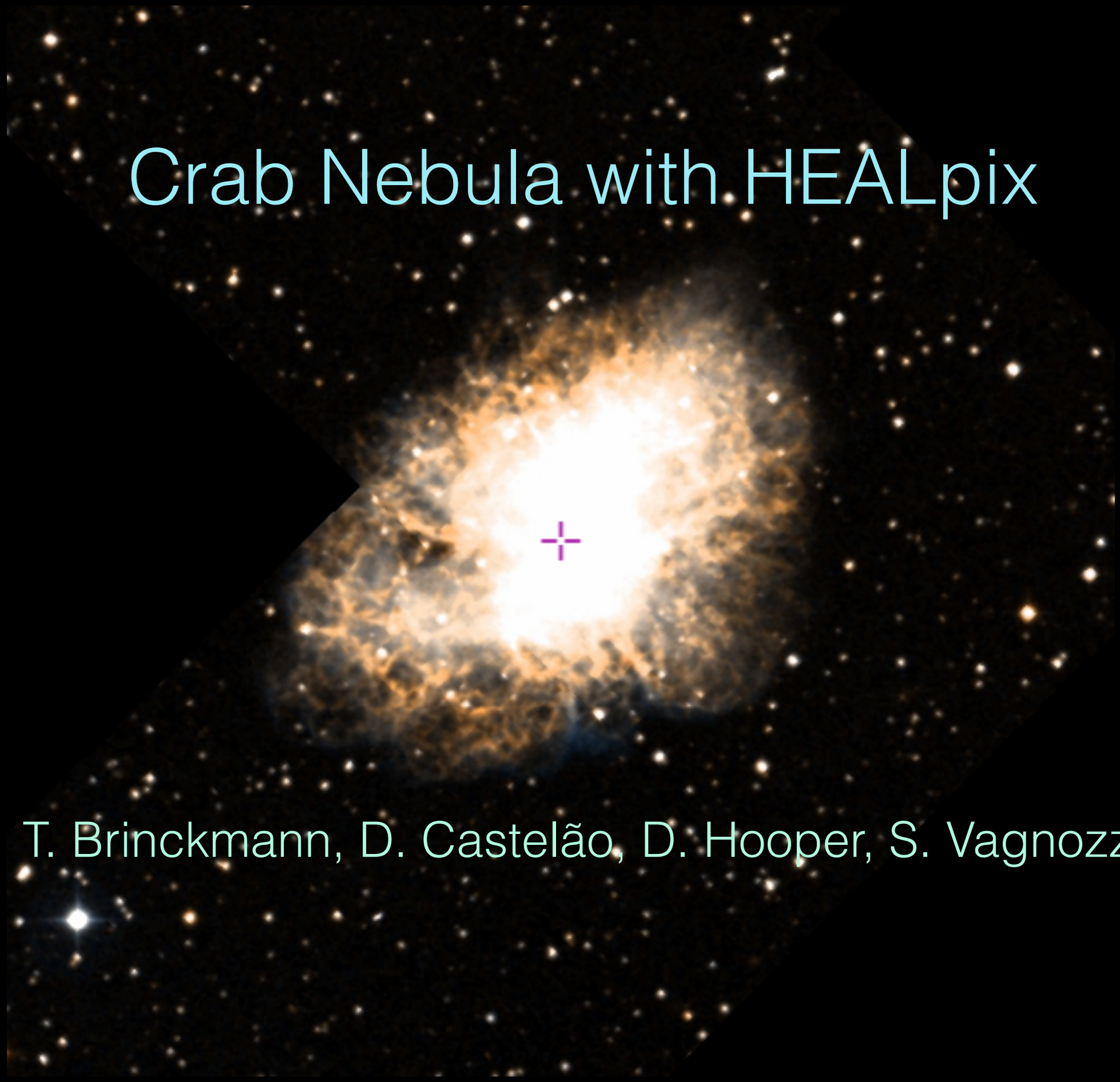
