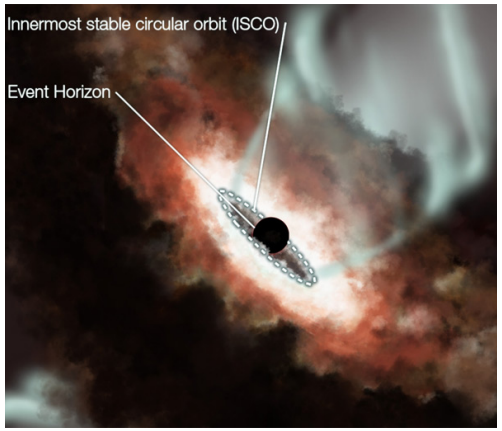
M87 seen at 230GHz



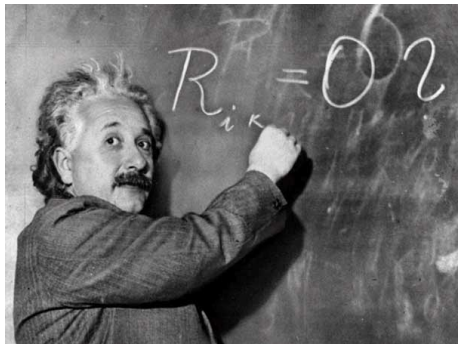
Motoki KINO

(KASI)

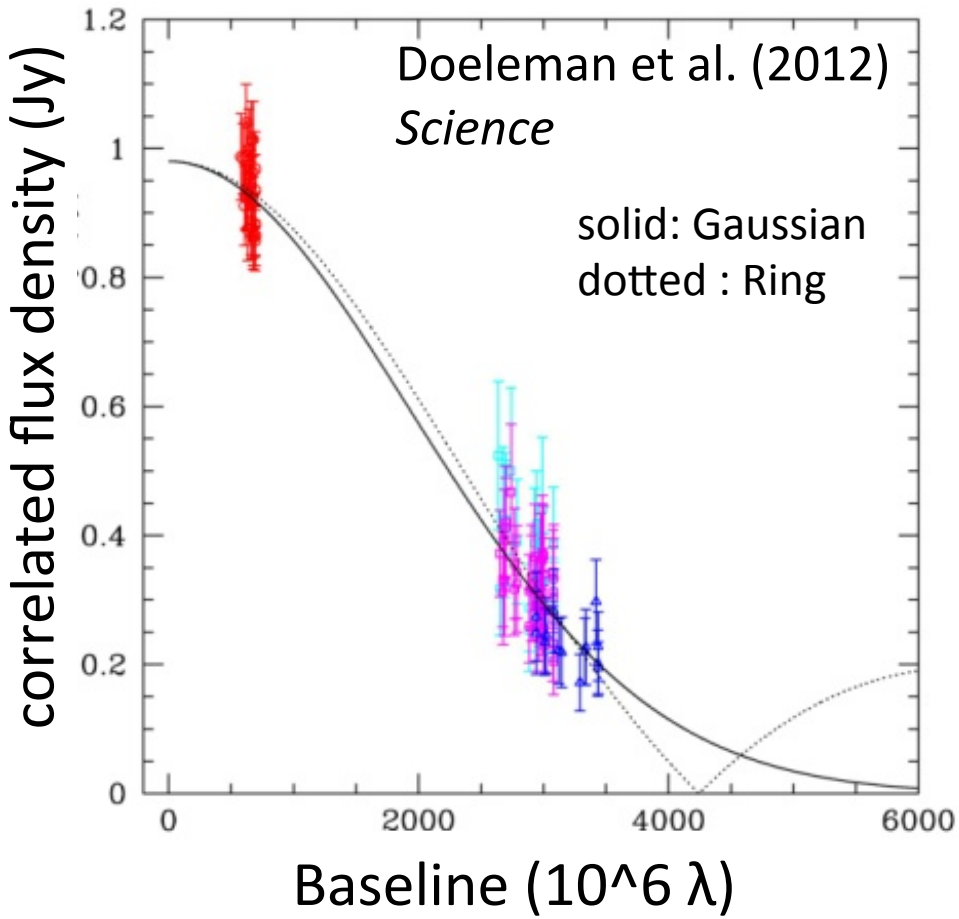
East Asia VLBI workshop @Hokkaido Univ. (2015 July)

Motivations

- We want to see “BH-shadow”.
- We want to know “jet-launch” mechanism.



