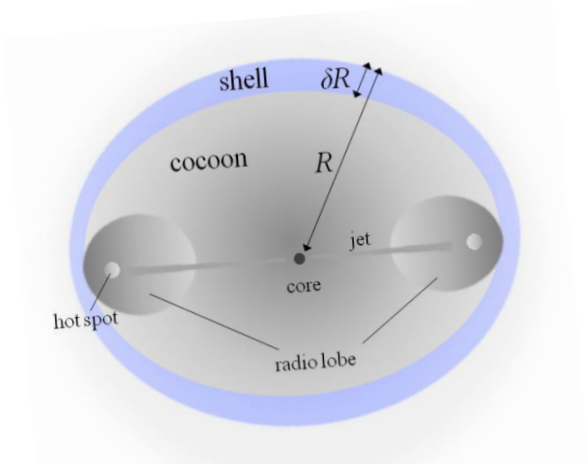
Fossil shell emission in dying radio-loud AGNs



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&

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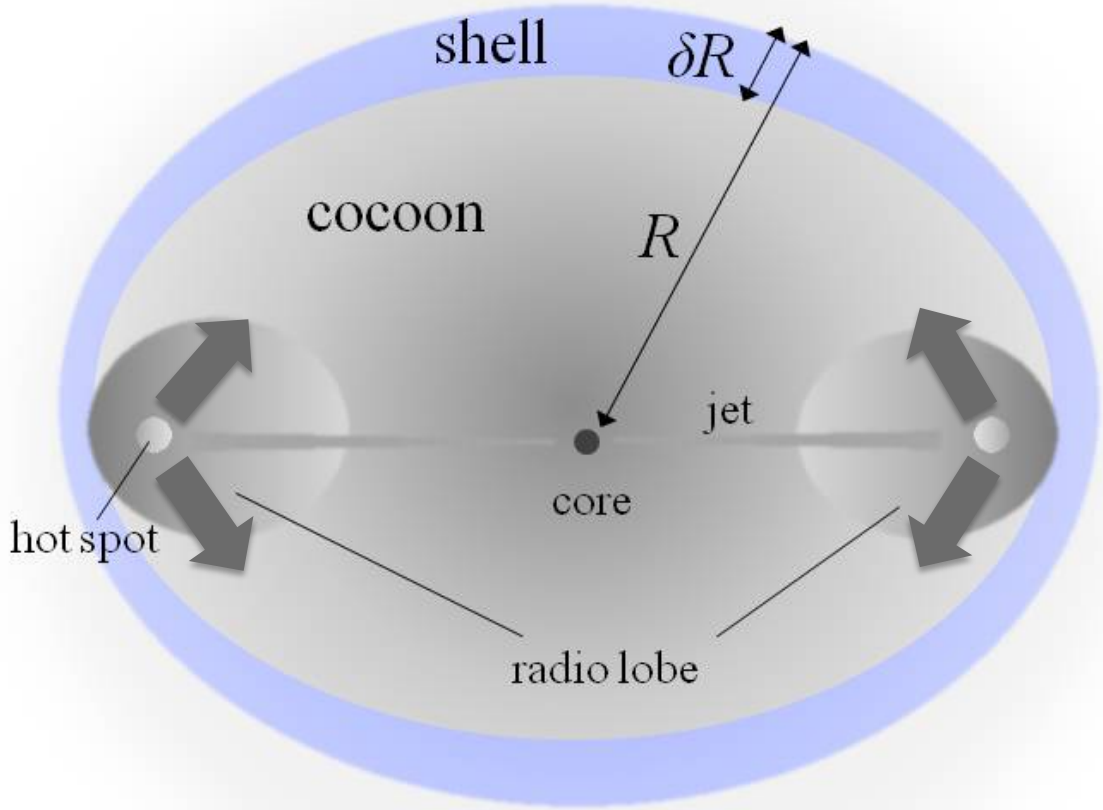
5th workshop on CSS and GPS (2015 May @ Rimini)

Shell = forward shocked ISM



- Fundamental ingredient in jet system
- AGN feedback in kinetic mode
  (e.g., Morganti+15, Tadhunter+14, Wagner+11)

However, the shell is radio quiet…

DISCOVERY OF THE BOW SHOCK OF CYGNUS A

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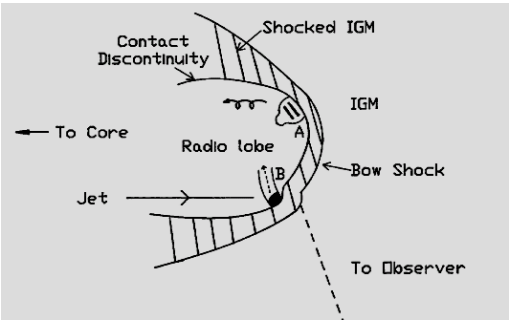


ABSTRACT

Rotation measure images of Cygnus A indicate that a bow shock precedes the supersonic advance of hot spot B into the intergalactic medium. The shock is radio quiet and is observed only by the rotation measure discontinuity which occurs at the point where the fields and particles in the IGM are compressed by the shock. The fact that this discontinuity is projected onto part of the source provides information on the three-dimensional structure of the radio source and supports models of extragalactic radio sources in which the jet varies direction on relatively short time scales. From the observed rotation measures, we calculate magnetic field strengths in the cluster gas of $\sim 7.5\ \mu G$.

Subject headings: galaxies: intergalactic medium — galaxies: jets — shock waves — radio sources: galaxies

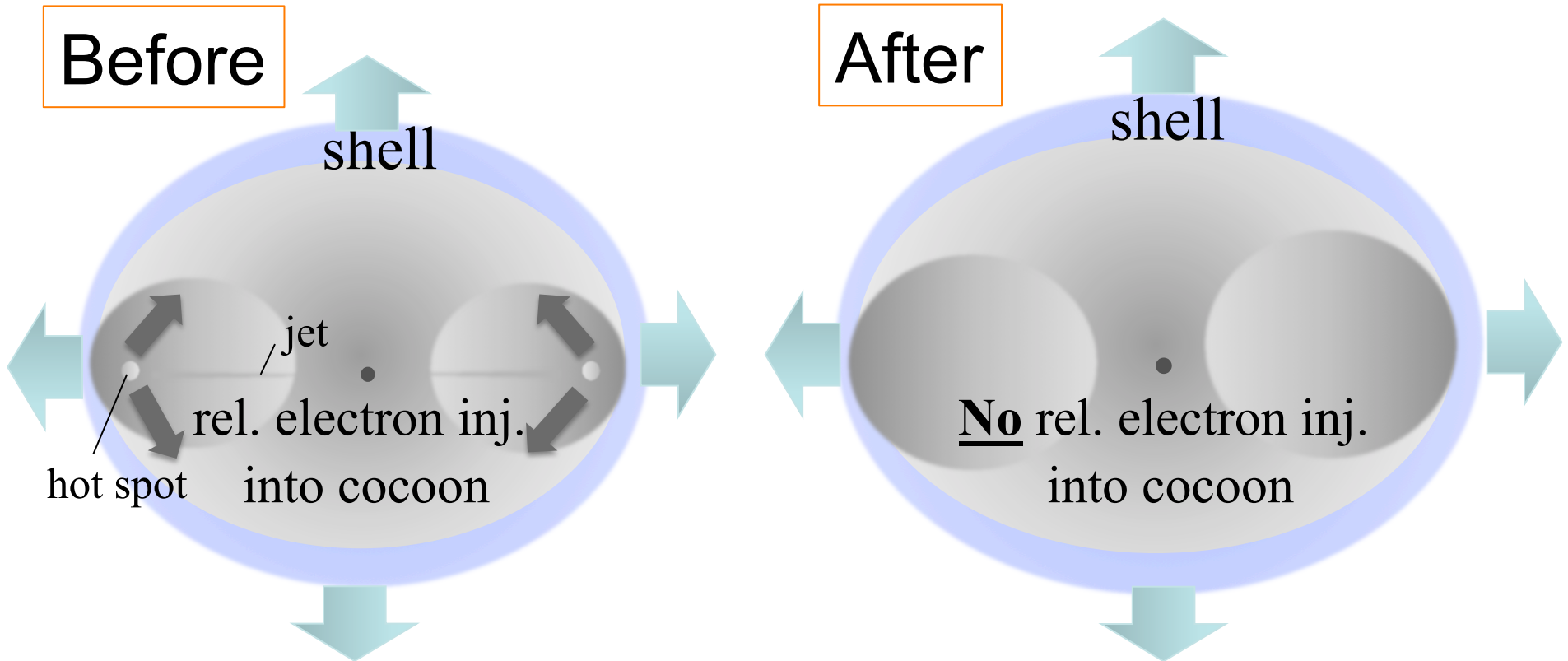
It is difficult to observe them...

