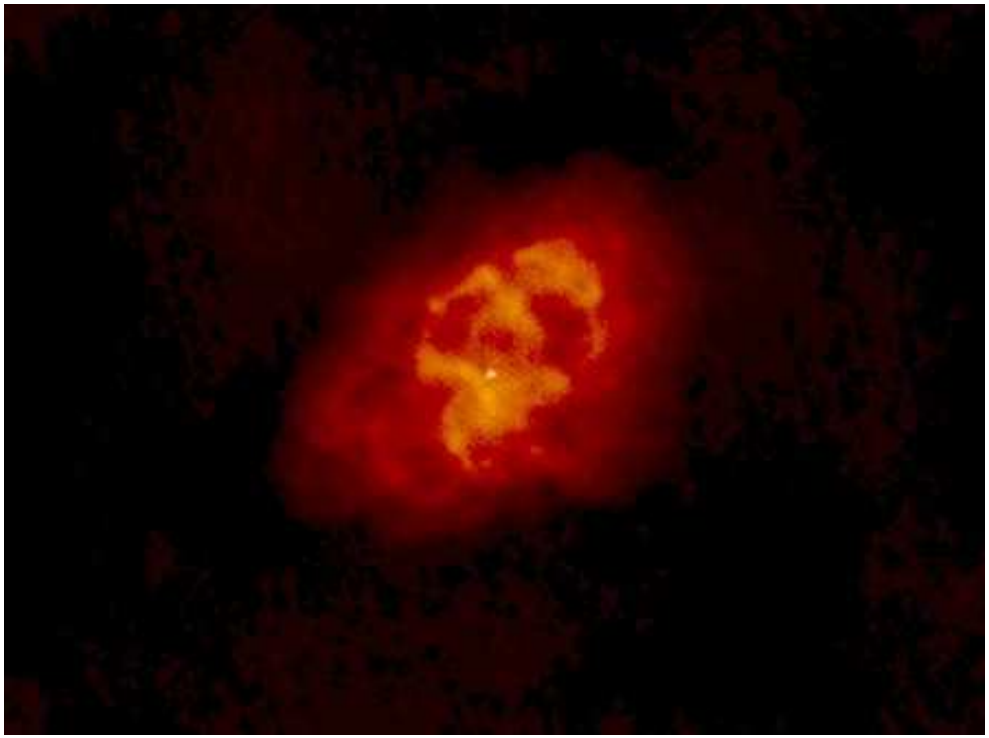
Application of Synchrotron Radiation



Crab nebula at 90 cm (NRAO 300′ telescope), resolution 1.3″