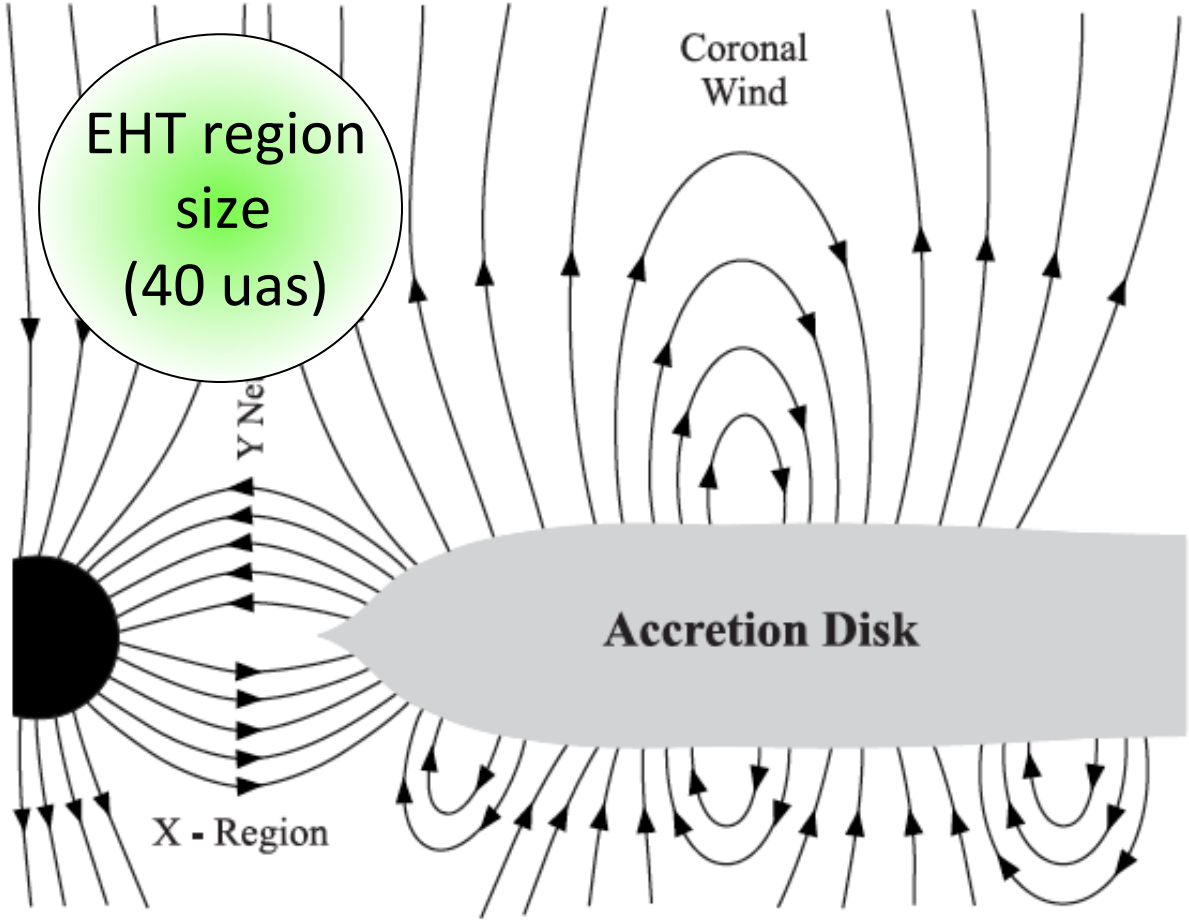
EHT detects synchrotron emission at the jet base of M87 @230GHz



The 230GHz emission region size is 40 μas.

The emission region size is ~6Rs!
That is why theorists also get excited!

1 Rs -> 7μas
(6*10^9M$_\odot$)



cartoon by
de Gouveira Dal Pino+

Kino, Takahara, Hada+ ApJ, 2015

<u>Fully SSA-thick one-zone</u> (θ_{FWHM}=40μas, 1Jy)
leads to too large L_poy?!