Ito, MK, Kawakatu & Orienti, ApJ (2015), *in press*
(arXiv:150408166)

Fate of dead Radio Loud AGNs: new prediction of long-lived shell emission

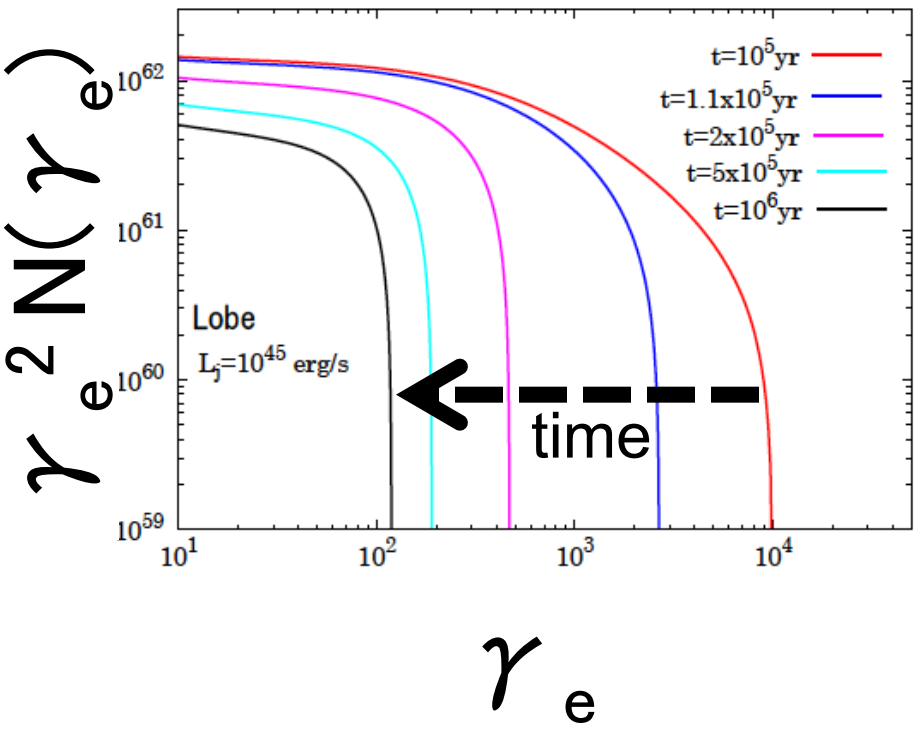
Key idea: What if jet stops? Fossil shell !

After the jet stops, the cocoon will fade out without rel. electron injection, while the shell continues to shine via forward shock.