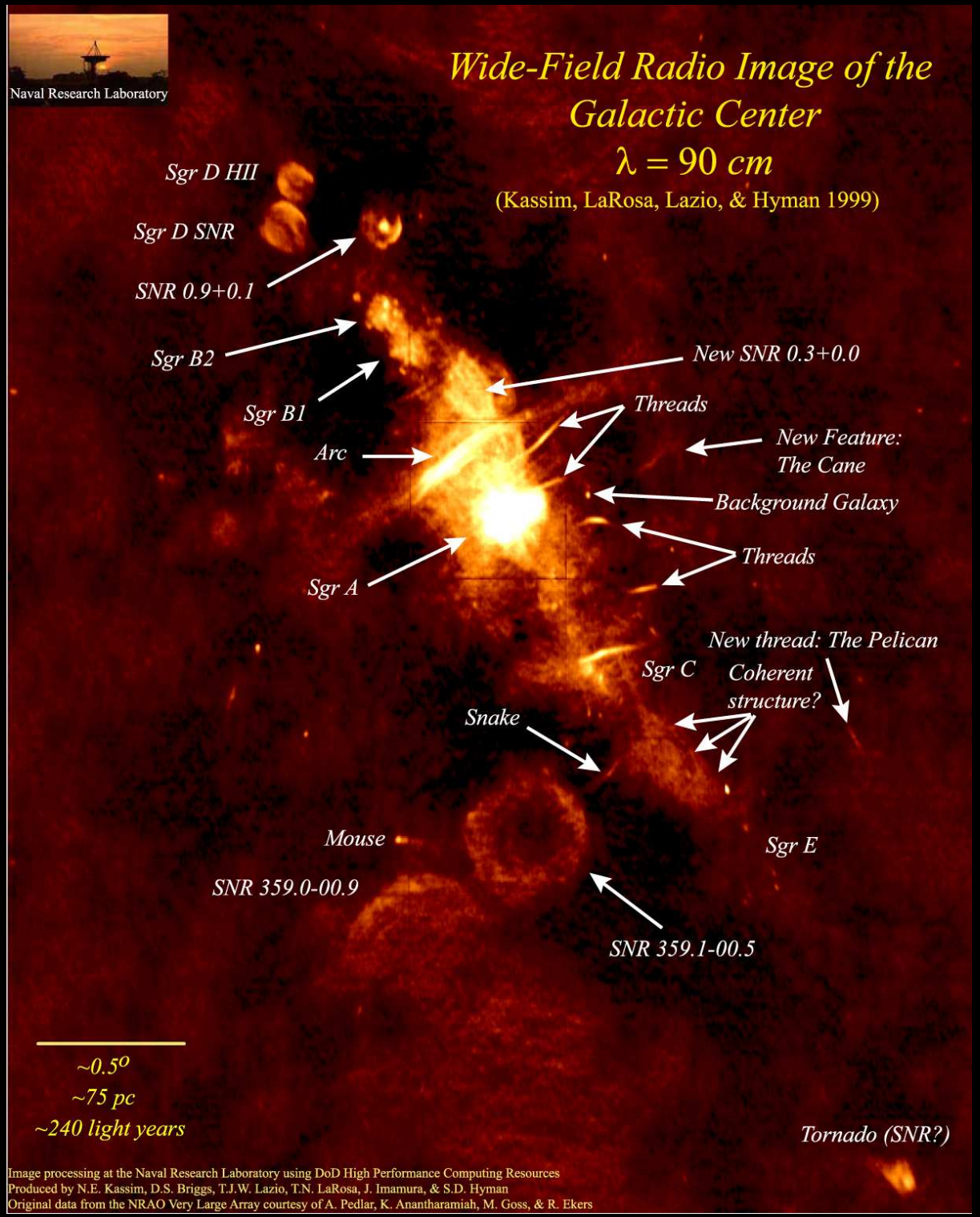
The characteristic frequency was

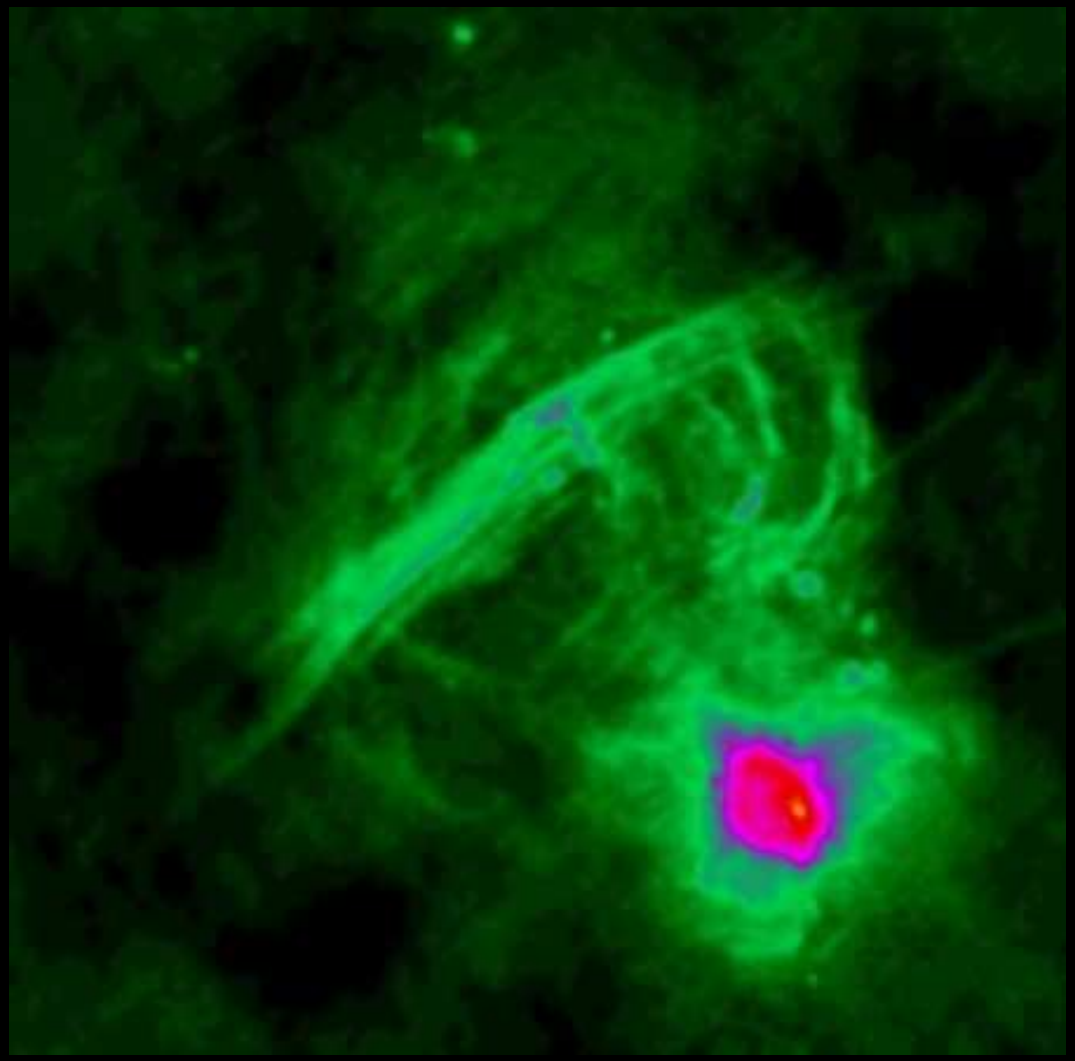
$$\nu_{\rm c} = \frac{\omega_{\rm c}}{2\pi} \tag{6.25}$$

