
High time-domain Astrophysics with SALT
Stephen Potter
South African Astronomical Observatory

Outline

SALTICAM

Observing modes

Results

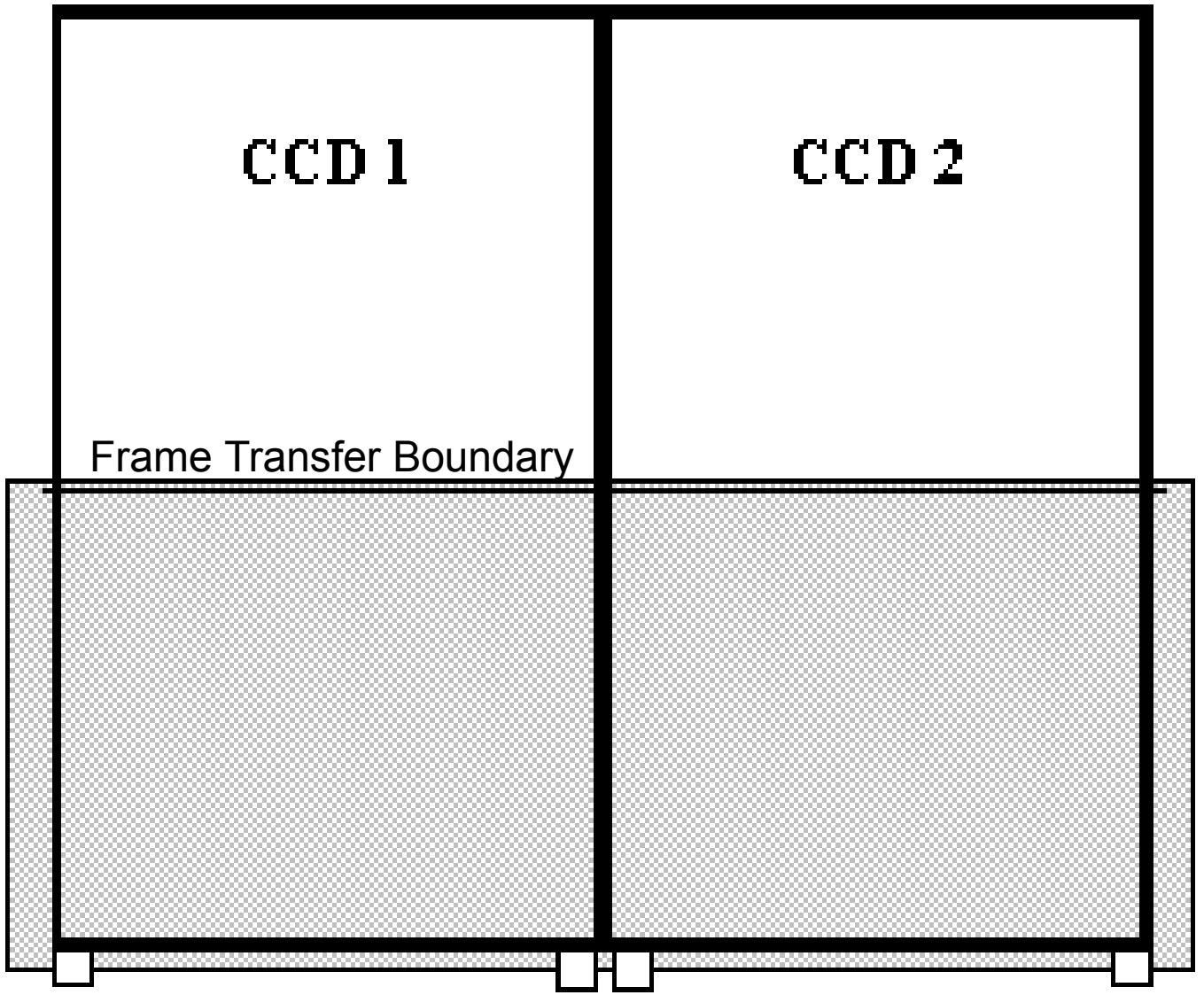
Future

RSS

Observing modes

Examples

SALTICAM



F.O.V 8 arcmins

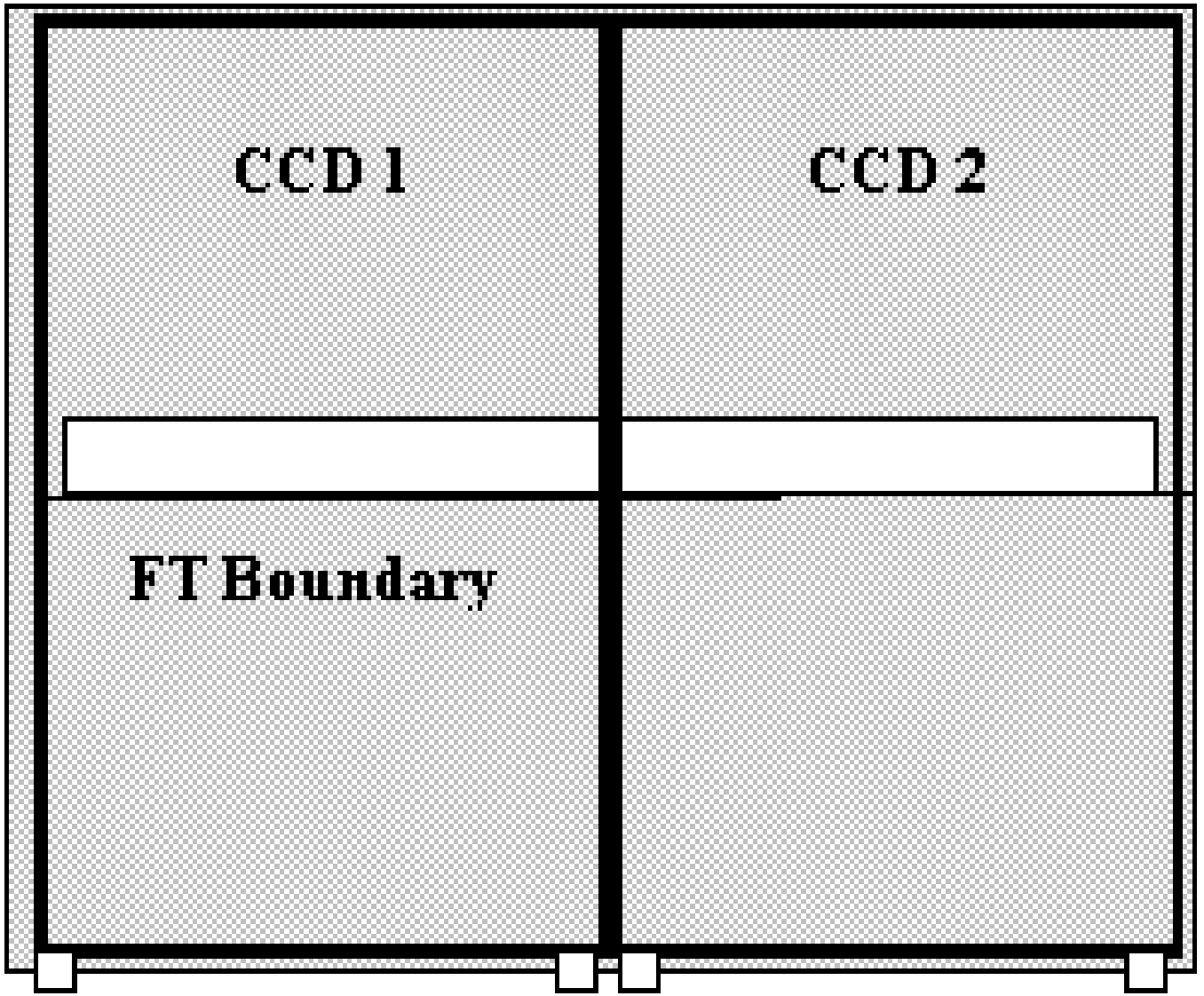
frame transfer boundary

frame transfer mask

4 read-out amplifiers

2x2, 4x4, 6x6'

SALTICAM



F.O.V 8'x20"