If EHT region is fully SSA-thick, then B~300 G. In this case, Poynting power exceeds L_jet, max ~ $5*10^{44}$ erg/s. Something's wrong.

EHT region size (40 μas)

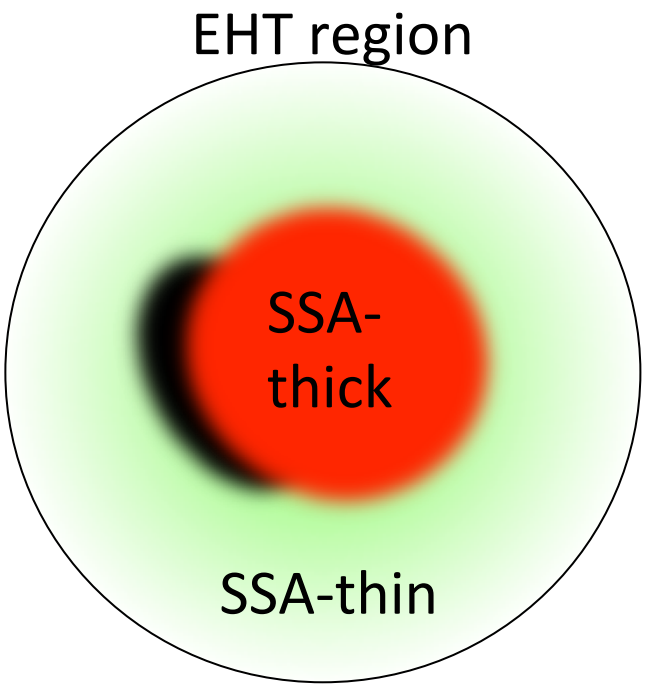
$$L_{\rm poy} = 1.5 \times 10^{47}\ {\rm erg\ s^{-1}} \times \left(\frac{B_{\rm tot}}{300\ {\rm G}}\right)^2 \left(\frac{2R}{1.8 \times 10^{16}\ {\rm cm}}\right)^2.$$

40 μas

?