$$= 6300 \left(\frac{B}{10^{-7}\,{\rm T}}\right) \left(\frac{E/m_{\rm e}c^2}{10^3}\right)^2 \,{\rm MHz} \tag{7.1}$$

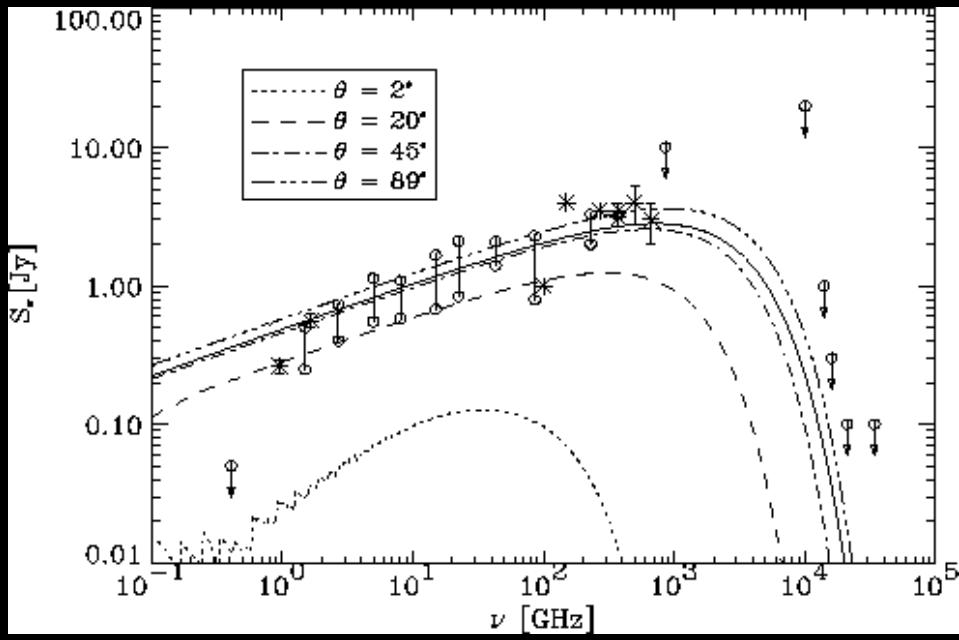
Optical light has $\nu \sim 10^8$ MHz. To emit this frequency, the electrons must have $\gamma \sim 10^6$ for a typical B-field!

Life time of electrons with $\gamma = 10^6$ (per Eq. 6.20): 16 years.
Diameter of Crab: $\sim$2 pc $\Longrightarrow$ it is not a problem to deliver all energy by accelerating electrons at the center of the neutron star in the center of the nebula.


