French Meteor Network PODET-MET

Prakash Atreya, Jeremie Vaubaillon, Francois Colas, Ivan Sauli, Sylvain Bouley

IMCCE / Observatory of Paris

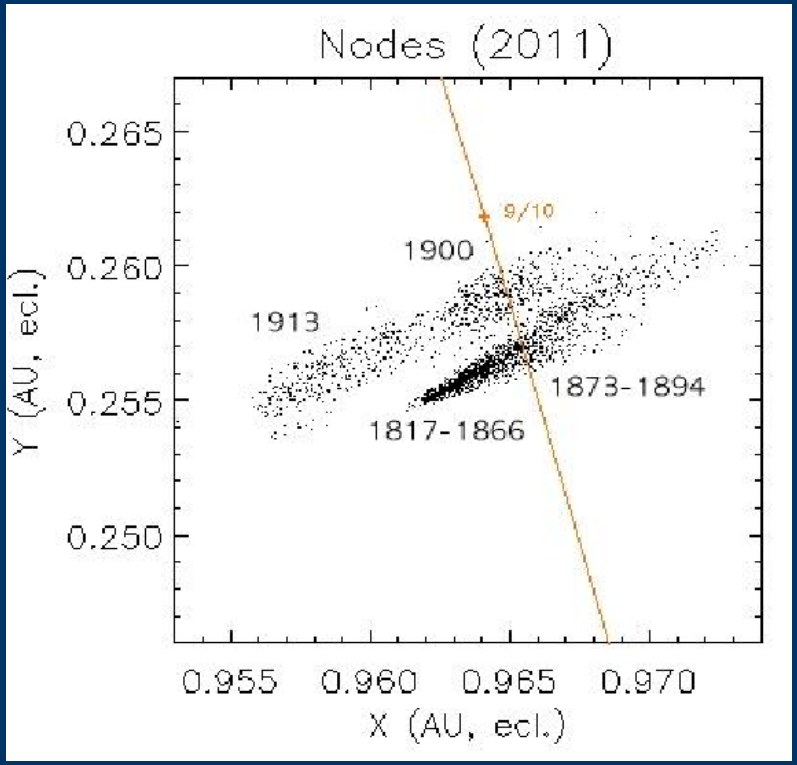
IMC 2010, Armagh
17th Sep. 2010

PODET Overview

- PODET: "**PO**le sur la **D**ynamique de l'**E**nvironnement **T**errestre"
- 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)



Vaubaillon (2010)

NEED HIGH PRECISION DATA !!!!!

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

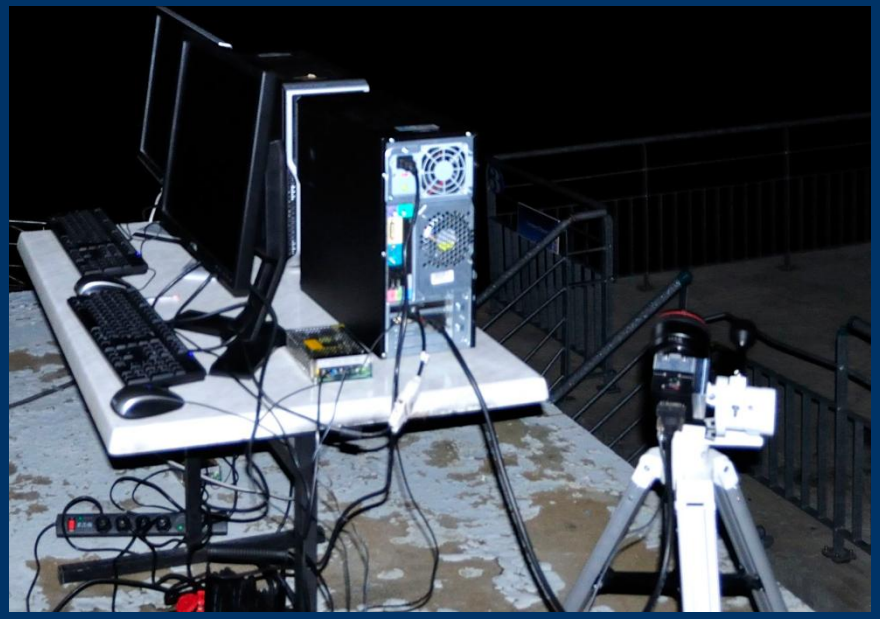
FOV 40 x 27 deg

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.

