SHARP:
The SHARC-II Polarimeter at the Caltech Submillimeter Observatory

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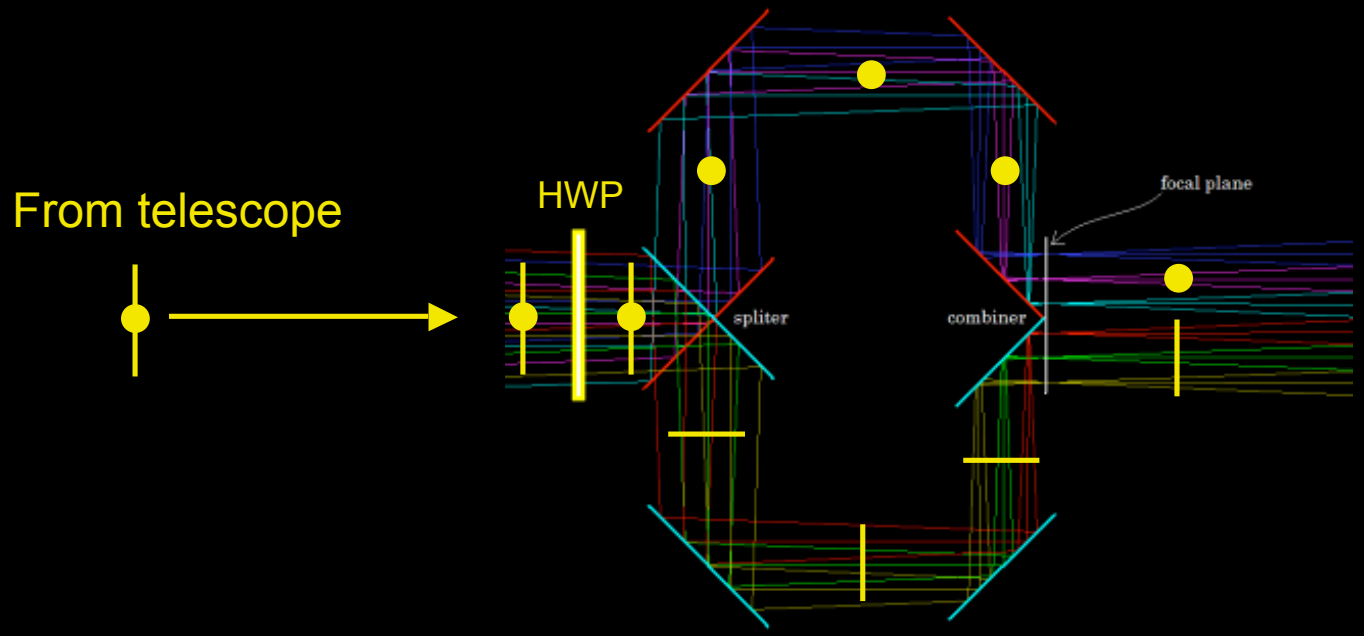
Basic Principle: orthogonal polarization components imaged to opposite ends of array