Kino, Takahara, Hada+ ApJ, 2015

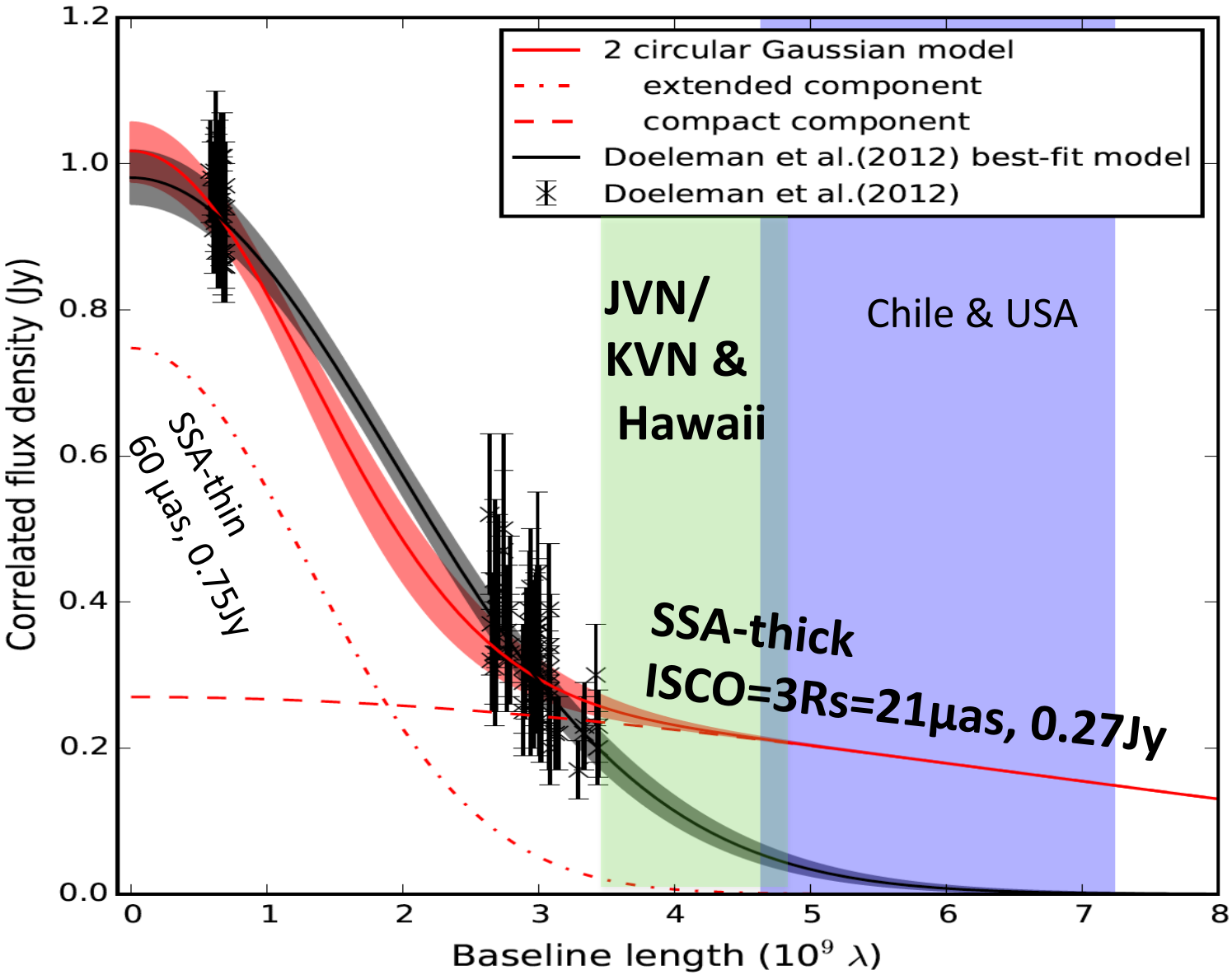
Solution: Partially SSA-thick



- The idea of partial-SSA-thick region can avoid too-large-L_poy problem because B ∝ ν_{ssa} ^5.
- If BH mass is smaller, then BH-shadow may be hidden by the SSA-thick region.