Naval Research Laboratory
Wide-Field Radio Image of the Galactic Center
λ = 90 cm
(Kassim, LaRosa, Lazio, & Hyman 1999)
Sgr D HII
Sgr D SNR
SNR 0.9+0.1
Sgr B2
Sgr B1
New SNR 0.3+0.0
Threads
Arc
New Feature: The Cane
Background Galaxy
Threads
Sgr A
New thread: The Pelican
Sgr C
Coherent structure?
Snake
Mouse
SNR 359.0-00.9
Sgr E
SNR 359.1-00.5
~0.5°
~75 pc
~240 light years
Tornado (SNR?)
Image processing at the Naval Research Laboratory using DoD High Performance Computing Resources
Produced by N.E. Kassim, D.S. Briggs, T.J.W. Lazio, T.N. LaRosa, J. Imamura, & S.D. Hyman
Original data from the NRAO Very Large Array courtesy of A. Pedlar, K. Anantharamiah, M. Goss, & R. Ekers



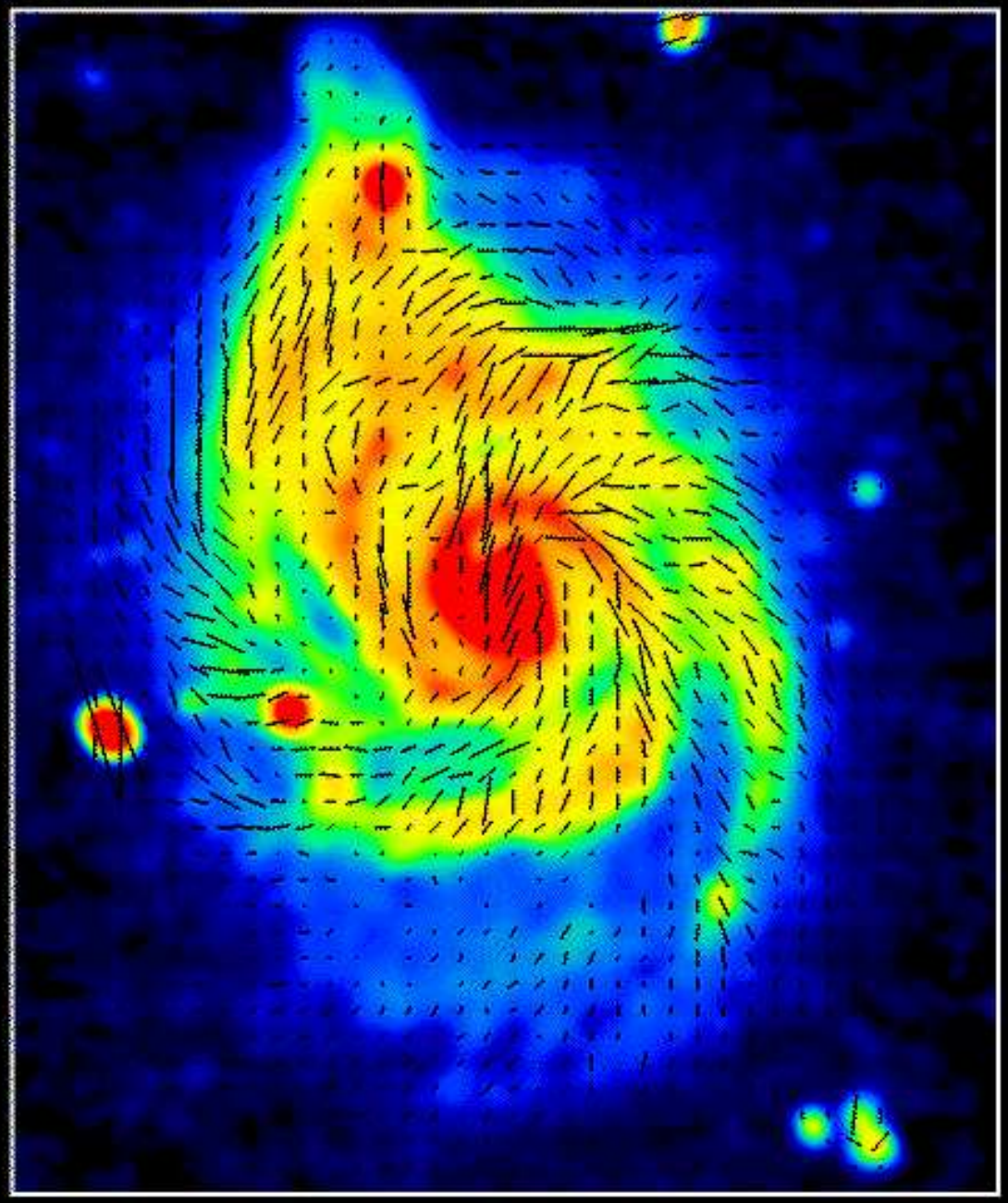
Galactic Center, courtesy NRAO



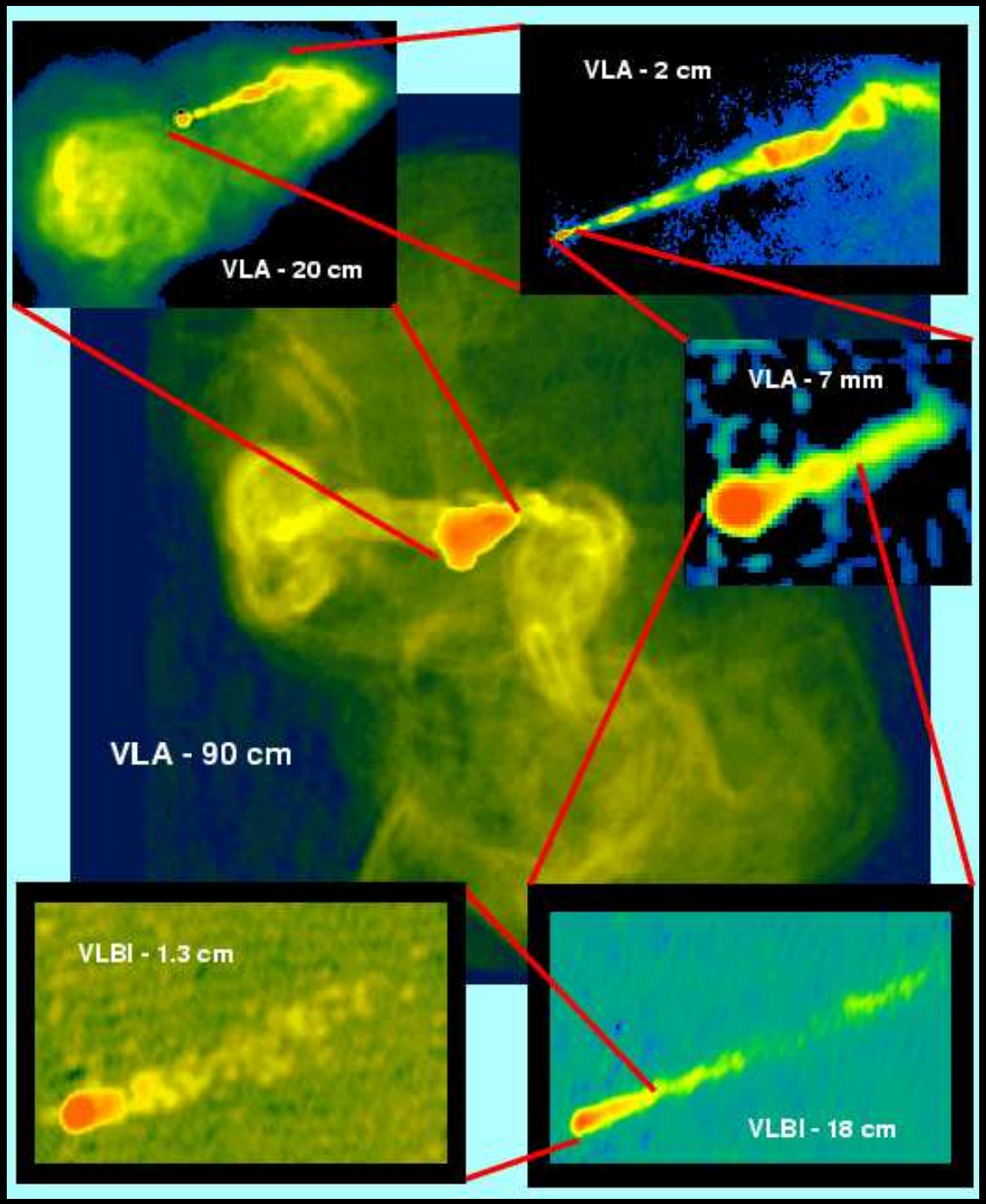
Emission from Sgr A, the galactic center: spectrum characteristic for synchrotron radiation.

Note how emissivity follows B-field structure!

M51 20cm Total Intensity+Magnetic Field (VLA)



B-field vectors inferred from the degree of polarization in spiral galaxy M51 by rotation of the observed E-field-vectors by 90° (Neininger 1992, A&A 263, 30)



AGN M87; courtesy Frazer Owen