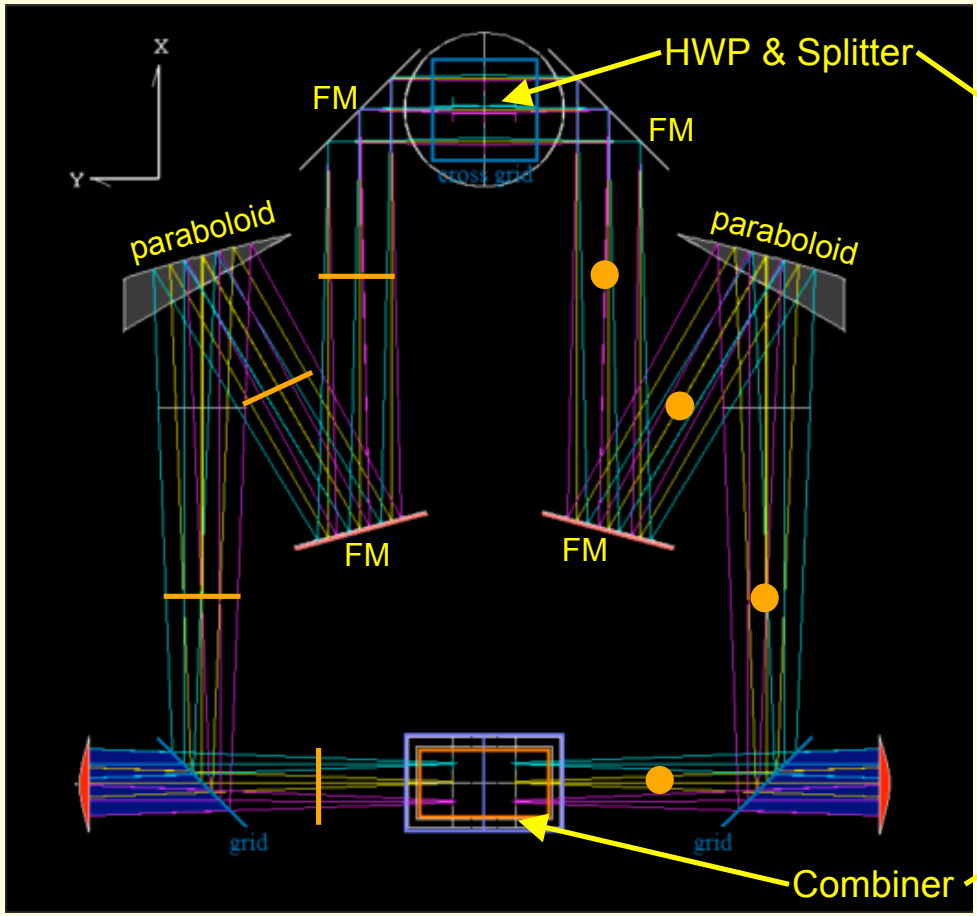
12 × 32 camera → 12 × 12 polarimeter



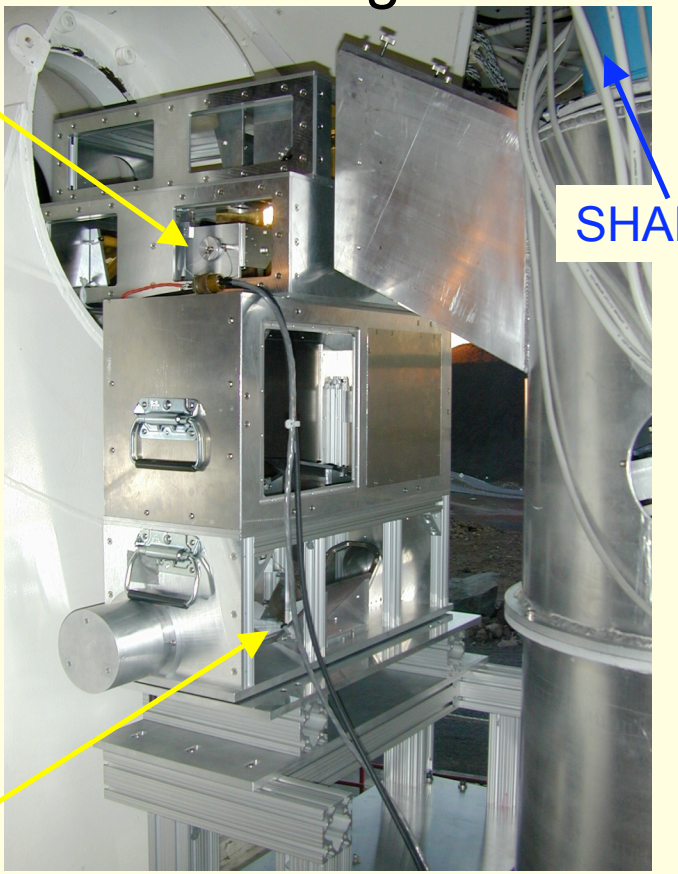
SHARC-II
12 × 32 bolometer array

Fold to Fit