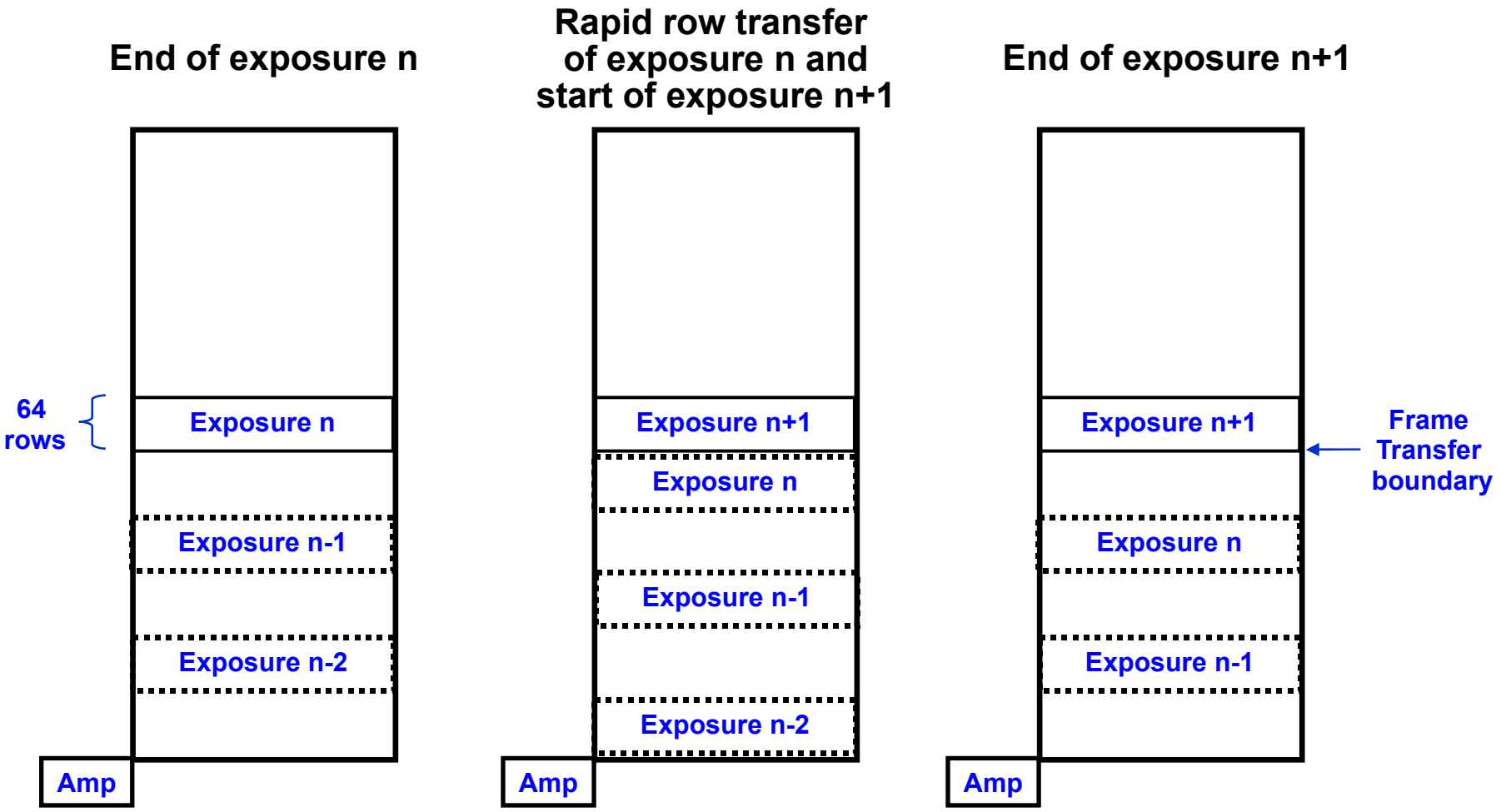
frame transfer boundary

slot mask

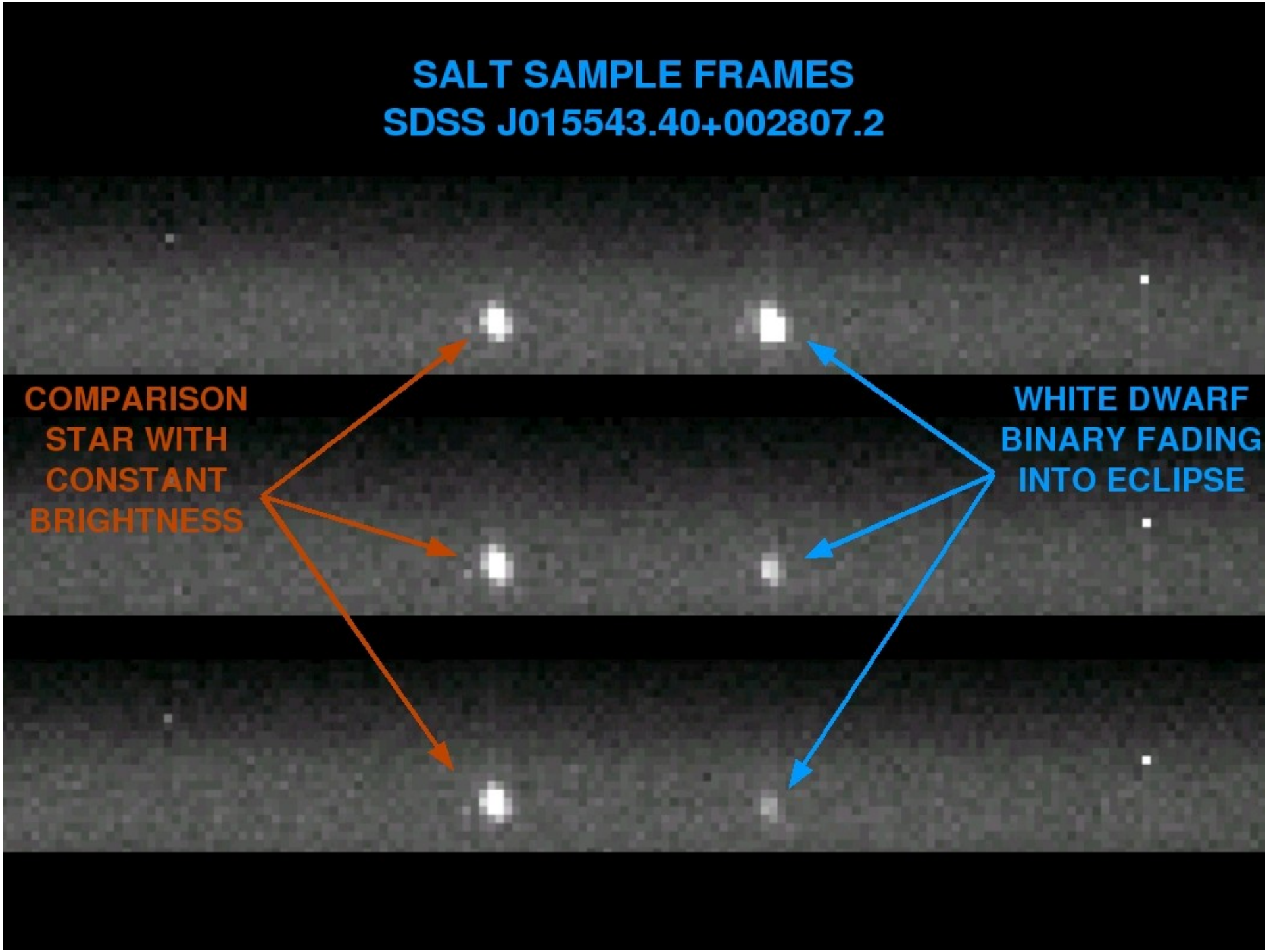
4 read-out amplifiers

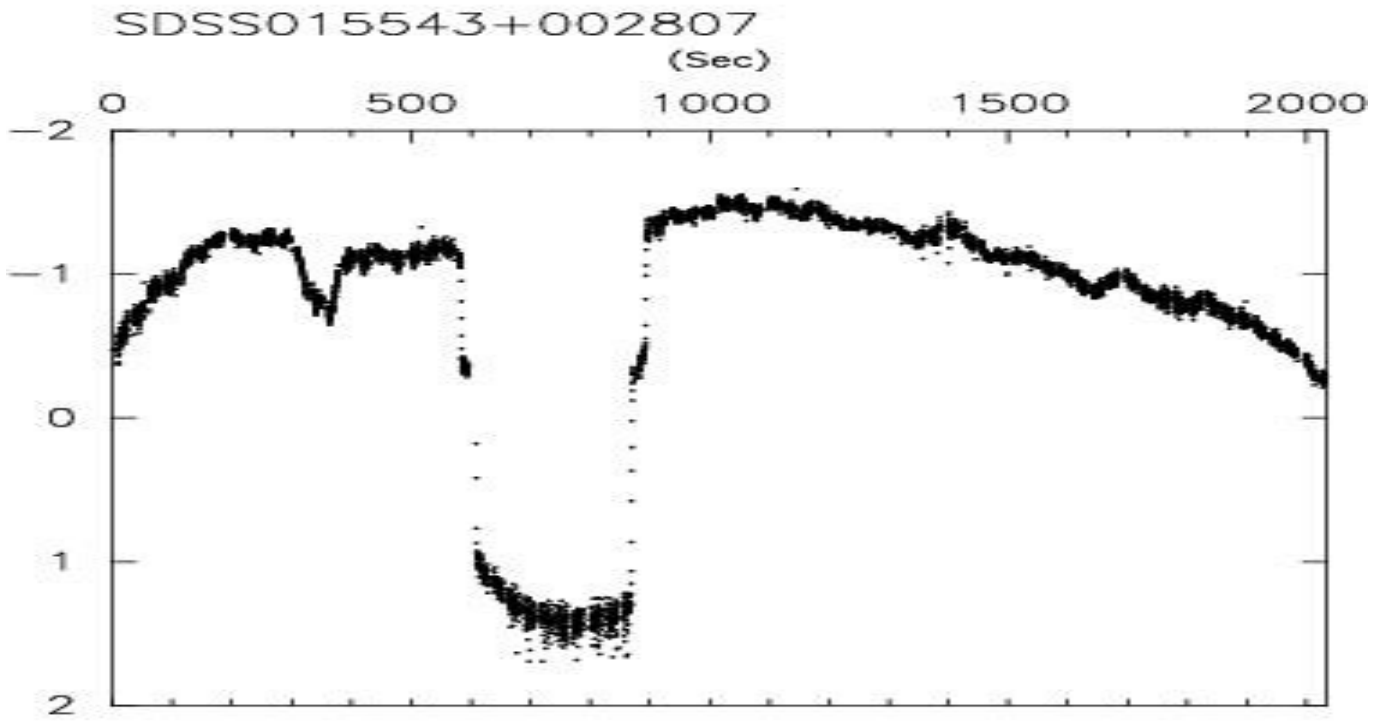
2x2, 4x4, 6x6'... 0.08s

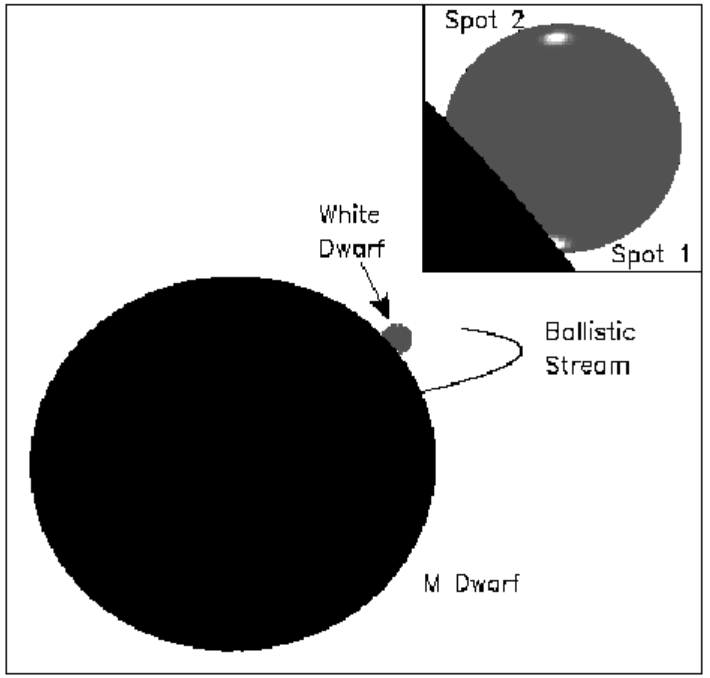
SALTICAM

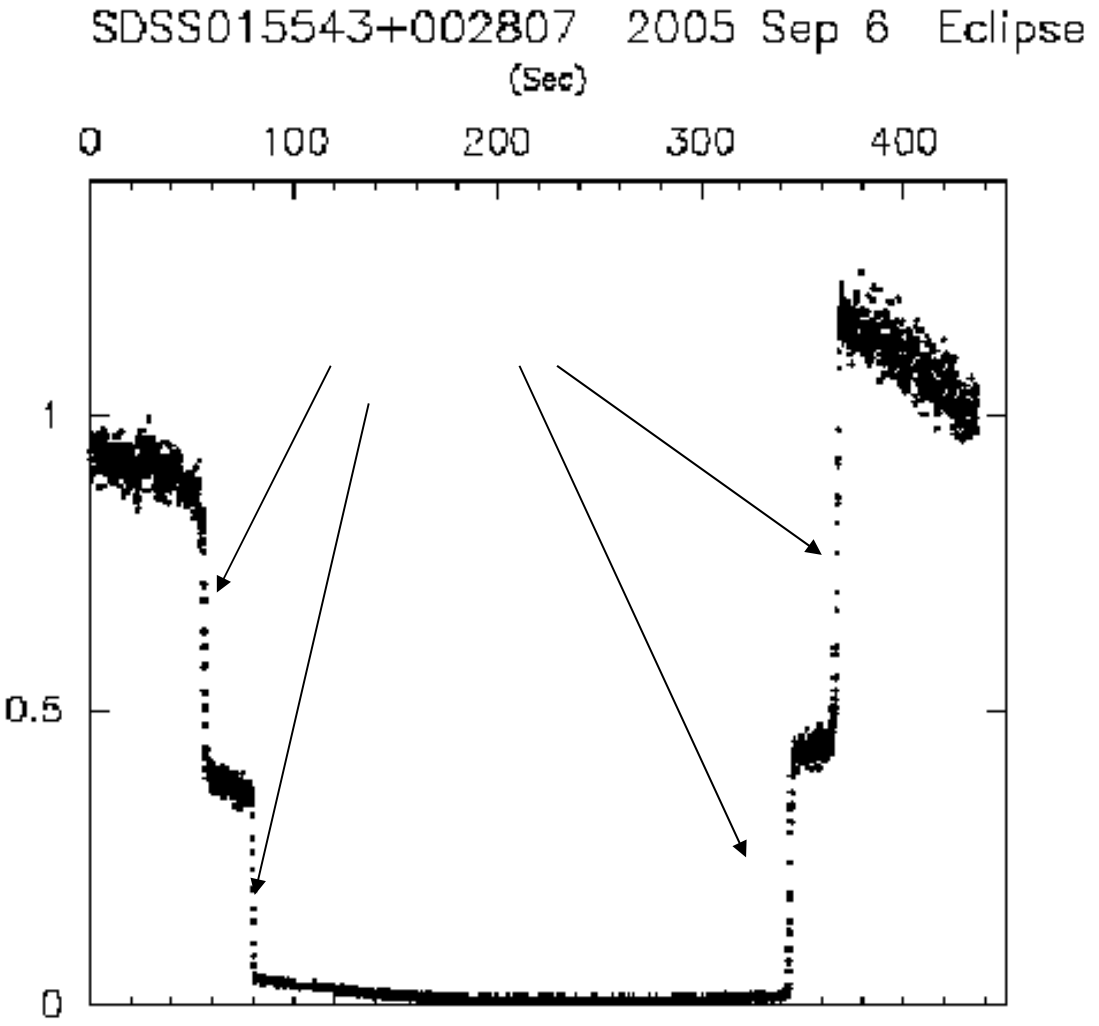


Control scheme for fastest sampling


SALT SAMPLE FRAMES
SDSS J015543.40+002807.2
COMPARISON STAR WITH CONSTANT BRIGHTNESS
WHITE DWARF BINARY FADING INTO ECLIPSE

