

APPOL

AND THE QUEST FOR RHO

A photograph of an outdoor observatory setup on a tiled patio. Three large telescopes are mounted on tripods. The central telescope is a gold-colored Dobsonian on a silver tripod with a yellow seat. To its left is a black Dobsonian on a silver tripod. To its right is a black Dobsonian on a white tripod with a white storage box. A colorful rug is on the left, and a black table is in the background. The text "STARPHYSICS OBSERVATORY 2019" is overlaid in white.

STARPHYSICS OBSERVATORY
2019



Guider

C14
Imaging Photo Polarimeter

APPOL EAST PIER

C8 Photometric Imager #1


Guider

C14
Imaging Photo Polarimeter

C8 Photometric Imager #2

Wide Field Sky Camera

APPOL EAST PIER



C11
Imaging Photo Polarimeter

APPOL WEST PIER 2017

MULTIPOL

APPOL WEST PIER



WHAT IS MULTIPOL?

*AN ALTERNATIVE TO DICHOIC COLOR SEPARATION
FOR THE MEASUREMENT OF DELTA THETA*

- **Ultralow Resolution Spectropolarimeter $R \sim 5 \text{ \AA}/\text{Pixel}$**
- **Very High Efficiency $\sim 50\text{-}60\%$ net of grating and camera**
- **Full VIS Spectrum to 425-750nm (waveplate limits)**
- **Direct imaging (slitless) spectroscopy with field rotation to manage starfield conflicts**
- **Long duration exposures using on axis guiding**
- **A work in progress!**

MULTIPOL LIGHTPATH

Innovations Foresight™ Beamsplitter

FILTERS

90+% Visible Light 370-750nm reflected to
Narrow Field ST7 Spectropolarimeter
and
90+% 770nm NIR Transmitted to ST10 guider

