

可視偏光サーベイプロジェクト SGMAP

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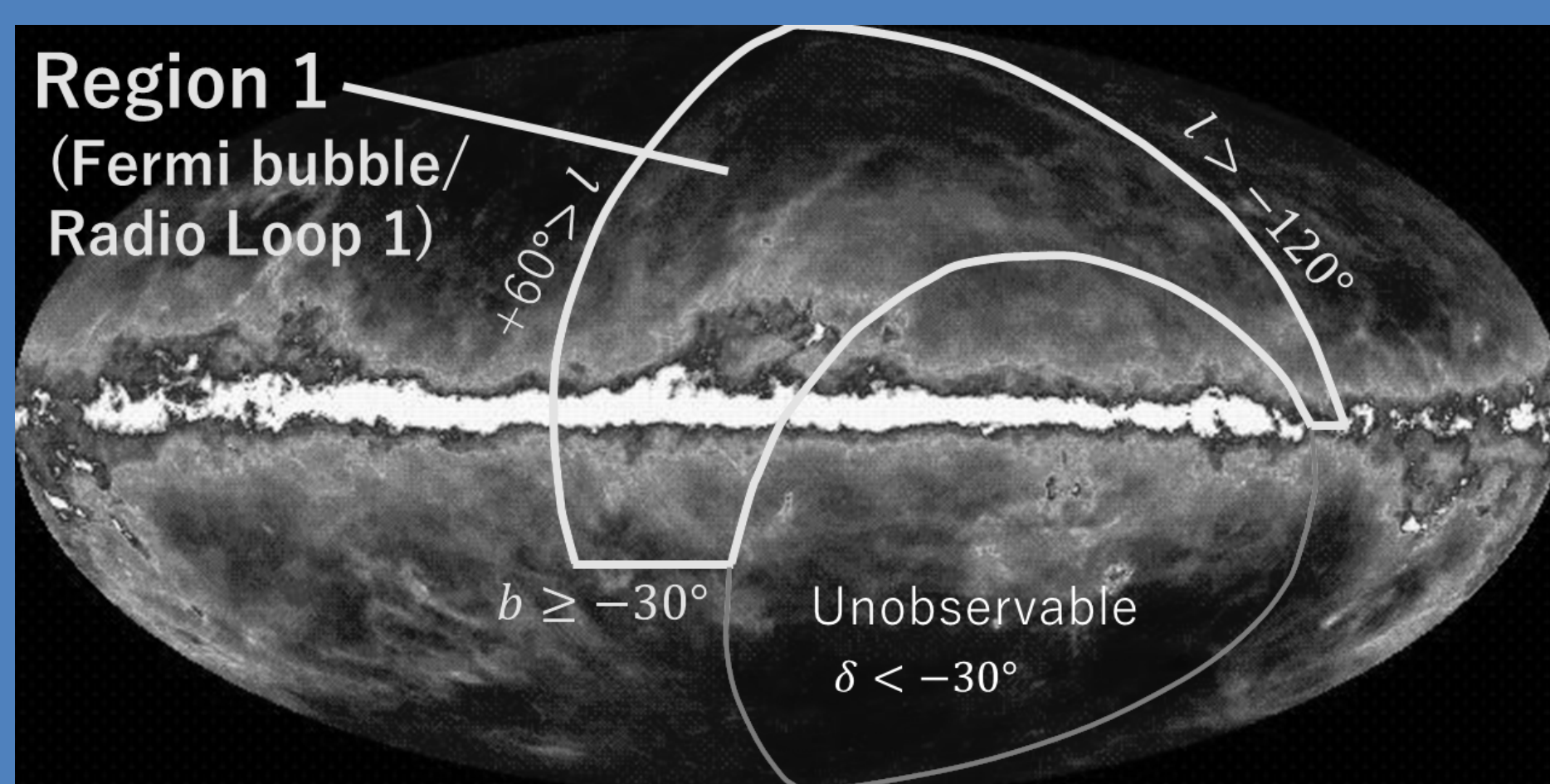