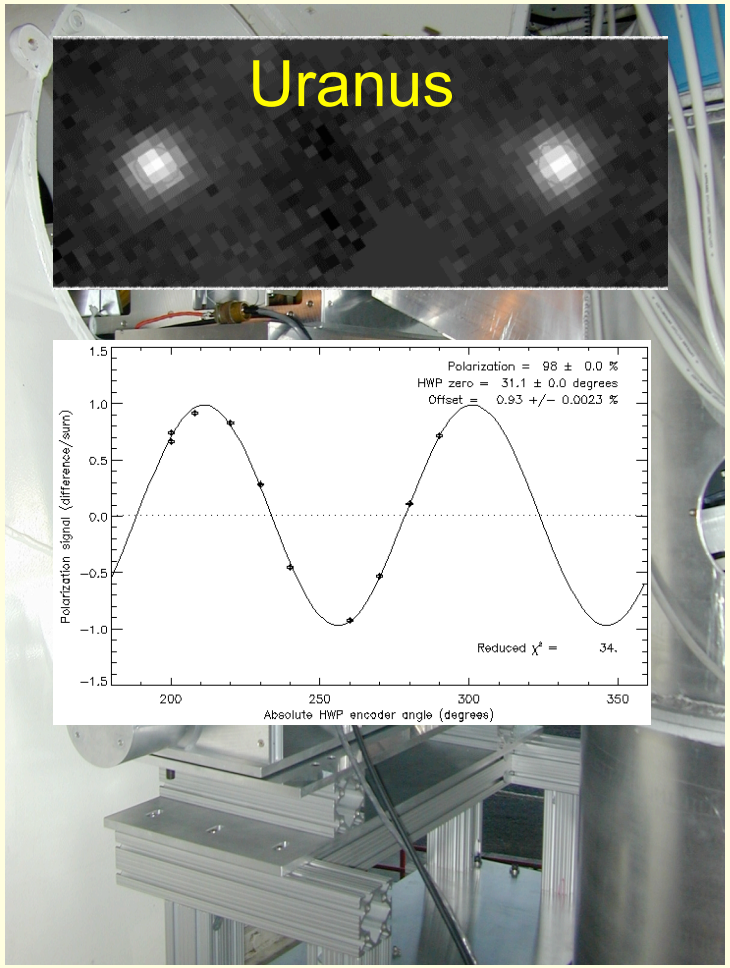
(Li et al. 2006, Novak et al. 2004)



Installed August 2005



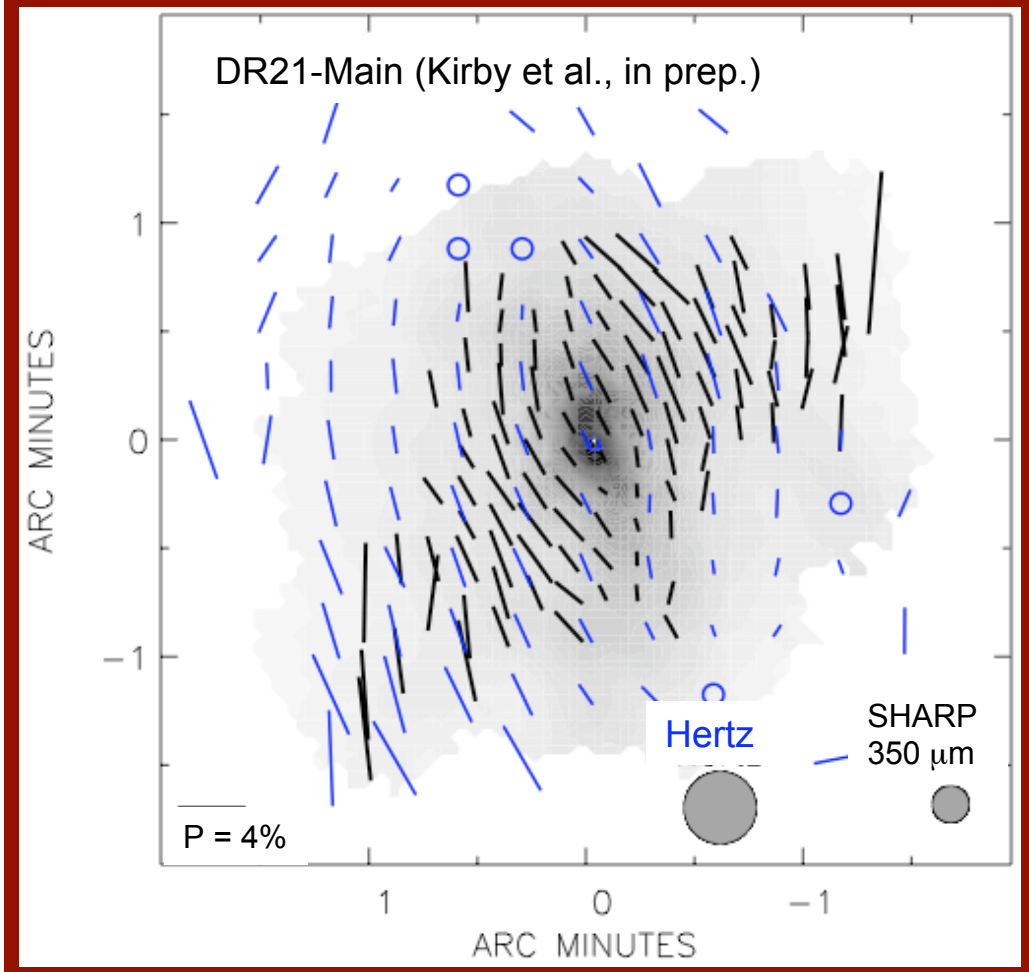
Measured Instrument spec.'s (Novak, Li, et al., in prep.)