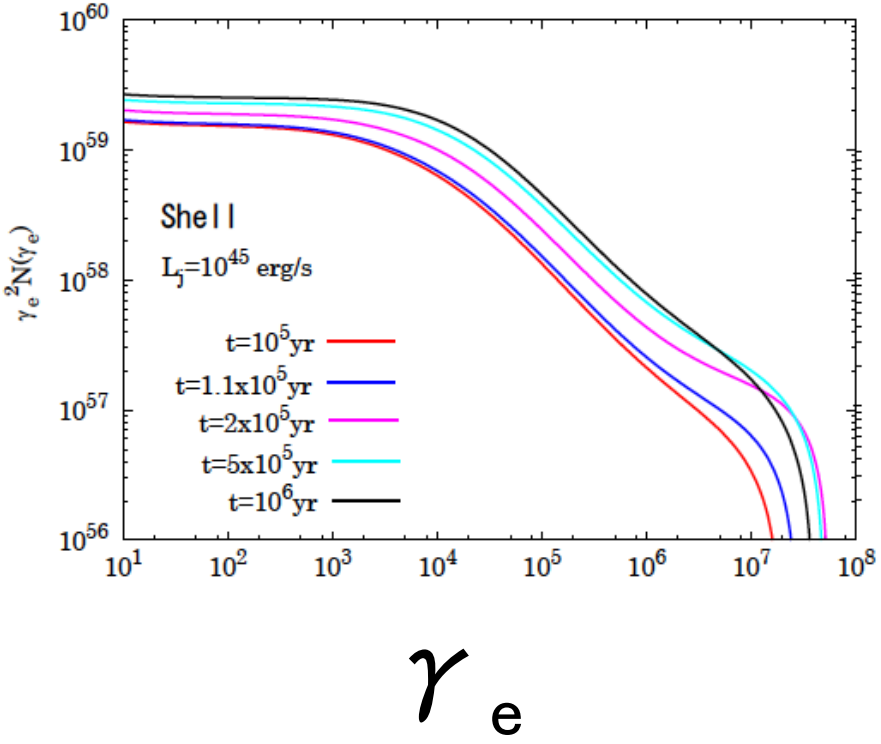


Evolution of Electron Spectra

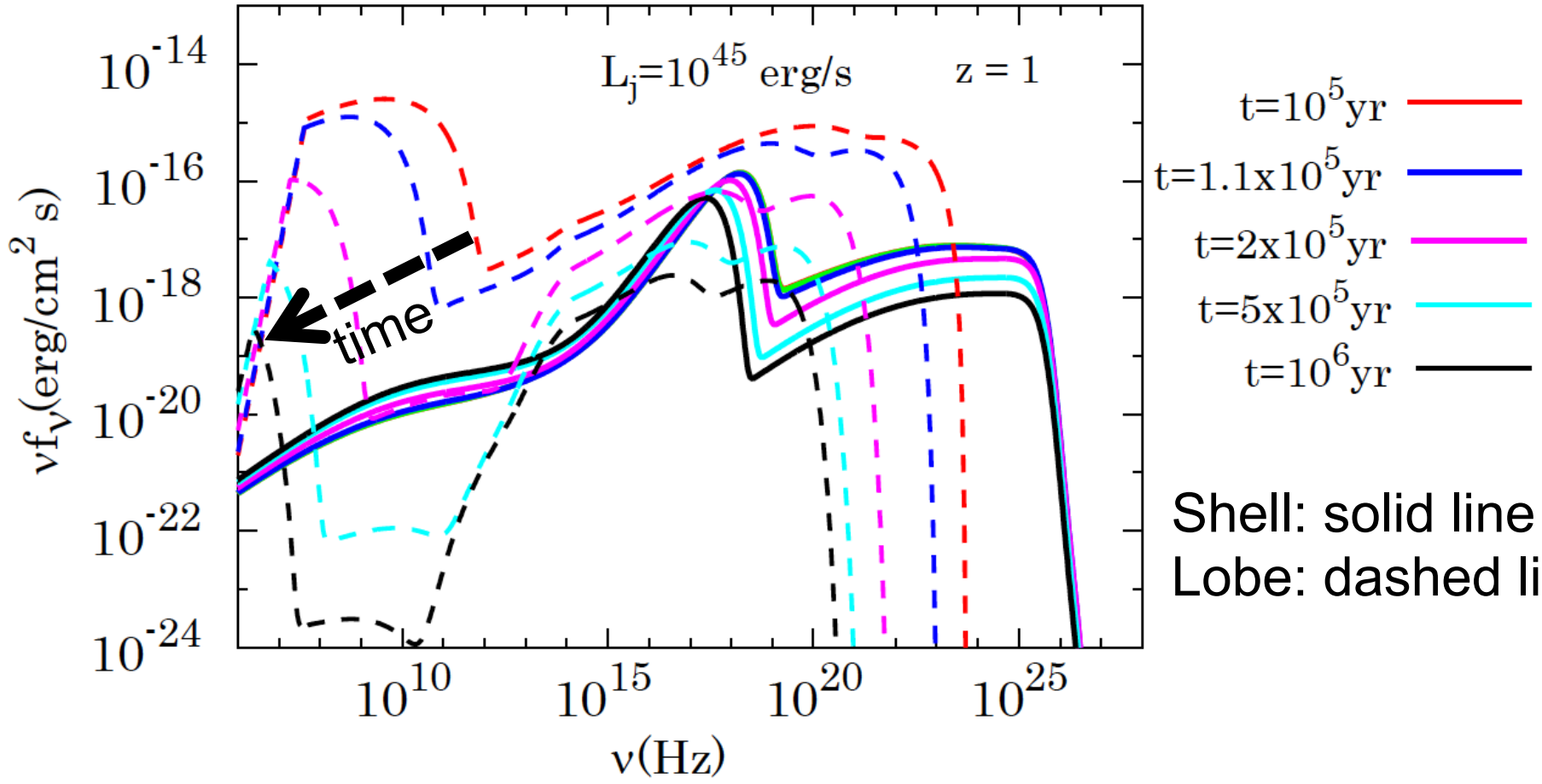
Lobe/cocoon: rapid cooling



Shell: little change



Corresponding evolution of photon spectra

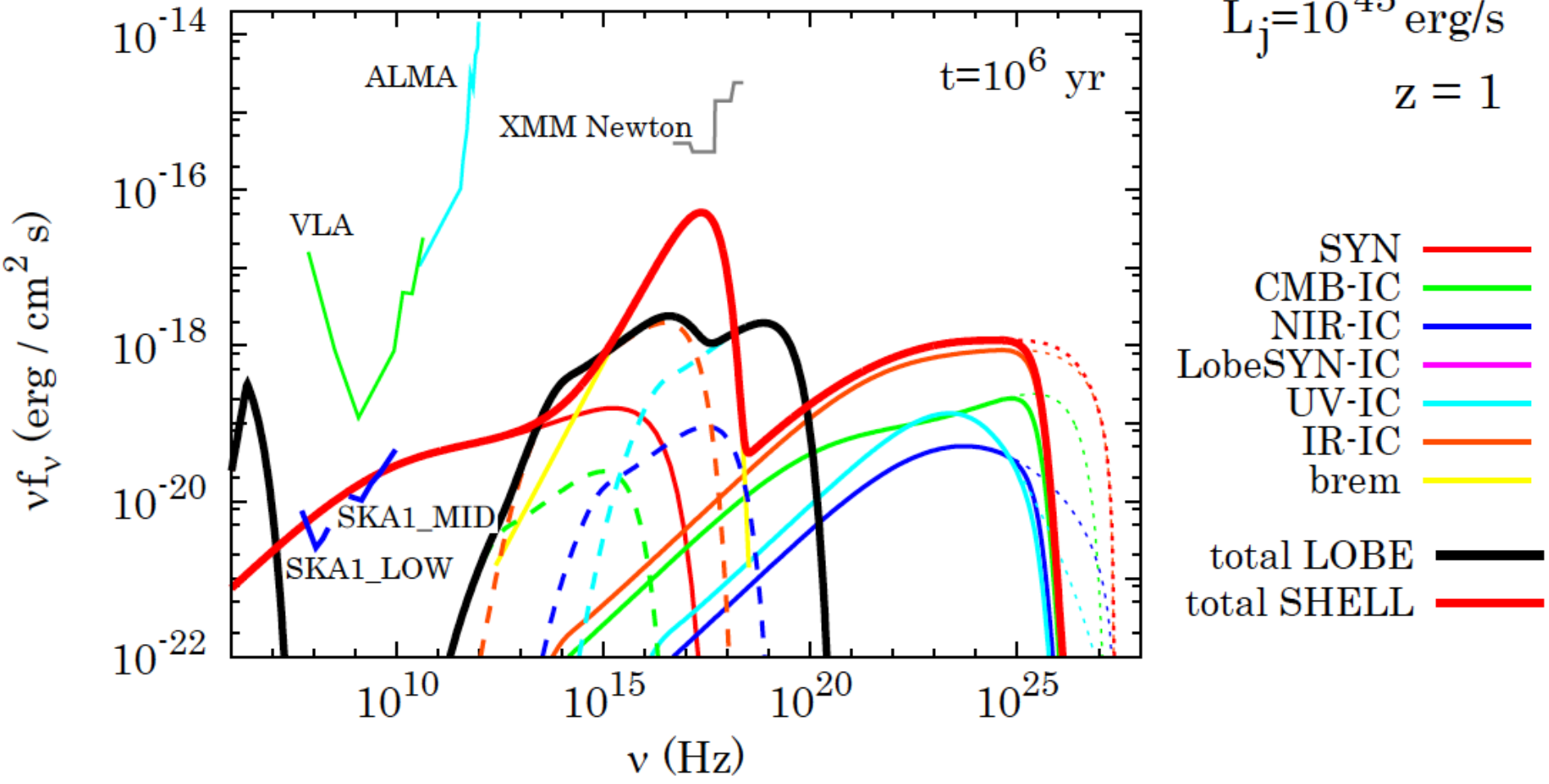


Shell: solid line
Lobe: dashed line

Fossil Shell as a new class of SKA target!