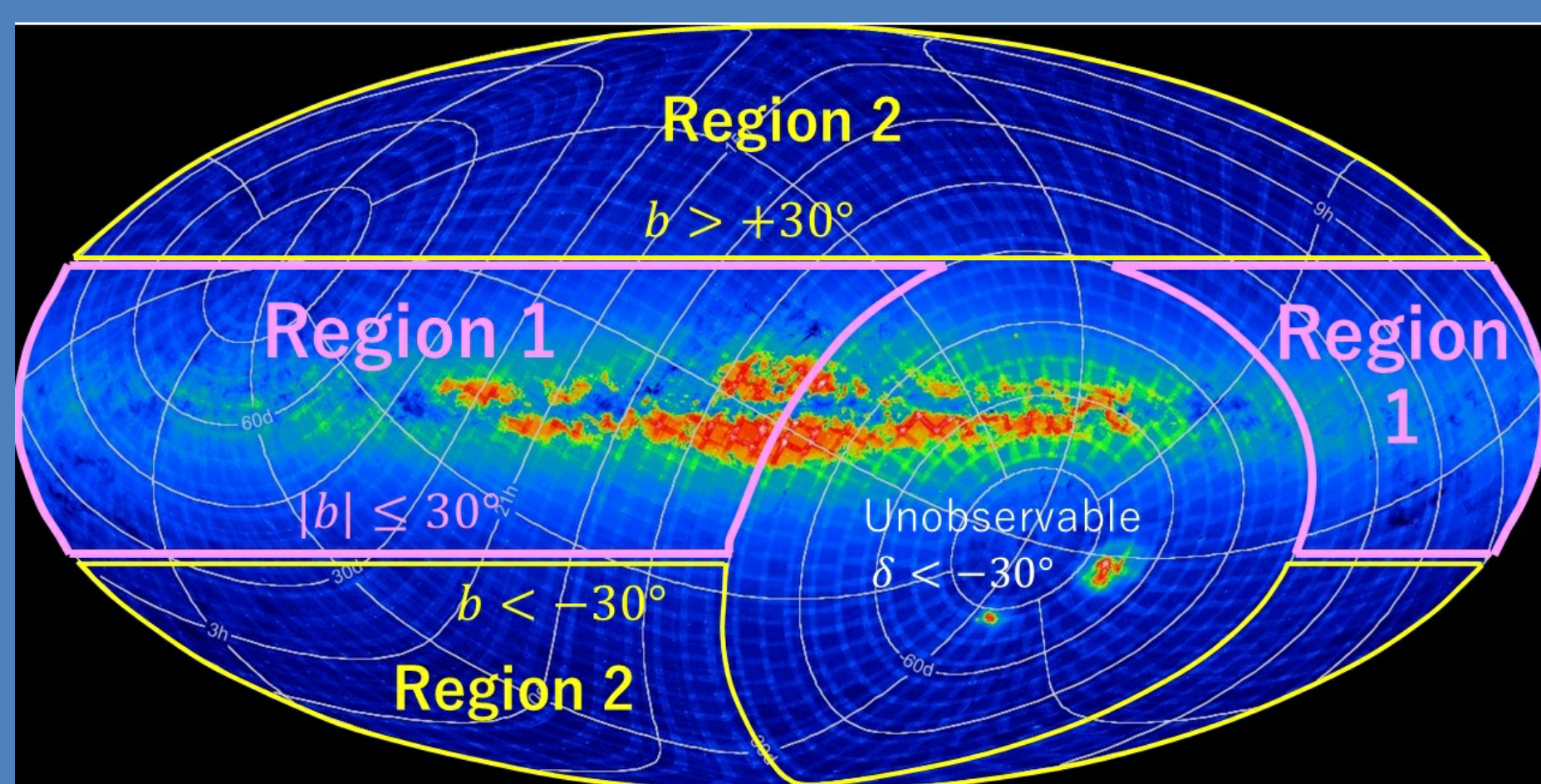
SGMAP = Search for Galactic Magnetic-Field by All-sky Polarimetric survey and Design of Its Optic