C14

Waveplate Rotator

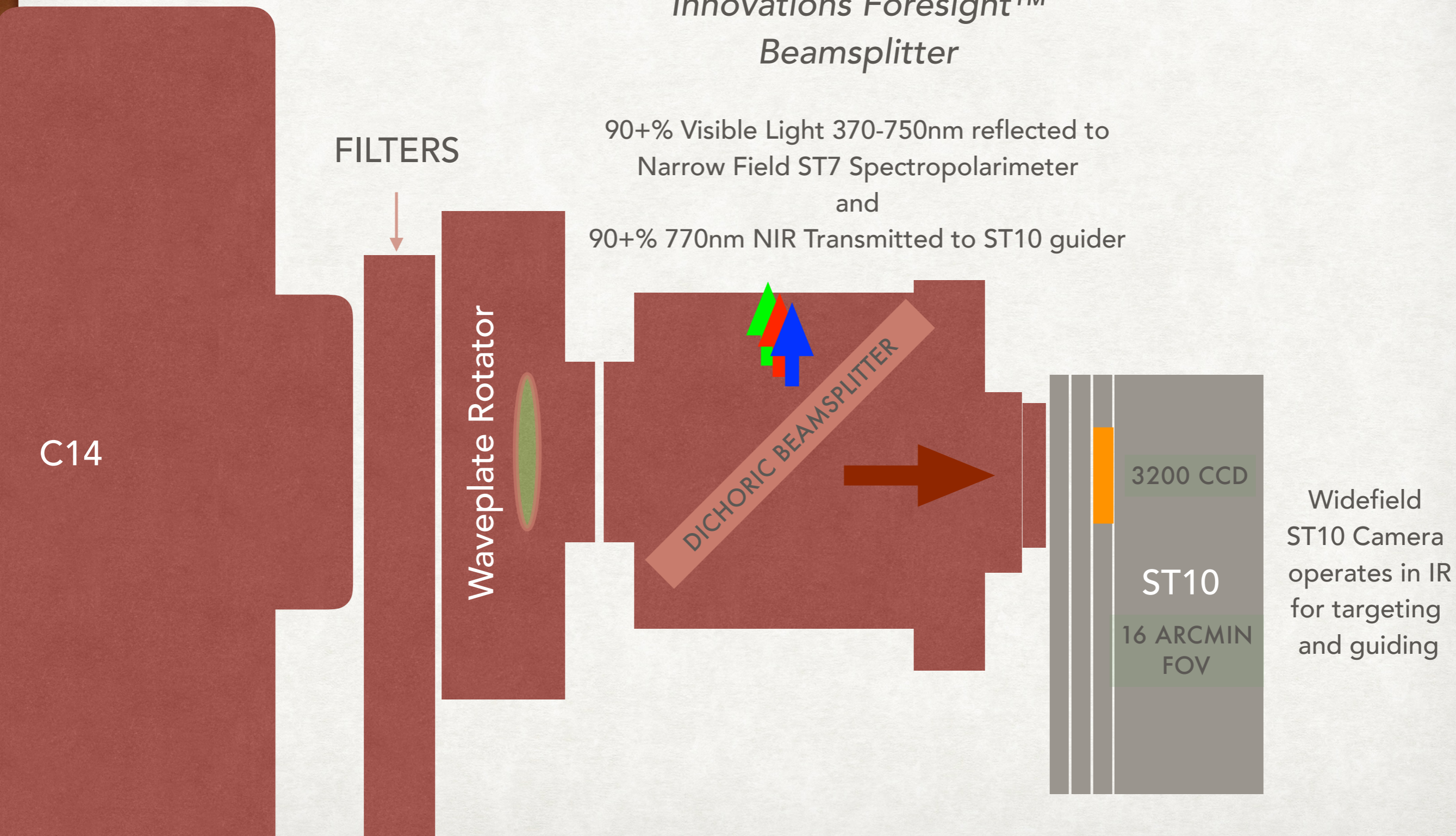
DICHORIC BEAMSPLITTER

3200 CCD

ST10

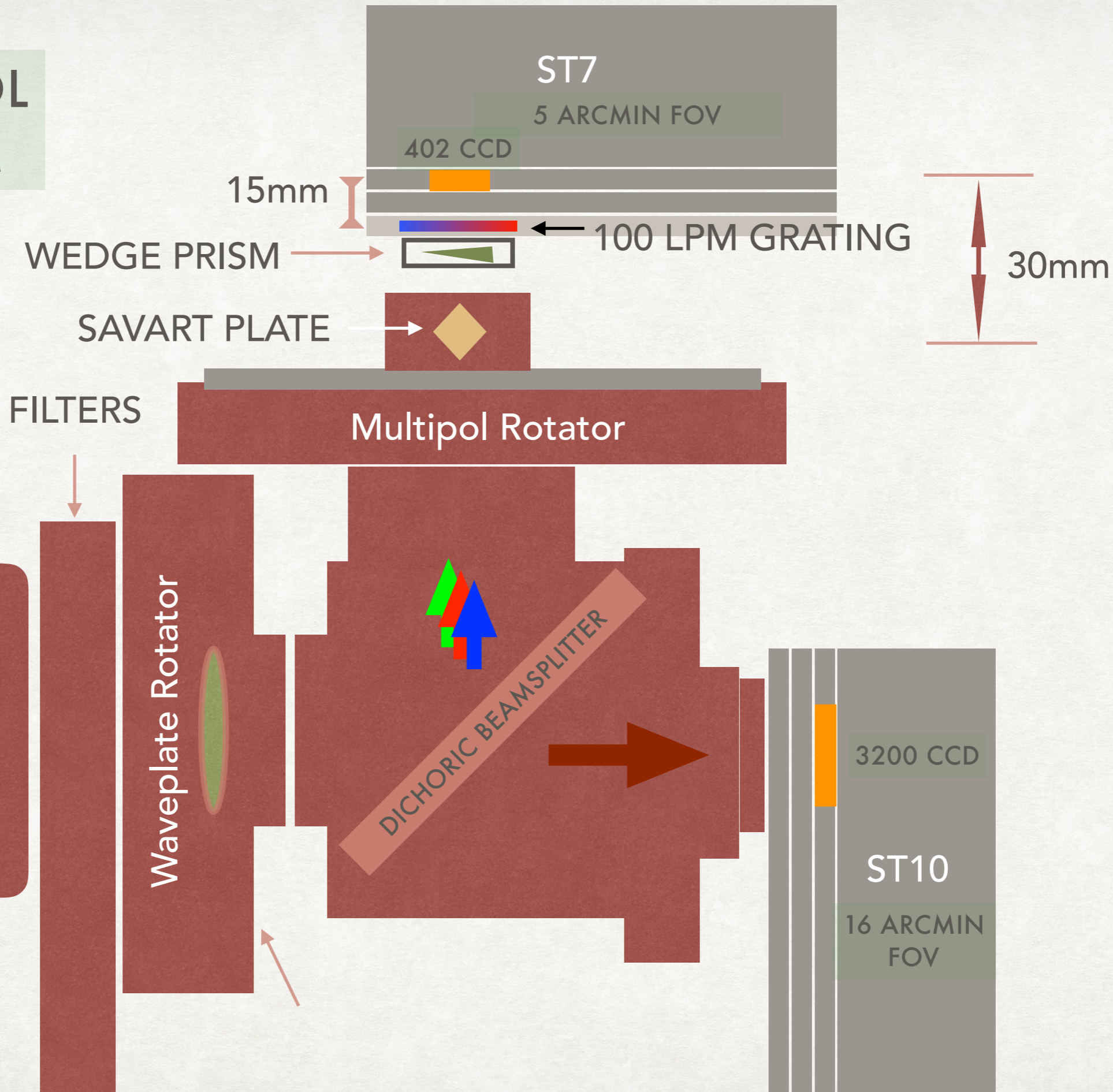
16 ARCMIN
FOV

Widefield
ST10 Camera
operates in IR
for targeting
and guiding



MULTIPOL SYSTEM

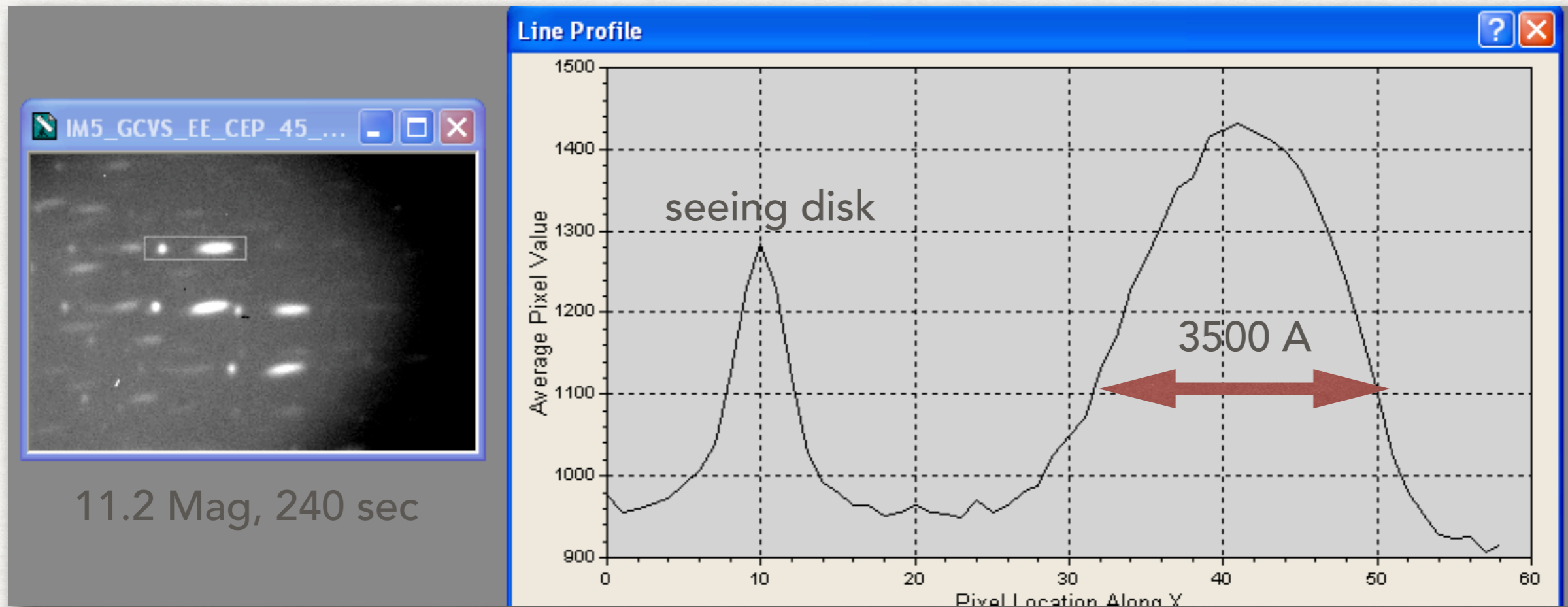
C14



MULTIPOLE IMPLEMENTATION



MULTIPOL FIRST LIGHT

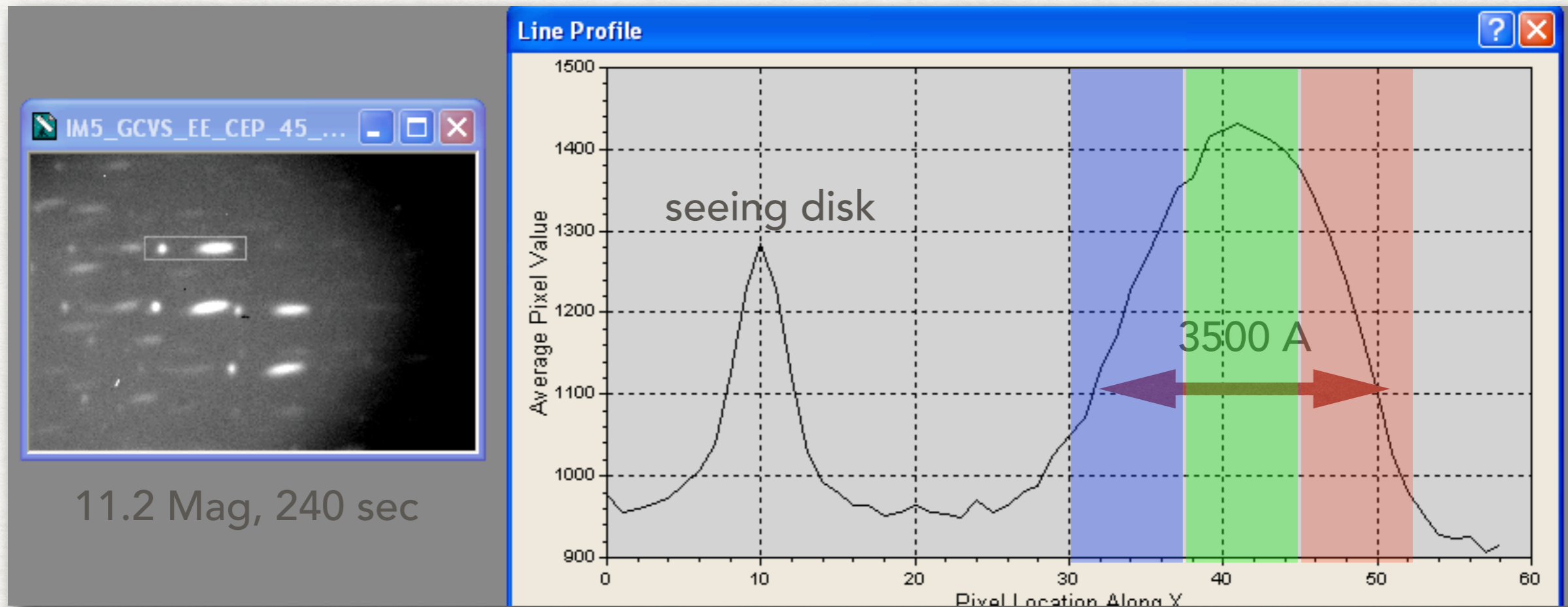


Bin X3, 1.5 arc sec/pixel, 62.5*3 Ang/Pixel

UNFILTERED SPECTRUM

REQUIRES EXCELLENT SAVART ALIGNMENT FOR EXTRACTION
