π of the sky

Apparatus to search for optical flashes of astronomical origin

Grzegorz Wrochna, Lech Mankiewicz,
Rafał Sałański

Gamma Ray Bursts (GRB)

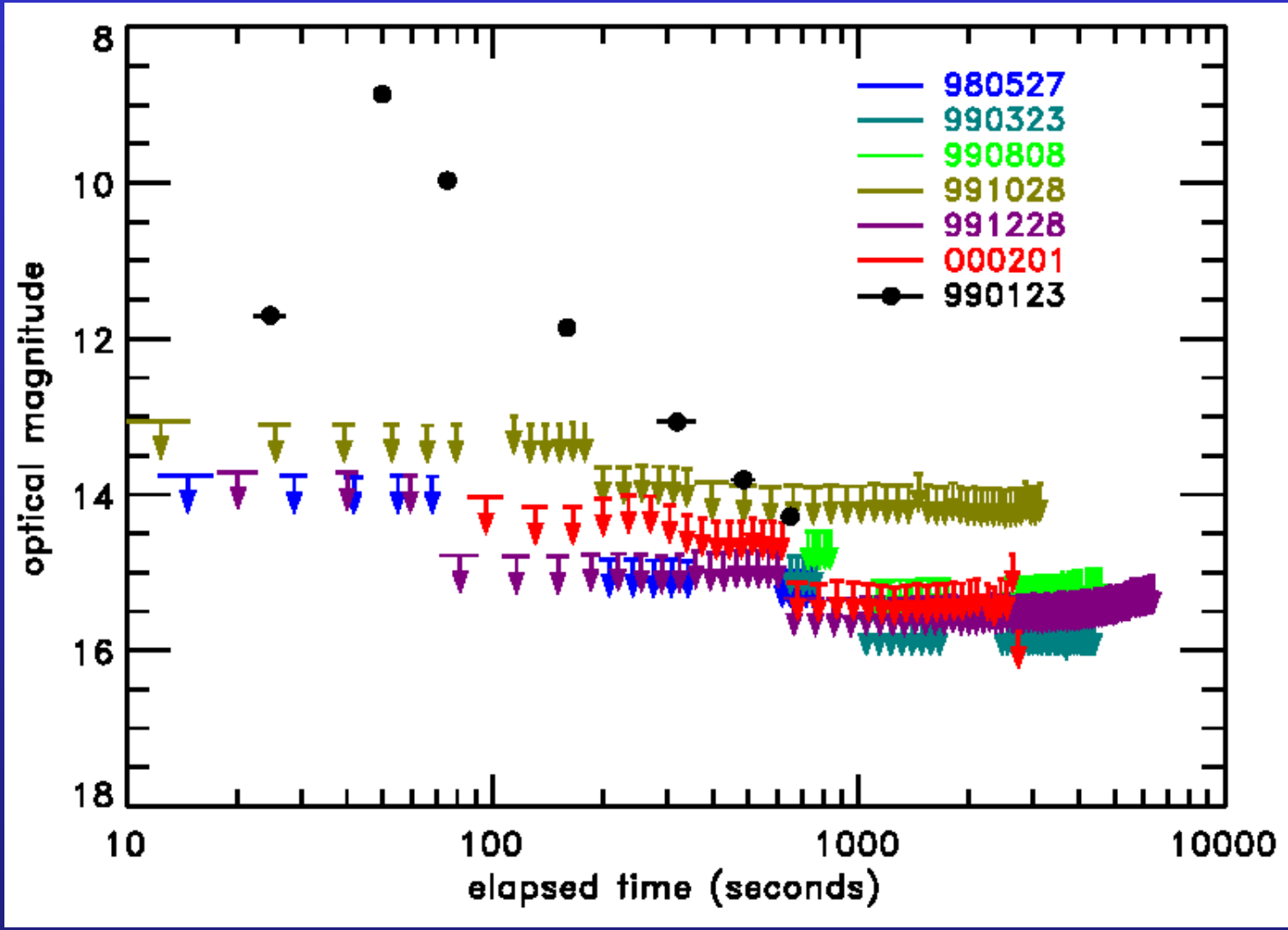
- Short (0.1-100s) pulses of gamma rays from point-like sources in the sky
- Brighter than whole rest of the sky
- Extragallactic origin
- The greatest catalysms ever observed

GRB origin

- Hotest topic in astronomy
- Hypothesis:
  - collision of black holes
  - collision of neutron stars
  - collapse of rotating star
  - quark star formation or collapse new physics?