■北天初の無バイアス直線偏光サーベイ計画。

- 銀緯 $> -30^\circ$ 、かつ東広島天文台から観測可能な全天域の直線偏光の無バイアスサーベイ。
- 偏光度測定精度 $\Delta P = 0.15\%$ @ $g' = 14.0$ mag
- 視野 $50'$ 角・2バンド同時 (g' , i' を予定) の広視野・ビームスプリッタ型高精度偏光撮像器を開発。
- 望遠鏡は東広島天文台かなた望遠鏡、もしくは隣接した新望遠鏡のカセグレン焦点を利用。

Survey Plan

- With $40s \times 4$ exposures, $\Delta p = 0.15\%$ @ $g' = 14.0$ mag
Seeing $1.8''$, Sky $18\text{mag}/\text{arcsec}^2$, total efficiency 20%
- 1 set of observation takes 4.6 minutes (with overhead), 100 sets in one night
- Survey speed: $46.4 \text{ deg}^2/\text{day}$



Region 1: Galactic plane survey

- $|b| < 30^\circ, l = \sim 0 - 220^\circ$ (12000 deg^2)
- $12000/46.4 \rightarrow$ taking 0.71 yr
- Weather factor 0.33 \rightarrow 2.1 yr

Region 1': Galactic structures in multiwavelength obs.

- Including Radio loop/Fermi bubble region

Region 2: Mid-high latitude survey

- $|b| \geq 30^\circ$ available from Hiroshima (13200 deg^2)
- Weather factor 0.33 \rightarrow 2.4 yr

Scientific Cases with SGMAP

Galactic Magnetic fields (disk, halo)

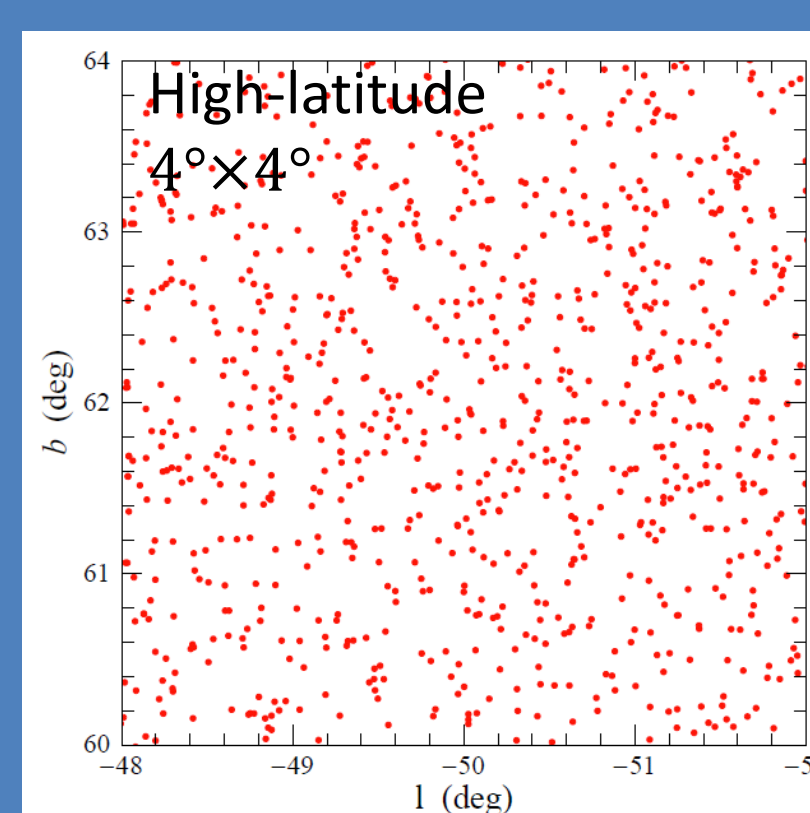
- Synergy with distance measurements by Gaia/JASMINE satellites
- Supplementary for all-sky radio polarimetric survey and targeted NIR polarimetric survey
- Process of magnetic field around circumstellar region/SNR, origin of large-scale magnetif field..etc.
- Discovery new/new-type polarized objects (active stars, AGNs)
- Statistical study of stellar atmosphere, activity, mass-loss
- Synergy with SDSS/PanStarrs catalogue, etc.
- Statistical study of asteroid/small body polarization
- Interstellar dust
- Estimation of Fore-ground interstellar polarization (Calibration of CMB polarization, external galaxies)

