The Broad Band Imager for the European Solar Telescope

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SCIENCE PROGRAMS

- Chromospheric response to convective collapse
- Internal structure of magnetic elements
- Fields in granular convection
- Flux cancellations
- Internetwork fields
- Polar magnetic fields
- Network element dynamics
- Highly variable phenomena in the chromosphere
- Sunspots
- Flares

REQUIREMENTS

Operational Wavelengths	See filter list
Number of spectral channels	3 channels working simultaneously
Observation modes	– Optimum spatial resolution – Maximum field of view
Maximum Field of View	2'x2'
Angular Resolution	– 0.04" @ 500 nm (goal of 0.03") – Optimum on a 60"x60" Field of View
Mosaic Mode	3'x3' mosaic mode at optimal resolution (60"x60" patches)
Wavelength Coverage	From 390 nm to 900 nm
Wavelength Bandpass	See filters specifications
Wavelength Switching	< 2 seconds
Maximum bandpass shift	5×10^{-3}nm (goal 3×10^{-3}) @ 500nm, 30" from the field center
Transmission	Total throughput > 30%

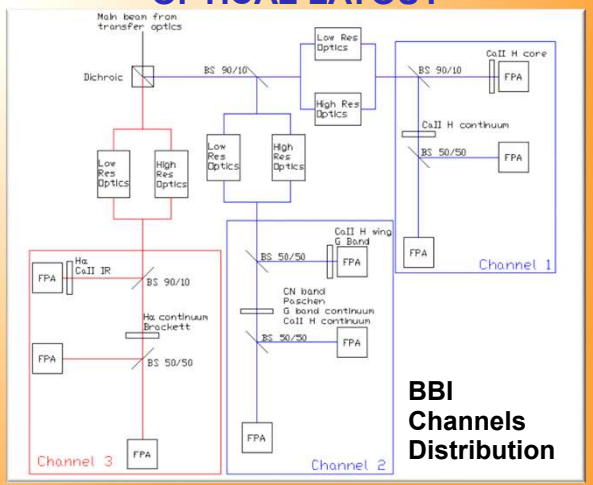
FILTERS

- Bandwidths between 0.05 and 0.5 nm
- Sizes from 5 to 10 cm
- Telecentric configuration
- Interference, Lyot, Etalon filters.
- Optical quality at least $\lambda/10$
- Homogeneous transmittance
- Maximum transmittance → Best effort basis

Filter Name	λ_C [nm]	FWHM [nm]	Spectral Feature
BBI-WF1	388.30	0.5	CN band head
BBI-WF2	395.37	0.5	Ca II H continuum
BBI-NF1	396.88	0.05	Ca II H core
BBI-NF2	396.47	0.05	Ca II H wing
BBI-WF3	417.00	0.5	Paschen continuum
BBI-WF4	430.50	0.5	G band
BBI-WF5	436.39	0.5	G band continuum
BBI-NF3	656.28	0.1	Hα
BBI-WF6	668.40	0.5	Hα continuum
BBI-WF7	840.00	0.5	Brackett continuum
BBI-NF4	854.20	0.05	Ca II IR

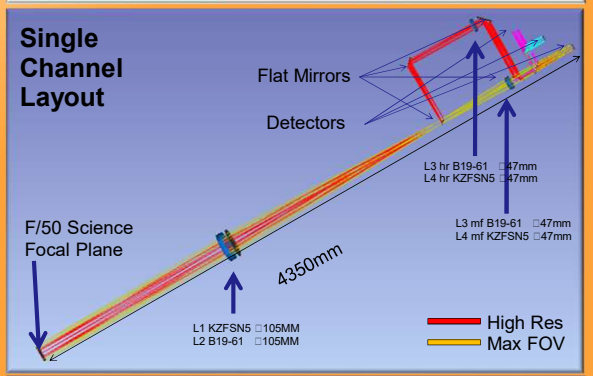
- ✓ Imaging instrument to obtain high resolution images over the full Field of View of EST (diffraction limited in 1'x1' patches) at multiple wavelengths and high frame rate.
- ✓ After evaluation of all refractive and reflective/refractive designs, an all refractive design has been chosen on the basis of performances and simplicity.
- ✓ Two Arms completely independent → A **Blue Arm** (for filters in the 380nm – 500nm range) and a **Red Arm** (for filters in the 600nm – 900nm range). Each arm will optimize optical performances and throughput through appropriate choice of optics, coatings and detectors.
- ✓ The **Blue Arm** → two channels each divided in three sub–channels.
- ✓ The **Red Arm** → one channel divided in three sub–channels.
- ✓ Each channel has two alternative observing modes → An High Resolution mode and a Maximum Field of View mode.
- ✓ At the moment all three channels share the same design: a four elements optical relay. Switching between the two modes is obtained using movable flat mirrors.
- ✓ The three sub–channels of each channel share the same optics → See the same aberrations
- ✓ CCD and CMOS detector s are being evaluated as default detectors for the BBI instrument
- ✓ Out of the three sub–channels of each channel, a first one hosts narrow band filters for chromospheric observations, a second one hosts in focus wide band filters used as reference for speckle reconstruction and photospheric observations and the third one hosts out of focus wide band filters for phase diversity reconstruction of photospheric observations.

OPTICAL LAYOUT



BBI Channels Distribution

Single Channel Layout



http://www.est-east.eu

PERFORMANCES

High Resolution Mode

- Sampling → 0.016"/pix
- Detector format → 4k x 4k
- Pixel size → 10 microns
- FoV → 64" x 64"
- Scale → F/32 → 1.6"/mm

Maximum FoV Mode

- Sampling → 0.03"/pix
- Detector format → 4k x 4k
- Pixel size → 10 microns
- FoV → 2' x 2'
- Scale → F/17 → 3"/mm