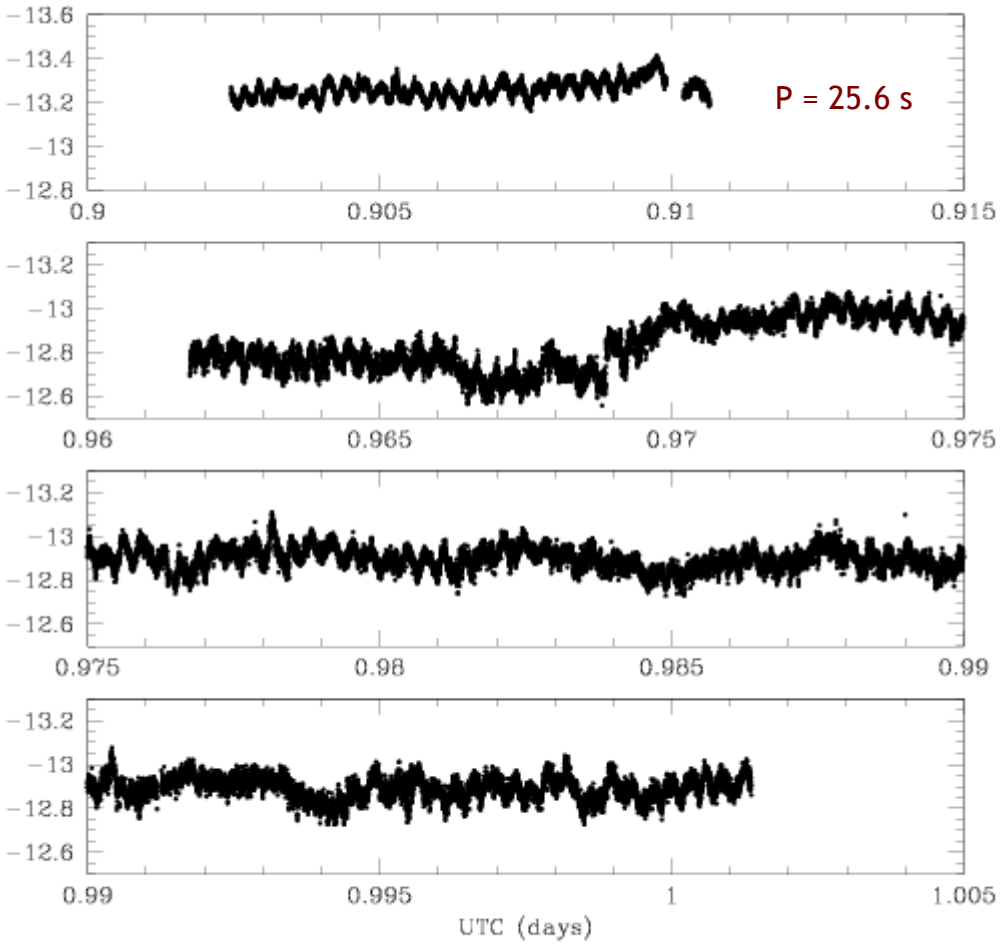

SDSS015543+002807
(Sec)
0
500
1000
1500
2000
−2
−1
0
1
2

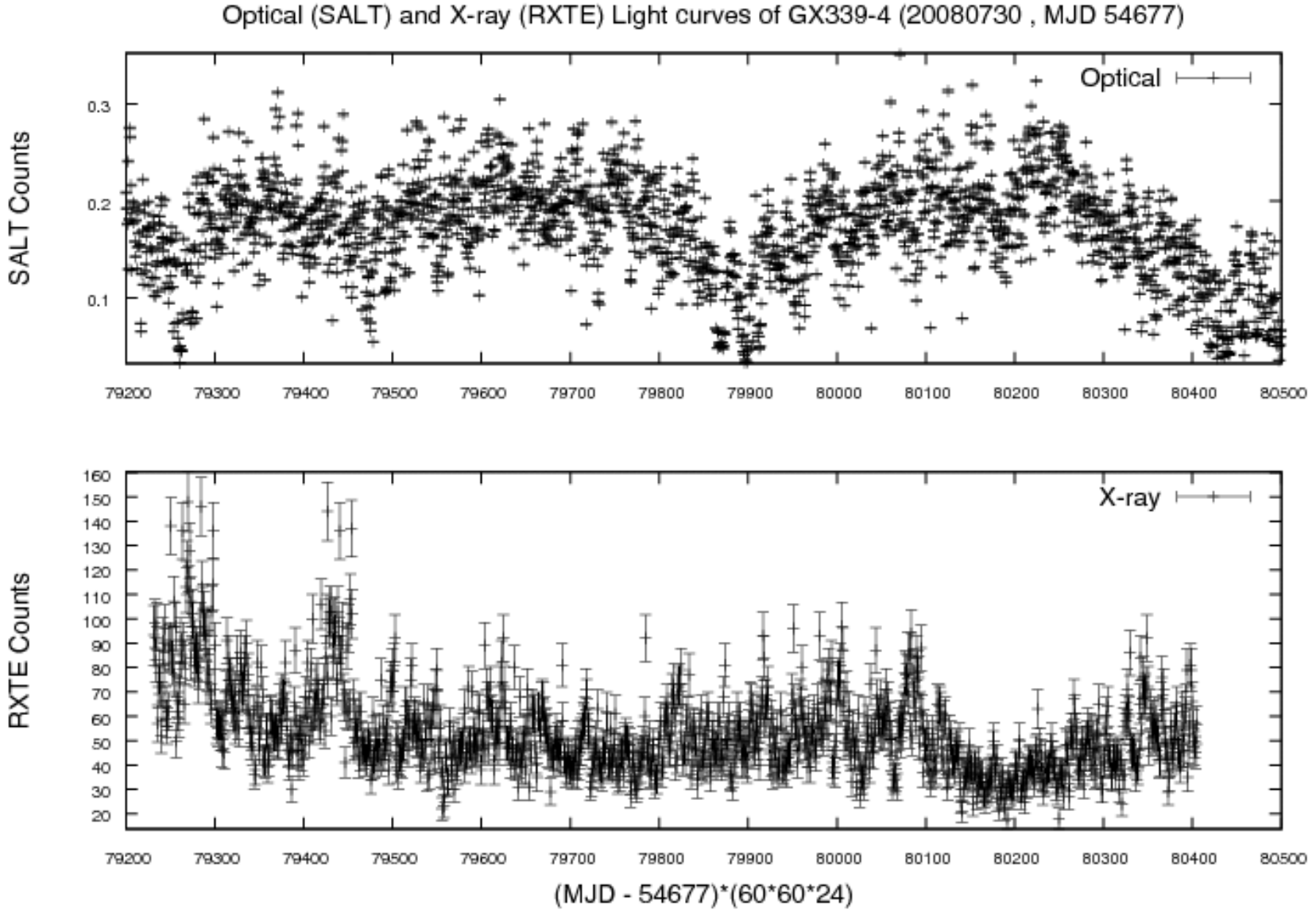

Spot 2
White
Dwarf
Spot 1
Ballistic
Stream
M Dwarf


SDSS015543+002807 2005 Sep 6 Eclipse
(Sec)
0
100
200
300
400
1
0.5
0

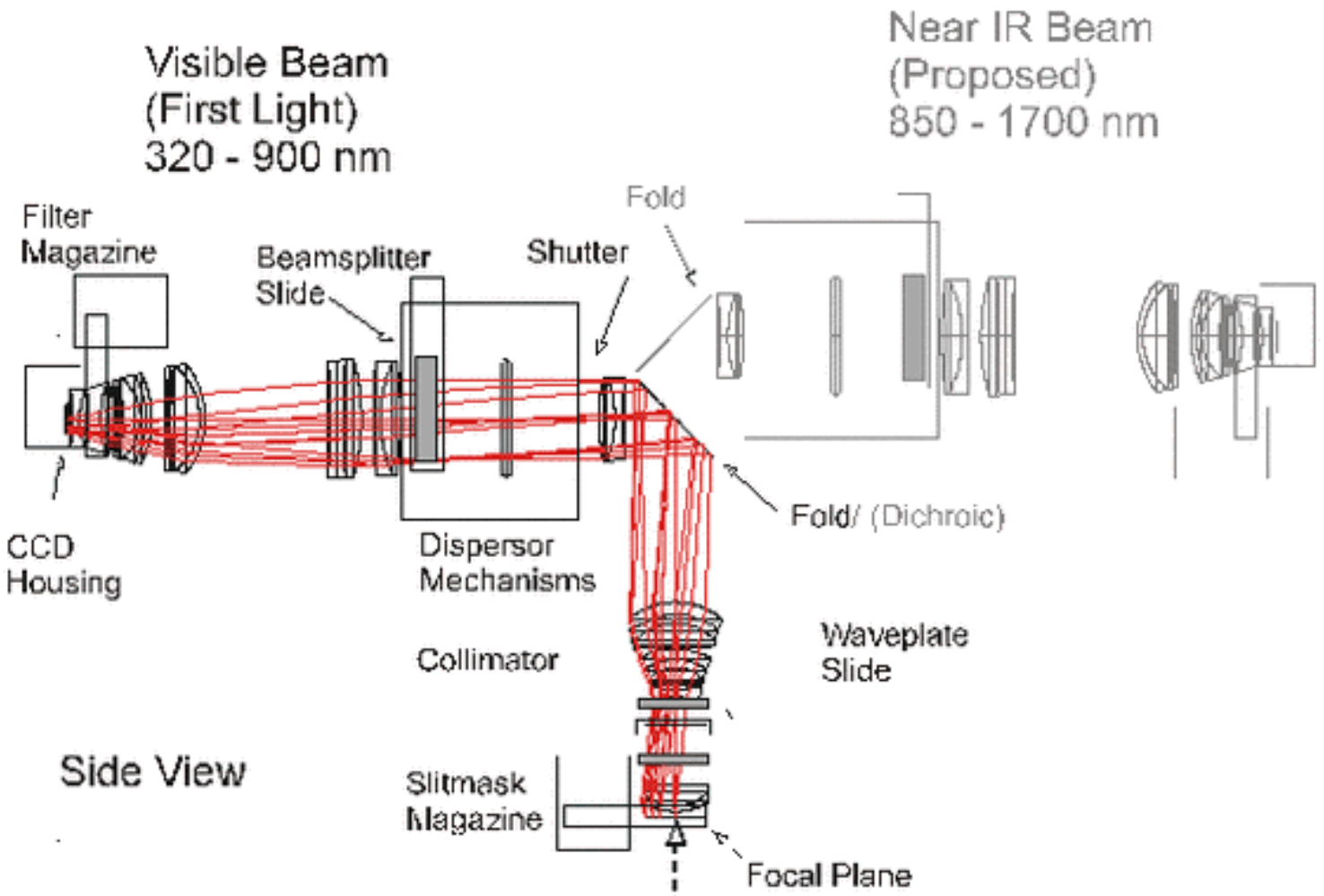
Rapid variability in cataclysmic variable stars: VW Hydri dwarf nova oscillation (DNO) / quasi-periodic oscillation (QPO)

V = 13.3 mag, Filter = white light, Binning = 6x6, T_{exp} = 80 ms
Photometry: 2.5 pix + aperture correction (relative)



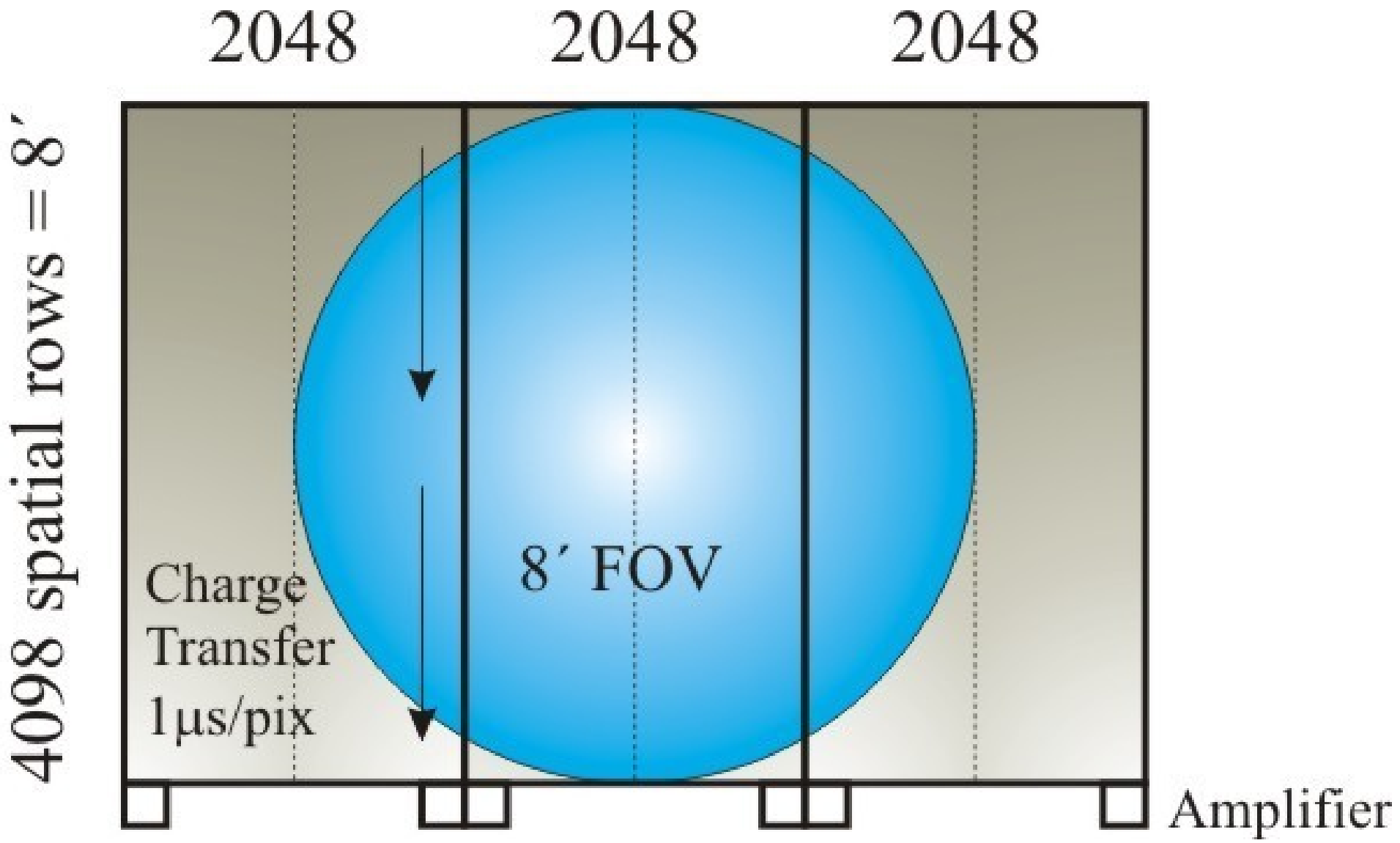

Optical (SALT) and X-ray (RXTE) Light curves of GX339-4 (20080730 , MJD 54677)
Optical
SALT Counts
0.3
0.2
0.1
X-ray
RXTE Counts
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
79200
79300
79400
79500
79600
79700
79800
79900
80000
80100
80200
80300
80400
80500
(MJD - 54677)*(60*60*24)

Robert Stobie Spectrograph (RSS)