Optical counterparts of GRBs

- ~100 GRB/year discoverd by satellites
- Only <30 afterglows observed by telescopes on Earth:
  - low precision of satellite information
  - small field and high inercy of telescopes



The only optical flash of GRB observed so far

ROTSE with ϕ=10 cm

Optical flashes

- Need for search
  - GRB study
  - exists many undocumented reports
  - „new window” of astronomy

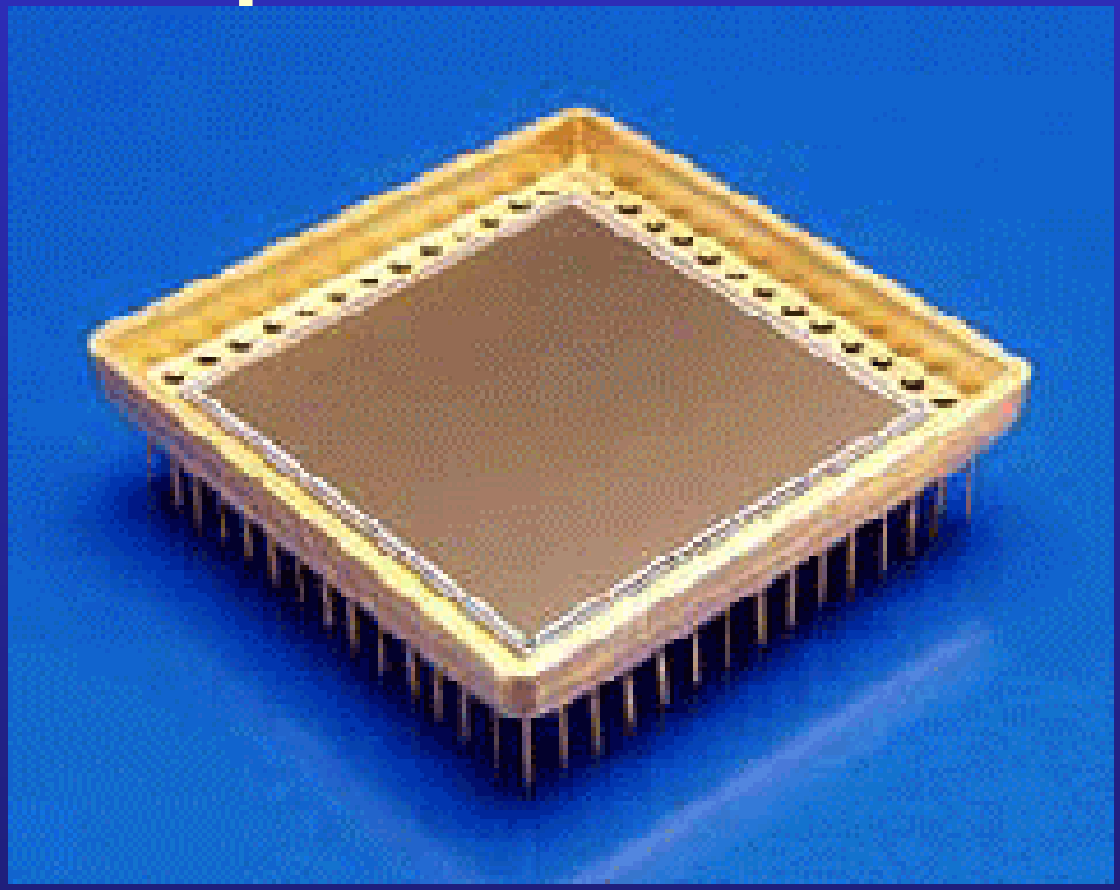
„π of the sky” project

- Inspired by particle physics experiments
- Full sky monitoring
- Large data flow
- Real time analysis, on-line data reduction, multi-level trigger