AND SPECTROPOLARIMETRIC REDUCTION

MULTIPOL FIRST LIGHT

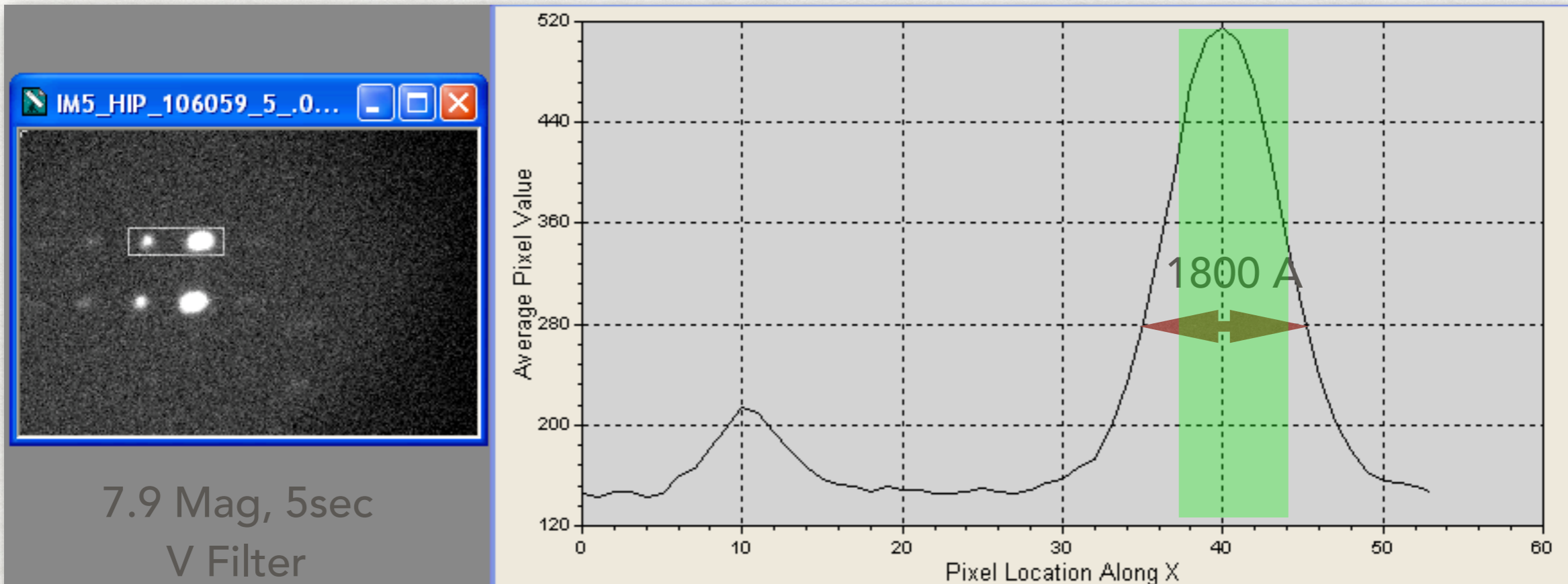


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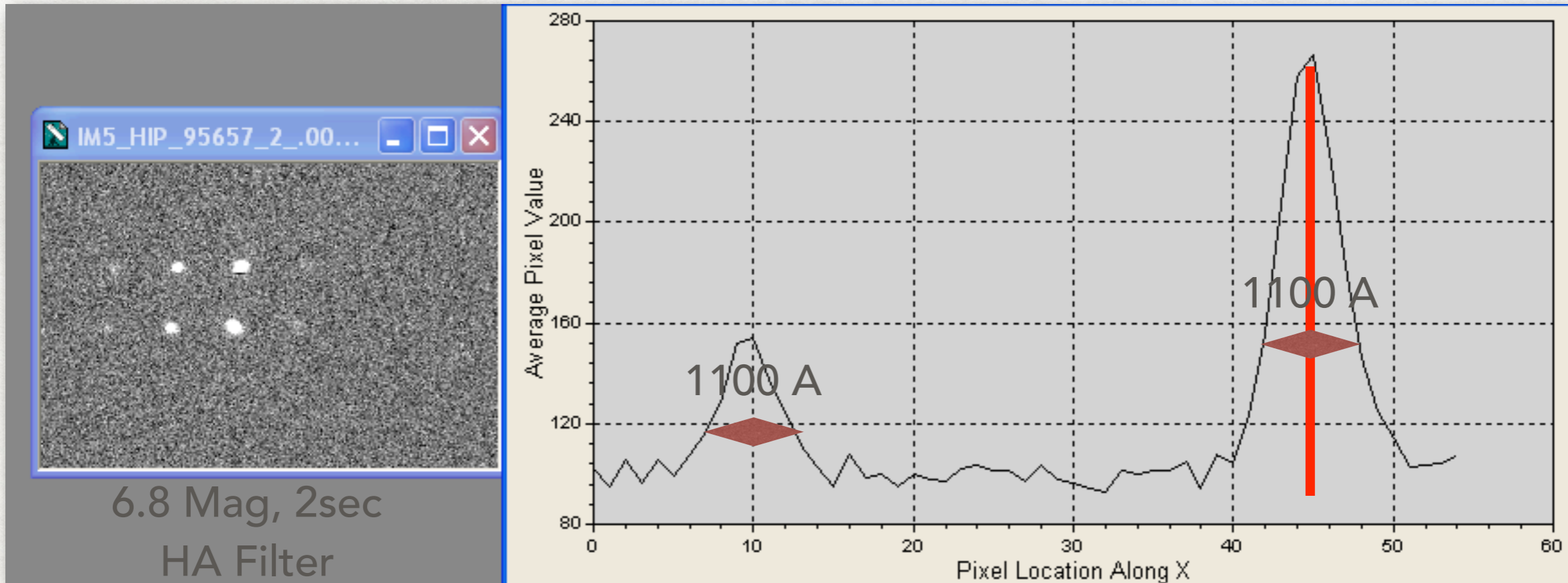
MULTIPOL FIRST LIGHT



Johnson V Band FILTERED SPECTRUM

BLOBBY STARS ALLOW STANDARD PHOTOMETRIC EXTRACTION
AND POLARIMETRIC REDUCTION

MULTIPOL FIRST LIGHT



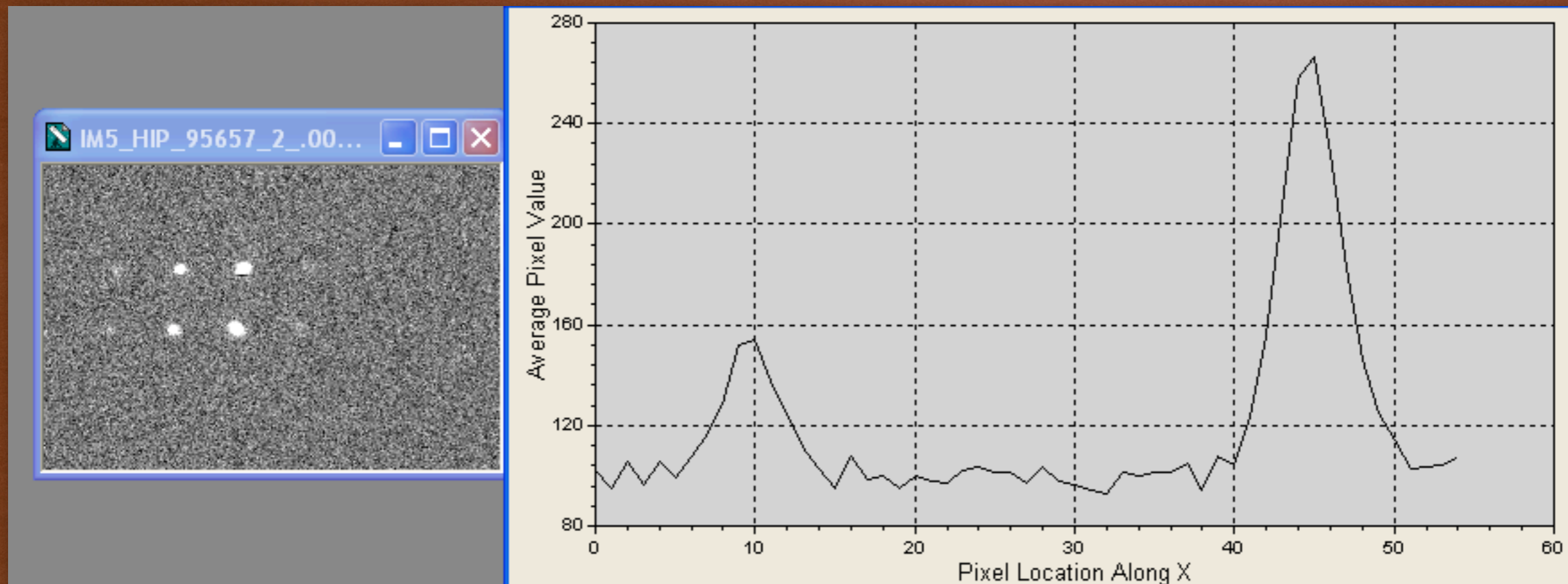
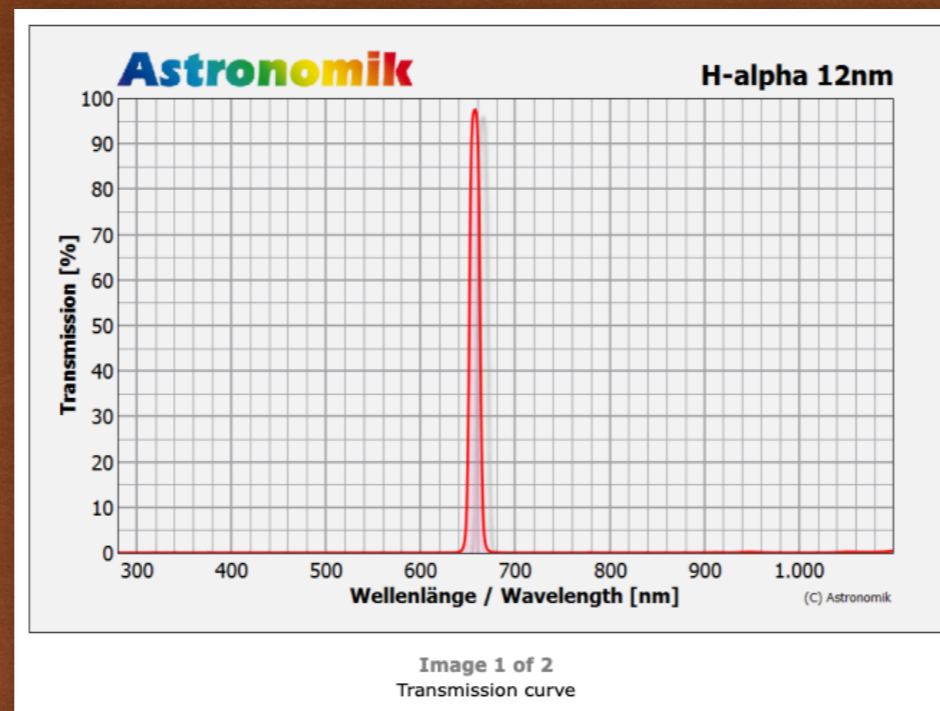
Effective resolution $R \sim 5$

