ASTRONOMY 121, BERKELEY'S UNDERGRADUATE RADIO ASTRONOMY LAB: DO IT YOURSELF, NO (ALMOST!) BLACK BOXES

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Abstract Submission Form

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Berkeley's Astronomy 121 lab course presents radio astronomy as a set of three technological puzzles, each of which the students must experience and understand using a minimum of black-box magic. The most basic puzzle is the heterodyne principle and its implementation with microwave and electronic devices, whose study takes up not quite half of the course time. The related topics include transmission lines, waveguides, and impedance matching; DSB and SSB mixers and phase measurements; noise power per unit bandwidth ass described by temperature; and spectral analysis using Fourier techniques.

The other two puzzles are astronomical in nature. One is interferometry, using a 12-GHz two-element interferometer composed of $\sim$ 1 m diameter dishes on a $\sim$ 10 m baseline. The telescopes are computer-controlled and the students can devise scripts for automatic observing—it's just like a "real observatory", except that they write their own software. The fringe spacing of $\sim 9'$ is ideal for accurately measuring the fringe pattern and diameter of the Sun and Moon by tracking them from rise to set and forcing the students to use Fourier analysis in a real-world experiment. The instrument is sensitive enough to see the major continuum sources such as Tau A and Ori A, and by using fringe-fitting the students measure declinations to within a few tens of arcsec. The other is single-dish radio astronomy, using a just recently-acquired prototype antenna of the Allen Telescope Array to map 21-cm line radiation, observe OH masers, and observe a strong pulsar (not yet actually accomplished with our new system).

All of these labs emphasize hands-on use of laboratory instruments and computer-controlled data taking. Students write their own software, using the IDL language, to obtain data, reduce data, and prepare them for the lab reports. Quality reports are an important part of the course, and we require the students to use LATEX.

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2. J - Radio Astronomy

3. (a) J1

4. I - Invited Paper

5. No special instructions