$L_j=10^{45}$ erg/s

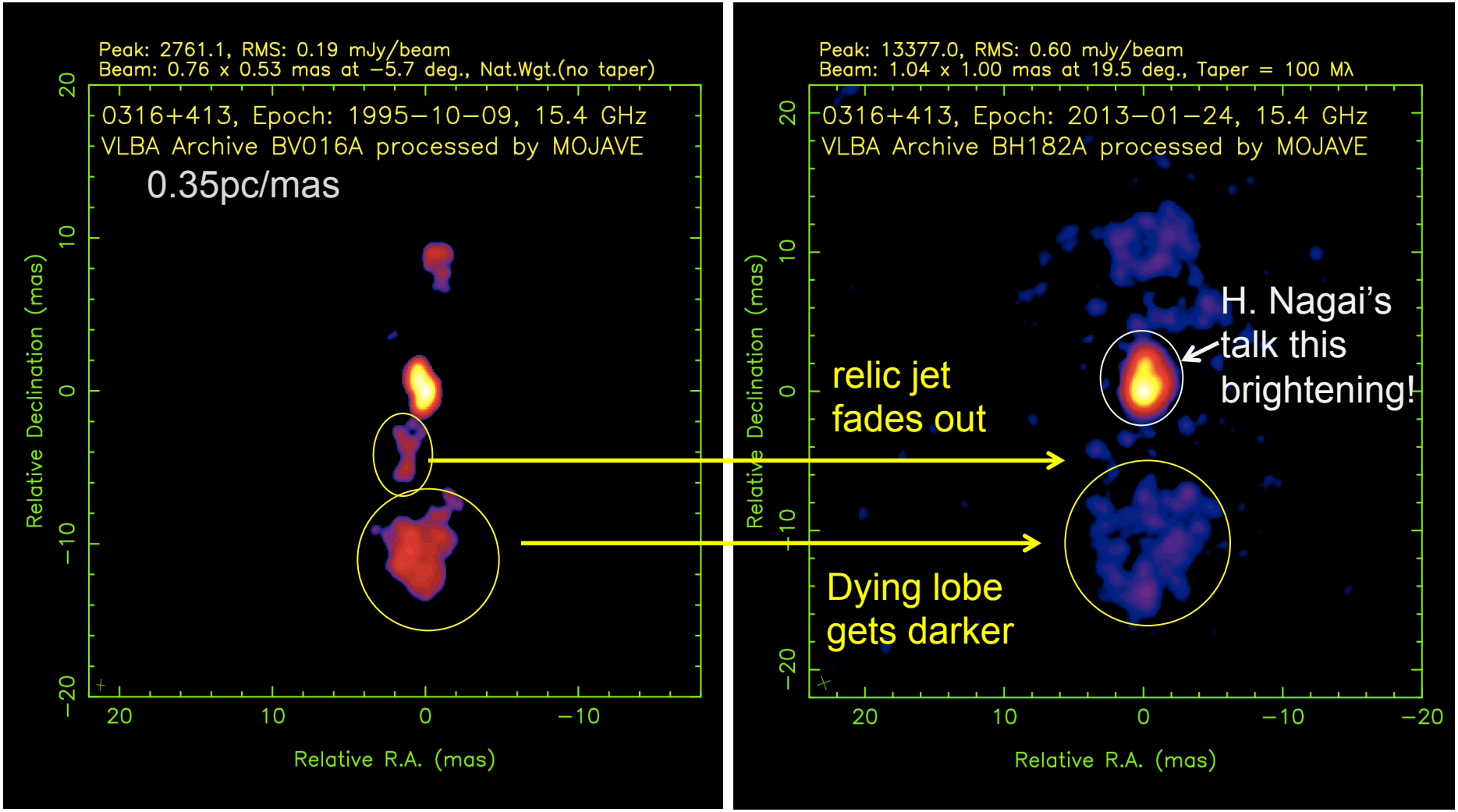
z = 1



Kino et al. in prep

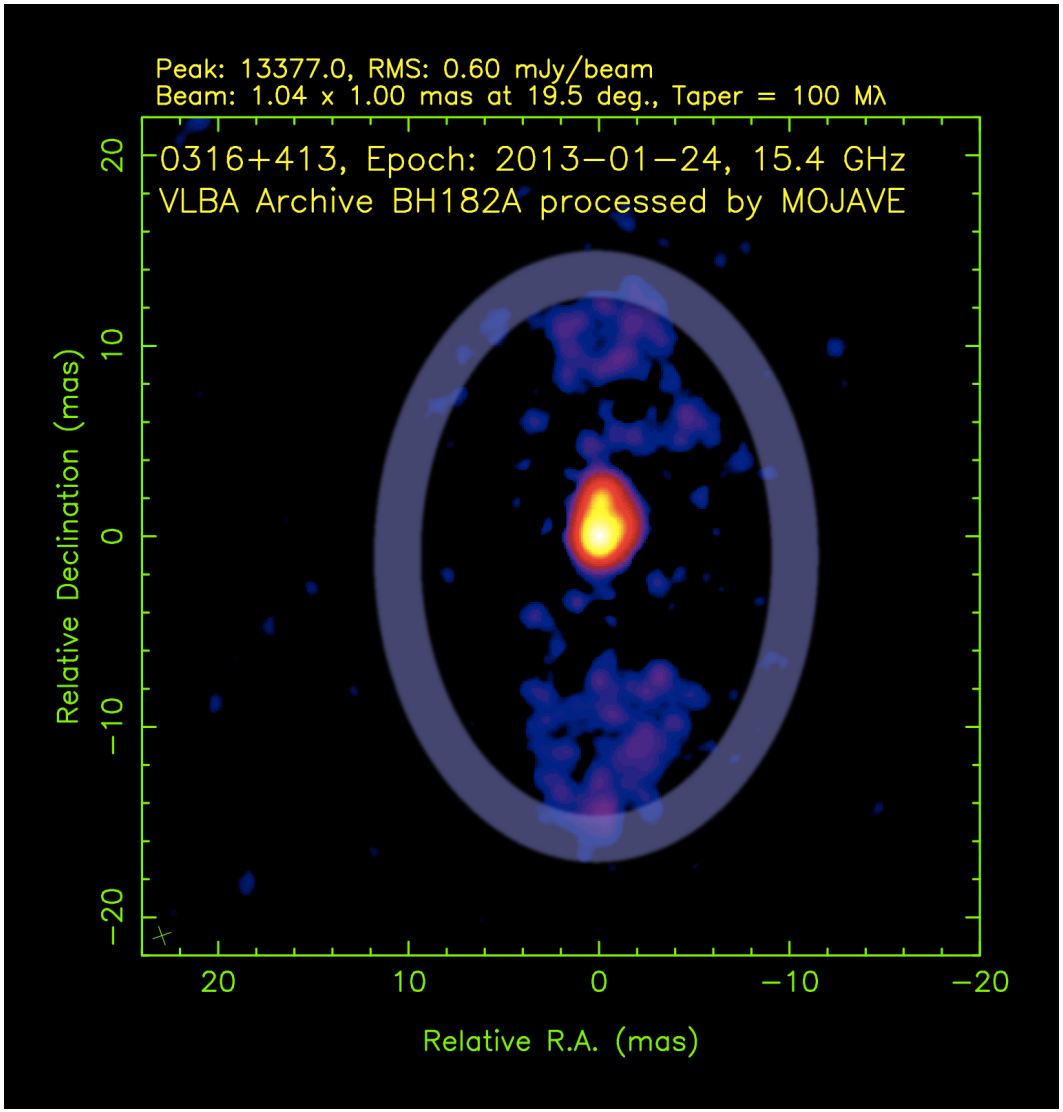
application to 3C84 (briefly)