8.5 nm Ha FILTER

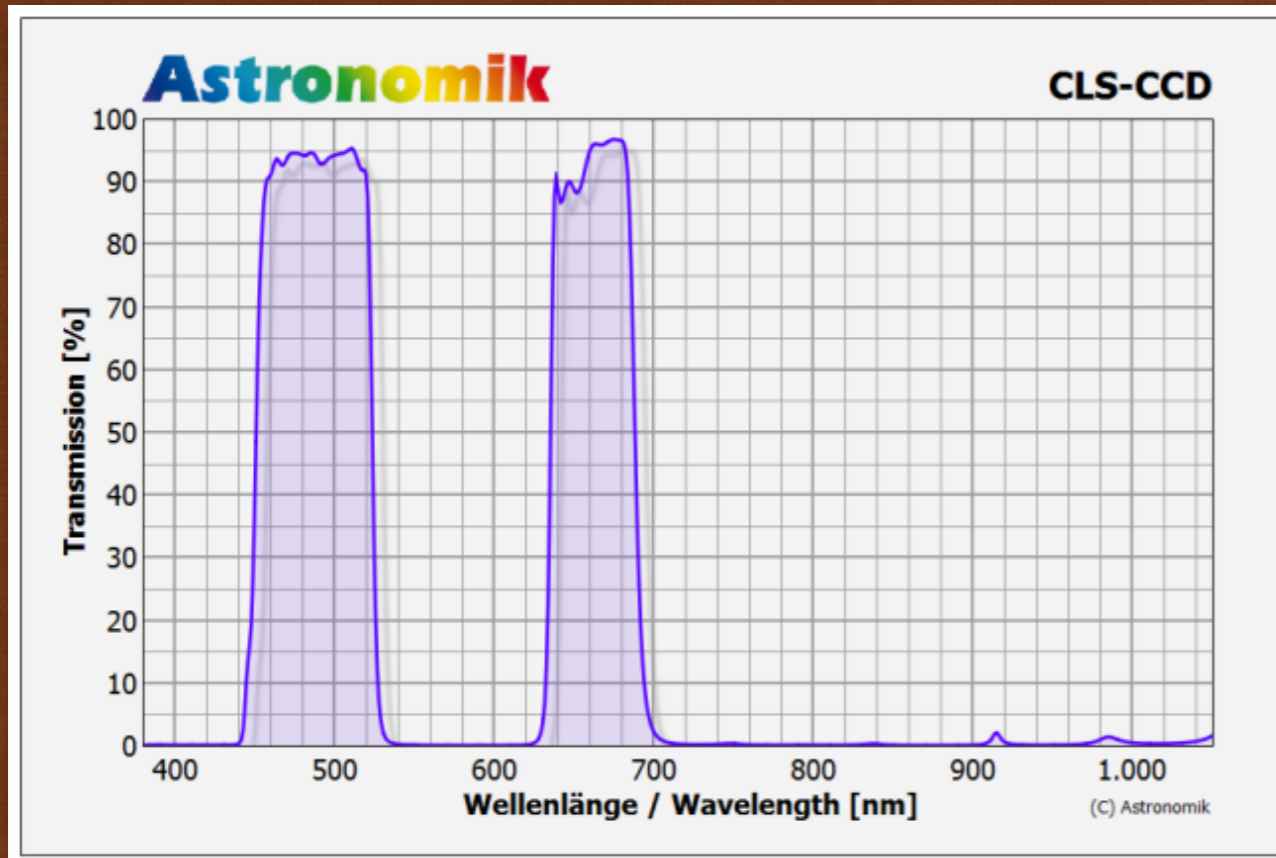
SHOWS EFFECTIVE SIZE OF STAR IMAGE

Could be reduced by moving grating or adding focal reducer

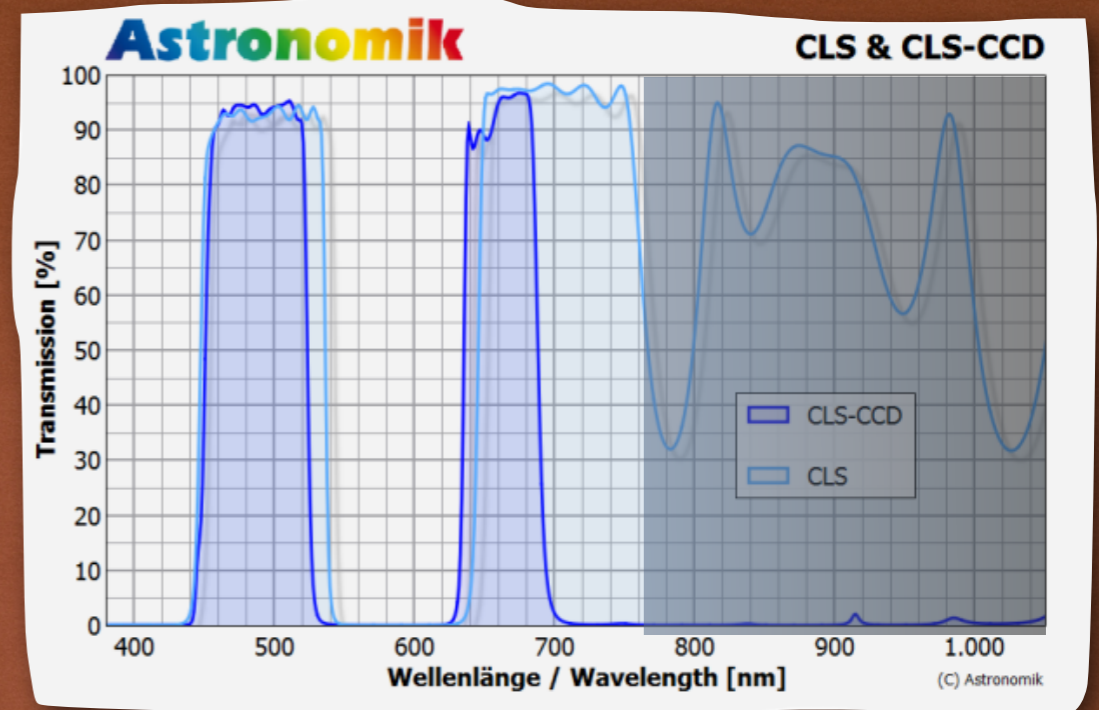
BANDPASS FILTERS CREATE DISTINCT STAR IMAGES and very easy polarimetry...