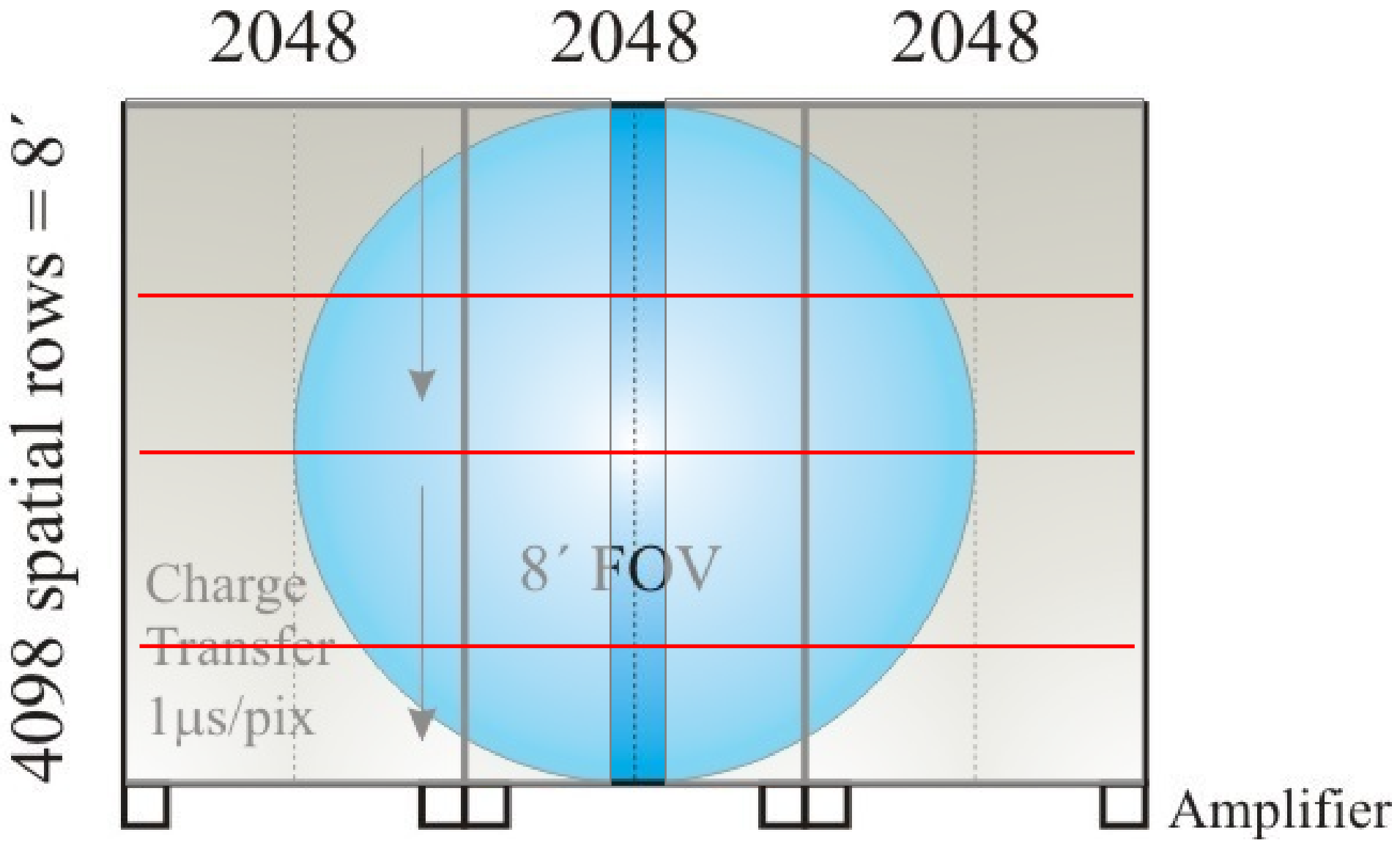


Gratings
Beamsplitter
½ and ¼ waveplates
Masks (e.g. slit masks)
Filters

Robert Stobie Spectrograph (RSS)

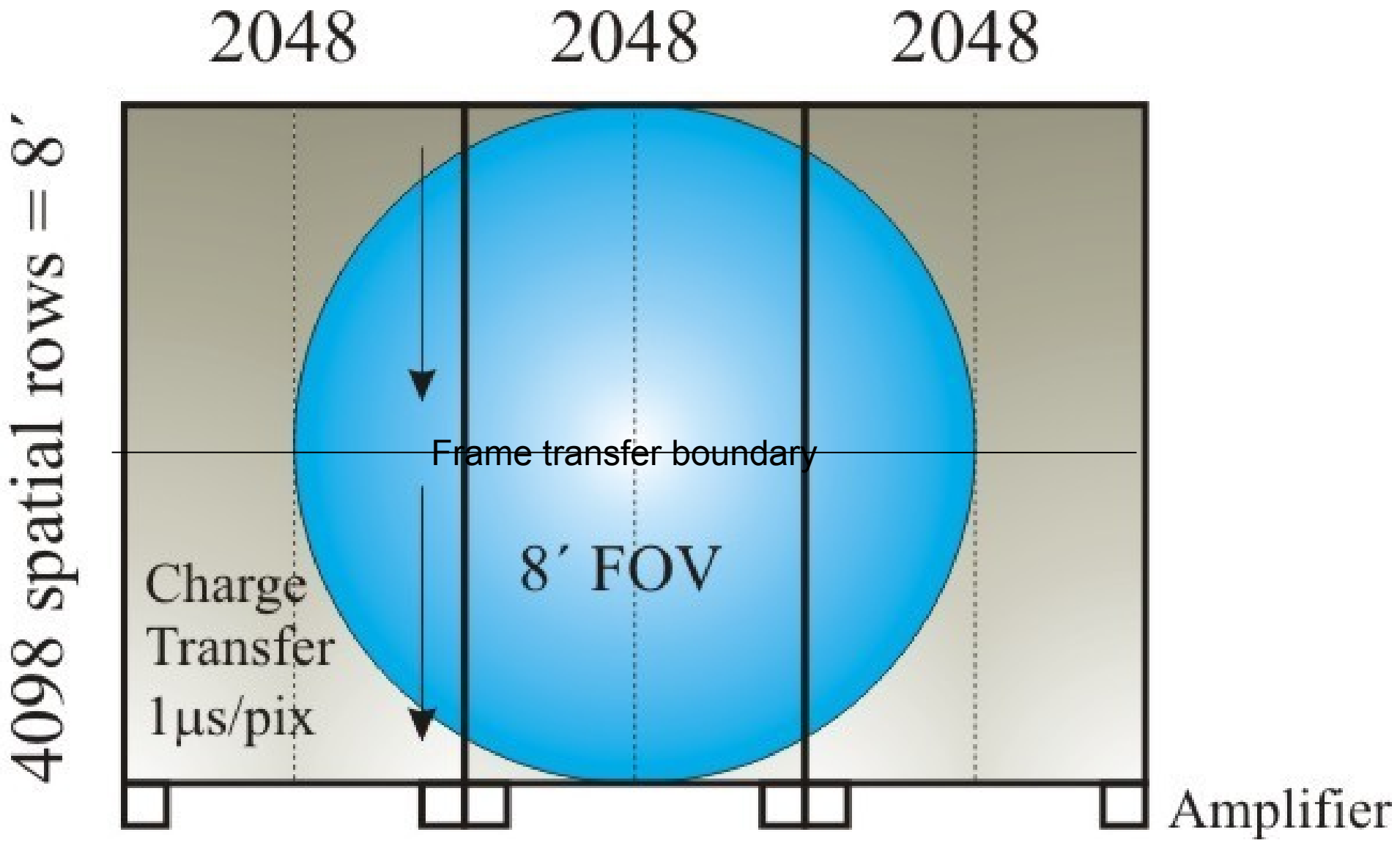


Robert Stobie Spectrograph (RSS)

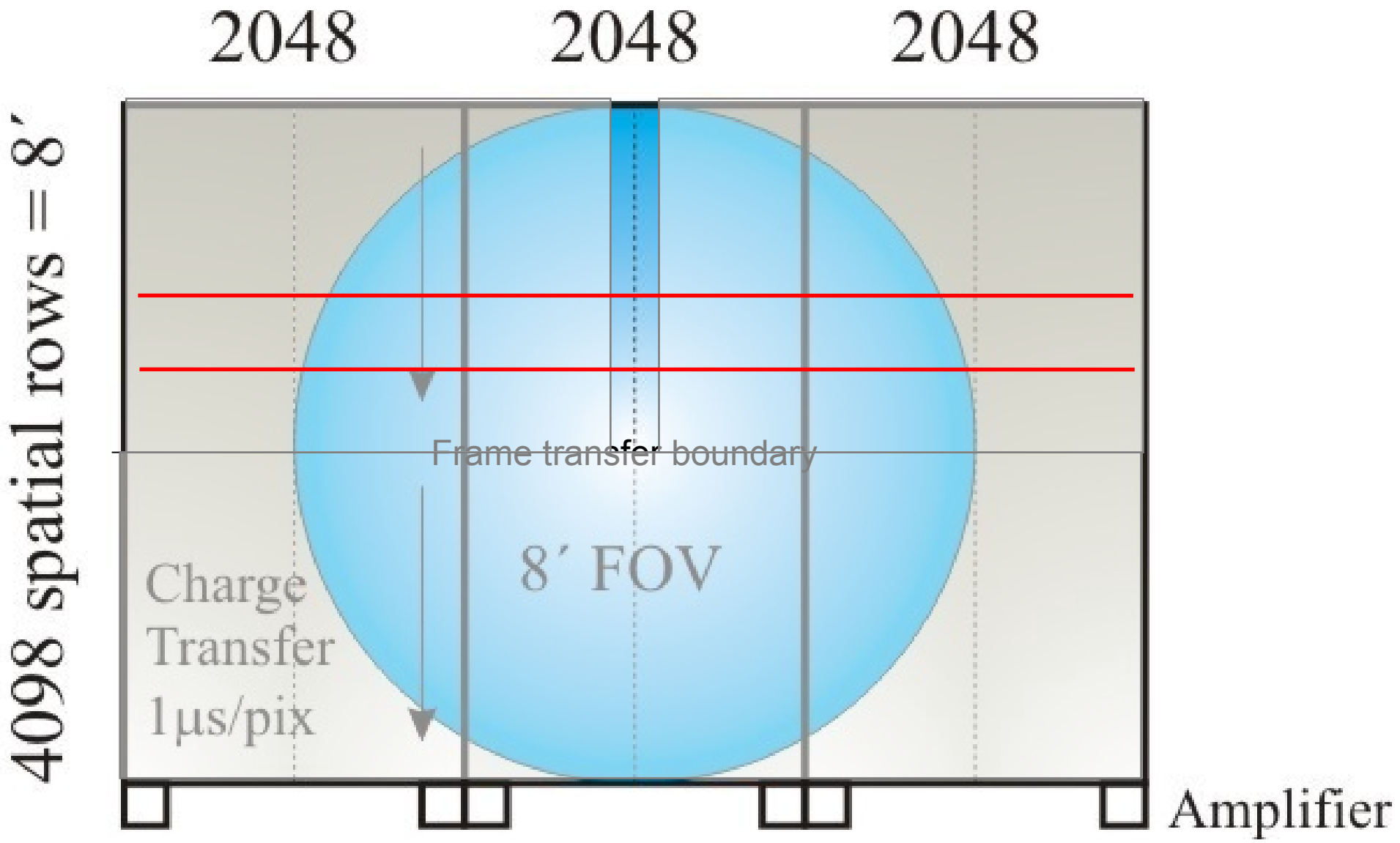


Long slit spectroscopy

Robert Stobie Spectrograph (RSS)

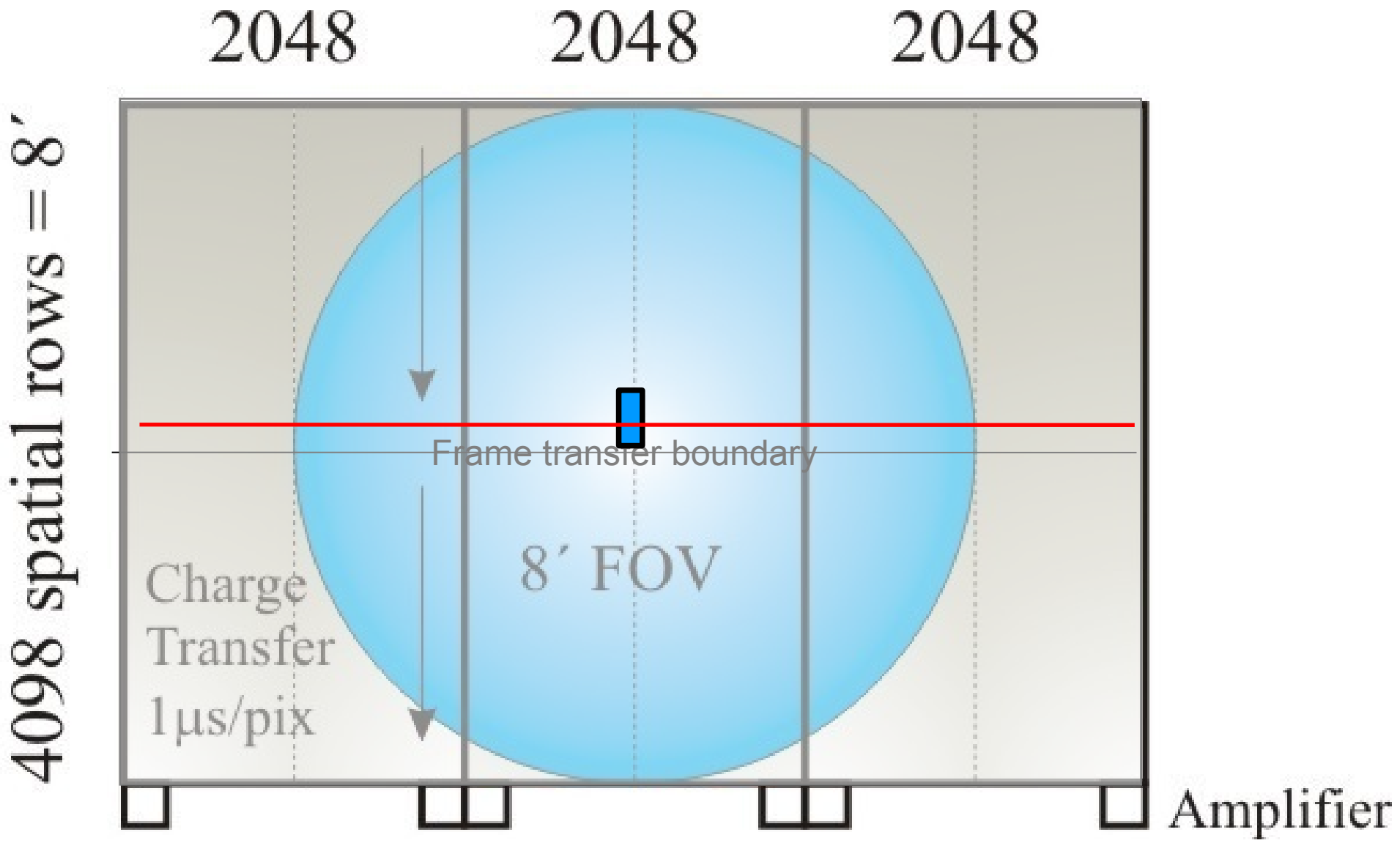


Robert Stobie Spectrograph (RSS)