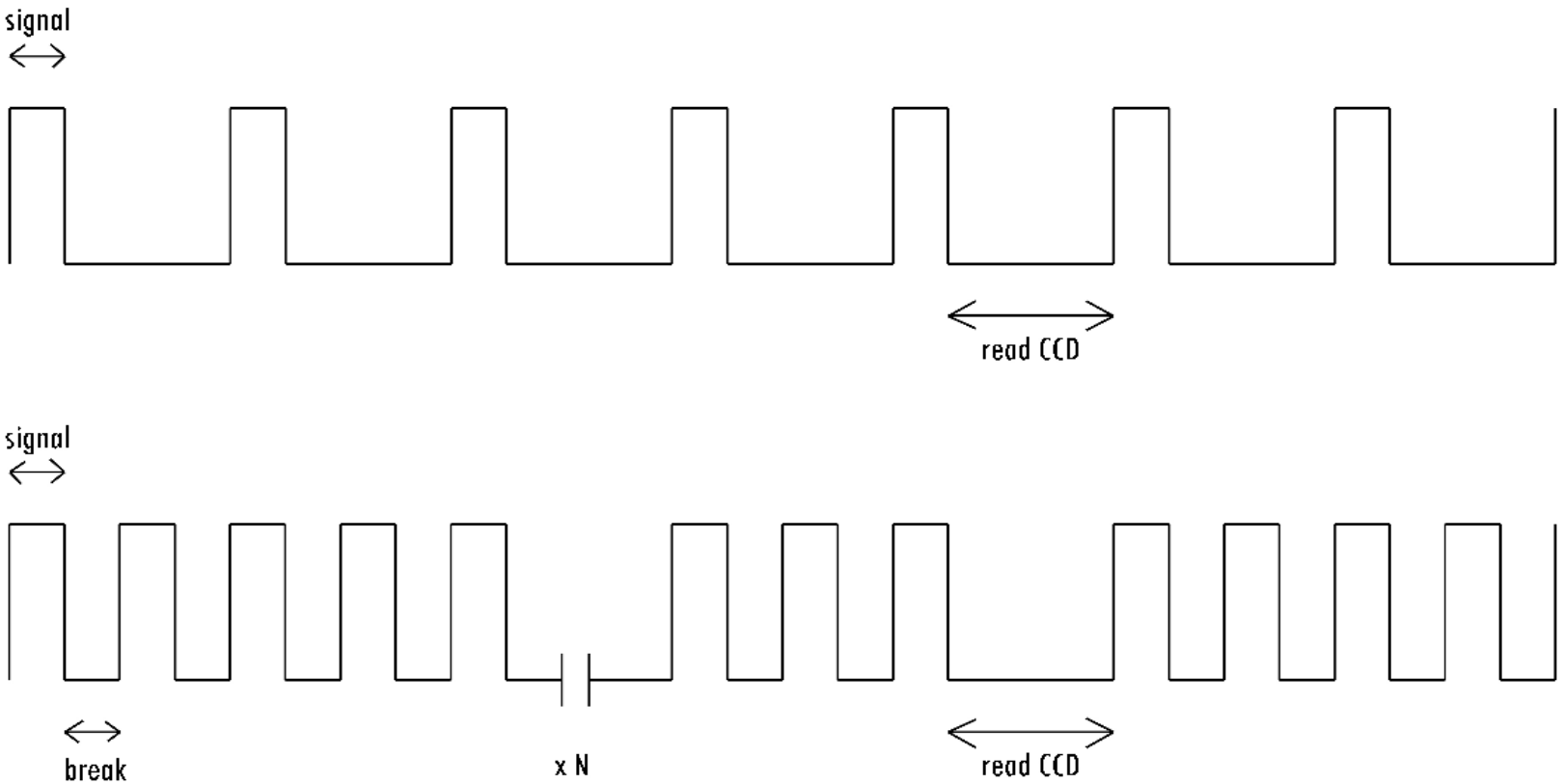
Technical Issues

- 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
- Astromerty & 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

