


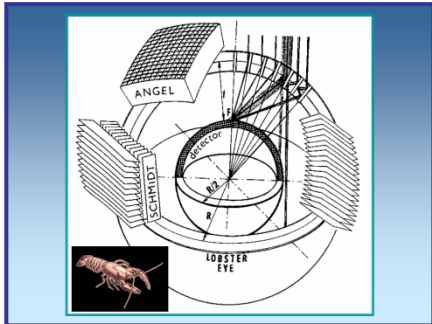
Astrophysics with Lobster Eye X-ray Telescopes

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Lobster-Eye (LE)




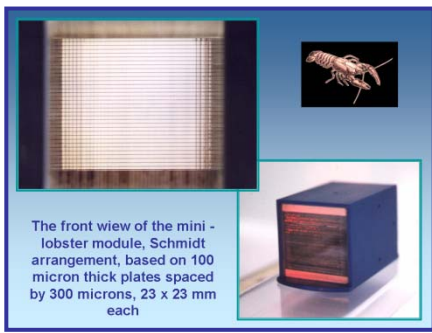
- Novel Wide Field X-ray Telescopes
- FOV of 100 sq. deg. and more easily possible (classical X-ray optics only 1 deg or less)
 - Analogy with lobster eyes
- Designed for astronomy, but laboratory applications also possible



LE International Space Station (ISS) like design

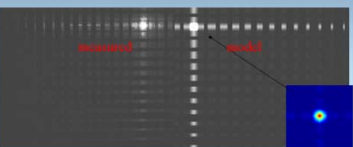
MCP design (microchannel plate)
 UK - Univ. of Leicester - collab.
 Angel arrangement

Thin foil design - Multi Foil Optics (MFO) (this talk)
 CZ- collaboration prototypes already available and tested
 high gain ~ 600
 better energy range - up to 10 keV
 Schmidt arrangement

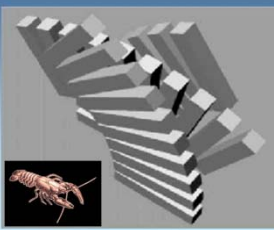



X-ray experiment vs. simulation

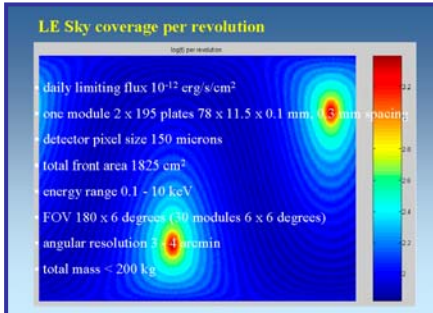
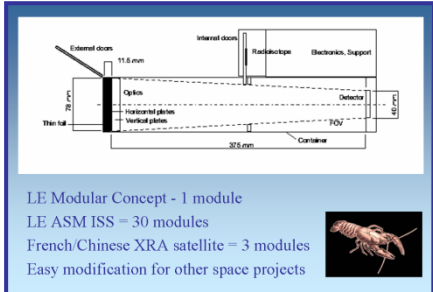
- Point-to-point focusing system, LE Schmidt mini
- source-detector distance 1.2 m, 8 keV photons
- image width: 2x512 pixels, 24 μm pixel
- Gain: ~570 (measured) vs. ~584 (model)



LE All Sky Monitor - Proposal



Modular concept
 Design for ISS
 Easy modification for EXIST or other satellites



Scientific goals

1. Alert System for X-ray transients

Fast recognition of new X-ray sources and/or sudden changes in X-ray flux of known sources, prompt emission study, precise positioning, alert system for narrow-field instruments

- GRB prompt and afterglow X-ray emission (20-60 triggers/year)
- X-ray flashes (> 8 triggers/year)
- orphan GRBs (detectable in X-rays but not in gamma)
- SNe prompt emission (thermal flash) 10-20 triggers/year
- X-ray binary & CVs flux changes
- Stellar events in the Sun's vicinity