HOW ABOUT HAVING TWO BANDS IN THE SAME IMAGE? USING OFF THE SHELF LIGHT POLLUTION FILTERS

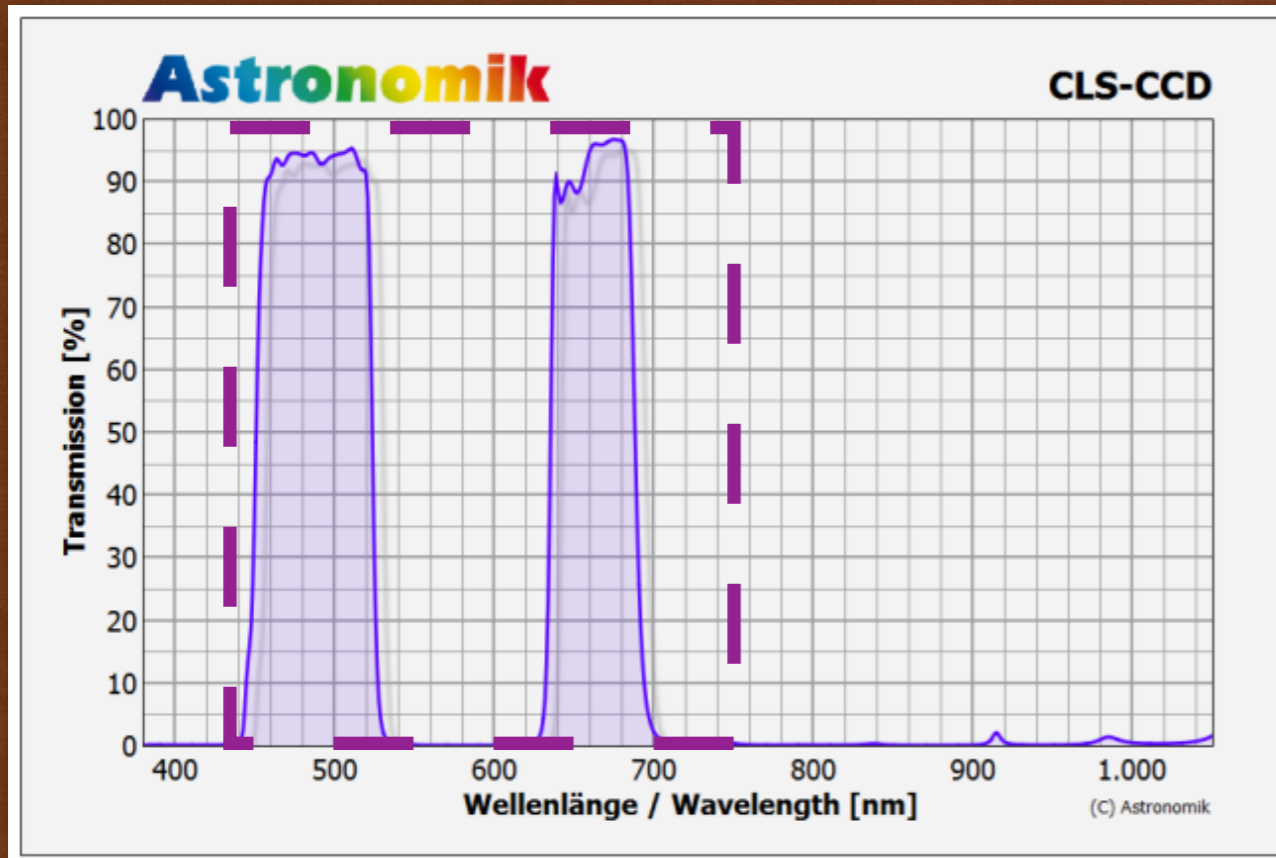


480nm and 670 nm
Band Centers
70 & 60 nm Bandwidths

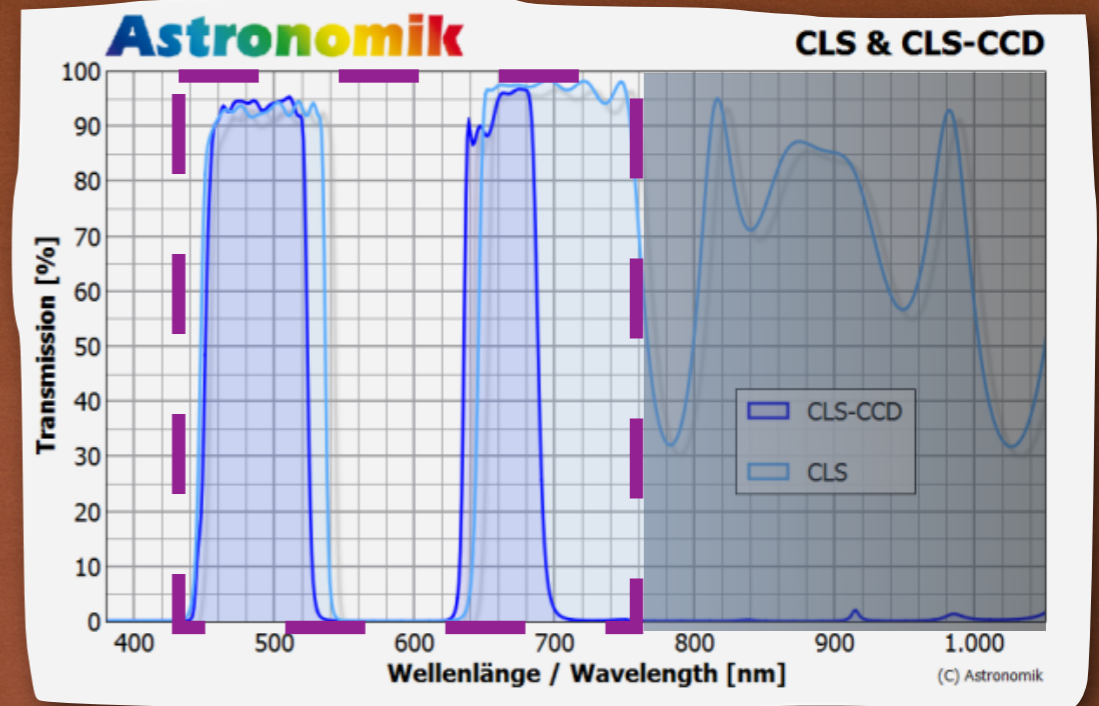


480nm and 700 nm
Band Centers
80nm & 170nm Bandwidths

HOW ABOUT HAVING TWO BANDS IN THE SAME IMAGE? THAT FALL PERFECTLY INTO THE RANGE OF THE WAVEPLATE

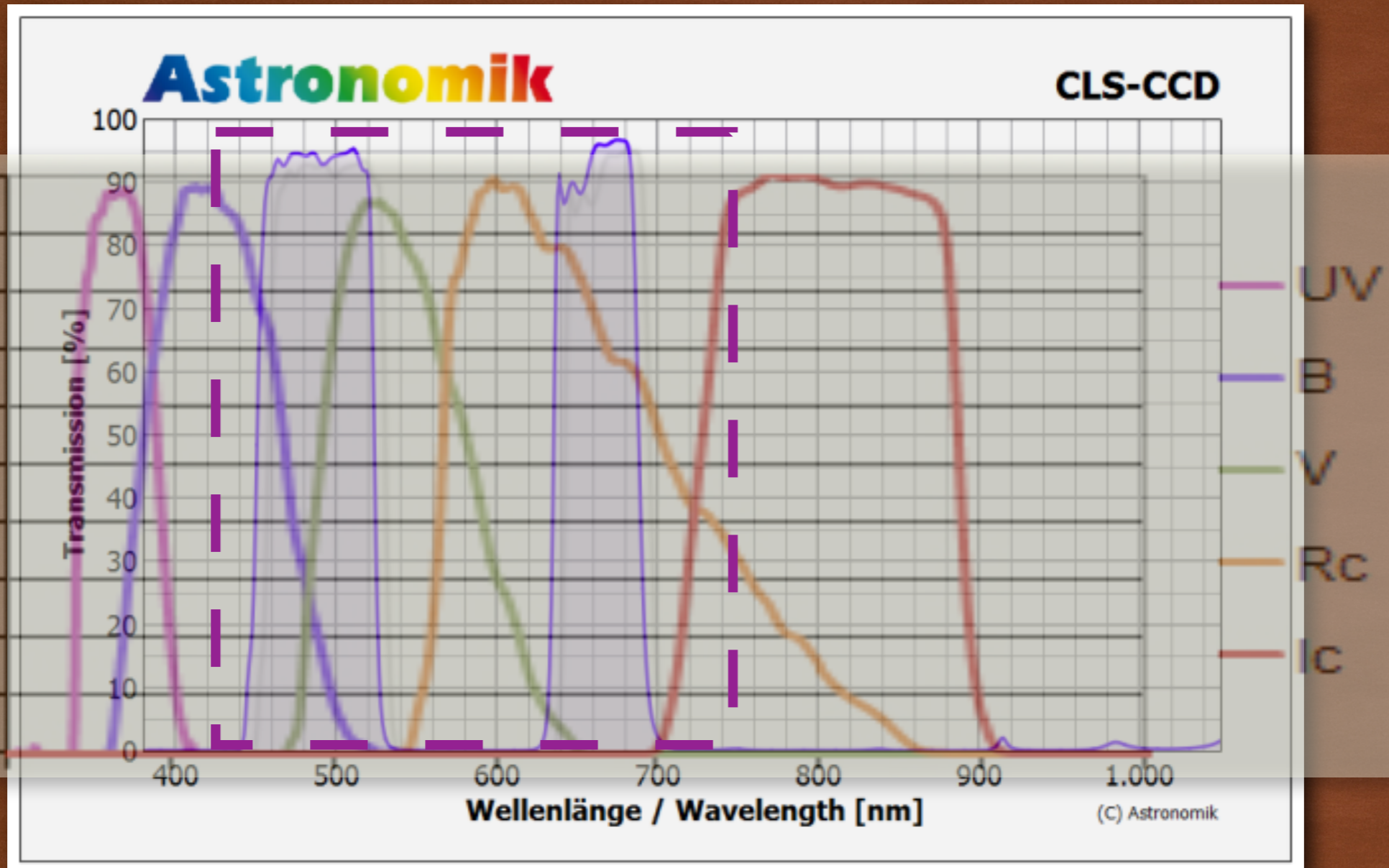


480nm and 670 nm
Band Centers
70 & 60 nm Bandwidths

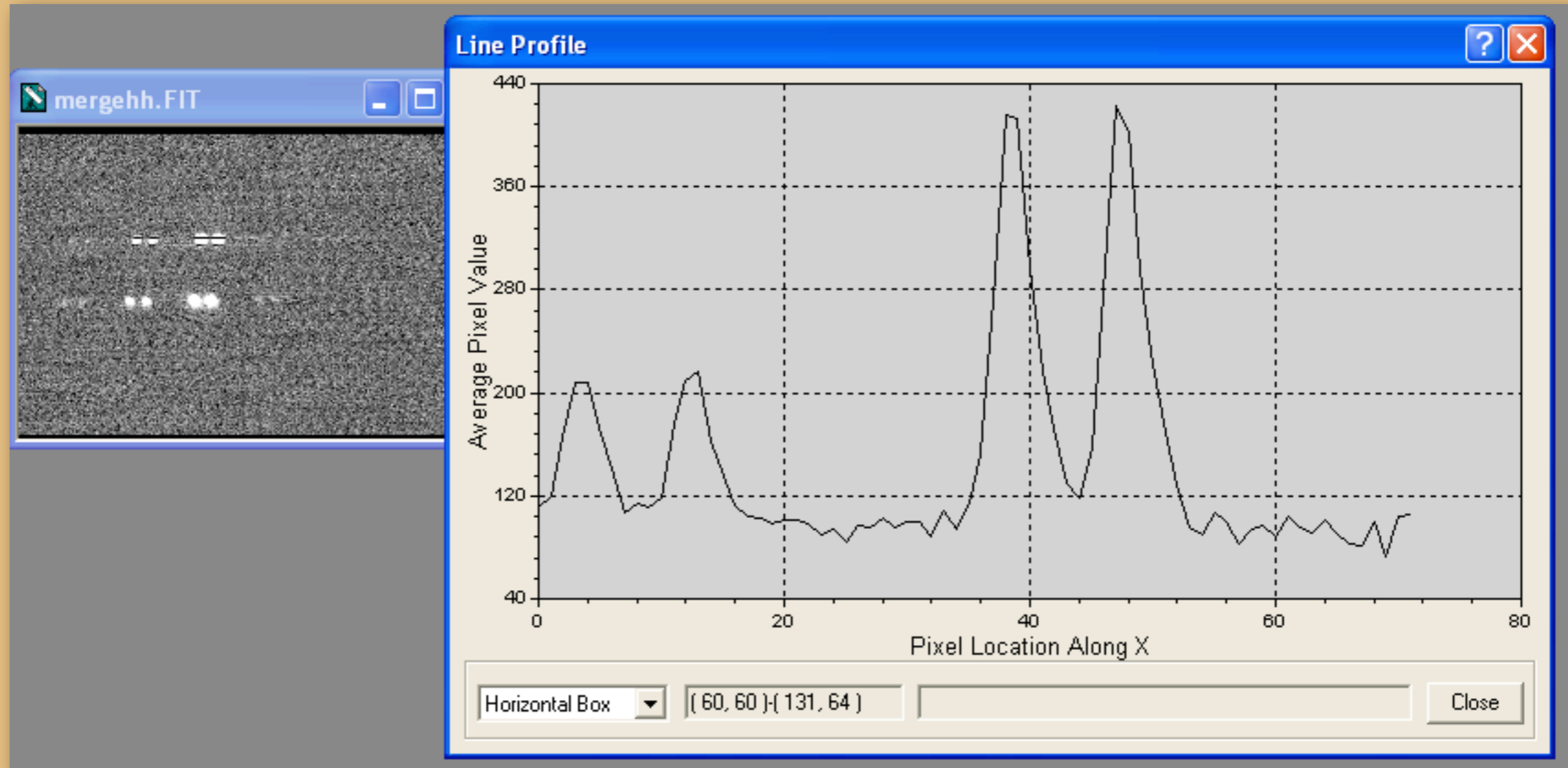


480nm and 700 nm
Band Centers
80nm & 170nm Bandwidths

Astronomik CLS vs JC Bands and Waveplate Limits



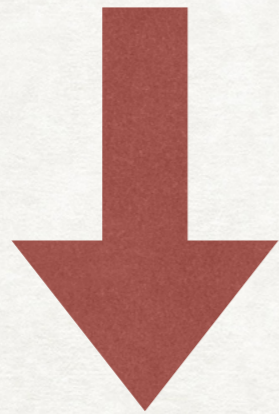
MULTIPOLE WITH DUAL BAND FILTER SIMULATED FILTER IMAGE