Technical data

- Lenses: f=50mm, f/2
- pixel size ~15μm
- pixel coverage: 1 arc min
- CCD coverage: 35° x 35°
- 16 CCD covers ~full hemisphere down to ~20° above horizon

Example CCD sensor



CCD 442A by Fairchild Imaging

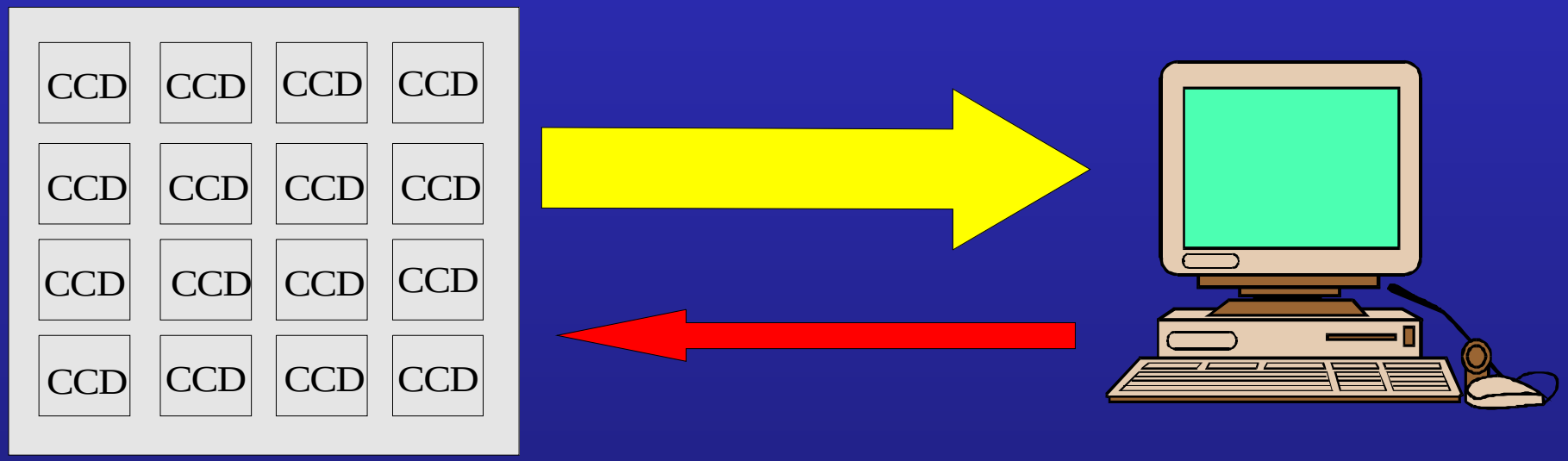
Data aquisition

- 16 CCD cameras,
  each 2048x2048 pixels
- 14 bit ADC converter
- 16 * 4M * 2 bytes = 128 MB
- transfer > 25 MB/s

Interface options

- IEEE 1394 Firewire (50 MB/s)
- USB 2.0 (60 MB/s)
- direct LVDS connection to a dedicated PCI card