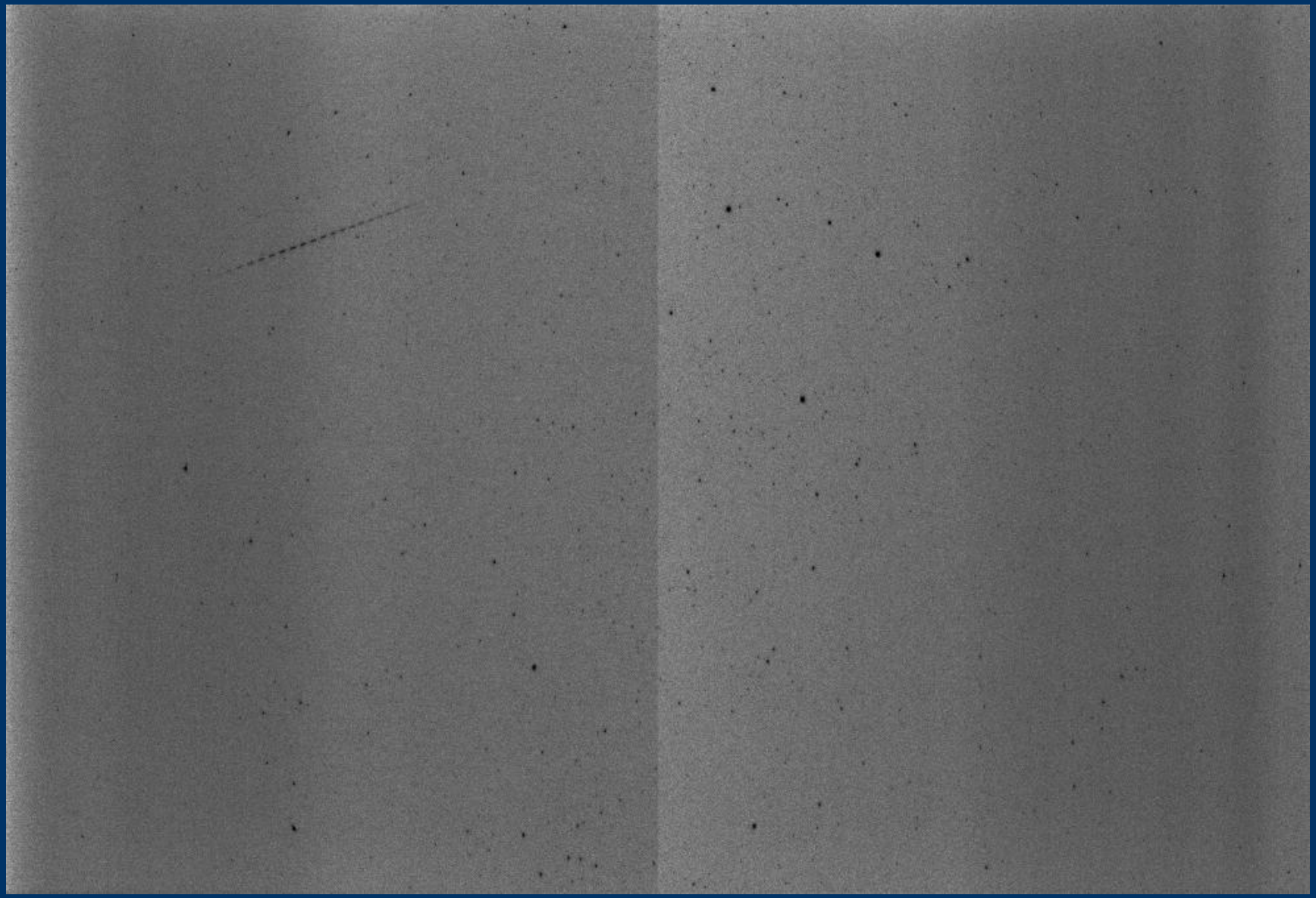
Electronic Shutter Process

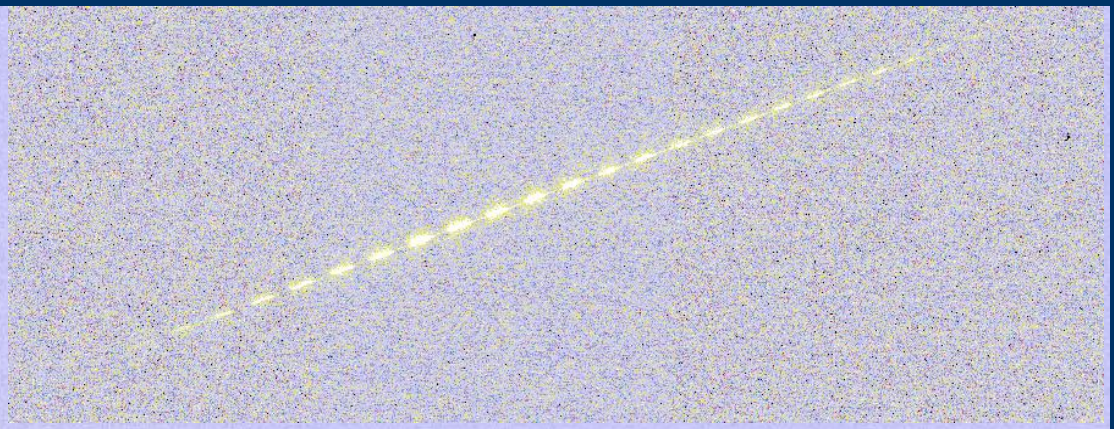


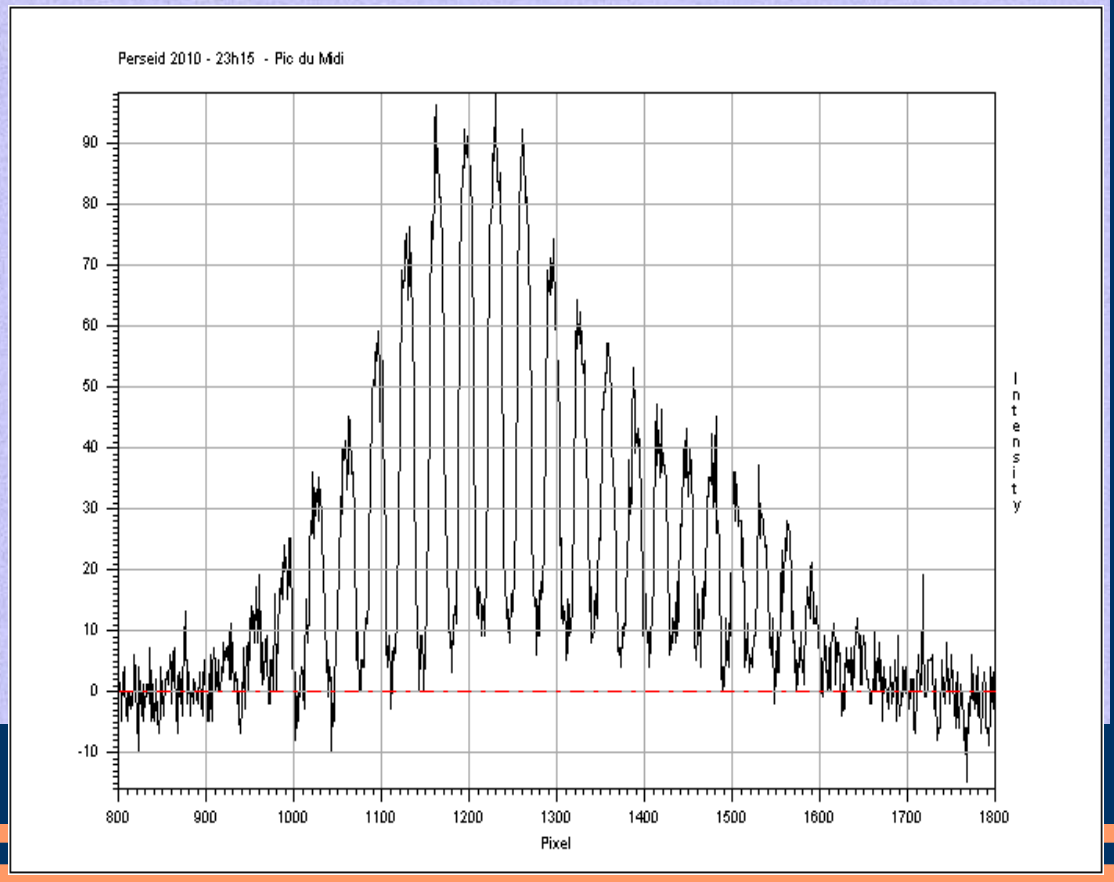
Electronic Shutter Process

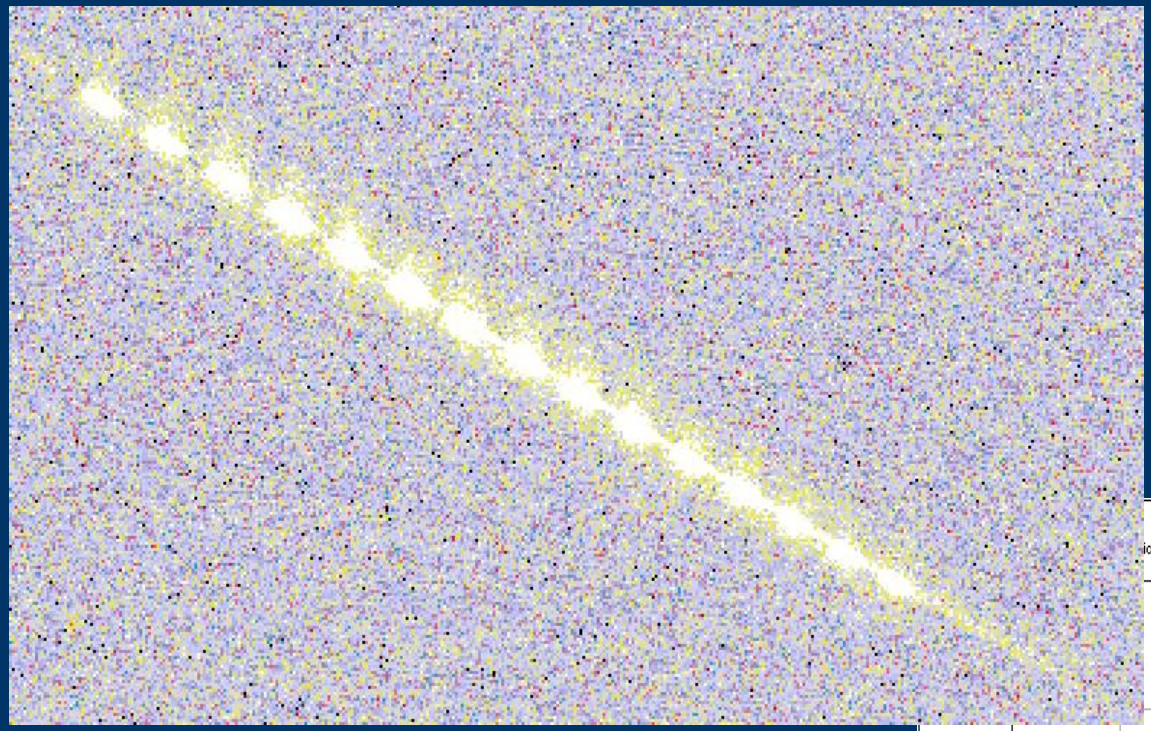
- Min exposure = 0.8 ms; Max Exp = 52428 ms
- The READOUT time is 149 ms.
- Maximum of 6.7 frames/second