The dense polarimetric catalogue will be helpful for removal/masking the fore-ground interstellar polarization of any astronomical object, including possible GW sources.

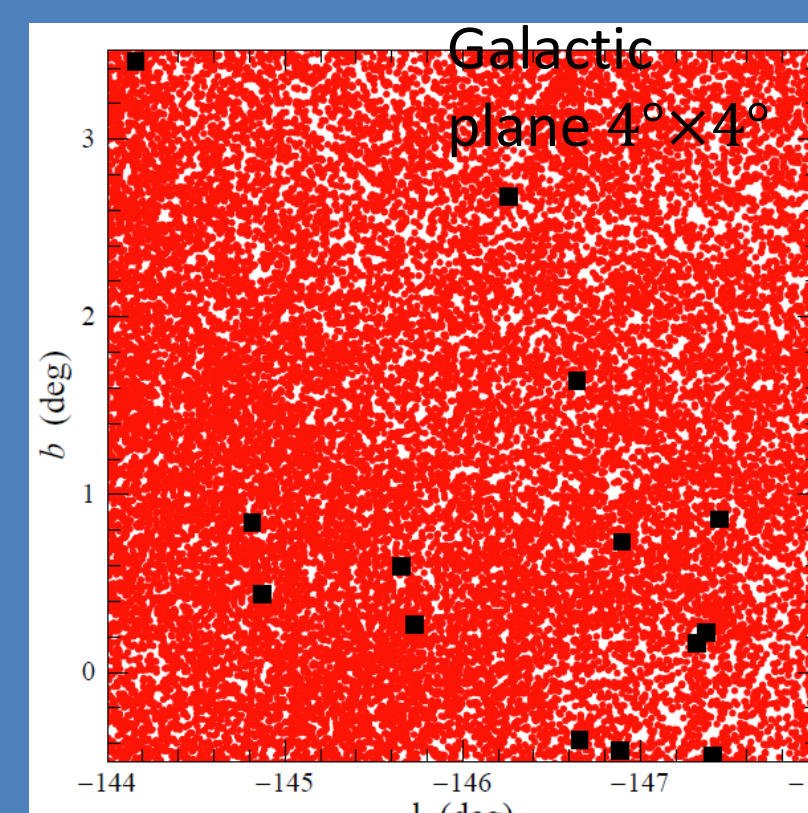
Spatial density of target stars

Red dots: Stars brighter than $V=14$ (SGMAP will survey; $> \text{several } 10^6$)

Black squares: Samples registered in existing catalog (Heiles 2000)



No star with Heiles (2000)



Only 14 stars in Heiles (2000)