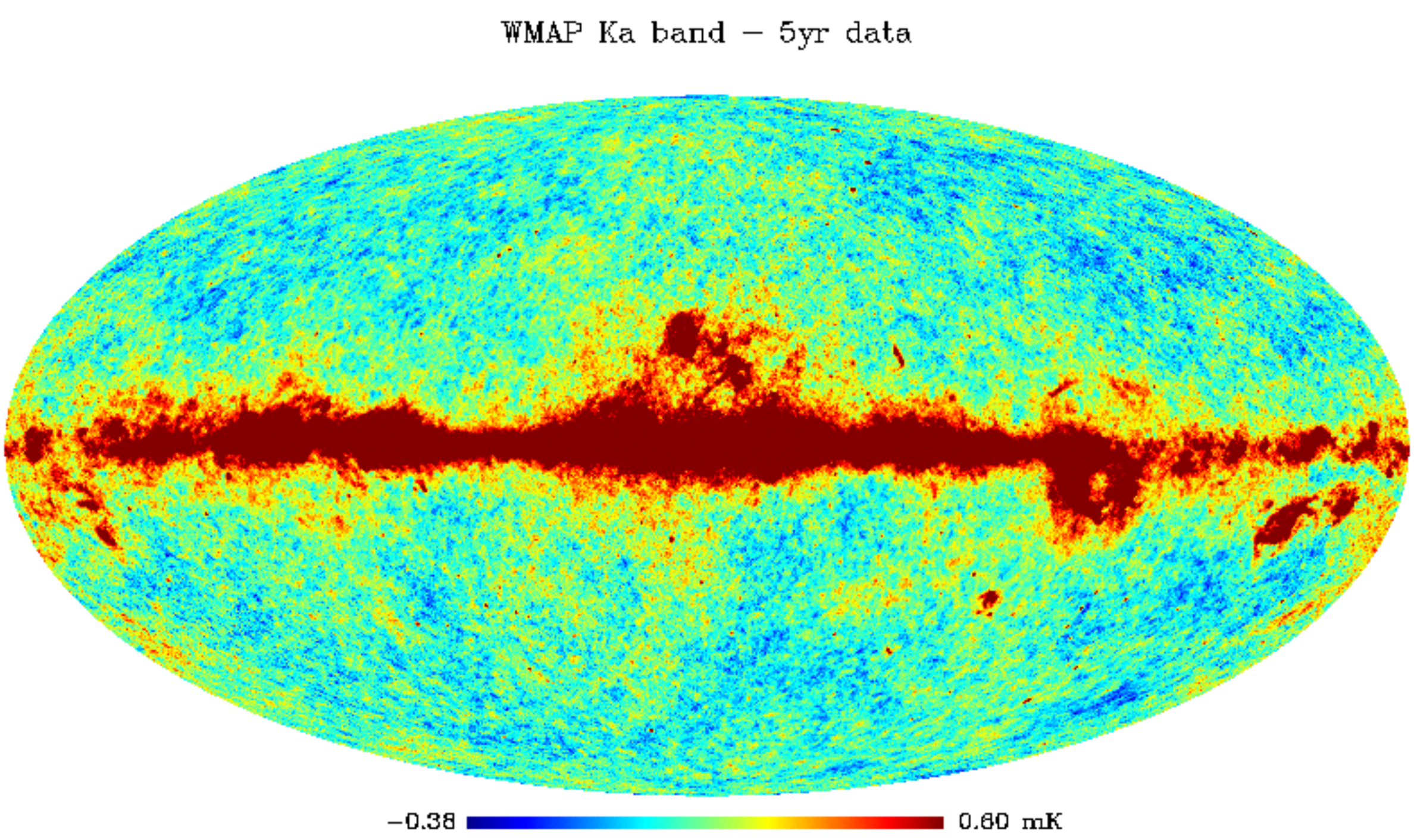
Crab Nebula with HEALpix



