

# I. Summary of SOAR Partner Science (draft)

The SOAR partners were polled by the SAC to learn what science they expected to execute on the SOAR telescope. The following trends emerged.

## 1 Visual and IR Photometry

### 1.1 High Spatial Resolution of Point Sources

The types of point source measurements covered in the partner's science descriptions include: astrometry (e.g. proper motion measurements for stars near the cores of globular clusters), discovery and multi-epoch monitoring of variable stars (both cluster and field stars), measurements of close companions to stars, and broad-band U to K photometry in crowded fields (again with cluster cores defining the crowding limits.) [refs]

The desirable image resolution is  $0''.3$  FWHM or better, and the magnitude limits range from 20-22 at K to 24-25 at B. (Scaling from the Blanco telescope, an exposure of 1200 s will yield  $S/N = 25$  at  $V = 25$ .)

Field densities for clusters range from those found in the centers of globular clusters such as M3 (0.2 stars/sq arcsec down to  $B = 21$ ), to those like 47 Tuc (6 stars/sq arcsec down to  $B = 21$ ). For close binary (and planetary) systems, separations range from  $0''.2$  to  $0''.05$  with brightness contrasts of  $10^4$ . Optimal sampling of  $0''.25$  FWHM implies  $0''.08$ , and somewhat finer sampling if charge diffusion within a single CCD pixel correlates pixel flux with that of its neighbours. With this image size, proper motion measurements should yield an accuracy of  $0''.002/\text{decade}$  at  $\lambda\lambda 1.2-1.4 \mu\text{m}$ .

### 1.2 Narrow-band Imaging in Emission Lines

Examples of projects which employ this observing mode include imaging of young stellar objects, surveys for cataclysmic variables and distant planetary nebulae, imaging of galaxies, and imaging of cooling flows in galaxy clusters.

Typical spectral  $R = 100$  but  $R = 1000$  is needed to image density contrasts using the red [S II] doublet. Spectral lines which were identified for different projects include the usual complement of [O II] $\lambda 3726/28$ , [O I III] $\lambda 5007$ ,  $H\alpha$ , [S II] $\lambda 6717/31$ ,  $H_2$ , Pa  $\alpha$ , and the coronal lines of Si X, Si IX, and Fe XII in the  $\lambda\lambda 1-4 \mu\text{m}$  range as well as their redshifted counterparts.

Field of view ranges from  $2'$  in the near-IR to  $8'$  in the visual.

### 1.3 Surface Photometry

Projects in this class include measurements of diffuse continuum light in galaxy clusters, surface photometry of arcs in the outer regions of elliptical galaxies, and profile measurements of elliptical and spiral galaxies. Standard U to K bandpasses were those most commonly desired, although there were some projects that requested narrower ( $R=50-60$ ) filters.

Desirable magnitude limits (in mags/sq arcsec) are  $B = 28.5$  in the optical and  $K = 24$  (?) in the near-IR. Fields of view range from  $2-4'$  in the near-IR to  $8'$  in the visual.

A particularly strong photometric constraint is the need for low external scattered light and good flat fielding. In the visual this leads to a limit of 30 mag/sq arcsec (B) to reach S/N = ?? at B = 28.5.

## 1.4 High-Speed Photometry and Simultaneous Differential Photometry

Objects in this class include pulsars, white dwarfs, AGNs, and variable stars of all types. These are located both in clusters and in the field. Spectral bands include the standard UB<sub>V</sub> and H with some specialized (R = 80-100) filters for flare stars.

High-speed photometry applications require data readout rates of  $\leq 0.1$  kHz over an area of 2 arcsec<sup>2</sup>. Differential photometry measurements require readout rates of  $\leq 10$  Hz over an area large enough to contain a stable calibration star. This latter area is estimated to be  $20 \times 10$  arcsec<sup>2</sup>. Readout capabilities over two windows are highly desired. Magnitude limits are V = 22-23 for differential photometry and as faint as possible for high-speed photometry.

## 2 Spectroscopy

### 2.1 Low-R IR

R band in Carbon stars, redshifts, black holes in Cen A

R = 200 - 6000 (night sky OH)

FOV? Target density?

Magnitude limits: K = ??

$\lambda\lambda$  ?

### 2.2 Low R UV-Visual

Spectrophotometry of AGN's, emission-line measurements of diffuse ionized gas, spectrophotometry of faint surface brightness continuum sources (galaxy arcs, spiral arms). Galaxy continuum energy distributions, spectral diagnostics.

R = 2000 - 5000

FOV? Density?

S/N = 10?? Rates ??

### 2.3 Moderate R IR

Diagnostics – nova, kinematics, obscured GC, dusty galaxies

R = 10-20K

FOV? Density?

$\lambda\lambda > 2.4$  desirable

### 2.4 Moderate R UV-Visual

Physical conditions in gaseous nebulae (galactic & extragalactic), emission-line radial velocities & abundances. Absorption-line radial velocities.

$R \geq 20,000$

B mag limit?

$V = 21$  S/N = 30  $R = 10^3$  in  $10^4$  sec. FOV 15"-long slit. Density?

$\lambda\lambda$  345 - 1000 nm

## 2.5 High-R Visual (UV & IR)

Abundance measurements, magnetic fields in solar type stars

$R = 10^5$

1 arcmin-long slit

B mag limit?

$\lambda\lambda$  305 - 1000 nm