2. Long-term X-ray source monitoring

Long-term monitoring of large number of X-ray sources with sampling of hours to days (depending on the source flux). Light curves for all the sources together with rough spectra (continuum monitoring, strong lines, iron detectable). In the list below we assume the limiting flux of 10^{-12} erg/s/cm² (but we can go deeper):

- X-ray binaries ~ 700 triggers
- Cataclysmic Variables ~ 200 triggers
- stars ~ 600 triggers
- AGN ~ 4 000 triggers
- galaxy clusters ~ 400 triggers
- SN remnants

Science with LE Supernovae

- only 17 supernovae detected in x-rays up to date
- thermal flash (1000 s, can reach 10^{43} erg/s bolometric, yet not detected)
- ejecta interaction with surrounding ISM - already detected, ranges 10^{37} - 10^{41} erg/s, not detected for type Ia SN
- thermal flash observable by LE up to several hundred Mpc (200 Mpc for $n = 10^{21} \text{ cm}^{-2}$, $\sigma = 3 \times 10^{-22} \text{ cm}^2$, $L_x = 10^{44} \text{ erg/s}$, limiting flux $f_x = 10^{-12} \text{ erg/s/cm}^2$ - 50 SNe/year, -half observable)

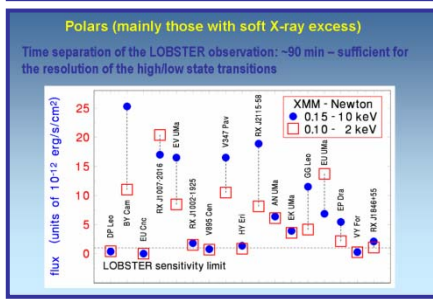
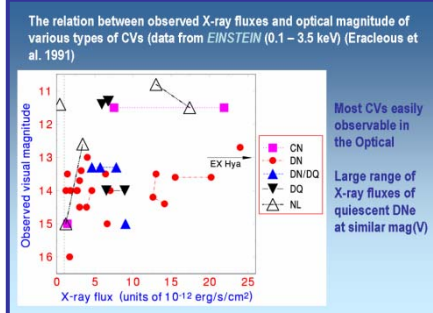
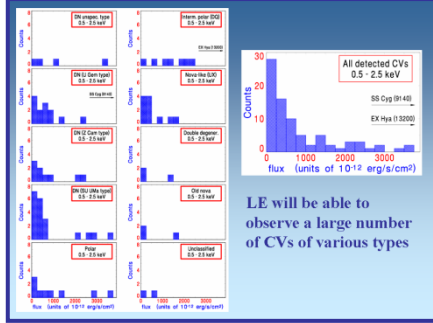
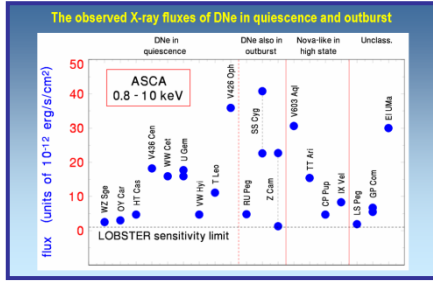
Science with LE Cataclysmic Variables

CVs - very active objects, often violent long-term activity in both the optical and X-ray passbands (outbursts, high/low state transitions, nova explosions)
 - often rapid transitions between the states of activity

Search for the relation of the optical and X-ray activity very important - monitoring of a large number of CVs necessary to catch them in various states of activity

Most up to now X-ray observations of CVs:

- Snapshots catching selected CVs in a particular state of activity
- In most cases the transitions between the states are not covered
- Poor statistics of phenomena and objects (deeper studies available for only a few CVs)



Conclusion

The LE ASM will very significantly contribute to various regions of recent astrophysics

The necessary technical background is already available, making proposals for space project based on Lobster Eye optics possible

Space Lobster projects recently considered by ESA and by China