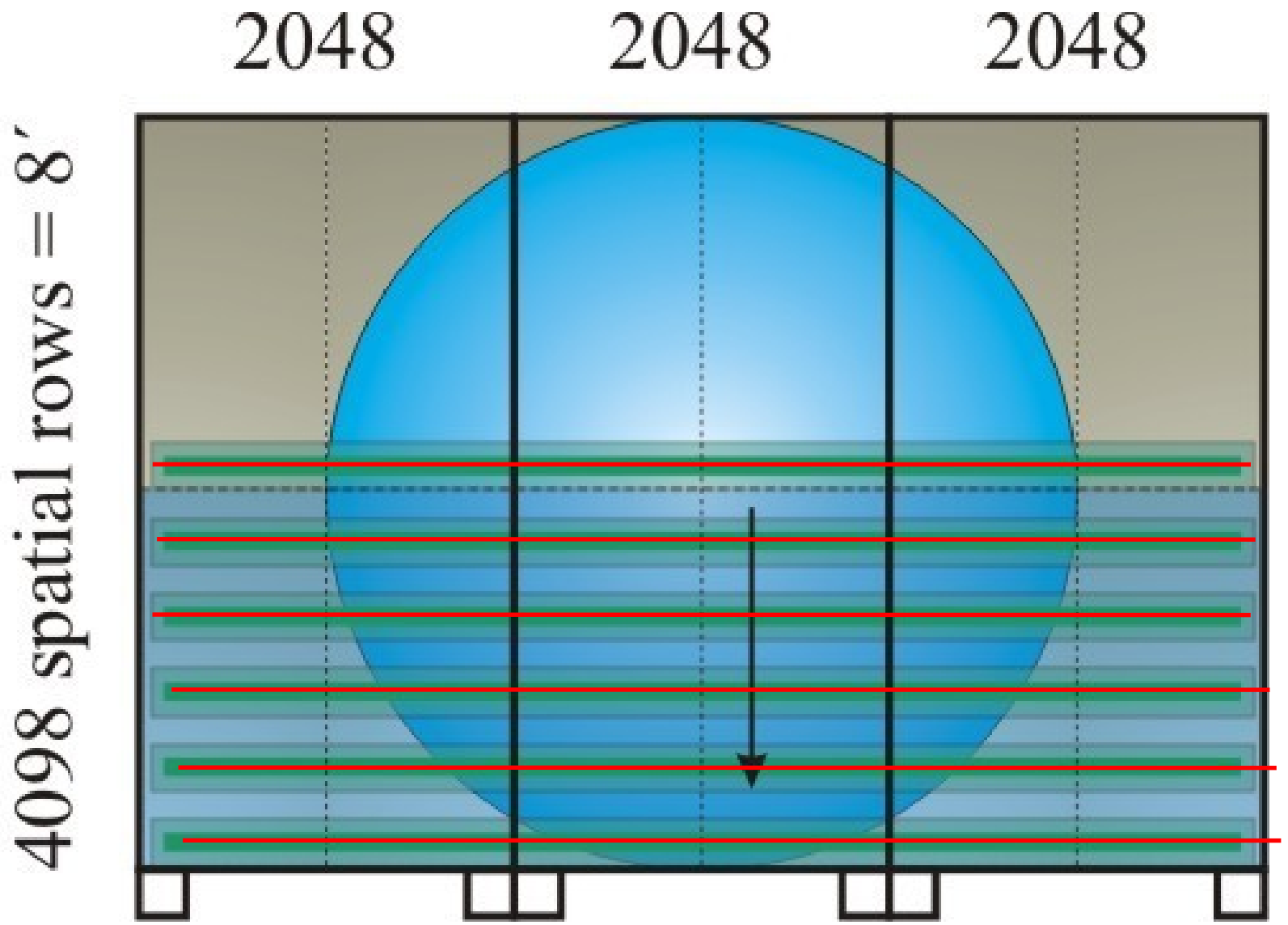
Frame transfer long slit spectroscopy

Robert Stobie Spectrograph (RSS)



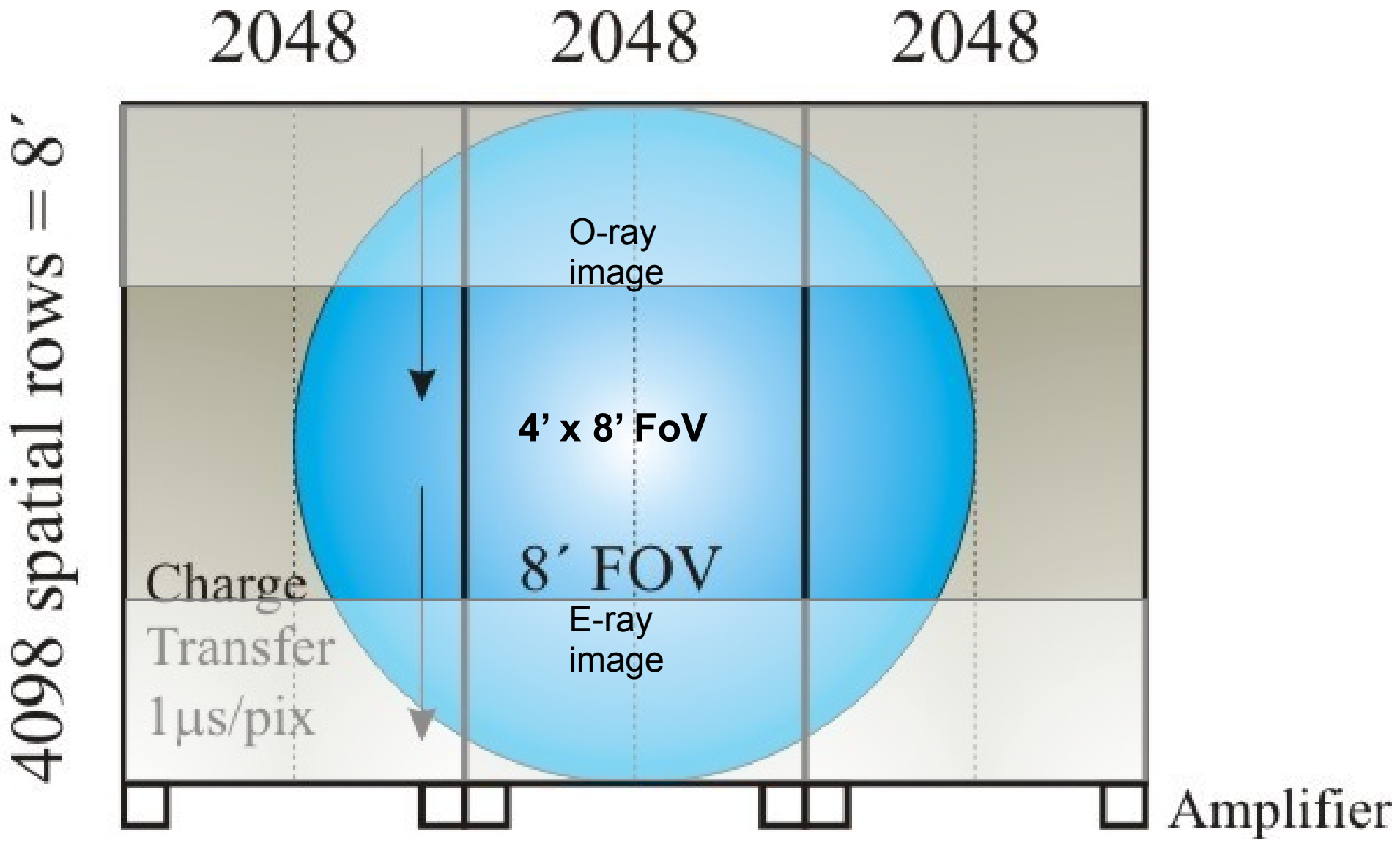
Slot mode spectroscopy

Robert Stobie Spectrograph (RSS)



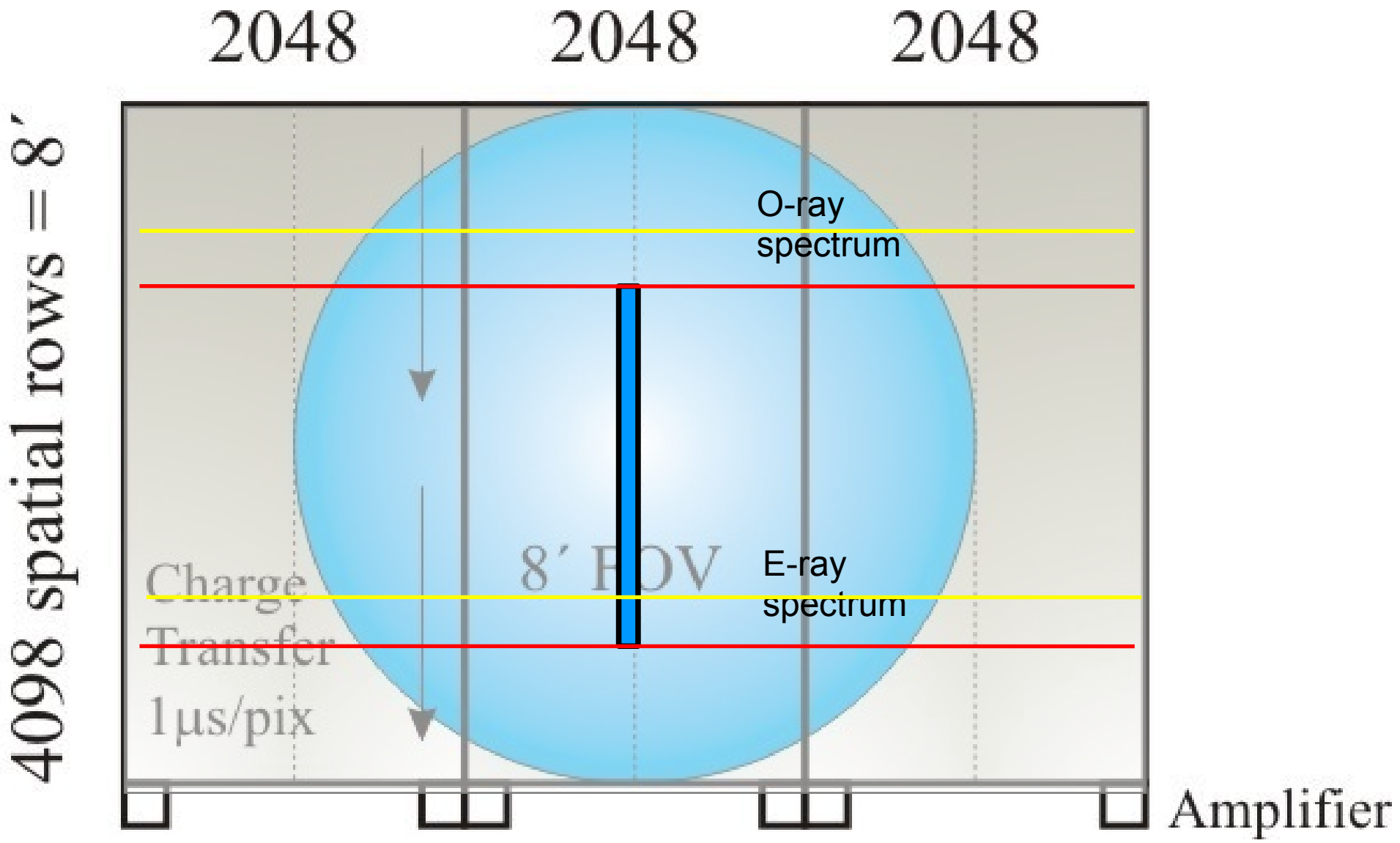
Slot mode spectroscopy

Robert Stobie Spectrograph (RSS)