MULTIPOLE EVOLUTION

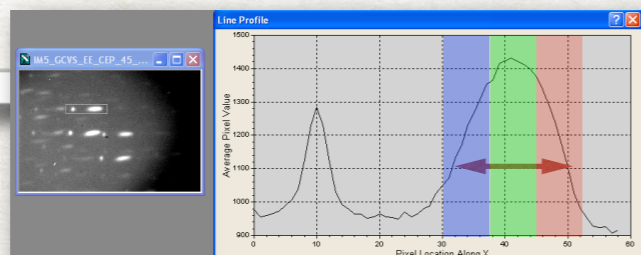


MULTIPOLE EVOLUTION

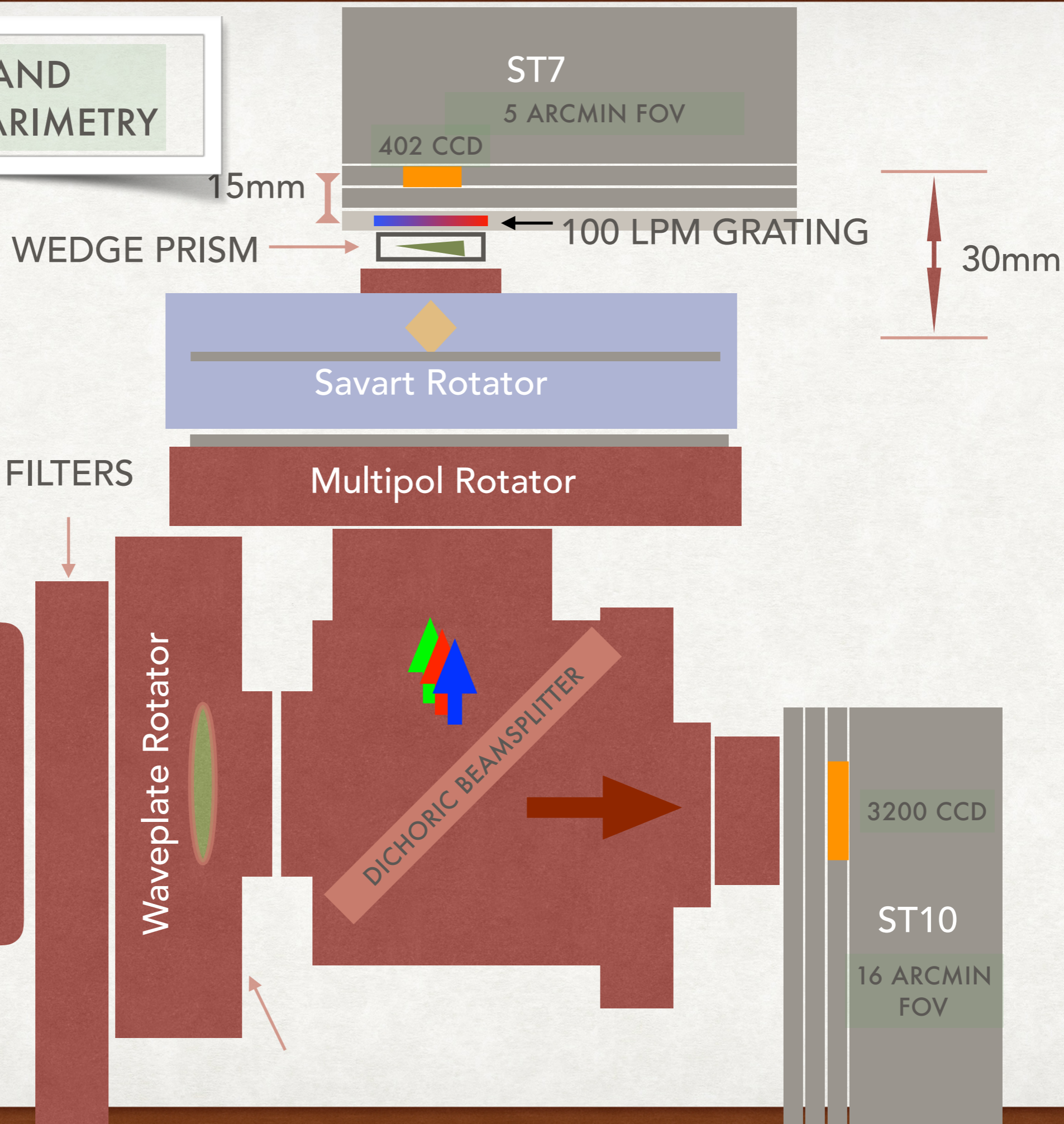


BROADBAND SPECTROPOLARIMETRY

- *Potential Three Color Data
- *Complex Alignment and Reduction

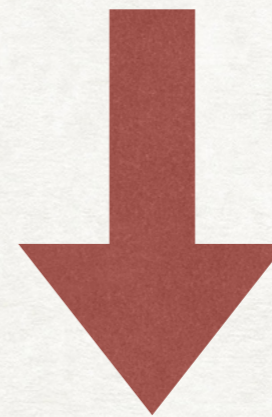


BROADBAND
SPECTROPOLARIMETRY



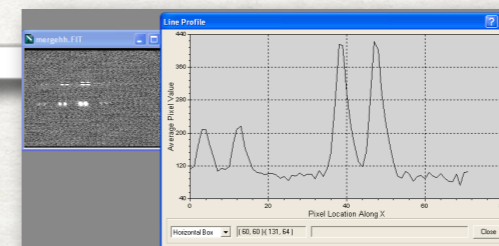
C14

MULTIPOLE EVOLUTION

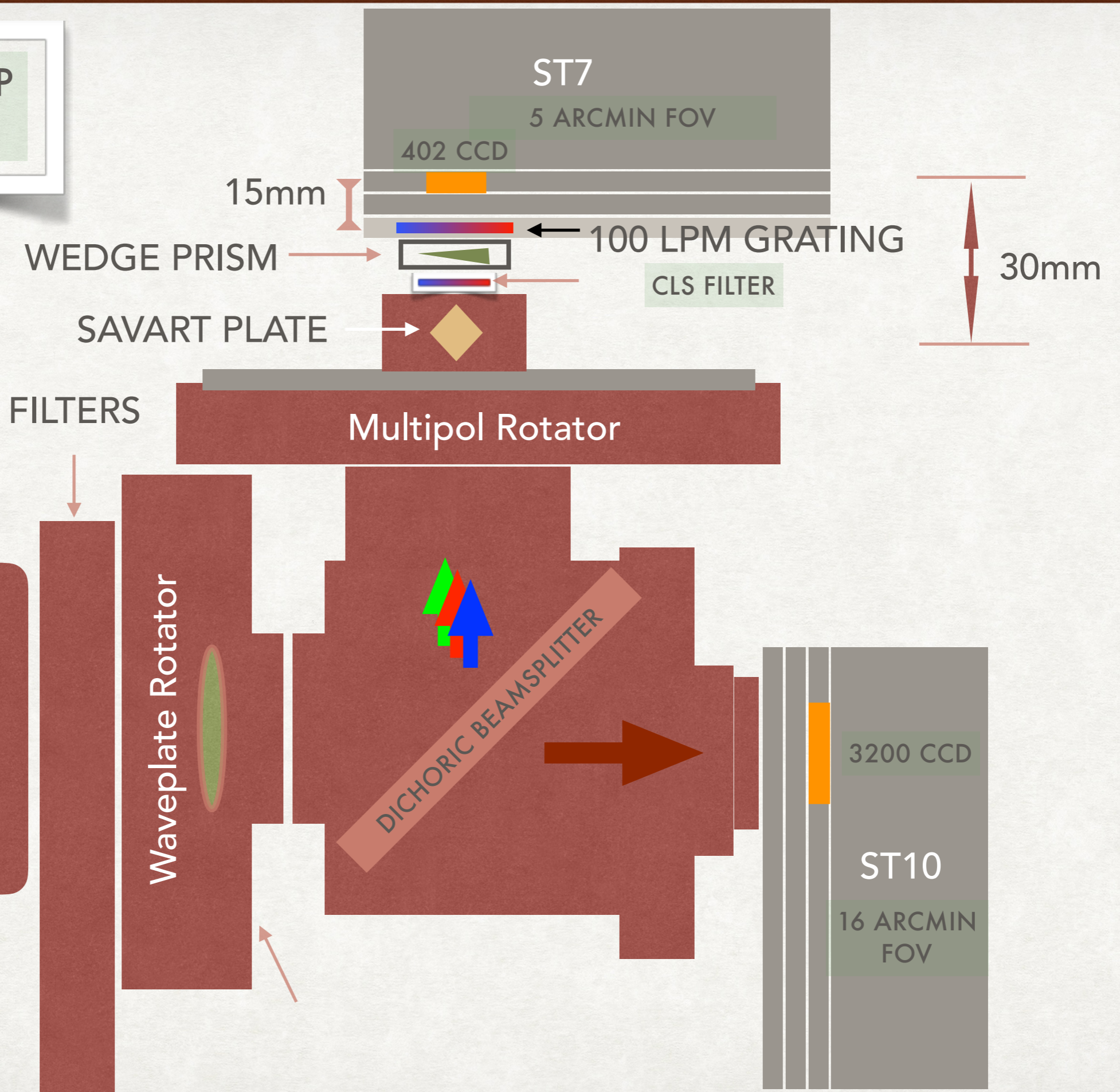


DUAL BAND SPECTRO- PHOTO-POLARIMETRY

- ✱ Two Color Data
- ✱ Easy Alignment and Reduction
- ✱ 3x reduction in sky background!