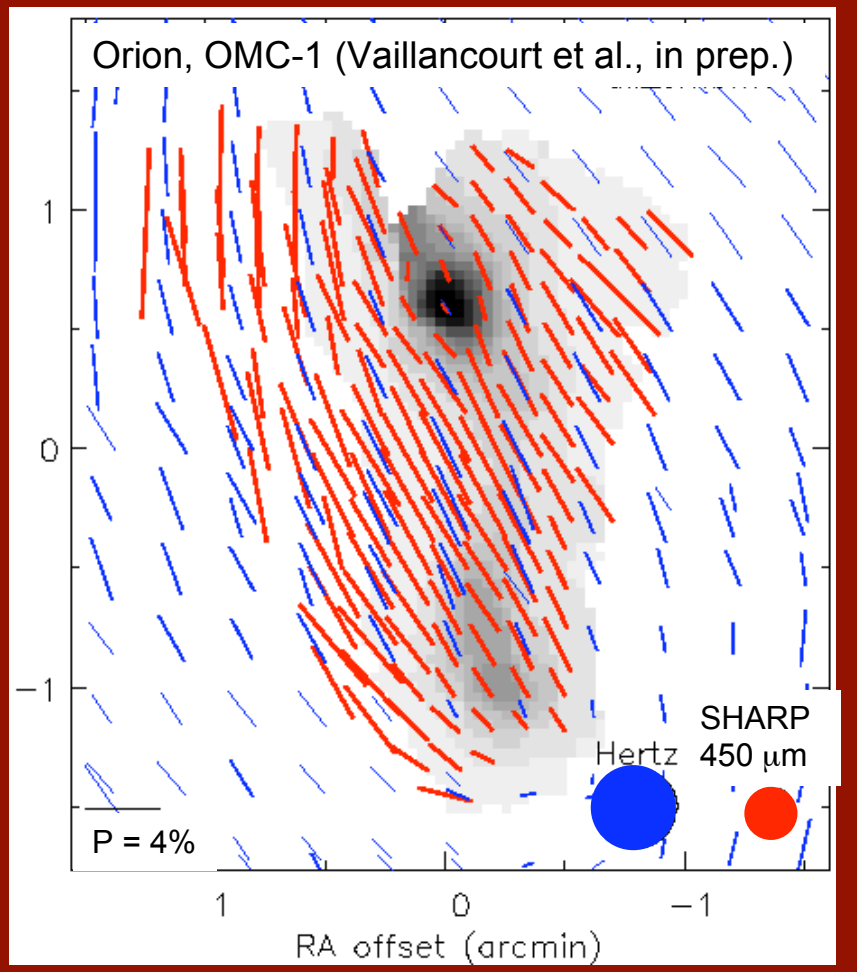


- **Transmission Efficiency**
  - 10 reflections + waveplate → 75 %
- **Beamsize (FWHM)**
  - 9″ at 350 μm
  - 10″ at 450 μm

  ~1′ × 1′ FOV
- **Polarization efficiency**
  - 93 ± 5 % at 350 μm
  - 98 ± 1 % at 450 μm
- **Instrument Polarization**
  - 0.4 - 0.5 % instrument
  - 0.3 - 0.5 % telescope
- **Sensitivity (σ_p = 1% in 5 hours)**
  - ~ 2.2 Jy/beam at 350 μm
  - ~ 1.5 Jy/beam at 450 μm