T. Brinckmann, D. Castelão, D. Hooper, S. Vagnozzi

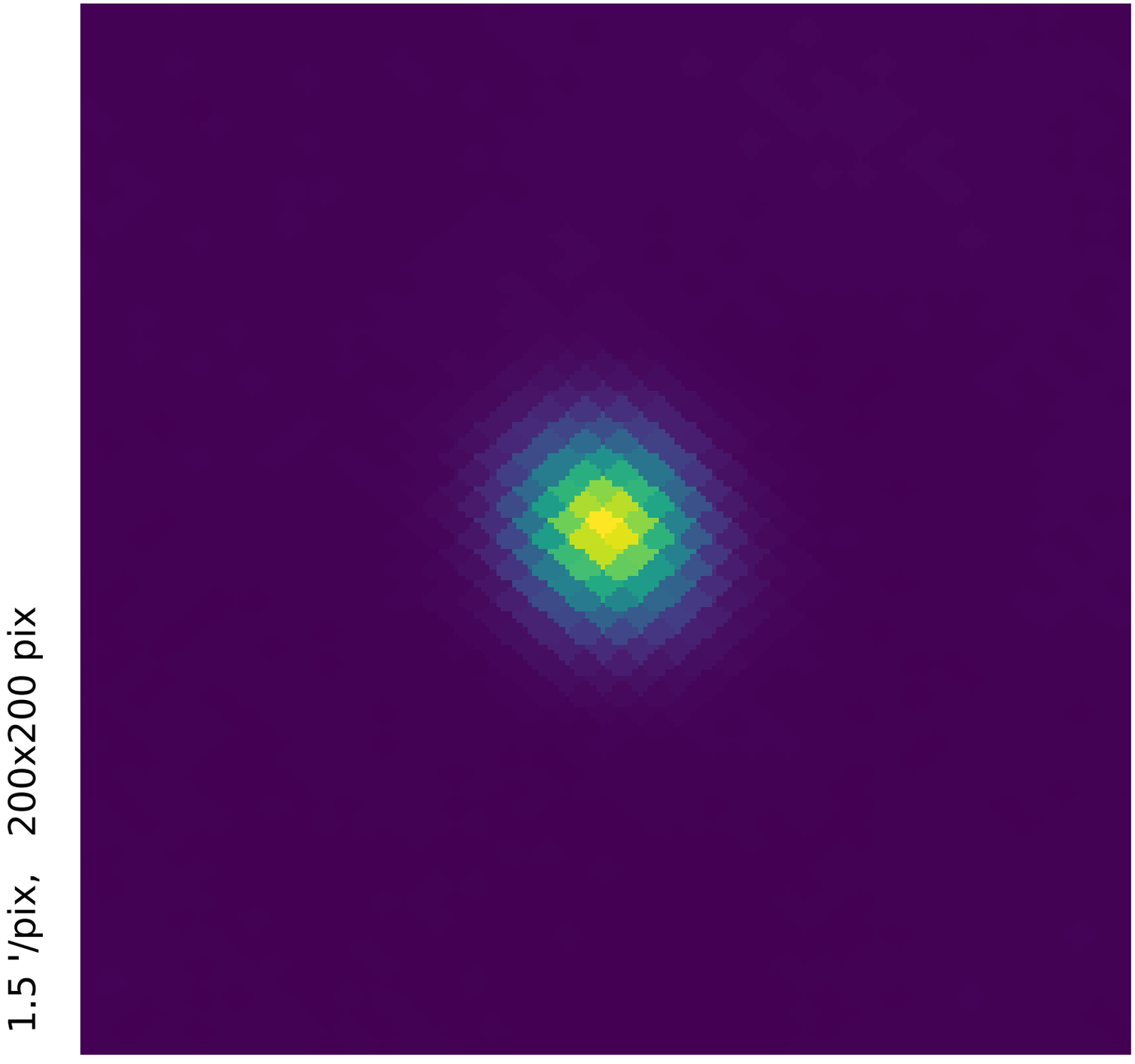
Extracting flux from Crab Nebula

- 1: Locate Crab Nebula (SIMBAD)
- 2: Convert galactic coordinates to vector coord.
- 3: Choose HEALpix parameters
    - Nside =512, Scheme = Nested
- 4: Use HEALpix to extract information



Map we are using: full Sky WMAP Ka band (26.5–40 GHz)

CRAB as seen by WMAP-Ka



1.5 '/pix, 200x200 pix

(184.558,-5.784)