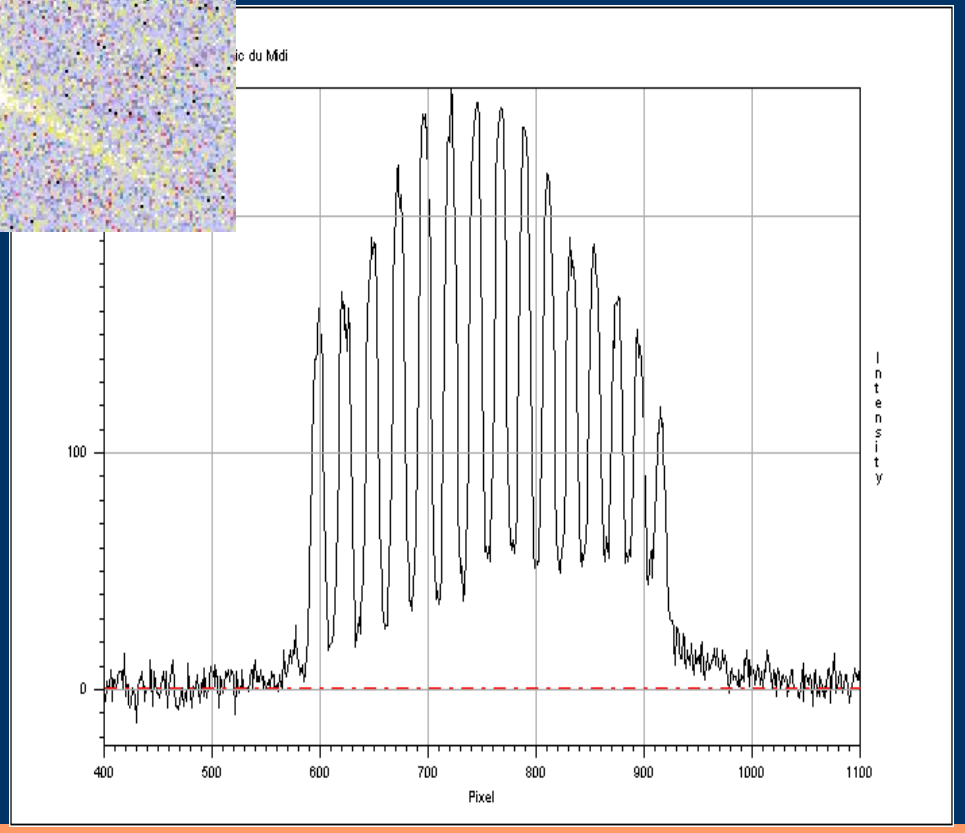
- Exposure = 10 ms, Break = 10 ms, Loop = 50 cycles
- The Readout (dead) time is 149 ms.
- Can vary these settings for fast and slow meteors






Perseid 2010 - 23h15 - Pic du Midi
90
80
70
60
50
40
30
20
10
0
-10
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
Pixel
Intensity