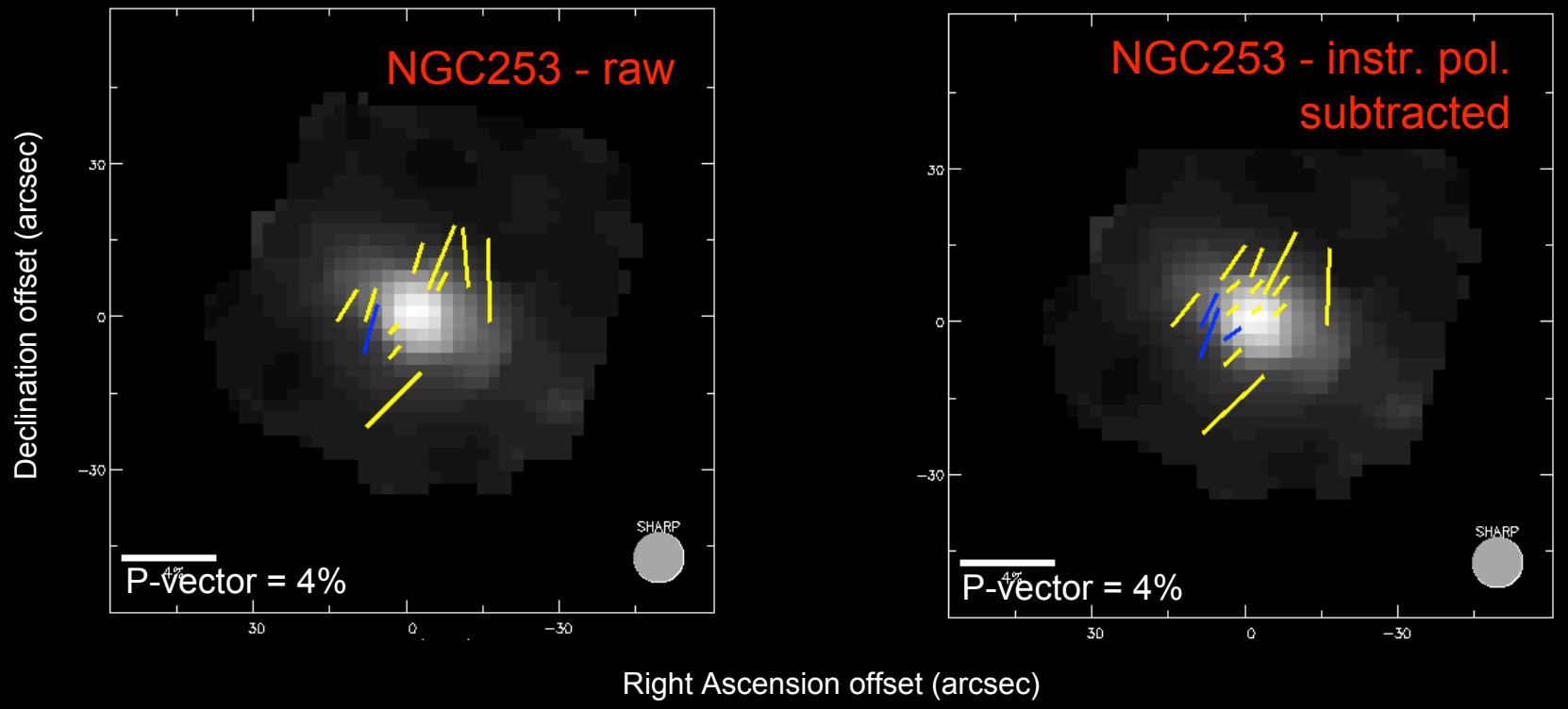
Preliminary Results: Comparison with Hertz @ 350 μm





Preliminary Results: First 450 μm extragalactic polarimetry

(1.3 hours observing time)



Blue vectors: $P/\sigma_p > 3$

Yellow vectors: $2 < P/\sigma_p < 3$

Future Work

- Refine measurements of
  - Instrument polarization
  - 450 μm sensitivity
  - Array alignment offsets
- Additional Hardware
  - Rapid switching between 2 waveplate wavelengths
  - Acquire 620 μm half-waveplate
- Data analysis for extended objects (> 1′ FOV)
  - Acquisition & analysis needs to be revised from step/chop mode to scanning mode






Some extra slides...