Simple model



Data processing

- Image reading
- Comparison of images
- Recognition of changes
- Data storage

Software prototyping

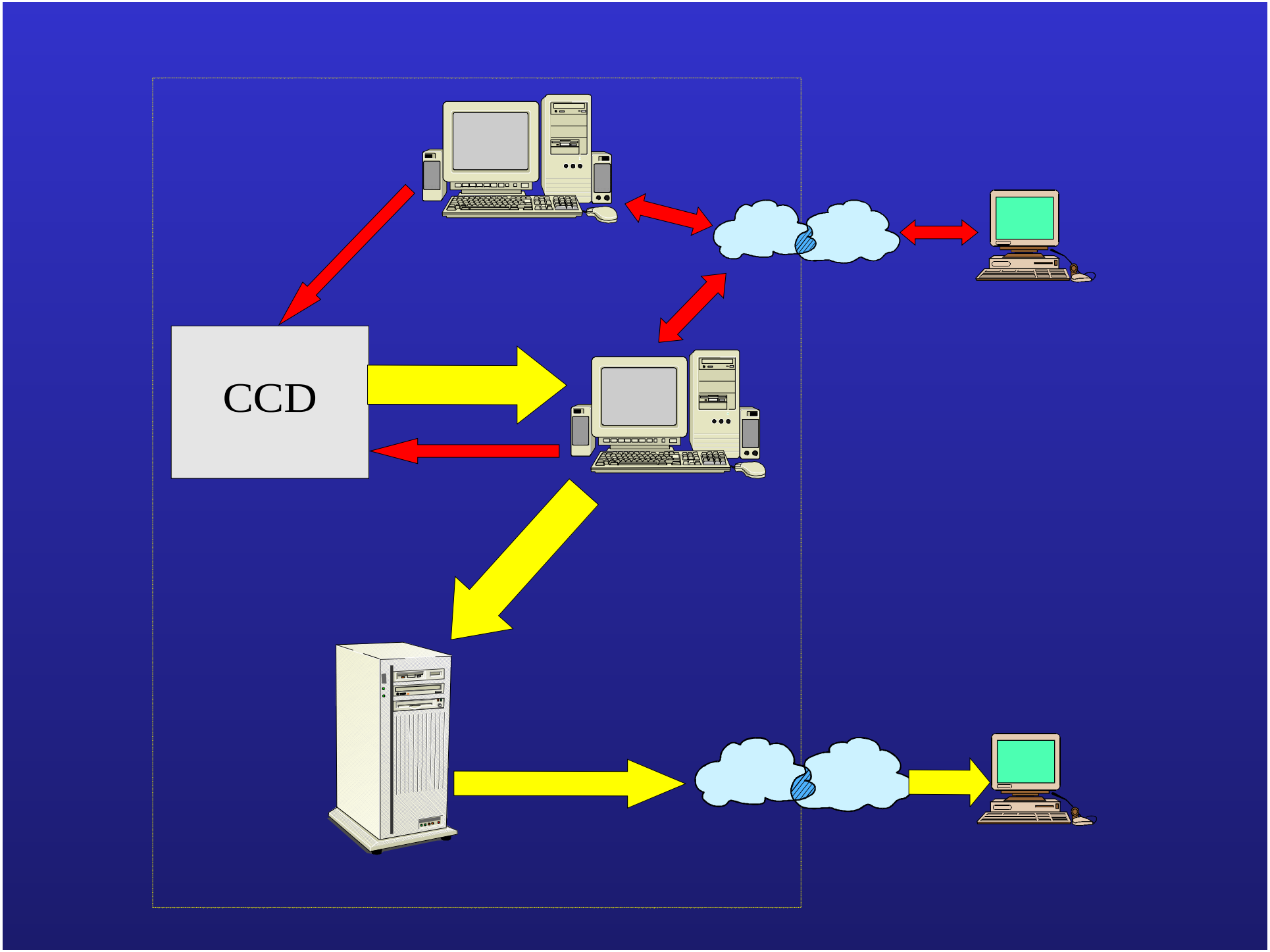
Computers' function:

- Mechanical steering
- CCD steering
- Data processing
- System reporting

Prototyping

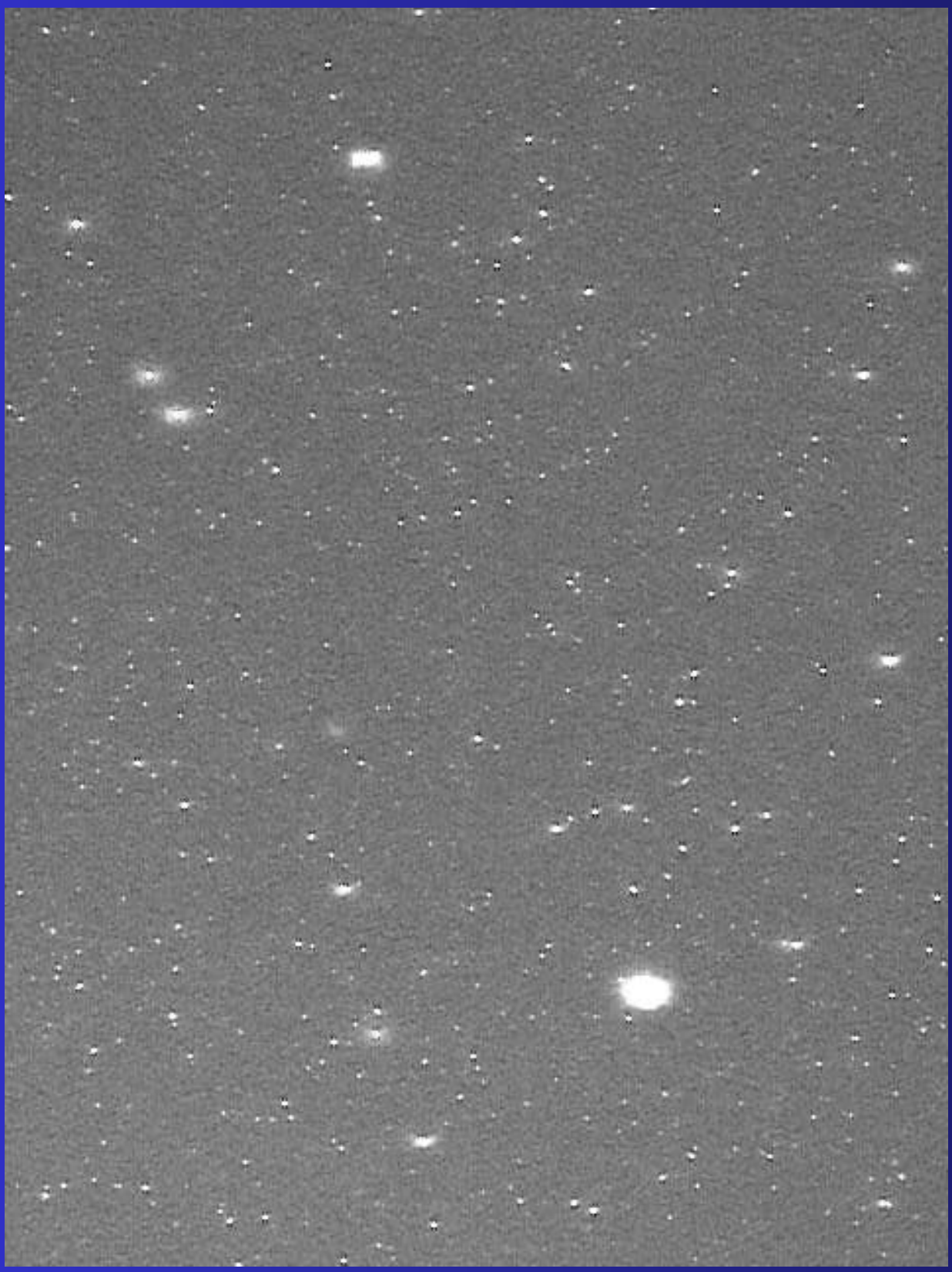
System function:

- Program steering via internet
- Notification via internet
- Backup function


CCD

Site

- Polish observatory at Las Campanas, Chile
- high altitude, clean atmosphere, no clouds
- power, ethernet, permament human supervision



Plans

- Algorithms development with existing ASAS device
- Software prototyping
- Single camera prototype - fall 2002