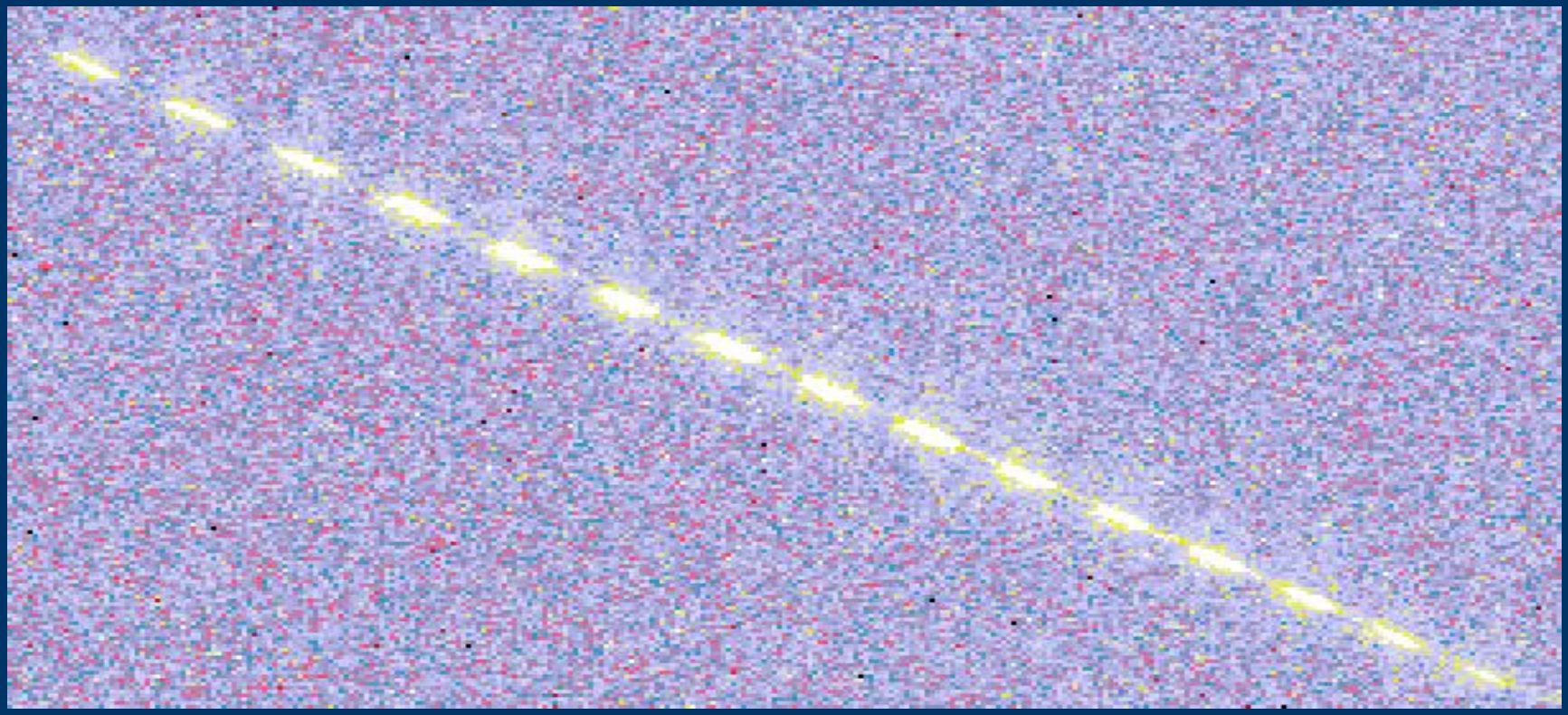


Distance between two peaks ~ 25 pix

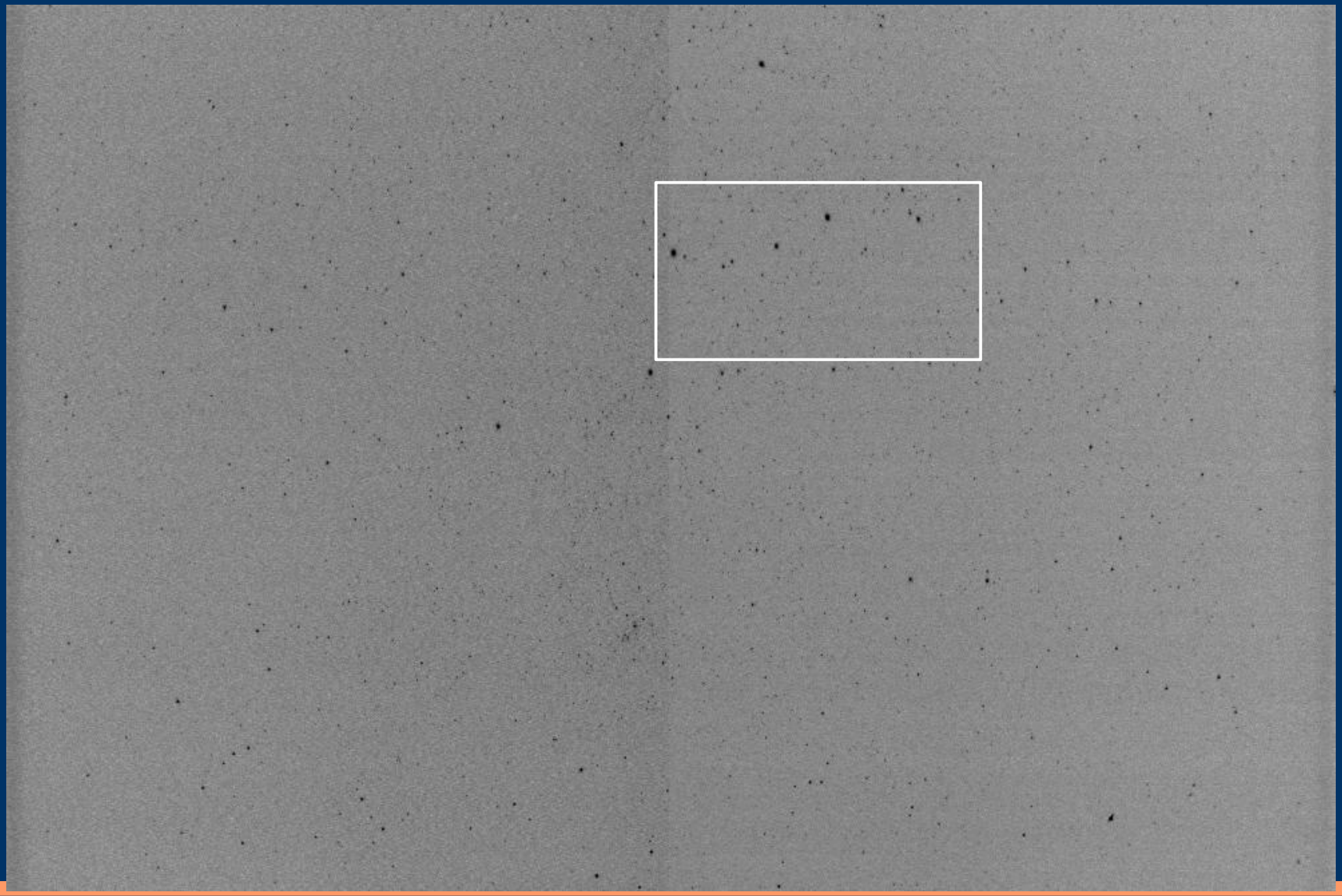
Time difference ~ 10ms

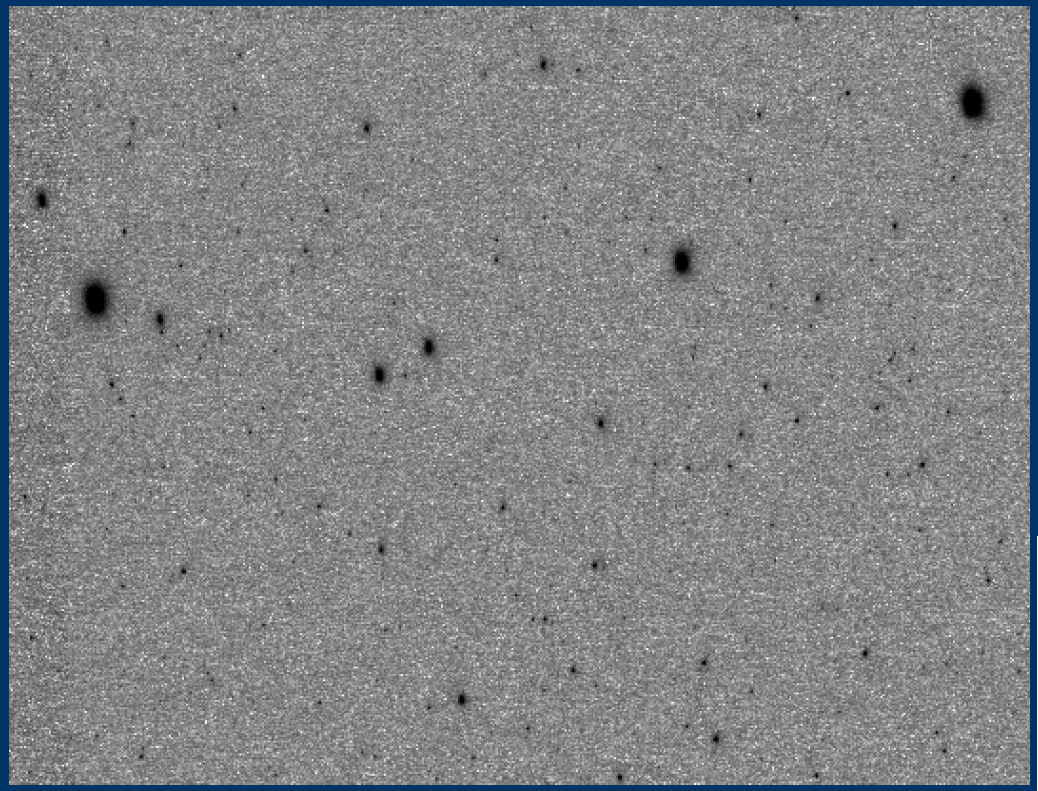
Angular Velocity ~

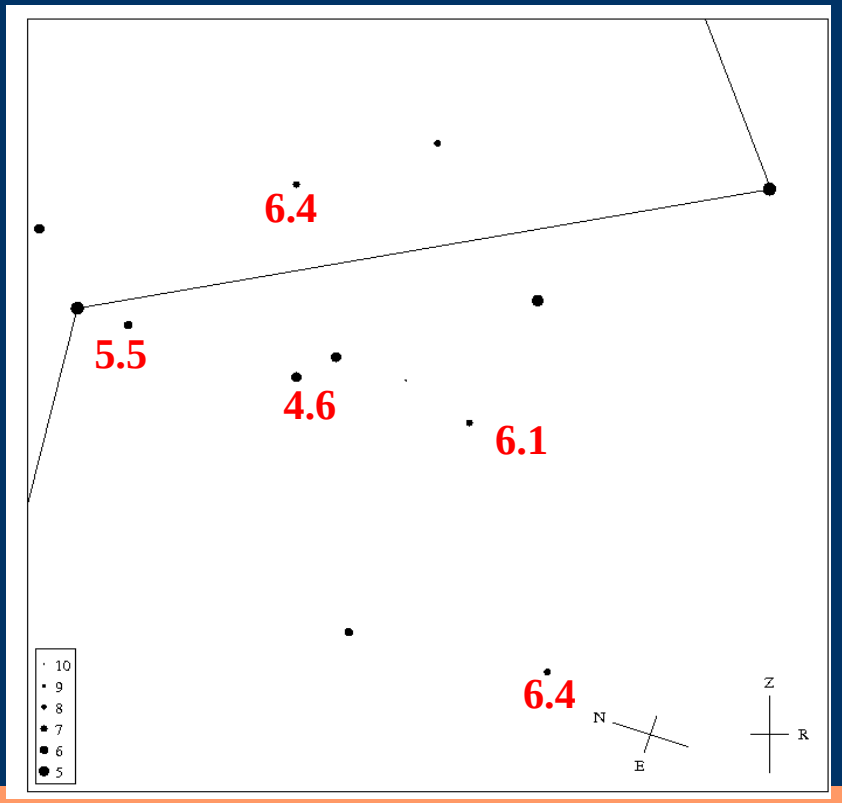
25 * 0.01 deg * 100 (1/s) = 25 deg/s

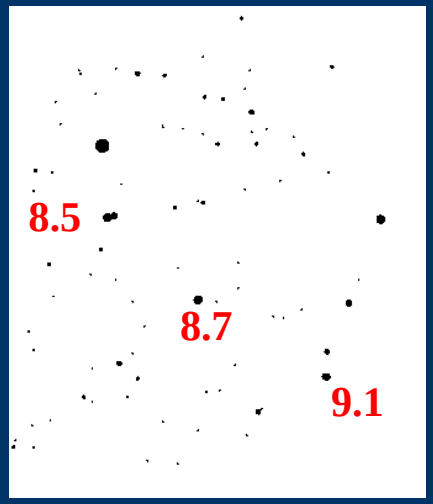


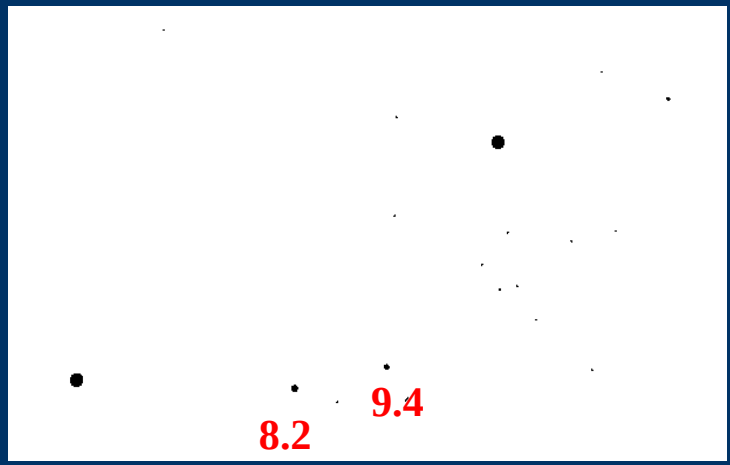
Stellar limiting magnitude





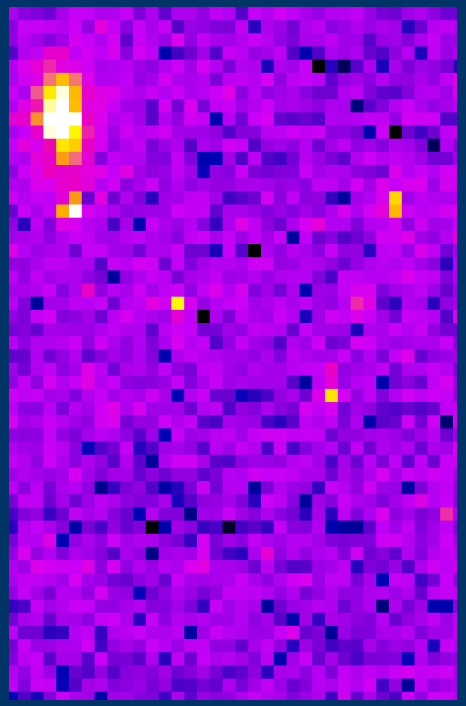

6.4
5.5
4.6
6.1
6.4
10
9
8
7
6
5
N
E
Z
R

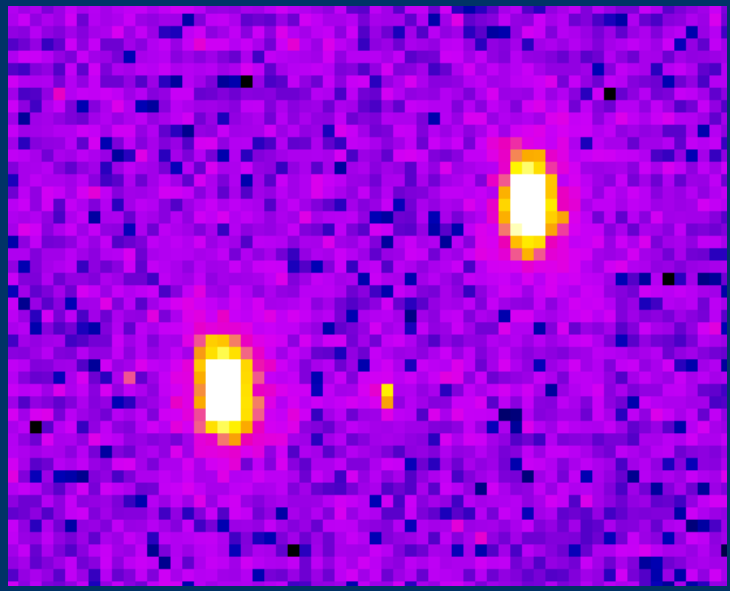


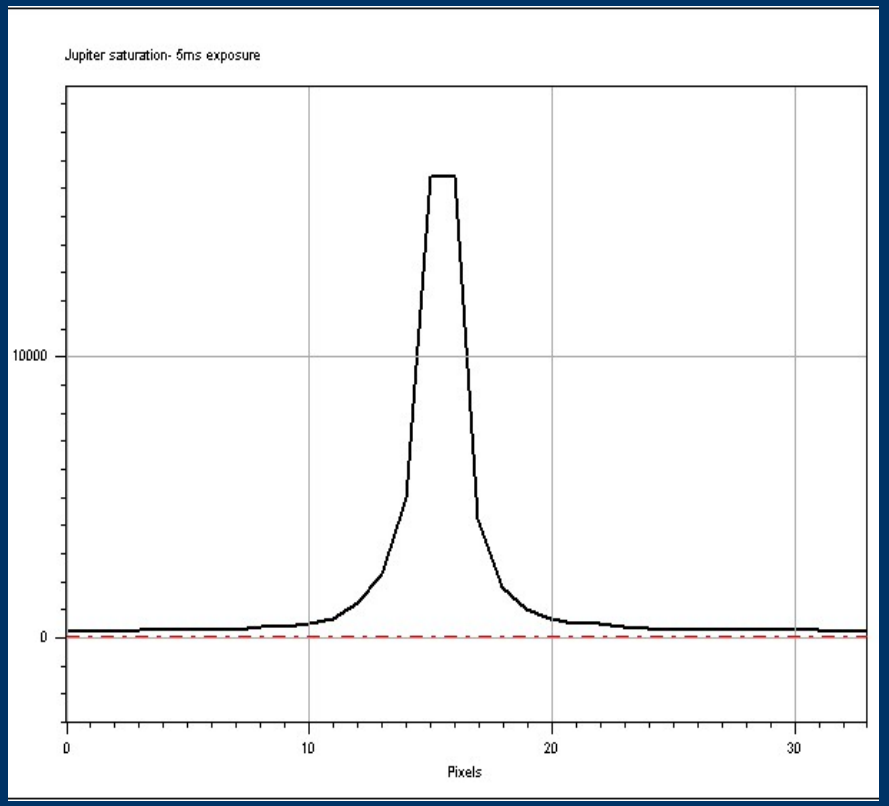


Stellar Limiting

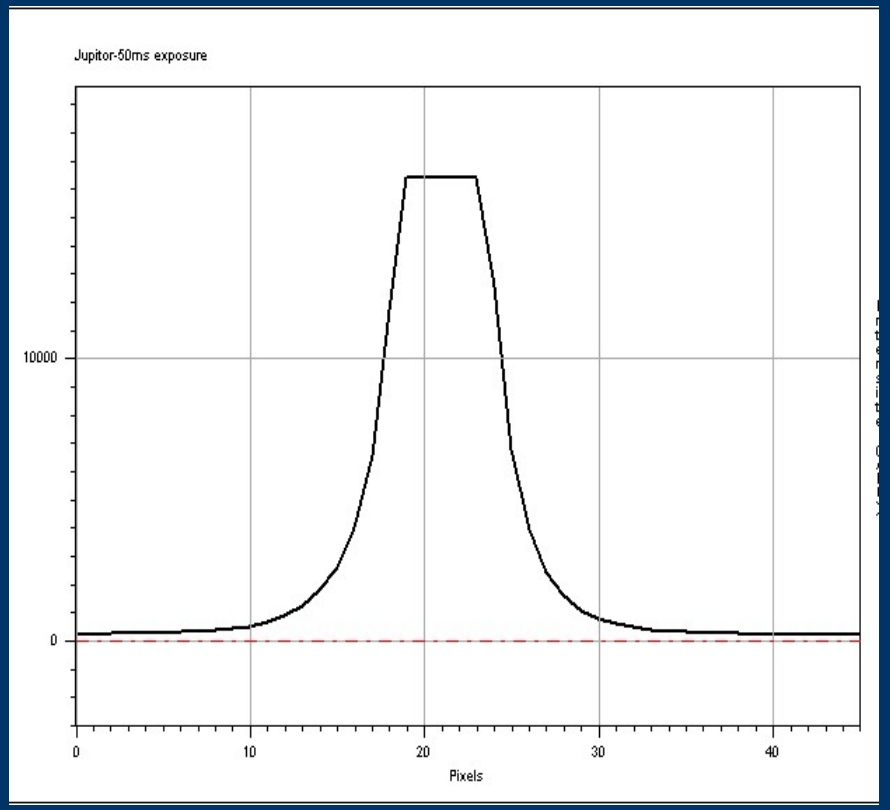