-0.159 70.3

First calculation with no corrections

Source

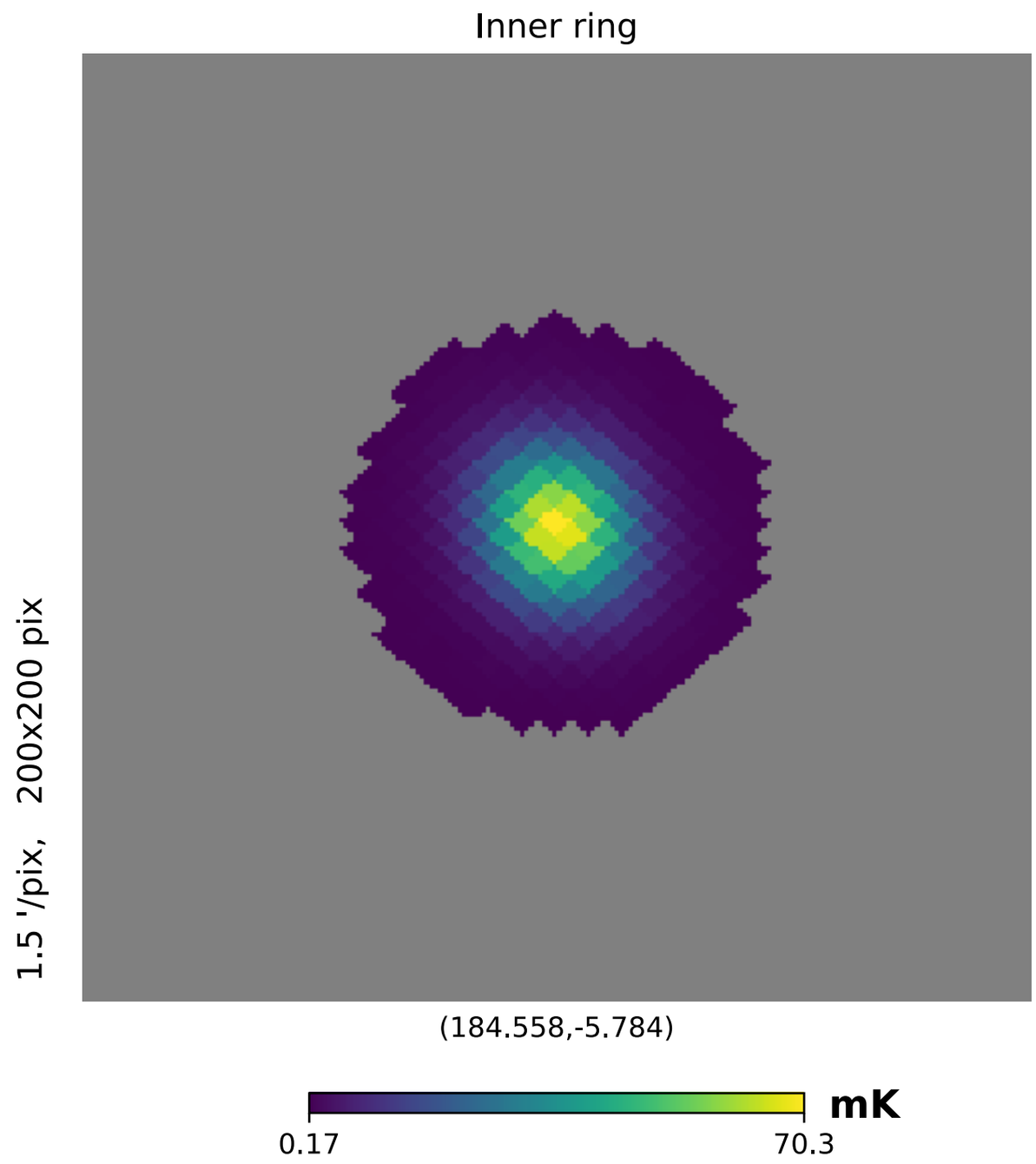
-> Define 1deg aperture

-> Use HEALpix to get temperature

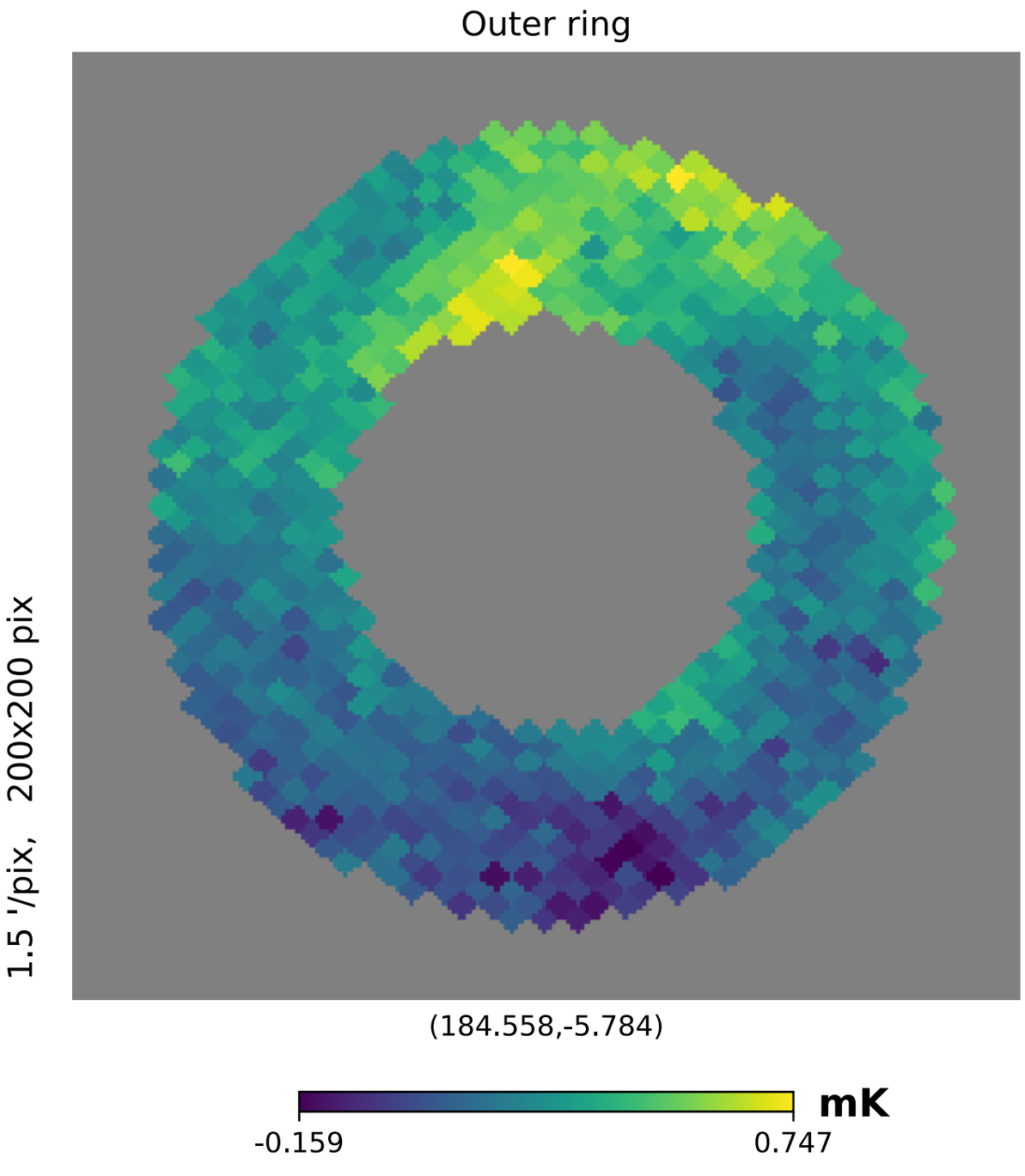
-> Use Rayleigh-Jeans law to get flux

$$B_\nu(T) = \frac{2\nu^2 k_\mathrm{B} T}{c^2}.$$

-> Flux without correction = 344.9 Jy



Second estimate considering background



Background

-> 2 deg aperture

-> Extract average temp
using HEALpix

-> Subtract background from source

-> Corrected flux F = 334.7 Jy

-> Published value: Page et al. (2003)
value using WMAP: 322 +/- 6 Jy

What is missing?

Final result using Black Body Spectrum

- Rayleigh Jeans law is low frequency approximation
- Use full black body spectrum

$$B_\nu(T) = \frac{2h\nu^3}{c^2} \frac{1}{e^{\frac{h\nu}{k_\mathrm{B}T}} - 1} \approx \frac{2h\nu^3}{c^2} \cdot \frac{k_\mathrm{B}T}{h\nu} = \frac{2\nu^2 k_\mathrm{B}T}{c^2}$$

- Final result: F = 325.5 Jy
  (to be compared with F = 322 +/- 6 Jy)
- We were able to reproduce published value!