Data Reduction & Acquisition - Summary

- observing mode: stare/chop/nod/rotate, repeat
- 2 components (H&V) measured at 4 HWP angles
  - θ = 0°, 22.5°, 45°, 67.5°
  - Polarization signal = $(H-V)_\theta$ / $(H+V)_\theta$ for all pixel pairs

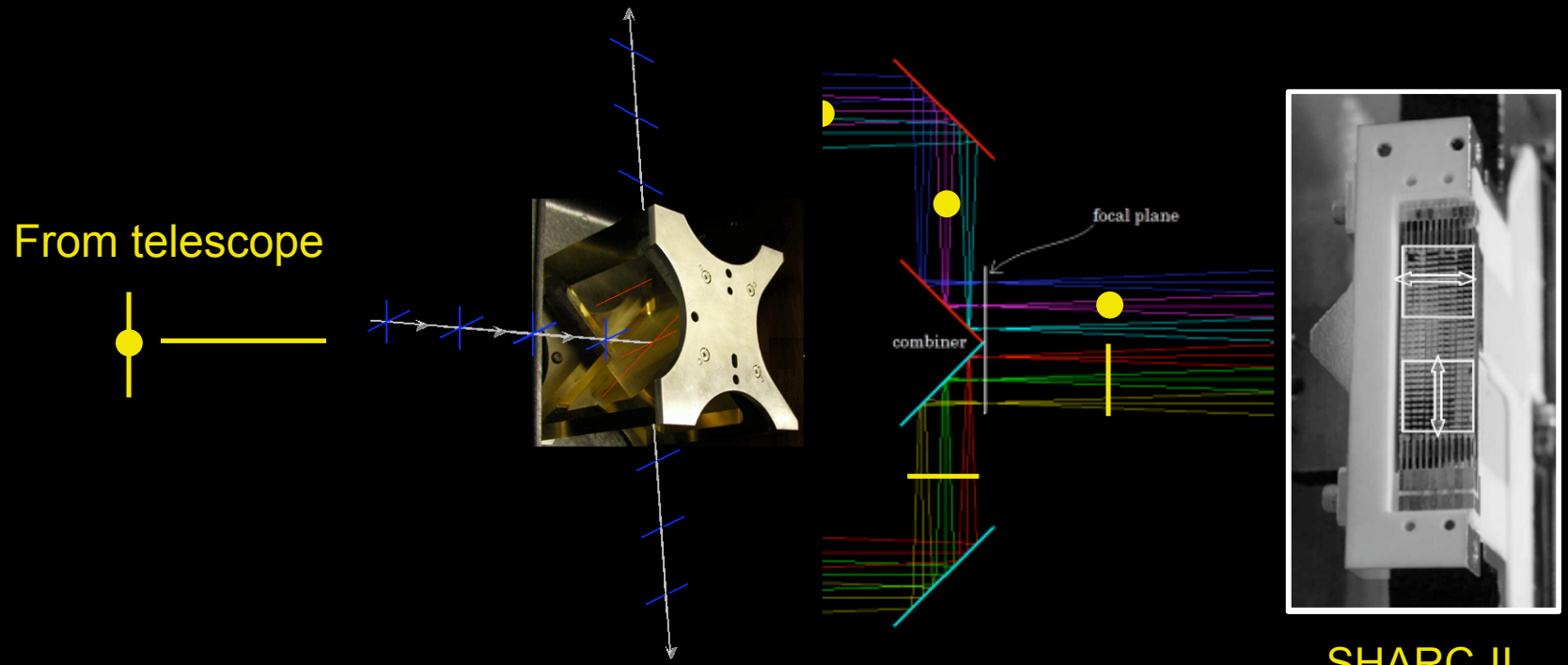
  $\Rightarrow$ linear polarization Stokes parameters *I*, *Q*, and *U*
- Correct for array misalignment (< 0.5 pix ~ 2″)
  - Relative offset, rotation, and magnification
- Measure and remove instrument polarization (IP)
  - Use (unpolarized) planets to measure
  - Combine all planet & source data to fit IP

Imaging Polarimetry at 350 and 450 μm

- *Dust grains aligned by magnetic fields*
- *B-field geometry in*
  - Molecular clouds
  - Protostars
  - Diffuse ISM
  - External galaxies
- *Dust grain physics*
  - Alignment models
  - Grain composition, shape, temperature, etc.
  - Polarization spectrum

Basic Principle: orthogonal polarization components imaged to opposite ends of array

12 × 32 camera → 12 × 12 polarimeter



SHARC-II
12 × 32 bolometer array