MULTIPOL SPP
(A)



MULTIPOL SPP
(B)



FILTERS

Multipol Rotator

Filter Selector

CLS FILTER

C14

Waveplate Rotator

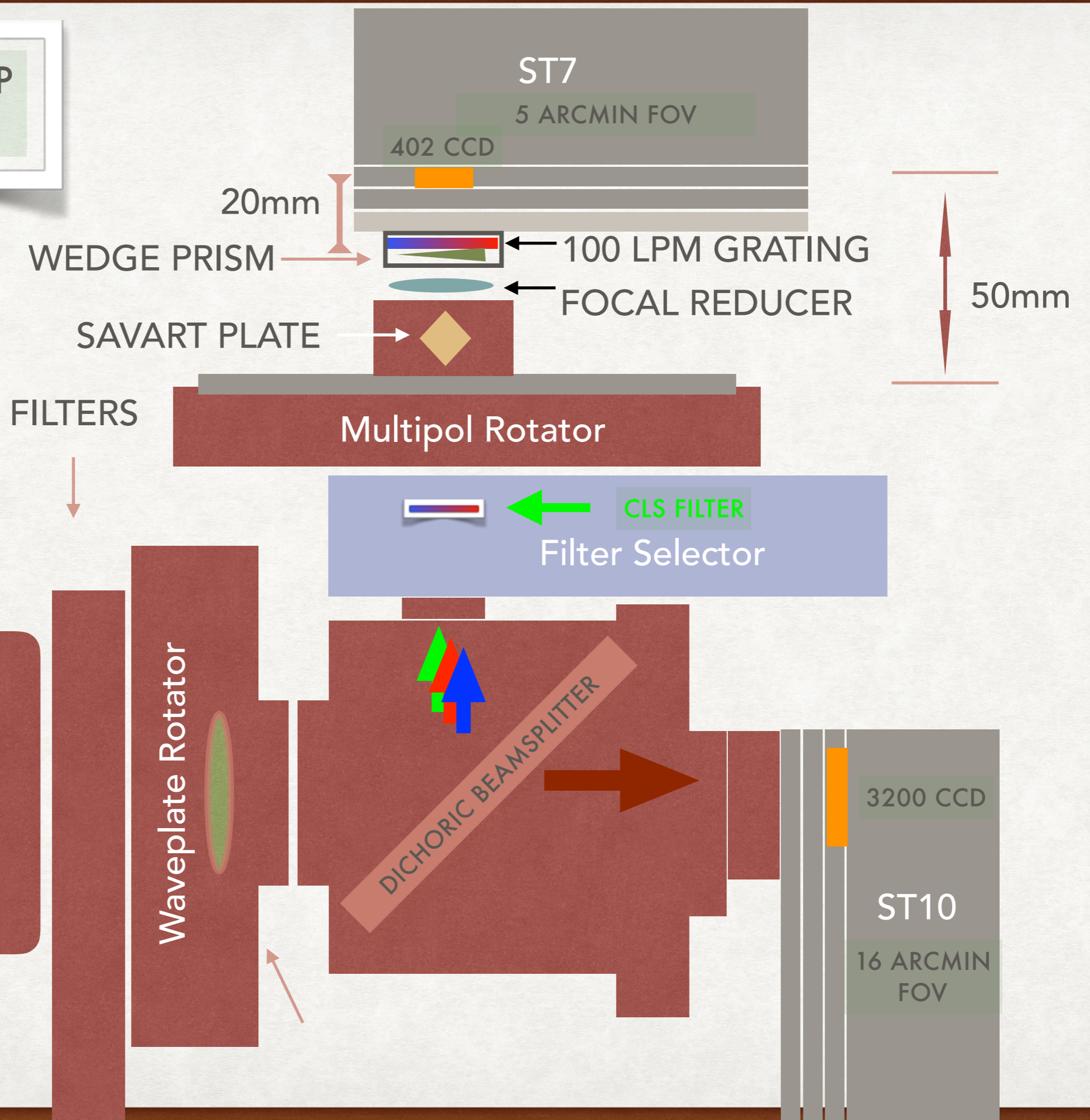
DICHORIC BEAMSPLITTER

3200 CCD

ST10

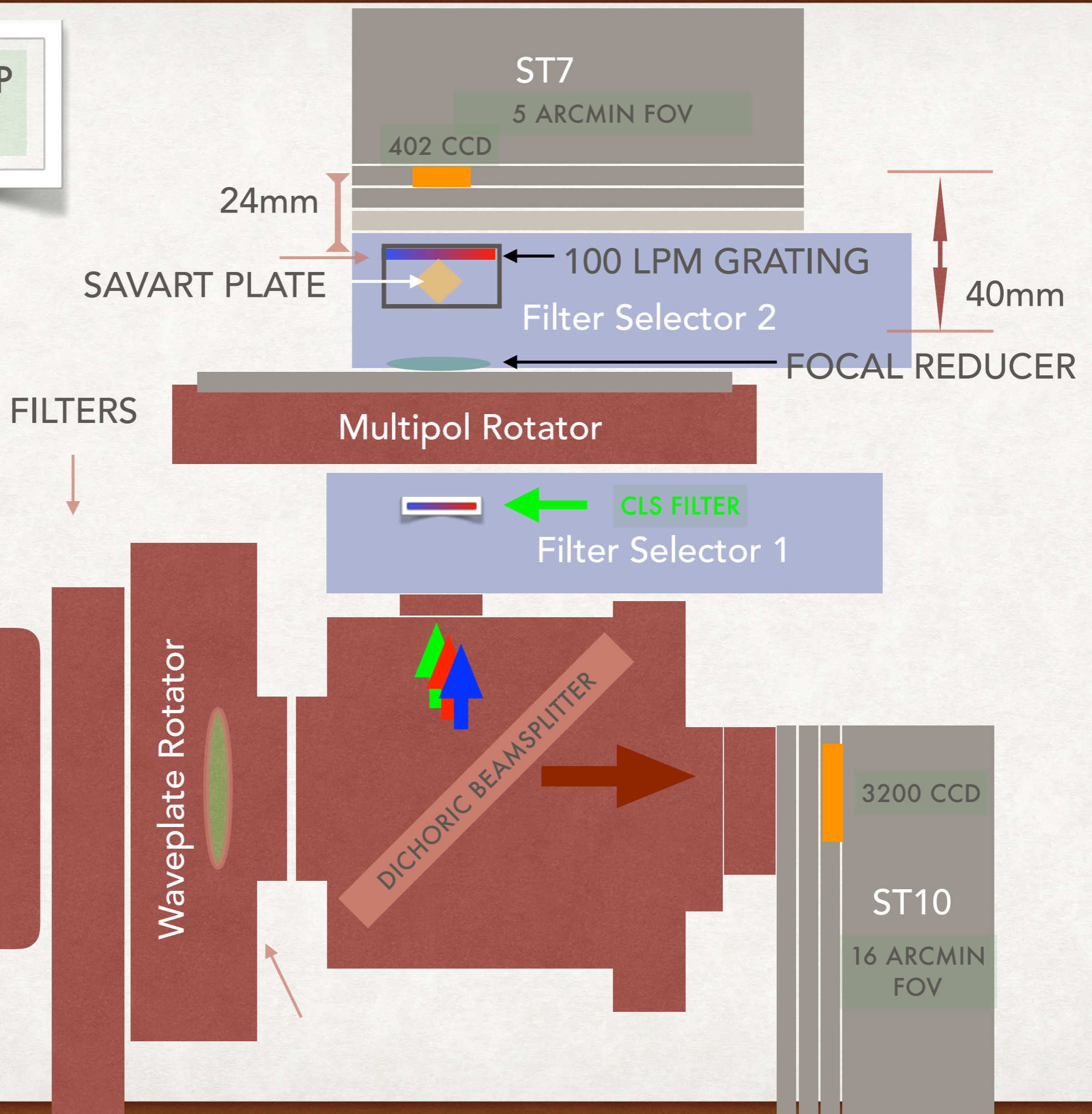
16 ARCMIN
FOV

MULTIPOL SPP
(C)