Dying radio lobe



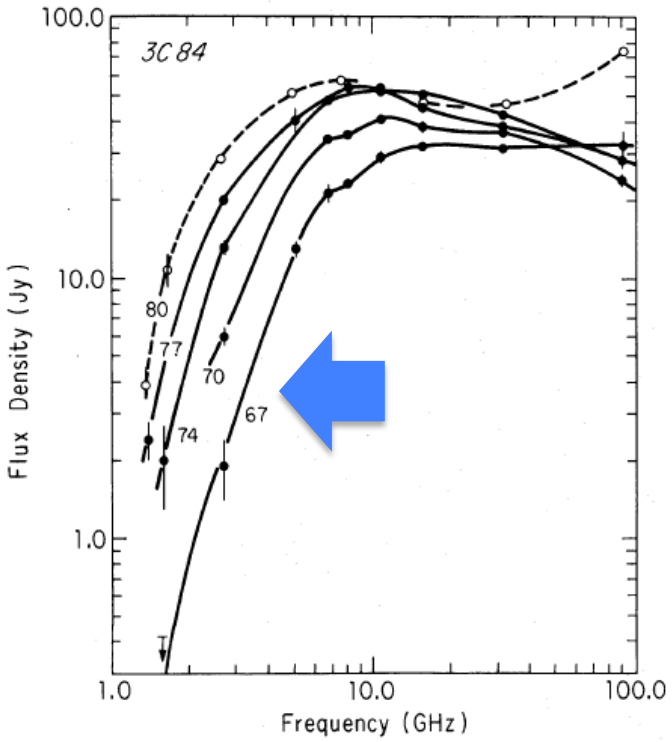
Data from MOJAVE archive

Faint shell would be associated. Can we detect relevant emission?

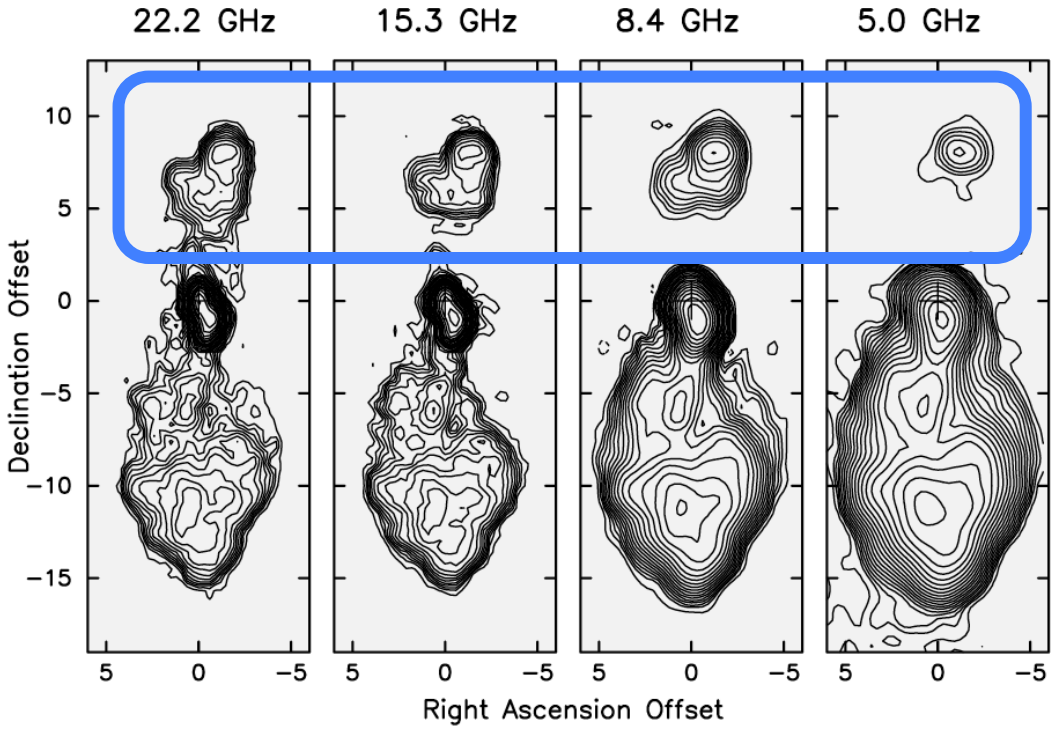


Don’t forget the existence of dense FFA plasma

O’Dea+ 84

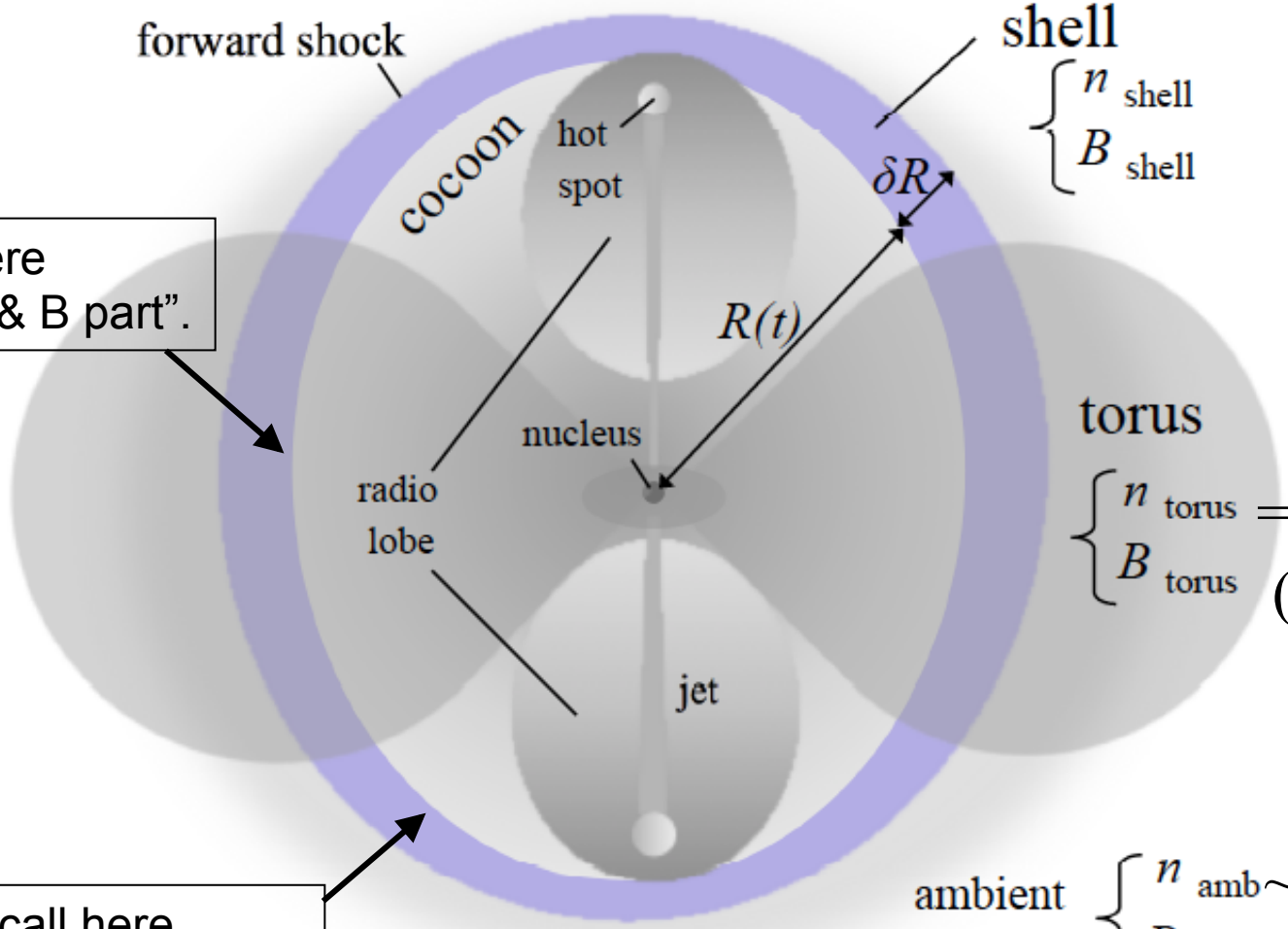


Walker+ 00



$n_e = 2 \times 10^3$ cm^{-3}
(O’Dea+84)