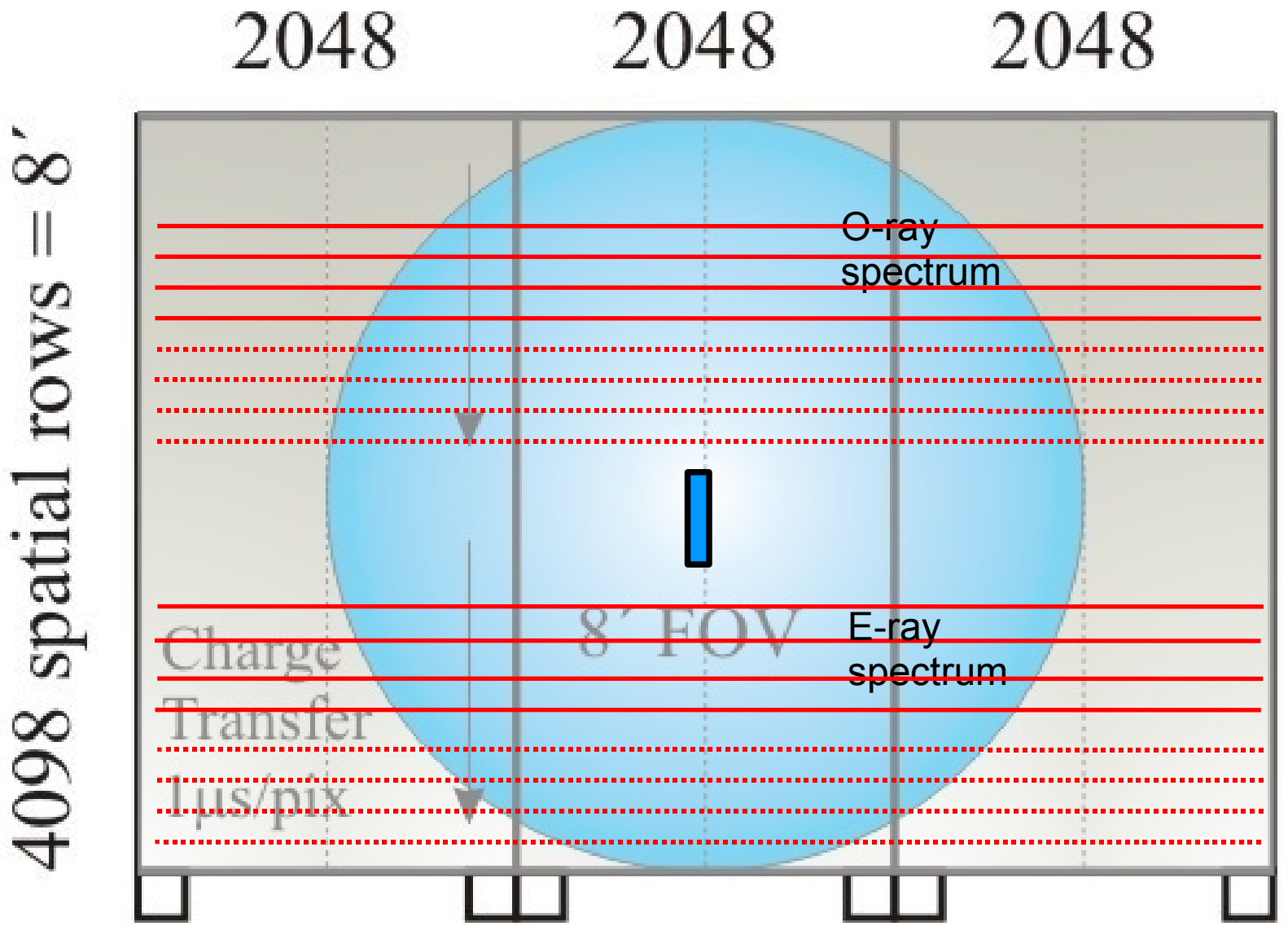
Imaging polarimetry
Beamsplitter has slight dispersion

Robert Stobie Spectrograph (RSS)



Spectro-polarimetry

Robert Stobie Spectrograph (RSS)



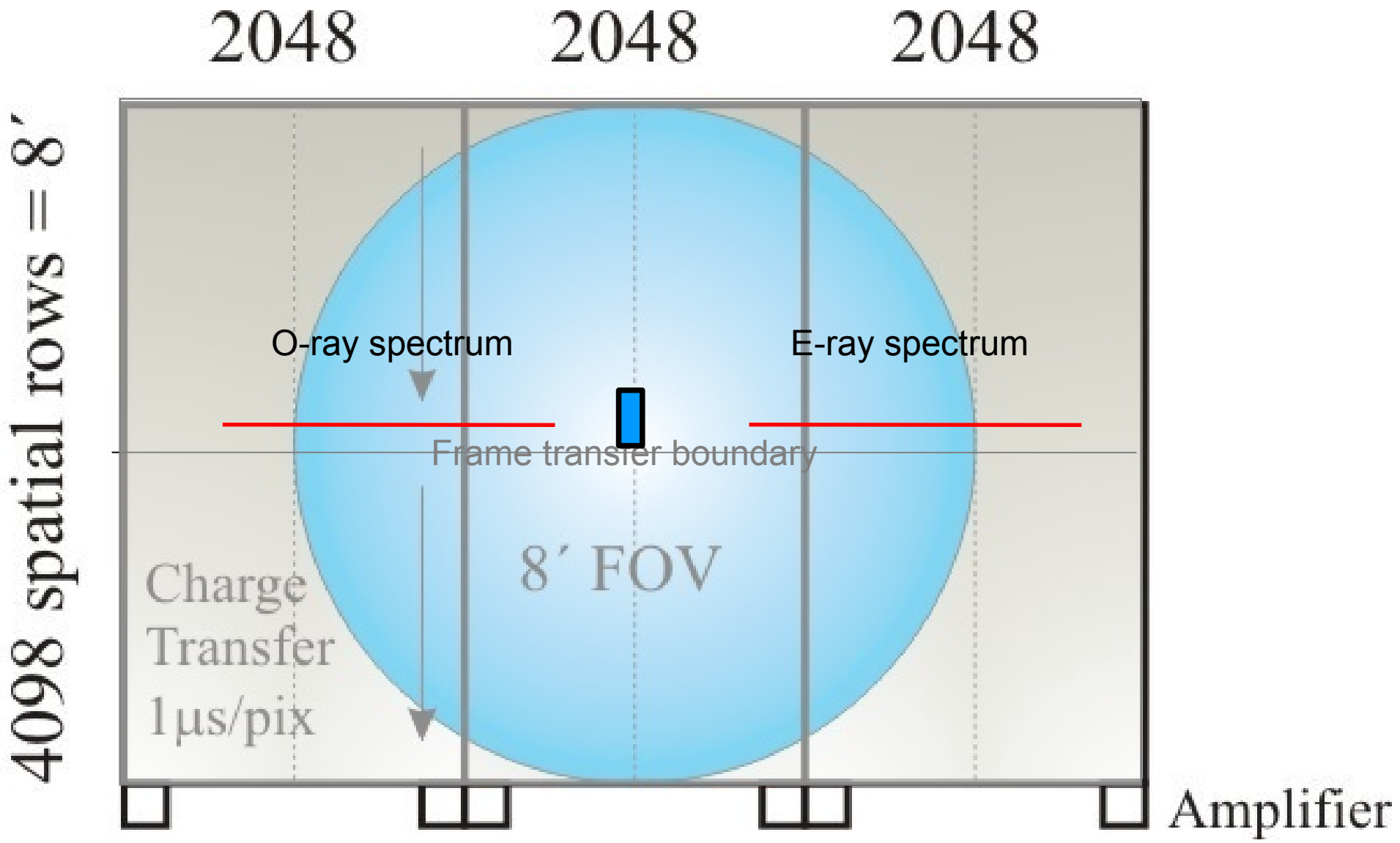
Rotate waveplates & Shuffle CCD rows down or backwards/ forwards

Waveplate angles

Spec	½	¼
1	0	0
2	22.5	33.75
3	45	67.5
4	67.5	101.25
5	90	135
6	112.5	168.75
7	135	202.5
8	157.5	236.25

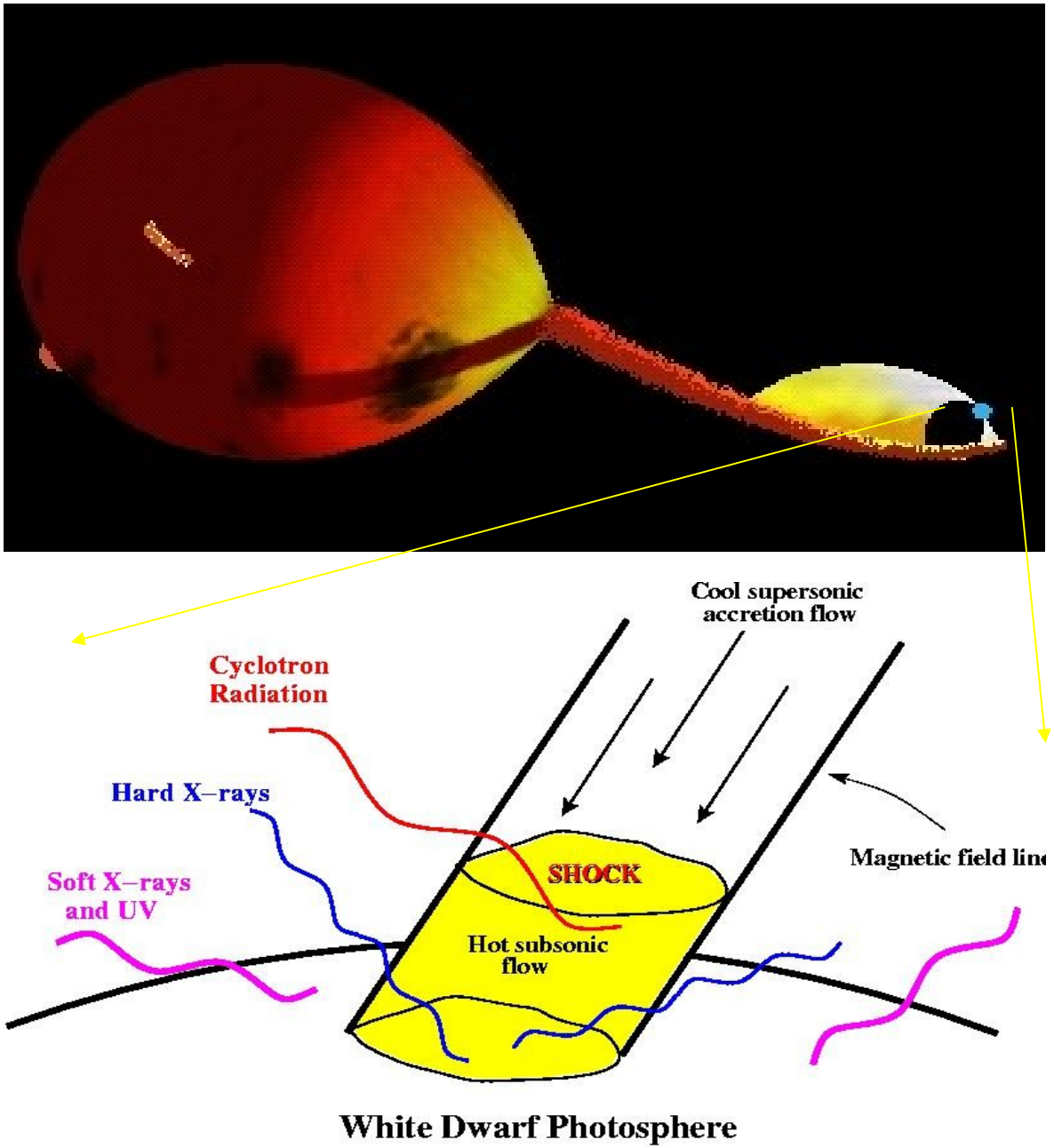
Charge shuffling Spectro-polarimetry

Robert Stobie Spectrograph (RSS)