magnitude ~ **8.0**





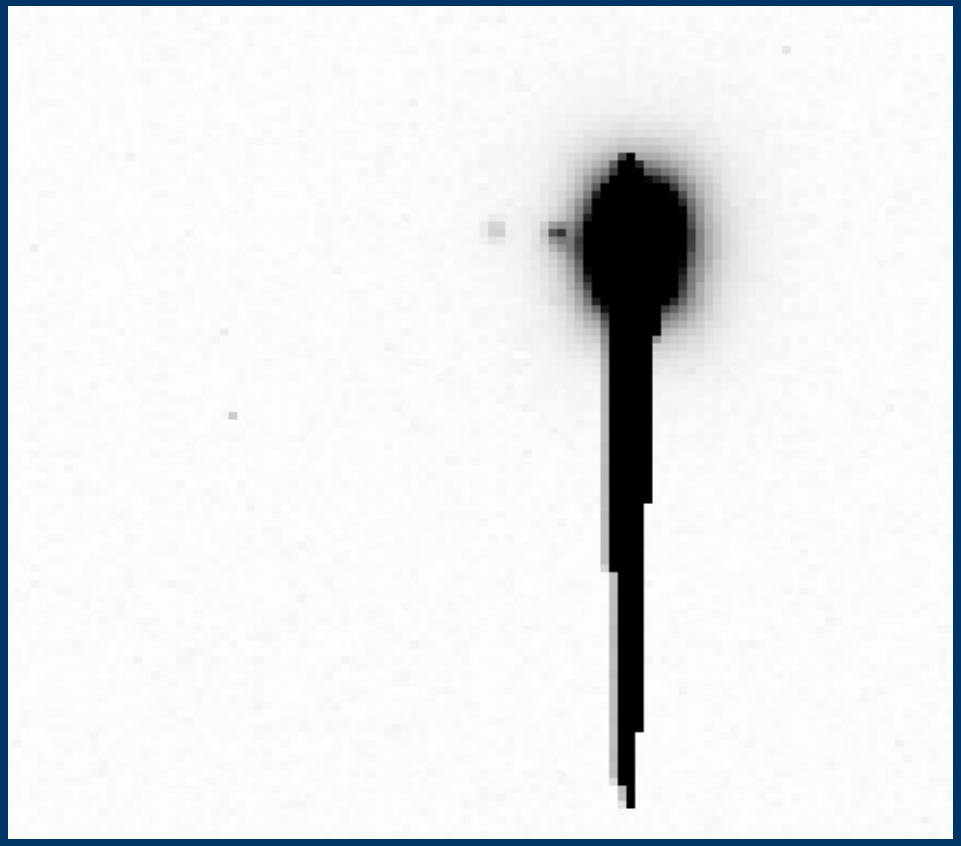


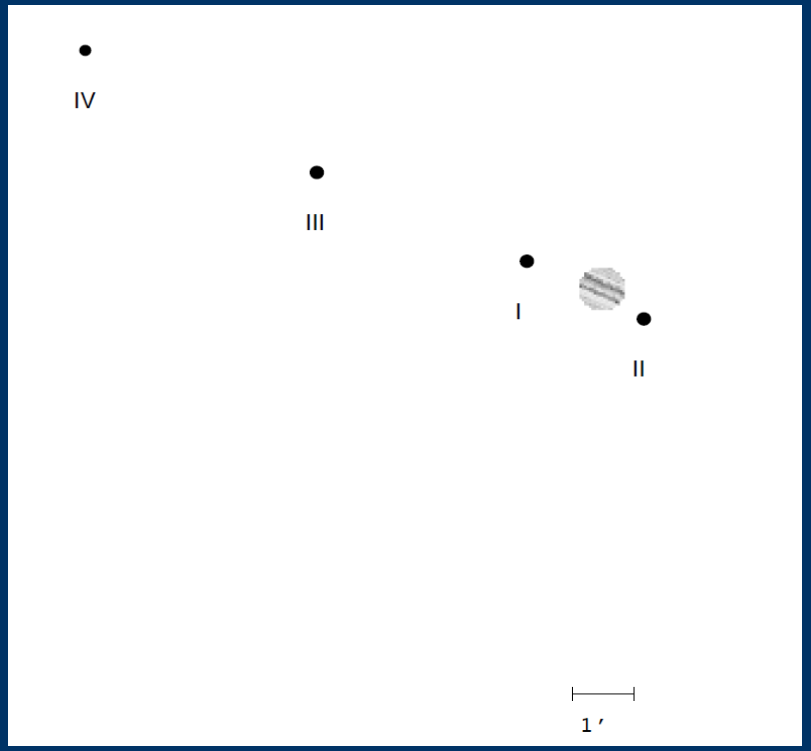
5 ms exposure



50 ms exposure

Jupiter : - 2.6 magnitude , saturates the CCD in 5ms exposure





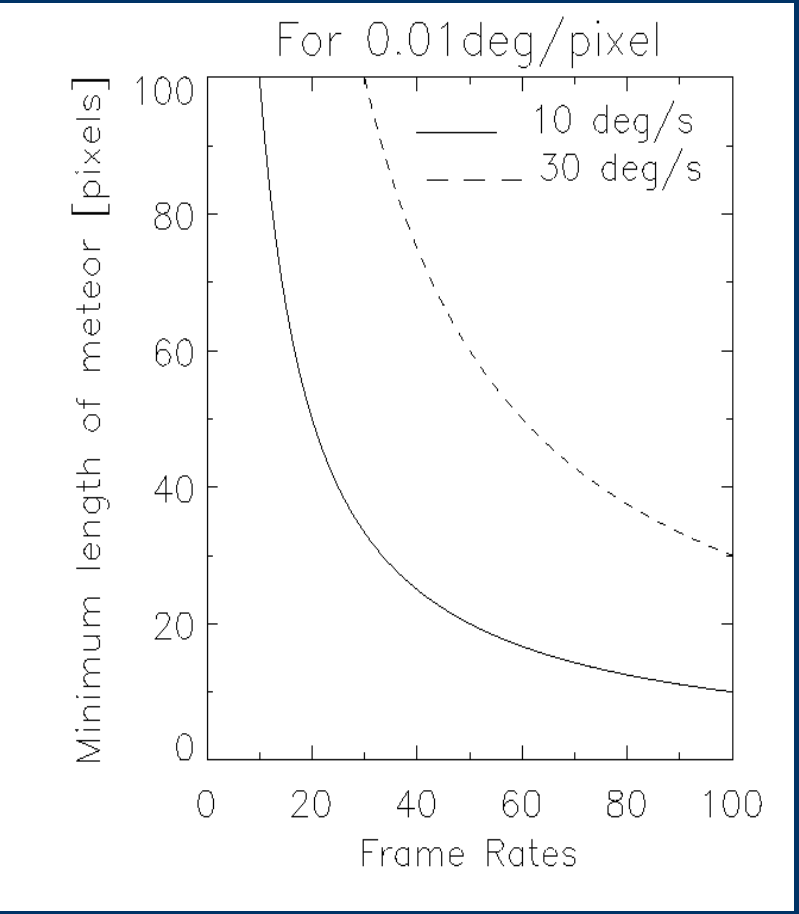
Tag	Name	E	S	P	T	X +E	Y +S	Z +front	RA	Dec	Mag
	Jupiter								0:11:01.52	-0:26:49.8	-2.7
I	Io	1	1	0	0	-3.076	1.239	-4.894	0:10:56.65	-0:27:19.3	5.7
II	Europa	1	1	0	0	1.635	-1.152	-9.251	0:11:04.11	-0:26:22.4	5.8
III	Ganymede	1	1	0	0	-11.400	5.077	-8.299	0:10:43.45	-0:28:50.5	5.3
IV	Callisto	1	1	0	0	-20.645	10.316	12.984	0:10:28.80	-0:30:55.0	6.7

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