Overall picture of 3C84 (edge-on view)

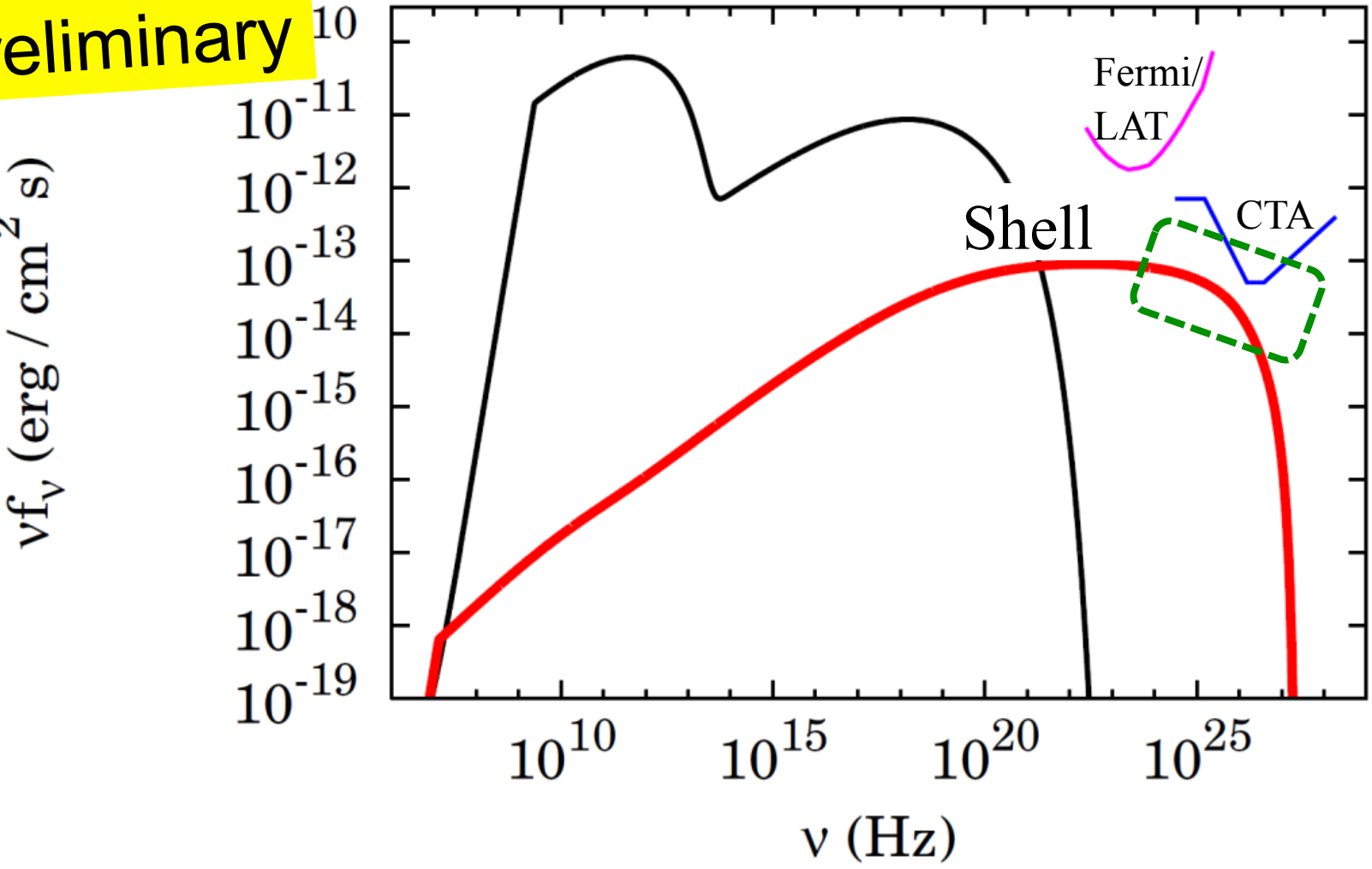


We call here "high n_e & B part".

We call here "low n_e & B part".

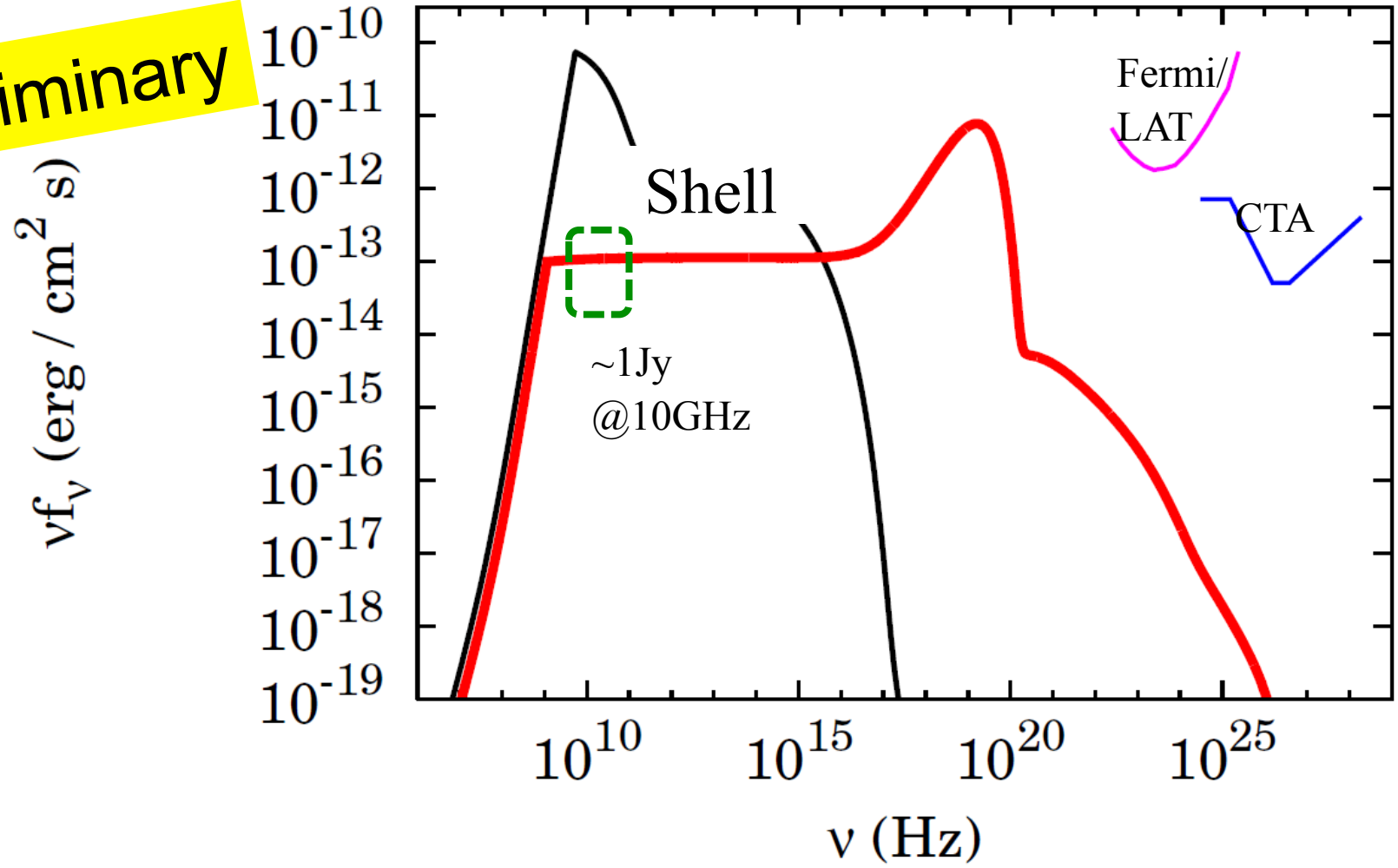
spectra @ low n_e & B part
Inverse Compton Dominated