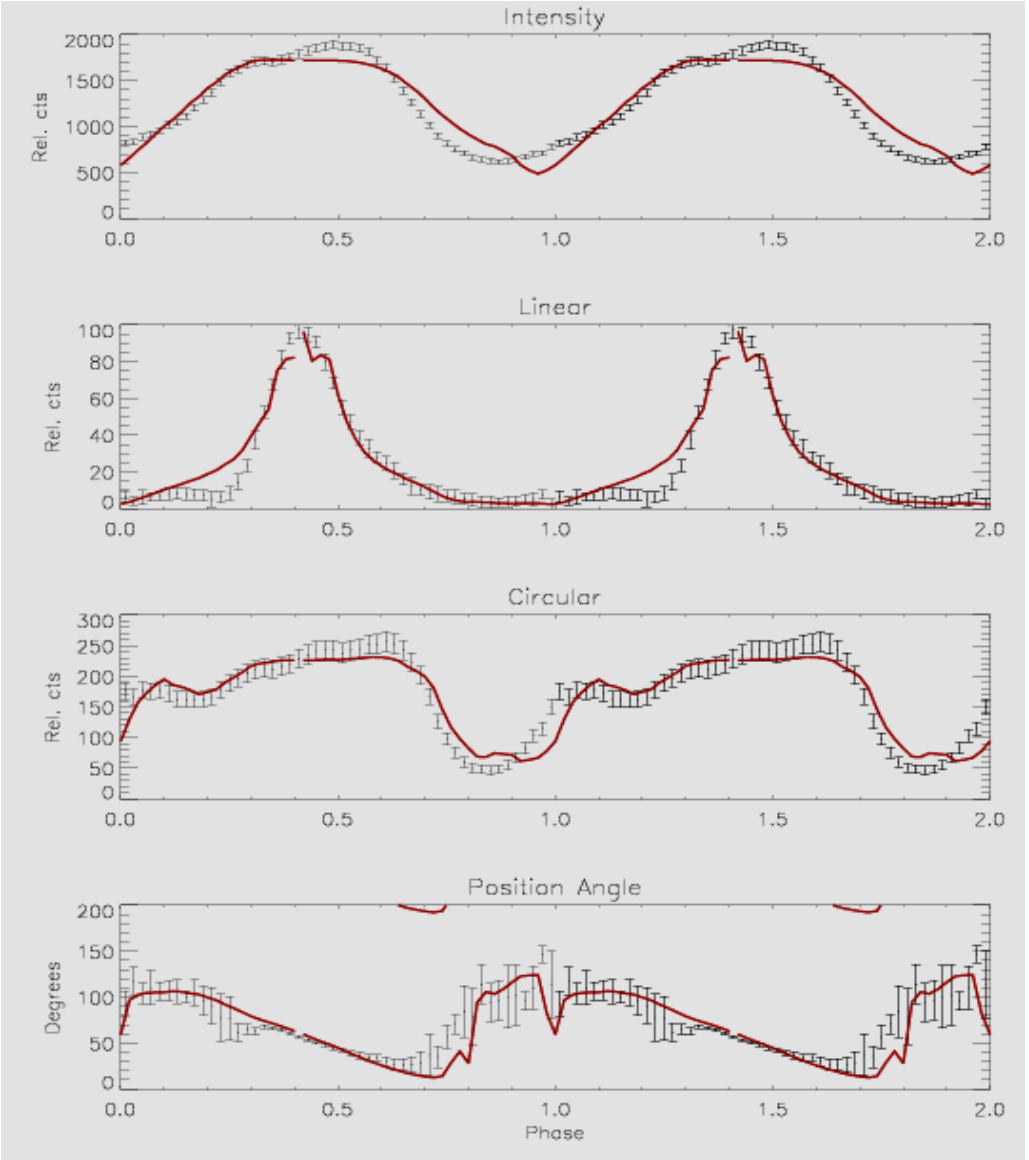


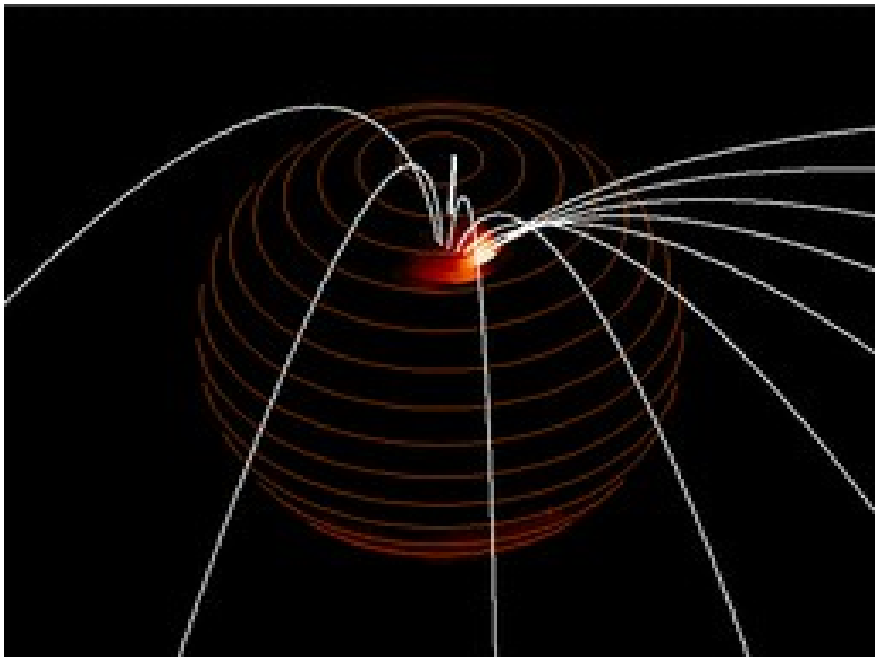
Rotated beamsplitter slot mode spectro-polarimetry

High Speed Polarimetry of Polars



High Speed Polarimetry of Polars





Stokes imaging technique (Potter):

Fitting model to data using a genetic algorithm.

Single pole-system with cyclotron emission region always in view

Spectro-Polarimetry of Polars

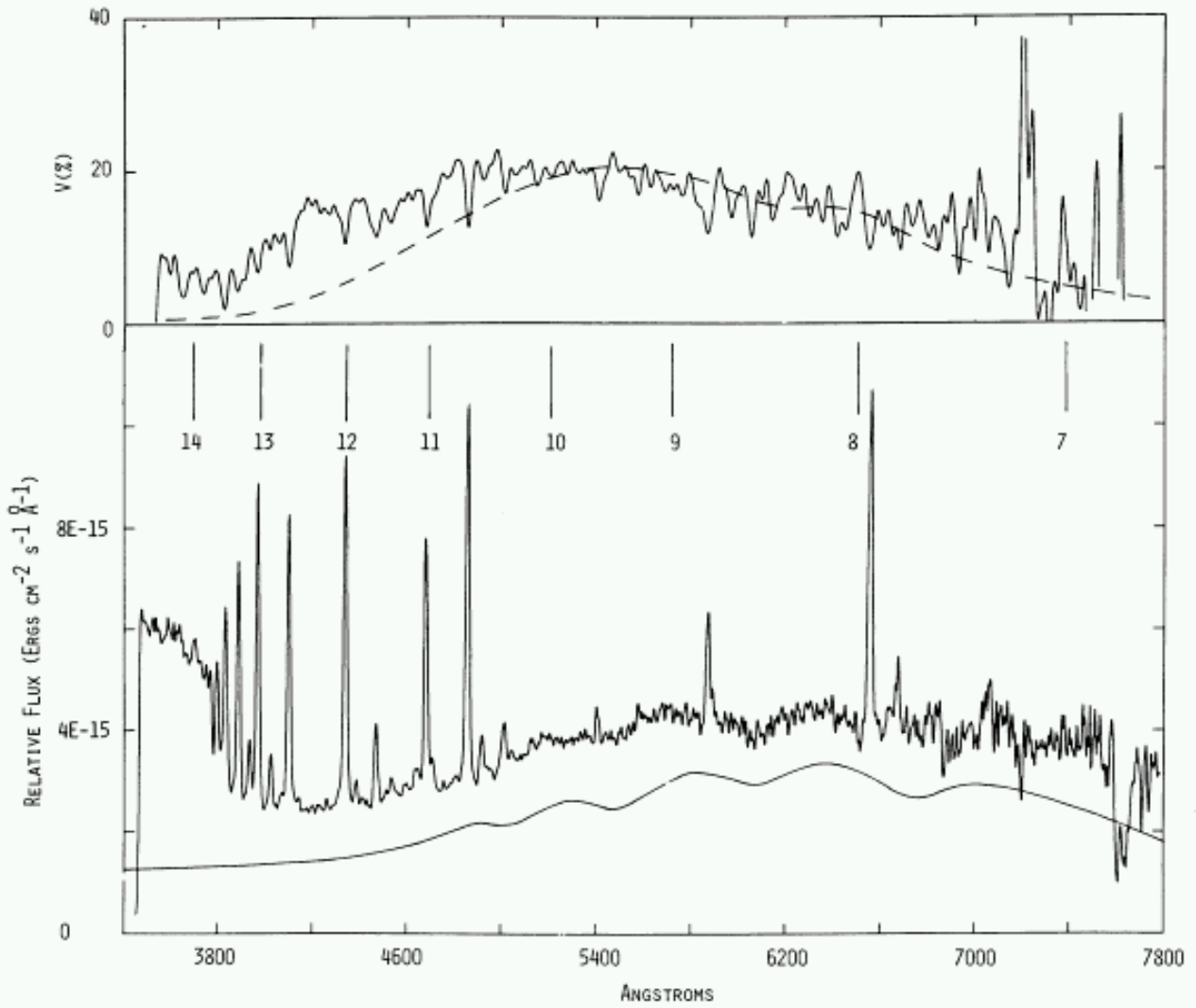
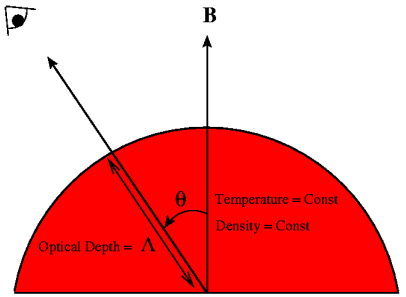


FIG. 4.—A constant Λ cyclotron model compared with observed intensity and polarization at $\phi = 0.5$ (bin 2). The model has parameters $B_p = 20.5$ MG, $T_e = 8$ keV, $N_e = 10^{16}$ cm^{-3}, $\Lambda = 10^7$, and $\theta = 85°$. The theoretical intensity curve has been scaled to match the observed intensity at 6400 Å but is displaced vertically for clarity. Cyclotron harmonic numbers between 7–14 are indicated.

Spectro-Polarimetry of Polars



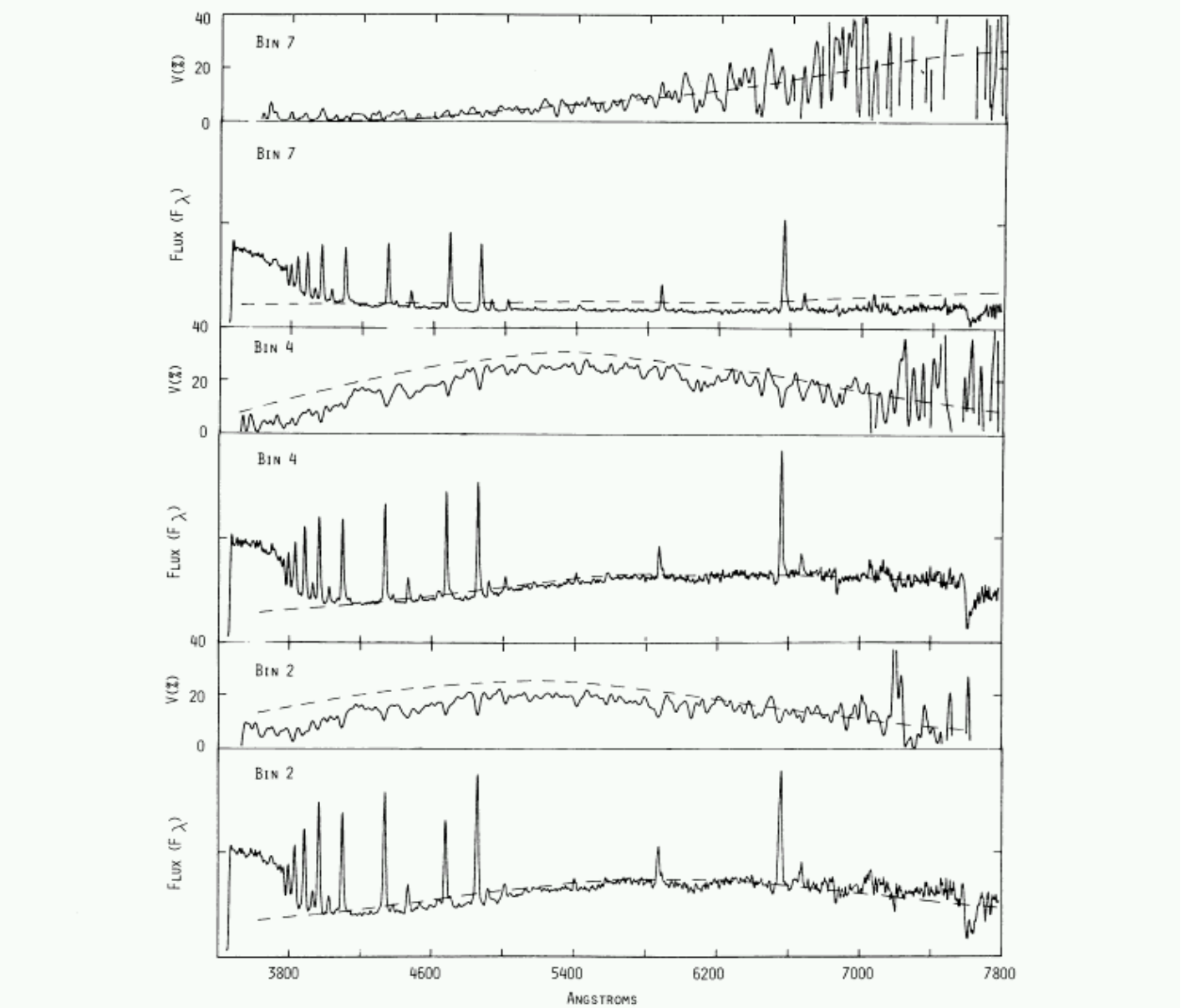
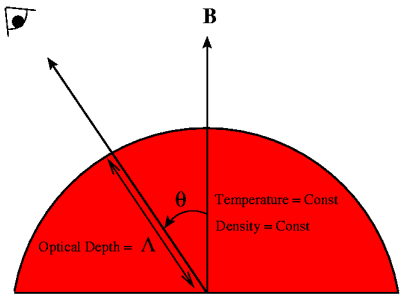
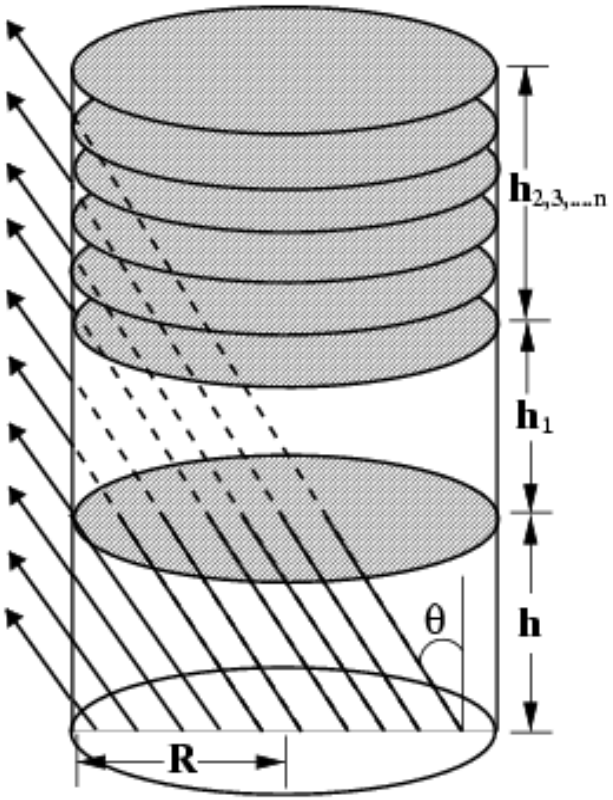
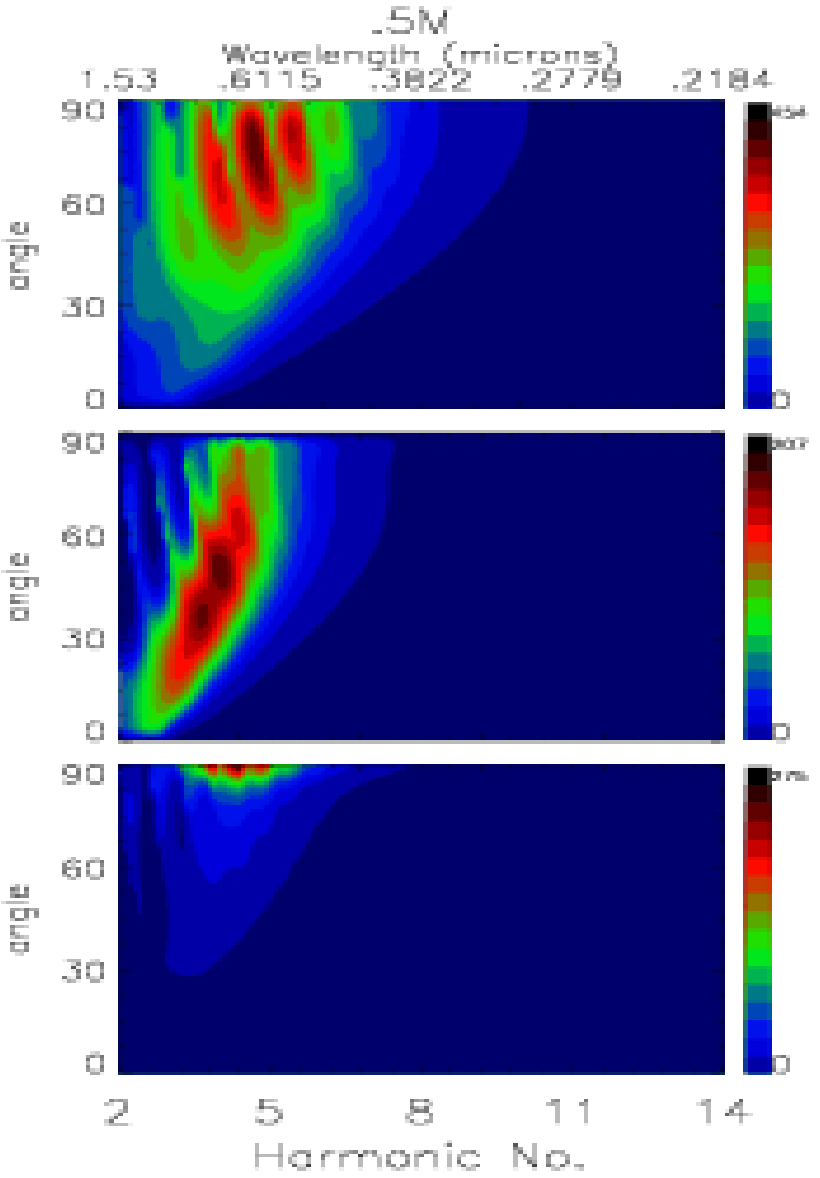


