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selves. From these papers we have compiled a data base of various observed
derived parameters for globular clusters (143 of them at last count). Our
main purpose is to use these data for correlative studies of globular cluster
properties. Others may find it useful for similar purposes, for planning and
support of observations, for testing of theoretical models, etc. We will describe
the data base, and present some simple analysis of the cluster properties and
correlations among them. The data will be made available to the community in
a computer form, as ASCII files. Interested users should send an email message
to the Internet address: george@deimos.calsitech.edu, and may also find the
above mentioned ASPCS volume useful in their work.

We thank our colleagues who contributed data for this compilation for their
efforts. S.D. acknowledges a partial support from the NASA contract NAS5-
31348, and the NSF FYI award AST-9157412.

Session 51: Instrumentation
Display Session

Pauley

51.01
The Berkeley SETI Program: SERENDIP III
C. Donnelly, S. Bowyer, D. Werthimer, D. Ng, J. Cobb (SSL/UCB)

The Berkeley SETI (Search for Extraterrestrial Intelligence) program, named
SERENDIP, was begun in the late 1970's. It is aimed at detecting narrow band
radio signals from extraterrestrial civilizations. The SERENDIP I, II and III
systems have operated autonomously in a piggyback search mode, conducting
unobtrusive, long-term observations on the world's largest radio telescopes.
The latest generation SERENDIP instrument, SERENDIP III, is a four million
channel FFT-based spectrum analyzer operating at 0.6 Hz resolution with a 1.7
second integration time. SERENDIP III has been operating at the NAIC Arecibo
Observatory since April, 1992. Several independent criteria suggest that this
search is the most sensitive SETI search in operation. To date SERENDIP III
has accumulated over 3600 hours of high quality telescope time, observing 75%
of the sky visible by the Arecibo telescope. Over this period SERENDIP III
has analyzed over 30 trillion spectral bins, and recorded information on 110
million strong narrow band signals in the 424-435 MHz band. A handful of
these signals have survived our RFI rejection and signal detection algorithms,
and have thus been added to our list of ETI candidate signals. A follow-up
observation program will be conducted next year in an attempt to verify each of
these candidate signals.

This work has been supported by NASA grant NAGW-2722.

51.02
The Optical and Mechanical Design of the new BIMA Receivers
J.B. Lugten, J. Hudson (UC Berkeley), X. Zhang (CFA)

Each of the receivers for the new Berkeley Illinois Maryland Array (BIMA)
millimeter wave telescopes is designed to accommodate 4 SIS mixers, covering
the 70-90, 90-115, 130-170, and 210-270 GHz frequency bands. For simplicity
and compactness, and because they must be remotely controlled, the receivers
are single polarization, with the 4 fixed-tuned waveguide mixers housed in one
dewar and cooled by a single 4 K closed cycle refrigeration. The Gunn diode
local oscillators are coupled quasi-optically. The receiver design is modular; for
example, entire local oscillator assemblies are easily interchanged. A complete
receiver weighs about 60 kg including local oscillators and the refrigerator
coldhead. The dewar is about 25 cm diameter and 55 cm long.

The receiver is mounted at the Cassegrain focus with each of the scalar feed
horns located slightly off the telescope axis. The straight-line optical path has no
movable elements; instead, changing frequency bands is accomplished by off-
setting the antenna pointing slightly. The coma due to the off-axis feed location
gives an rms wavefront error of less than 1/550 wavelength even at 270 GHz.
Aspheric teflon lenses along the optical path form an image of the telescope at
the aperture of each feed horn, providing frequency independent coupling. The
lenses also serve as the dewar vacuum wall and radiation shield windows,
giving high transmission at mm wavelengths along with adequate blocking of
infrared radiation. The measured telescope background temperature is only 6
K due to the clean straight-through design of the telescope and receiver optics.
Aperture efficiencies are expected to be 70% to 75% at all frequencies.

This work was supported by NSF grant AST91-00307.

51.03
A 4 K Gifford-McMahon Refrigerator for Astronomy
R.L. Plambeck, N.A. Thatte, and P.B. Sykes (UC Berkeley)

SIS mixers on the BIMA array are cooled to 4 K with novel closed cycle
refrigerators. These refrigerators utilize the Gifford-McMahon cycle, which is
used in most commercially available cryopumps. In this cycle helium is
expanded from 20 to 6 atm after it is precooled in a heat exchanger matrix,
or regenerator. Conventional GM refrigerators bottom out at temperatures of
8 to 10 K because their regenerators have inadequate heat capacity at lower
temperatures. By adding a third stage to a standard commercial refrigerator,
and by using spheres of Er2Ni as the third stage regenerator, we reach much
to lower temperatures.

Our refrigerator operates at 2.2 K with no heat load applied to the third stage.
With 10 W on the first stage, 1 W on the second stage, and 50 mW on the third
stage, the third stage temperature can be maintained at 3.5 K. By comparison
with hybrid Joule-Thomson/GM refrigerators traditionally used to reach 4 K,
our refrigerator is far more compact, cools more quickly (to 4 K in a little over
an hour), requires only a single helium compressor, and is less prone to clogging
by contamination. The principal challenge in building such a refrigerator is to
fabricate a helium-tight reciprocating seal which operates reliably at 7 K on the
refrigerator’s third stage.

This work was supported by NSF Grant AST91-00307.

51.04
High Resolution Spectroscopy in the Non-thermal Infrared: Use of an
Existing Coude System
Gibor Basri (UC Berkeley), Geoffrey W. Marcy (San Francisco State Univ., UC
Berkeley)

We describe a recent effort to use a NICMOS 3 chip as the detector on the 160"
coude spectrograph camera at Lick Observatory. This new instrument (IRCS)
has a useful spectral range of 1.2-2.4 μm with spectral coverage in one expo-
sure of about 25 μm, and resolutions up to 7500. We have successfully obtained
astrometrical observations with essentially no modification of the (uncooled)
spectrograph, using an existing gratings blazed at 1.22μ, and a dewar without
optics (but containing a filter) easily mounted at the position of the old pho-
tographic plates. The throughput of the system is very high. Its sensitivity is
primarily limited by the background from the warm spectrograph. Using filters
with 0.1μ bandwidth, the expected background is negligible below 1.5μ, but
limits exposures to one minute near 2μ. With this optimized dewar, one can
remain photon (rather than background) limited down to 5th magnitude even
at 2μ.

Our current system (using a test dewar and engineering grade chip) has been
tested at 1.6μ. We have operated with and without an image slicer. We show
spectra and discuss the current successes and problems. Our first application is
to study the Zeeman-sensitive line at 1.56μ at high resolution. We expect to
be able to achieve S/N of 200:1 in 10 minutes on 6th magnitude stars now, and
eventually 100:1 in one hour on 10th magnitude stars using the 3-m telescope.
This opens the possibility of measuring magnetic fields for large numbers of
RS CVn and dB(e)ars (in addition to many G,K dwarfs), and even perhaps a
few pre-main sequence stars. There is a lot of potential for science in the 1.2-μ
range at high resolution, which cannot be done as easily with any other type of
instrument. This includes: (1) molecular lines in giants and winds, (2) lines
from the ISM for abundances and kinematics, (3) detailed atmospheric analysis
of embedded stars (and disks?).

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