Preliminary



spectra @ high n_e & B part
Synchrotron Dominated

Preliminary



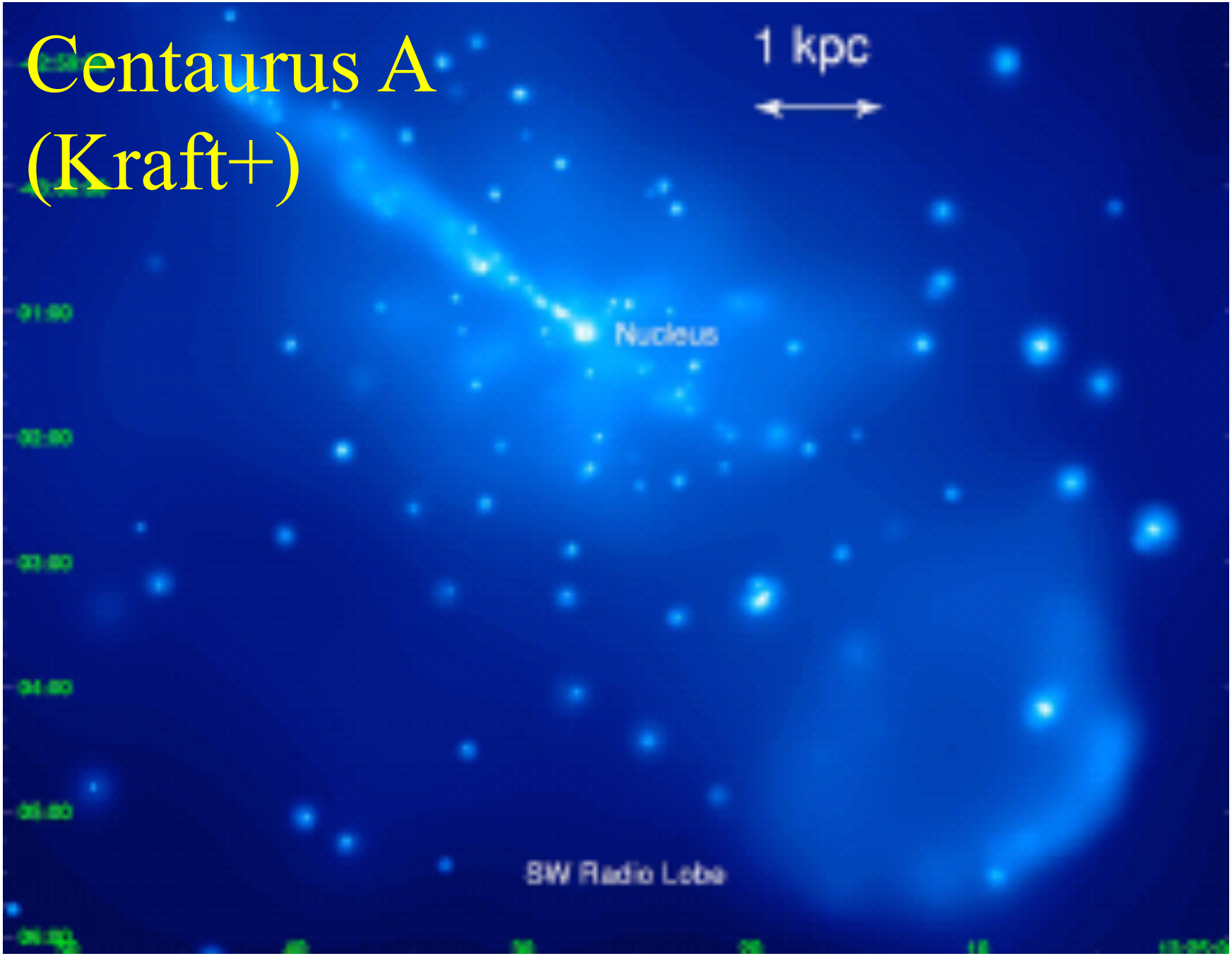
Summary

- Fossil shell as a new class of SKA target.
  Ito, MK, Kawakatu & Orienti (2015), ApJ, in press

- Fossil shell model is applied to the well known dying radio lobe in 3C84.
  - At the high n_e & B region (i.e., shocked torus), the emission can be detected in VLBI range.
  - At the low n_e & B region (i.e., shocked diffuse ambient matter), the emission can be detected in CTA range.
    MK et al. in prep