C14

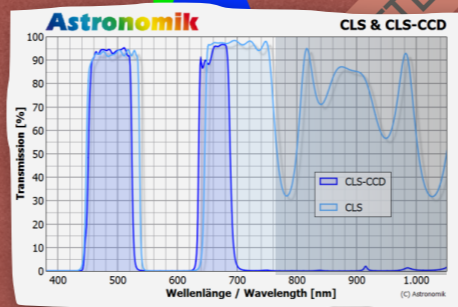
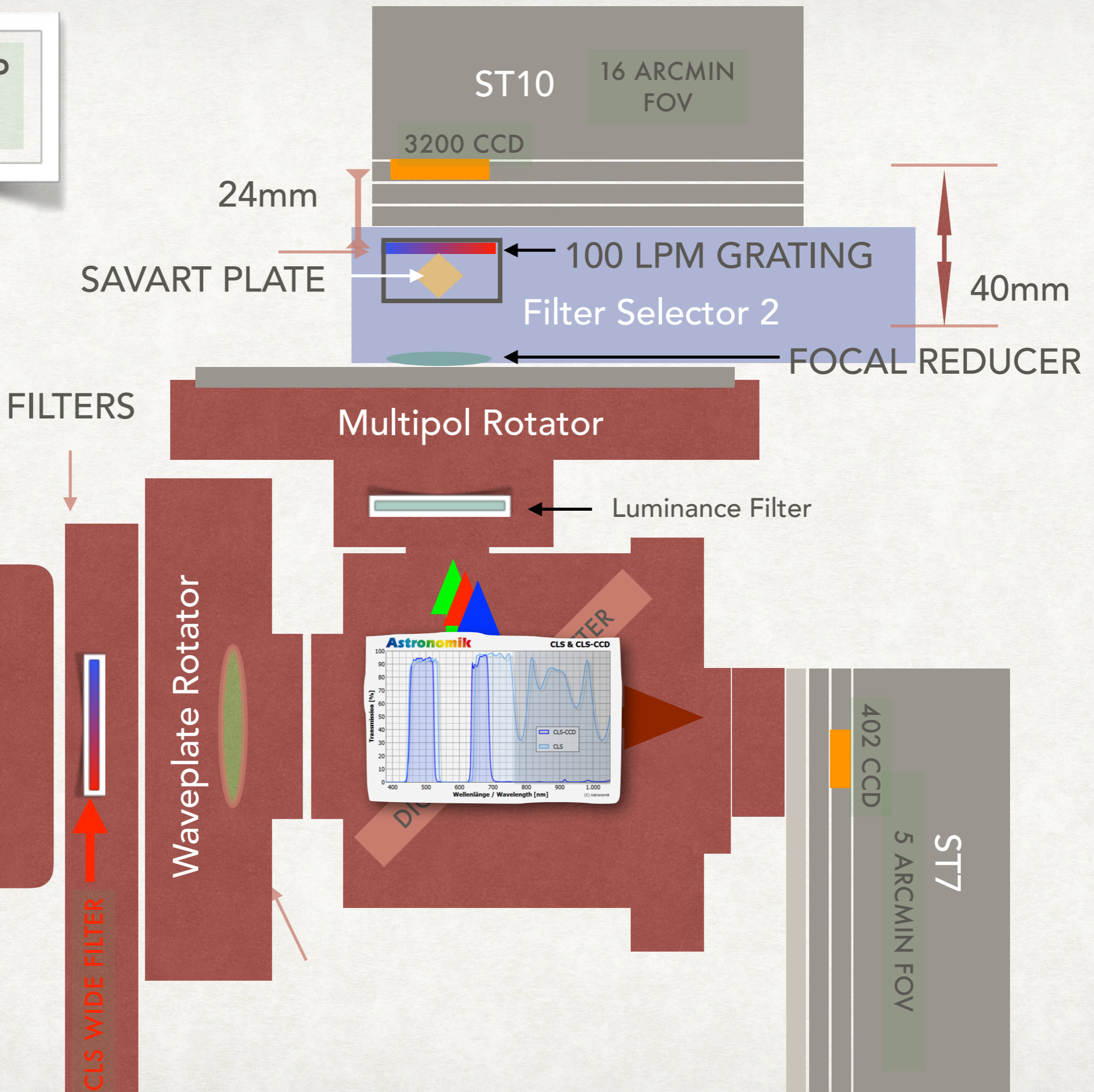
MULTIPOL SPP
(D)



C14

MULTIPOL SPP
(E)

C14



MULTIPOLE EVOLUTION



NOW

DUAL BAND SPECTRO- PHOTO-POLARIMETRY

- * Two Color Data
- * Easy Alignment and Reduction
- * 3x reduction in sky background!

MAYBE LATER

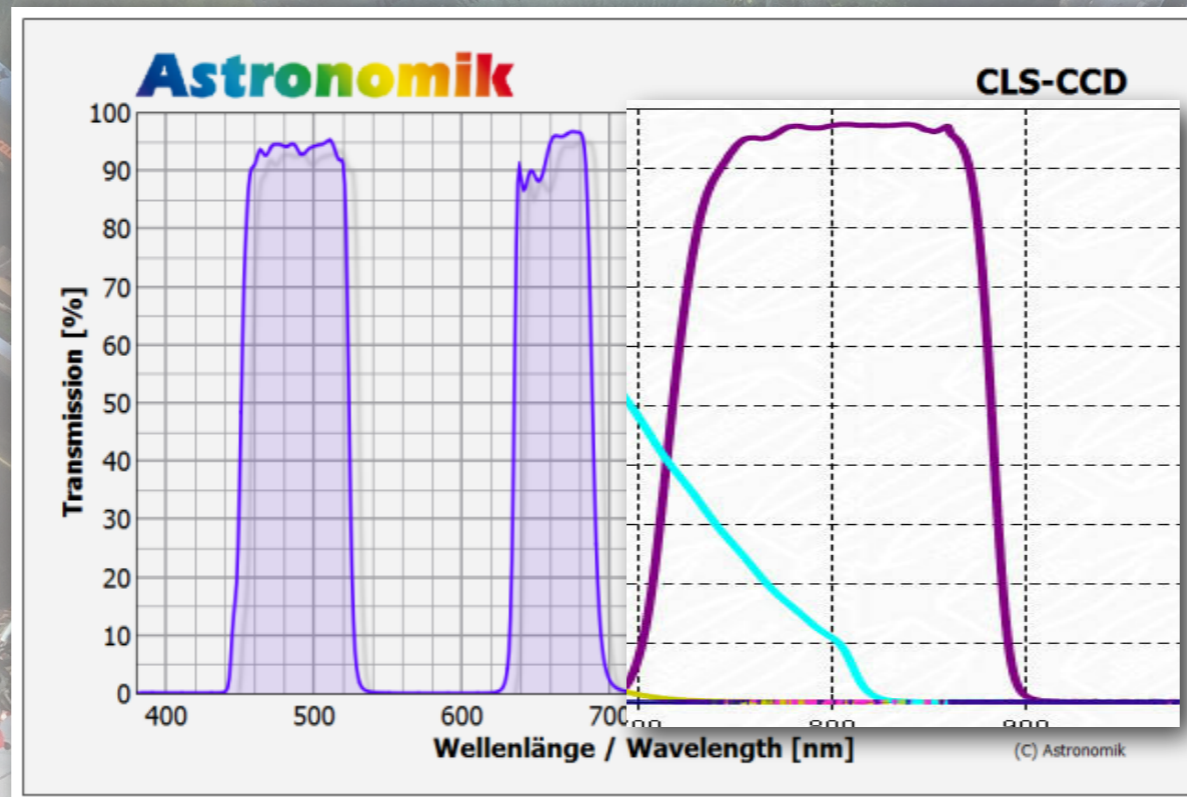
BROADBAND SPECTROPOLARIMETRY

- * Potential Three Color Data
- * Complex Alignment and Reduction

PROPOSED 2019 APPOL OPERATION

3 BAND (460-680-800) POLARIMETRY
WITH 2 BAND (L&I') PHOTOMETRY

USING 2,4 OR 8 MINUTE CADENCE AS REQUIRED



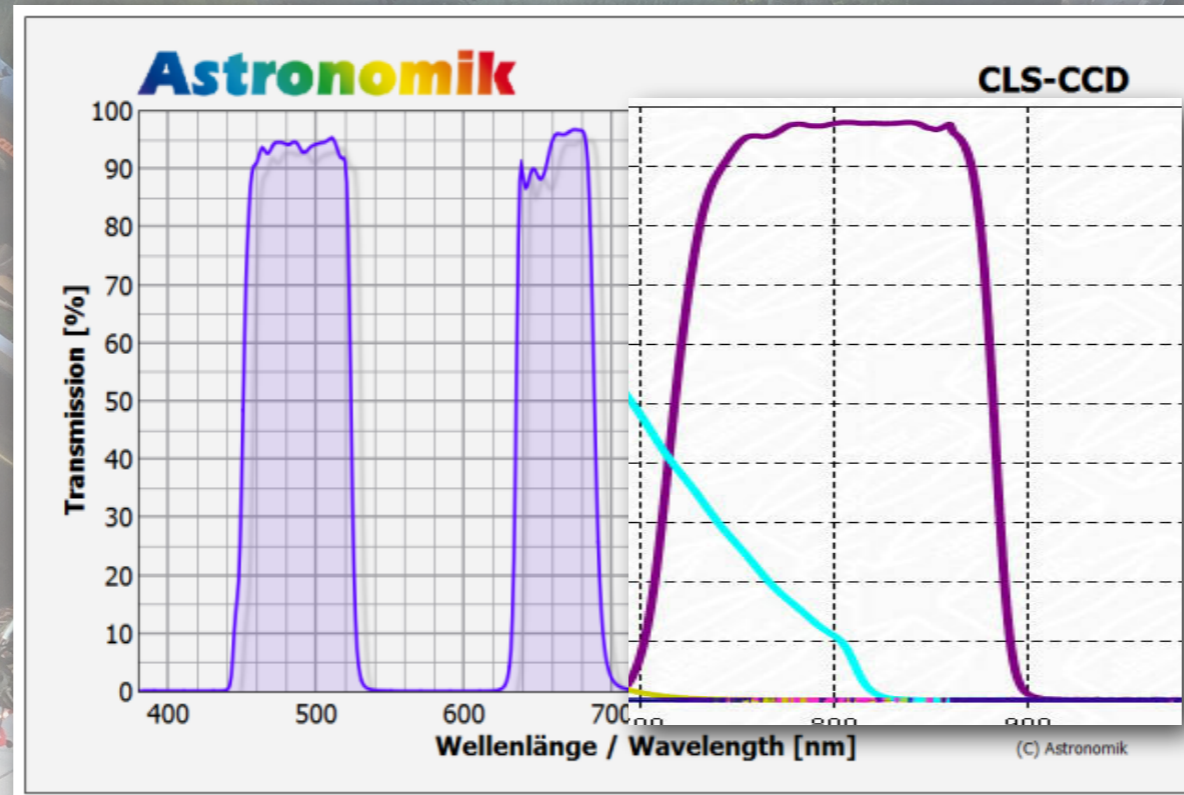
MULTIPOL SPP

I POL

PROPOSED 2019 APPOL OPERATION

3 BAND (460-680-800) POLARIMETRY
WITH 2 BAND (L&I') PHOTOMETRY

USING 2,4 OR 8 MINUTE CADENCE AS REQUIRED



IS THERE ANYTHING YOU WANT TO OBSERVE?

THANK YOU.