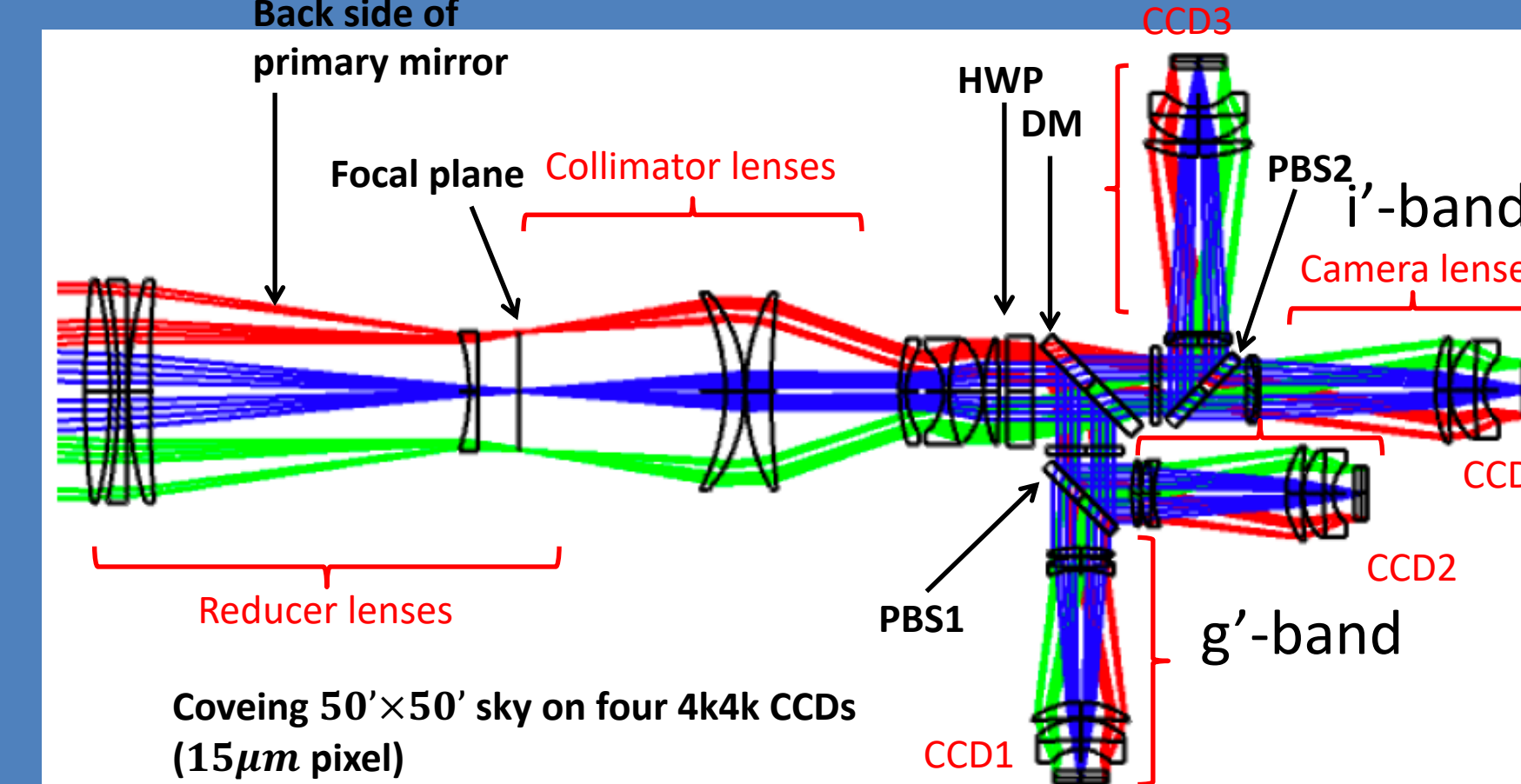
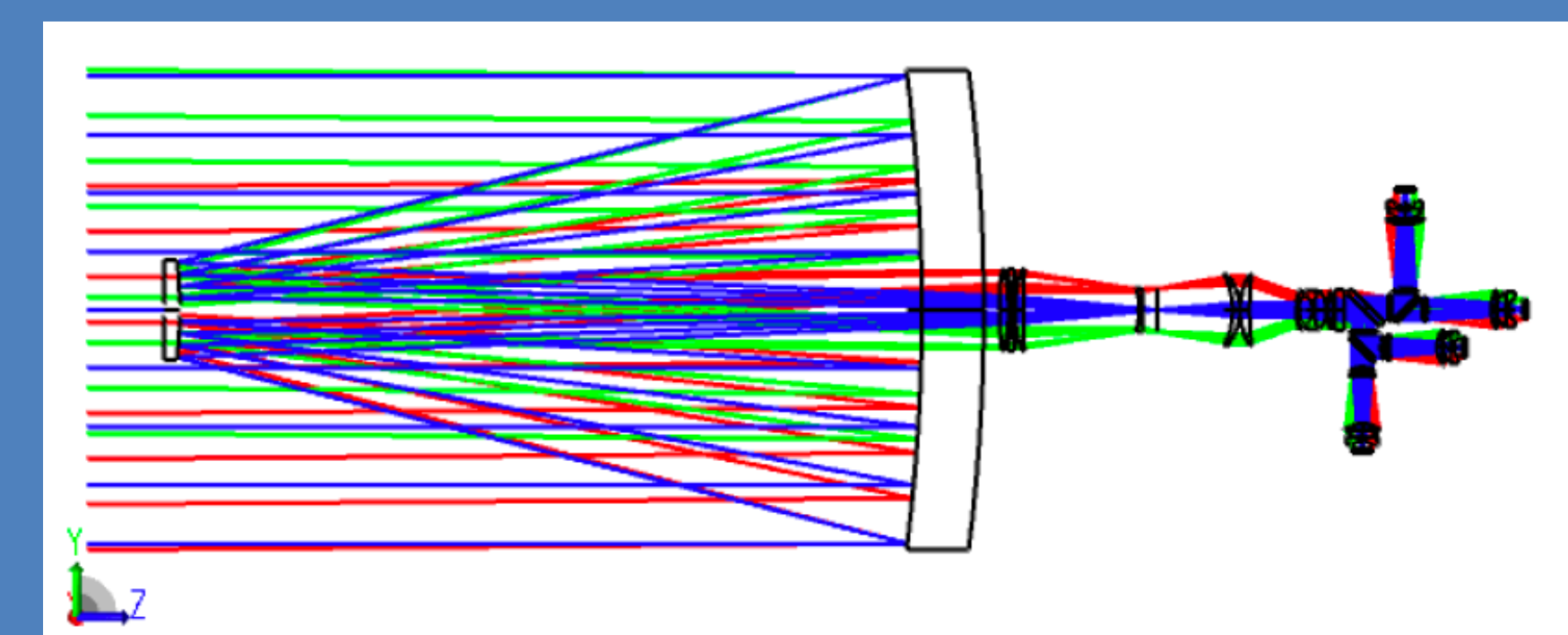
Design of SGMAP 2-band imaging polarimeter