FIG. 7.—Cyclotron emission spectra (intensity and polarization) are compared with observations at three different phases corresponding to $\phi = 0.0$ (bin 7), $\phi = 0.7$ (bin 4), and $\phi = 0.5$ (bin 2). Model parameters are $B_p = 25$ MG, $T_e = 20$ keV, $N_e = 10^{16}$ cm^{-3}, $\Lambda_h = \Lambda_d = 4.5 \times 10^4$.

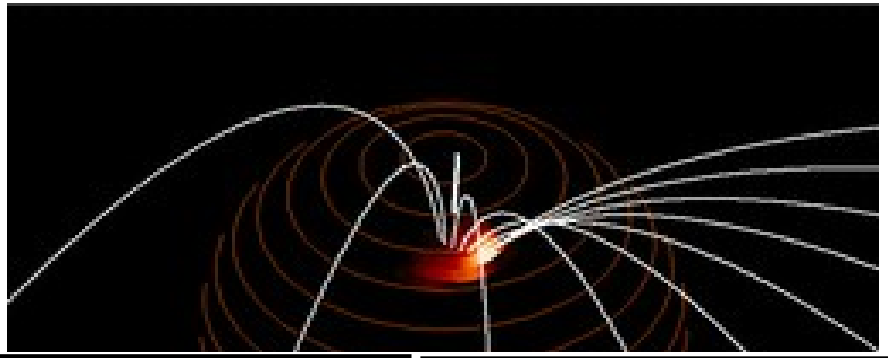
Stratified accretion shocks

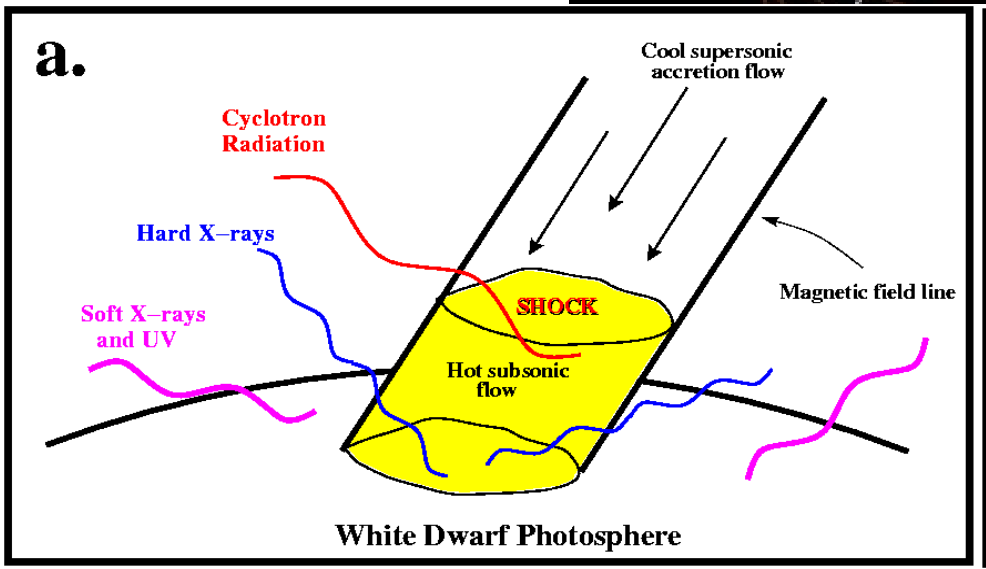


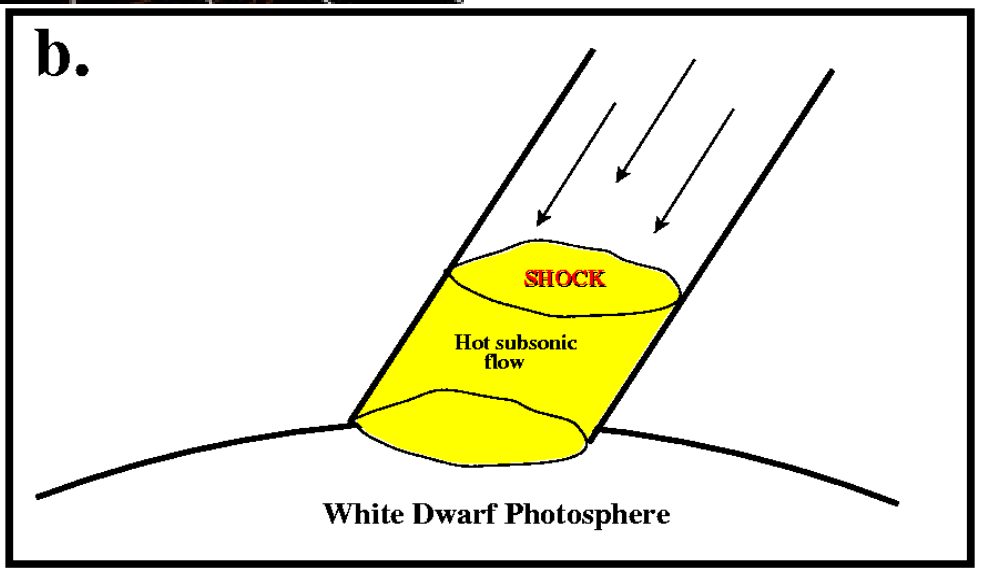


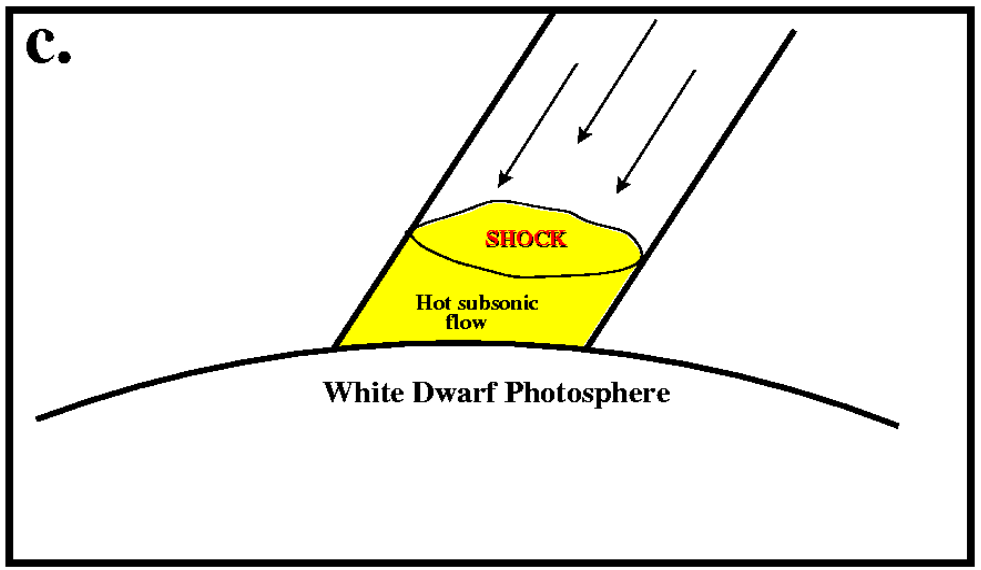


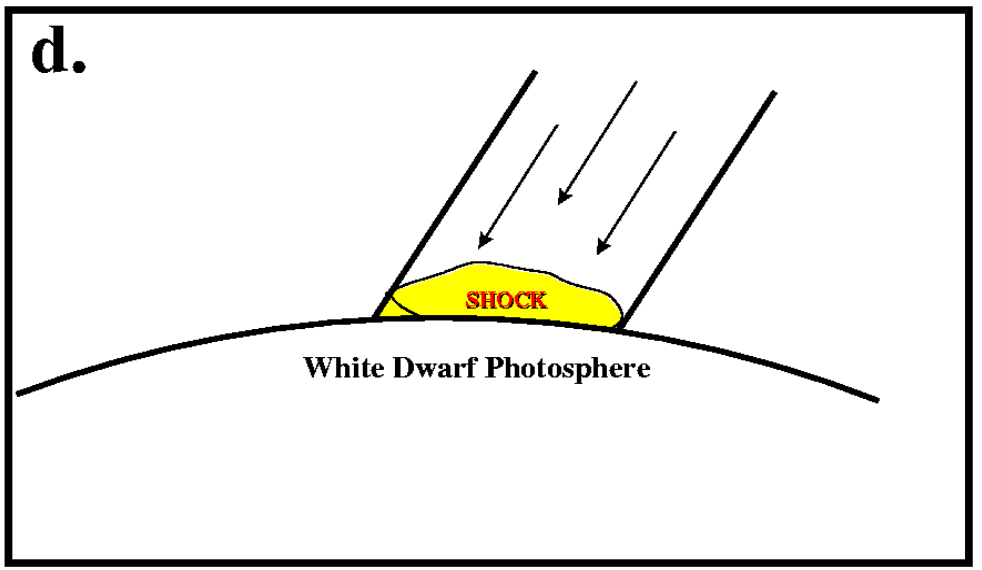
Allow testing of more realistic shock models with stratified temperature and density profiles dependent on parameters like:
White dwarf mass, accretion rate
magnetic field strength..




a.
Cool supersonic accretion flow
Cyclotron Radiation
Hard X–rays
Soft X–rays and UV
Magnetic field line
SHOCK
Hot subsonic flow
White Dwarf Photosphere


b.
SHOCK
Hot subsonic flow
White Dwarf Photosphere


c.
SHOCK
Hot subsonic flow
White Dwarf Photosphere


d.
SHOCK
White Dwarf Photosphere

The Other Telescopes

Telescopes include:

1.9m, 1.0m, 0.75m 0.5m, IRSF 1.4m, MONET 1.2m

Instruments include

UCTCCD
CASS Spectrograph
HIPPO
SIRIUS

Why?

Simultaneous: absolute photometry for SALTICAM and RSS photo-polarimetry

Monitoring: Outbursts
High/low states
Novae etc