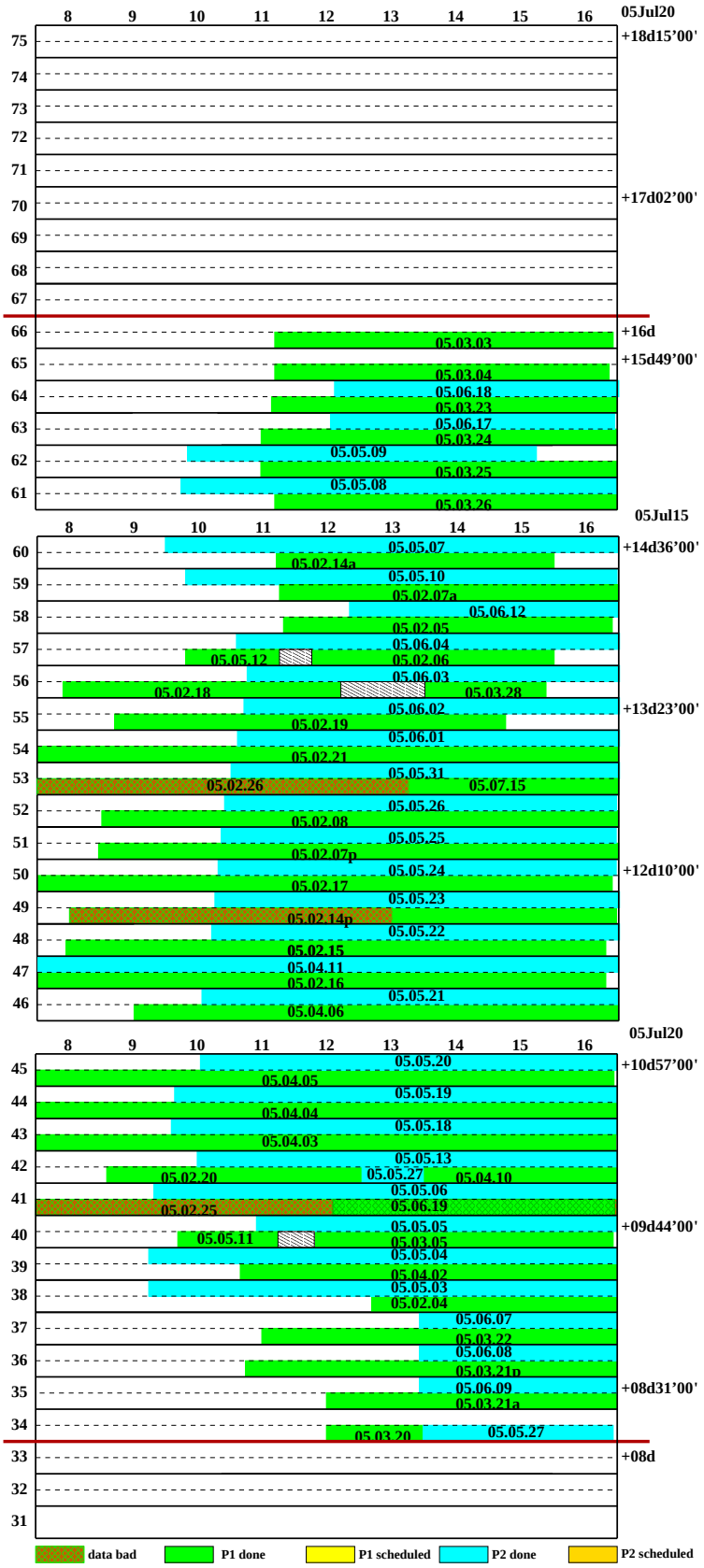


Figure 1: Actual A2010 sky coverage for Feb-July 2005. Ideally, ALFALFA would have covered homogeneously the region extending from $7^h30^m$ <R.A.< $16^h30^m$, $+8^\circ$ < Dec.< $+16^\circ$. By the nature of ALFALFA science, survey completion of contiguous areas is strongly desired.