SGMAP optics is designed

- to keep any incident ray to the superachromatic half-wave plate (HWP), dichroic mirror (DM), band filters and polarizing beam-splitter (PBS) is inclined by less than 12° against the optical axis to satisfy their required optical efficiencies,
- to keep the effective diameter of HWP $\leq 130 \text{ mm}$ and
- to keep the effective sizes of PBS and DM (both set by 45° inclined to the optical axis) $\leq 80 \times 140 \text{ mm}$ and $\leq 132 \times 192 \text{ mm}$, respectively.

Ordinary and extraordinary rays of SDSS g' and i' band are imaged onto four 4k4k CCDs, each covering $50' \times 50'$ FoV.

80% encircled energy radius $< 0.7''$ over $50' \times 50'$ FoV.



Cooperation / Competition

- SOUTH POL (PI: A. M. Magalhaes@Univ de Sao Paulo)
0.84m robot telescope (CTIO) + EEV 9k9kCCD
FoV 2.0 deg^2 1 optical wide-band
Sothern hemisphere, Dec $\delta < -15^\circ$
Survey has been started ≥ 2017 .
- WALOP: Wide Field Polarimetry (PI T. Pearson & T. Readhead, Caltech)
Robopol-type instruments on small telescopes
Future Northern + Southern hemisphere (i.e. all-sky)