Boris Gaillard
Tel. : +33 (0)1 34 24 38 20
Email : bgaillard@lheritier-alcen.com
WEB: http://en.lheritier-sa.com/home.html

Cost per Station in Euros

LH11000 Camera	**13,400**
Cannon 50 mm f1.2 Lens	1,630
Cameralink-GigE convertor	1,140
Computer	1,100
Extras* (Cables/..)	730
Total	**17,000**

Parameter	Value
Architecture	Interline CCD; Progressive Scan
Total Number of Pixels	4072 (H) x 2720 (V) = 11.1M
Number of Effective Pixels	4032 (H) x 2688 (V) = 10.8M
Number of Active Pixels	4008 (H) x 2672 (V) = 10.7M
Number of Outputs	1 or 2
Pixel Size	9.0 µm (H) x 9.0 µm (V)
Imager Size	43.3mm (diagonal)
Chip Size	37.25mm (H) x 25.70mm (V)
Aspect Ratio	3:2
Saturation Signal	60,000 electrons
Quantum Efficiency (KAI-11002-ABA)	50%
Quantum Efficiency (KAI-11002-CBA) RGB	34%, 37%, 42%
Output Sensitivity	13 µV/e
Total Noise	30 electrons
Dark Current	< 50 mV/s
Dark Current Doubling Temperature	7 °C
Dynamic Range	66 dB
Charge Transfer Efficiency	> 0.99999
Blooming Suppression	> 1000X
Smear	< -80 dB
Image Lag	< 10 electrons
Maximum Data Rate	28 MHz
Package	40-pin, CerDIP, 0.070" pin spacing
Cover Glass	AR Coated

All parameters above are specified at T = 40°C


METEOR
HOTEL
RESTAURANT
LA METEORITE
METEOR
HOTEL DE TOURISME
H
MINISTÈRE chargé du TOURISME