French Meteor Network PODET-MET

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IMCCE / Observatory of Paris

IMC 2010, Armagh
17th Sep. 2010
PODET Overview

PODET: "POle sur la Dynamique de l'Environnement Terrestre"

Part of a projects' triplet:

- **MET**: Based on meteors observation
- **DEB**: Take care of Special fragments
- **AST**: Deals with near-earth asteroids
PODET-MET Objective

- To identify different trails of the meteoroid stream
- Comparison of sub-structure filaments within the meteoroid stream with the theoretical models
- Determination of parent bodies (with specific trail)

**NEED HIGH PRECISION DATA !!!!!**

_Vaubaillon (2010)_
French Meteor Network

- High Precision Cameras
- All sky Camera
- Triple Stations
  - Pic Du Midi (2880 m)
  - Guzet (1530)
  - Sebastian (260 m)
  - 95 -100 km distance between stations
  - Remote and Automated
**LH-11000 Camera**

Effective Pixels : 4032 x 2688
Pixel size : 9 μm
Readout noise : ~30 e-
Bit : 14

Canon 50 mm f1.4 lens
FOV 40 x 27 deg

Resolution ~ 0.01 deg ~ 35 arc-sec
~18 m for meteor observed at 100 km
**System Setup**

- Canon Lens
- LH-11000 camera
- Camera-link Cable
- Camera-link to GigE convertor
- Ethernet Cable
- PC/Laptop

- A weather proof box is being made to keep camera, lens and the cables
- A “cooling finger” will be used to cool the CCD for better results.
Technical Issues

- Camera Operating Software - BATS (modified by the company for remote and automated operation)
- Event/meteor detection - We are testing Meteor Finder (see Ivan Sauli talk 11:40 Saturday) & SFI (Peter Gural)
- Automated transfer of meteor frames to IMCCE database
- Meteor Position and Flux – ongoing research
- Astrometry & Photometry – SPARVM (ongoing modification)
- Multiple Station & orbit computation - SPARVM
- Storage of results – XML (PODET format, also useful for VO)
- Developed Java tool for double station observation (http://tiny.cc/j9a88)
Electronic Shutter Process

- Min exposure = 0.8 ms; Max Exp = 52428 ms
- The READOUT time is 149 ms.
- Maximum of 6.7 frames/second
Electronic Shutter Process

![Diagram of Electronic Shutter Process](image-url)
Min exposure = 0.8 ms; Max Exp = 52428 ms
The READOUT time is 149 ms.
Maximum of 6.7 frames/second

Exposure = 10 ms, Break = 10 ms, Loop = 50 cycles
The Readout (dead) time is 149 ms.
Can vary these settings for fast and slow meteors
Distance between two peaks ~ 25 pix
Time difference ~ 10ms
Angular Velocity ~
25 * 0.01 deg * 100 (1/s) = 25 deg/s
Stellar limiting magnitude
Stellar Limiting magnitude $\sim 8.0$
Jupiter: - 2.6 magnitude, saturates the CCD in 5ms exposure
Email: atreya@imcce.fr

IMCCE group: http://tiny.cc/g19r7
Just buying a big CCD camera is not enough !!!

- Better **Spatial** resolution
- Higher **Temporal** resolution
- **Inverse** Relationship

Direction of meteor not taken into account
Since 1981, LHERITIER has allied conception, development, and production of colour and BWX cameras (Low light level, HDTV, Interlaced, Day/Night mono-channel, Mega-pixel) and Vision Systems of very high performance.

LHERITIER's experience and know-how are internationally recognised in the field of imagery: a Specialist of Low Light Level (LLL) vision by camera, the company is today the European leader on the subject. More than 2500 LHERITIER cameras with light intensification are currently in service in the world.

We propose visualisation, acquisition and image processing systems and sub-systems, which are "made-to-measure", constantly evolving and intelligent.

LHERITIER: DESIGNER AND DEVELOPER OF CAMERAS AND VISION SYSTEMS

NEWS

LHERITIER HAS MOVED 17/10/2009

As from 19th October 2009, the LHERITIER company... Read more

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<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (€)</th>
</tr>
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<tbody>
<tr>
<td>LH11000 Camera</td>
<td>13,400</td>
</tr>
<tr>
<td>Cannon 50 mm f1.2 Lens</td>
<td>1,630</td>
</tr>
<tr>
<td>Cameralink-GigE convertor</td>
<td>1,140</td>
</tr>
<tr>
<td>Computer</td>
<td>1,100</td>
</tr>
<tr>
<td>Extras* (Cables/..)</td>
<td>730</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,000</strong></td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Architecture</td>
<td>Interline CCD; Progressive Scan</td>
</tr>
<tr>
<td>Total Number of Pixels</td>
<td>4072 (H) x 2720 (V) = 11.1M</td>
</tr>
<tr>
<td>Number of Effective Pixels</td>
<td>4032 (H) x 2688 (V) = 10.8M</td>
</tr>
<tr>
<td>Number of Active Pixels</td>
<td>4008 (H) x 2672 (V) = 10.7M</td>
</tr>
<tr>
<td>Number of Outputs</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Pixel Size</td>
<td>9.0 μm (H) x 9.0 μm (V)</td>
</tr>
<tr>
<td>Imager Size</td>
<td>43.3mm (diagonal)</td>
</tr>
<tr>
<td>Chip Size</td>
<td>37.25mm (H) x 25.70mm (V)</td>
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<tr>
<td>Aspect Ratio</td>
<td>3:2</td>
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<tr>
<td>Saturation Signal</td>
<td>60,000 electrons</td>
</tr>
<tr>
<td>Quantum Efficiency [KAI-11002-ABA]</td>
<td>50%</td>
</tr>
<tr>
<td>Quantum Efficiency [KAI-11002-CBA]</td>
<td>34%, 37%, 42%</td>
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<tr>
<td>Output Sensitivity</td>
<td>13 μV/e</td>
</tr>
<tr>
<td>Total Noise</td>
<td>30 electrons</td>
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<tr>
<td>Dark Current</td>
<td>&lt; 50 mV/s</td>
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<tr>
<td>Dark Current Doubling Temperature</td>
<td>7 °C</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>66 dB</td>
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<tr>
<td>Charge Transfer Efficiency</td>
<td>&gt; 0.99999</td>
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<tr>
<td>Blooming Suppression</td>
<td>&gt; 1000X</td>
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<tr>
<td>Smear</td>
<td>&lt; -80 dB</td>
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<tr>
<td>Image Lag</td>
<td>&lt; 10 electrons</td>
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<tr>
<td>Maximum Data Rate</td>
<td>28 MHz</td>
</tr>
<tr>
<td>Package</td>
<td>40-pin, CerDIP, 0.070” pin spacing</td>
</tr>
<tr>
<td>Cover Glass</td>
<td>AR Coated</td>
</tr>
</tbody>
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All parameters above are specified at T = 40°C