SIRIUS
Simultaneous-color InfraRed Imager for Unbiased Surveys

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Our Team is currently developing ‘SIRIUS’, an infrared camera which can image a large field of view in three-bands at near-IR simultaneously.

The purposes and characteristics of the instrument are as follows:
- Most efficient for a deep but a relatively large-field imaging
- Higher resolution, compared with a large-scale surveys
- To obtain accurate color information by 3-band simultaneous imaging
- To be used mostly on the Univ. Nagoya 1.4-m telescope in South Africa, but also to be used on UH 2.2-m or Subaru 8.2-m telescopes, i.e., SIRIUS is a ‘portable’ IR camera.
Examples of sciences that are merited from the characteristics of SIRIUS

- Deep JHKs surveys of the whole LMC and SMC
- Large-scale JHKs surveys the Galactic center and plane
- Deep JHKs surveys of the southern molecular clouds and star-forming regions (for very low-mass stars)
- Line-surveys of the southern molecular clouds and star-forming regions
- A large number of background stars detected for studies of interstellar matter
SPECIFICATIONS

(on a 1.4m/F10 telescope)

- detectors: three 1024x1024 HgCdTe (HAWAII) science-grade arrays
- wavelengths: JHKs broad-band filters (‘filter consortium’ standard) the same field imaged at the three bands simultaneously
- pixel scale: 0.45 arcsec/pixel
- field of view: 7.8 arcmin/frame
- limiting magnitudes (15 minutes, 5 sigma):
  \[ K_s = 19.1, \ H = 19.4, \ J = 20.6 \]
- survey efficiency: roughly 1 square degree per 6 nights
## Comparison with DENIS/2MASS

<table>
<thead>
<tr>
<th></th>
<th>DENIS</th>
<th>2MASS</th>
<th>SIRIUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bands</strong></td>
<td>I,J,Ks</td>
<td>J,H,Ks</td>
<td>J, H, Ks</td>
</tr>
<tr>
<td><strong>pixels/row</strong></td>
<td>1024,256, 256</td>
<td>256,256,256</td>
<td>1024,1024,1024</td>
</tr>
<tr>
<td><strong>pixel scales</strong></td>
<td>0.7”,3”,3”</td>
<td>all 2”</td>
<td>all 0.45”</td>
</tr>
<tr>
<td><strong>fov</strong></td>
<td>12’</td>
<td>8.5’</td>
<td>7.8’</td>
</tr>
<tr>
<td><strong>integ. times</strong></td>
<td>1.22secx9</td>
<td>1.3secx6</td>
<td>15min</td>
</tr>
<tr>
<td><strong>det. limits</strong></td>
<td>18.0,16.1,13.5</td>
<td>16.5,15.8,15.0</td>
<td>20.6,19.4,19.1</td>
</tr>
<tr>
<td><strong>telescopes</strong></td>
<td>ESO 1m</td>
<td>1.3mx2</td>
<td>SA 1.4m</td>
</tr>
<tr>
<td><strong>targets</strong></td>
<td>b&lt;+2 d</td>
<td>all sky</td>
<td>several-several tens sq. degrees</td>
</tr>
<tr>
<td><strong>observation starts</strong></td>
<td>1995.12</td>
<td>1997.4</td>
<td>2000.spring</td>
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</tbody>
</table>
OPTICS

- fairly simple optics with a high throughput (> 45%)
- F conversion lenses; enabling uses on many other telescopes
  
  UH 2.2-m  
  0.28”/pixel  
  4.8’/frame

  Subaru 8.2-m  
  0.075”/pixel  
  1.3’/frame

- Offner relay optics; less astigmatisms, easy to make (spherical mirror), easy optics alignment, less affected by mirror position (tough for transporting)
- beam splitters; enabling JHKs simultaneous imaging, wedged
- STATUS: under manufacturing
ARRAY ELECTRONICS

- array controller: MessiaIV
  multi-purpose array controller
devolved at NAOJ

- front-end electronics: MACS
  simultaneous control of multi-arrays
developed at the University of Nagoya

- STATUS
  design & manufacturing finished, MUX is operated
  ann engineering array to be installed soon
  (2 of 3 science arrays already in hand)
CRYOSTAT and MECHANICS

- cryostat
  small & light-weight for high portability
  size: 570x420x280 mm³
  weight: about 100 kg including cooler

- mechanical cooler
  array cassette: 70 K, optical bench: 100 K

- mechanics & drives
  no moving parts except for a cold dark shutter
  stability & portability

- STATUS
  design & manufacturing completed, vacuum & cooling test completed
SOFTWARE

- Data reduction
  one of the most important part of the project
  pipeline software dedicated for the surveys
  details presented by Yasushi Nakajima

- Data acquisition
  simple imaging + survey software
  quick-look for ‘unique color’ objects
SCHEDULE

- 1999 August
  end of hardware construction
- 1999 September-November
  test observations in Japan
- 1999 December - 2000 spring
  test and science observations overseas
- around 2000 summer
  start of surveys on the South Africa telescope