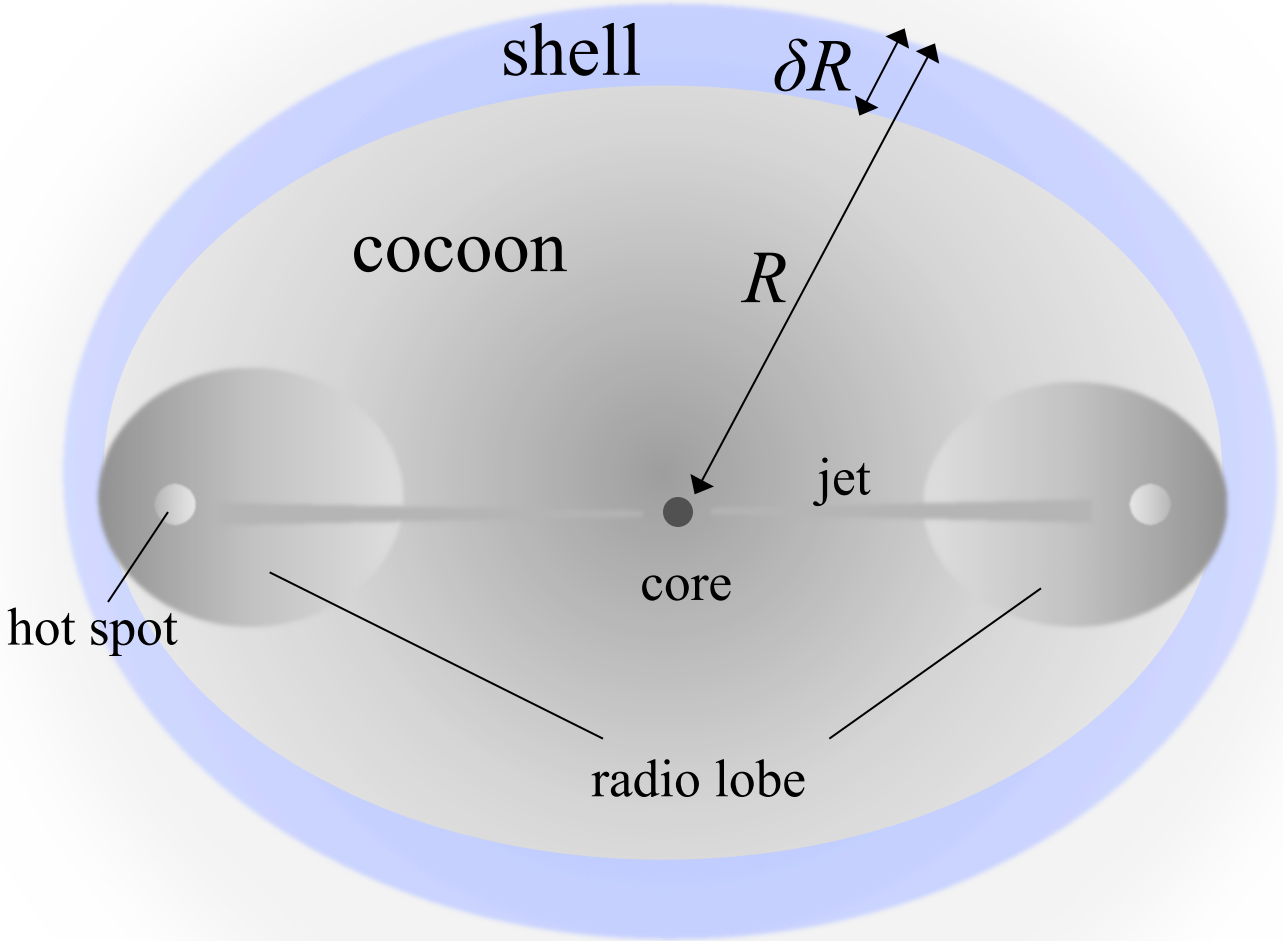
Back-up Slide

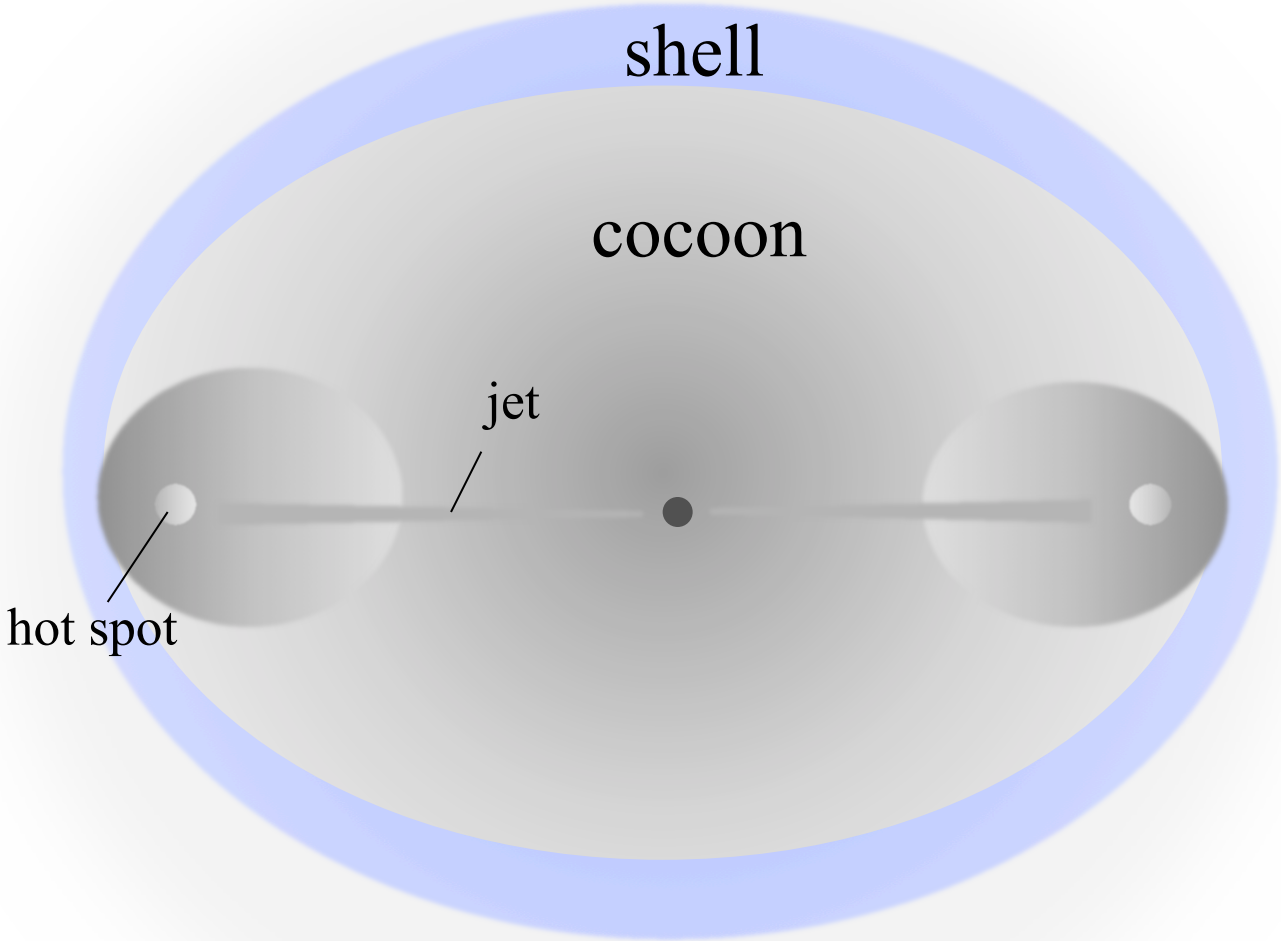
Centaurus A (Kraft+)



quantities

	size	magnetic field	ref
RIAF (by SMA/CALMA)	0.2-8 pc	~800uG? (RM~9*10^5rad/m^2)	Planbeck+14
C3	~0.13mas	50-370uG (SED)	Abdo, Nagai, Suzuki
lobe	~6pc, ~15mas		Taylor+06, Asada+ Walker+00
lobe's tip (hotspot)	~2mas	50 uas<= Foreground filament(周辺媒質) w/ 1pc path-l 幾何依存極端なのでok?	Taylor+06
milli-halo (inner-jetにとっては周辺媒質)	~200pc, ~500mas	~200 uG (eq w/ hot gas)	Silver+98
central region (inner-jetにとっては周辺媒質)	<2kpc	~300 uG (eq w/ hot gas)	Taylor+06


shell
δR
cocoon
R
jet
core
hot spot
radio lobe


shell
cocoon
jet
hot spot