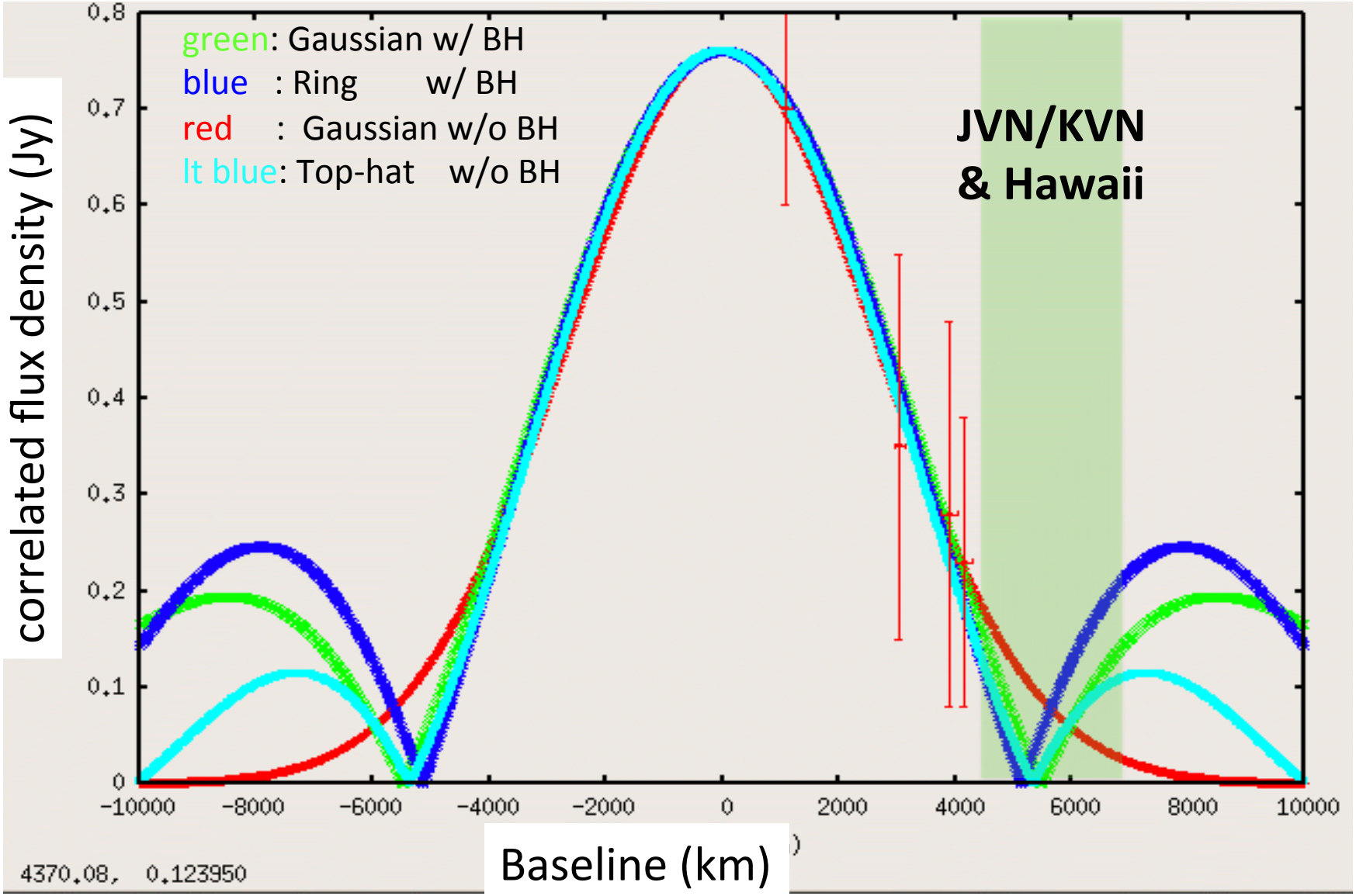
Kino, Takahara, Hada+ ApJ, 2015

ISCO give us the upper limit flux of the SSA-thick region

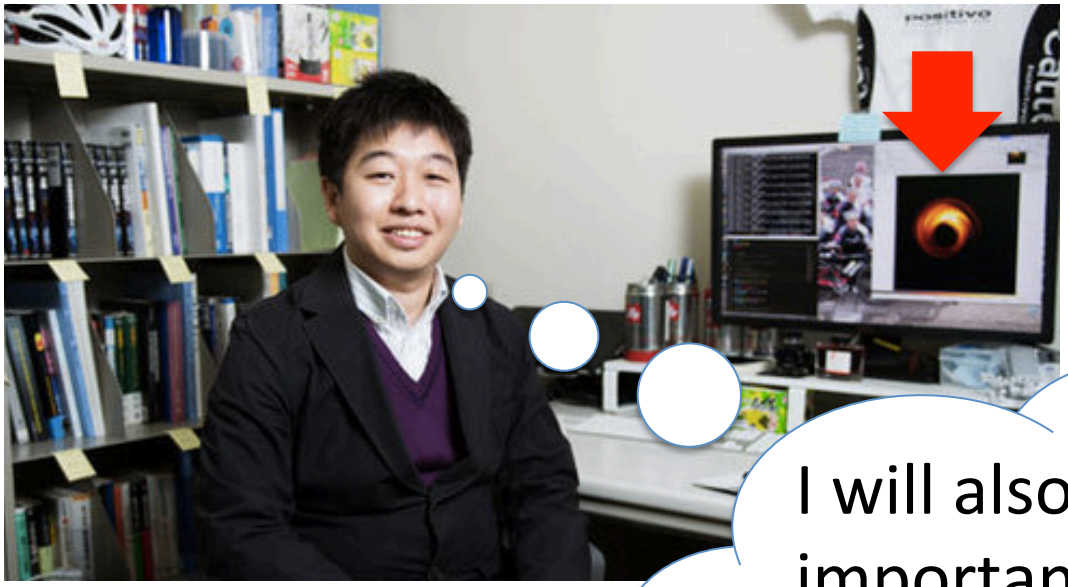


Toy Model Prediction of corr. flux density

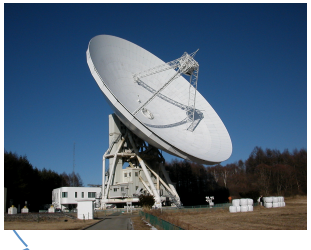
(simulation by Satomi Nakahara, under-grad work)



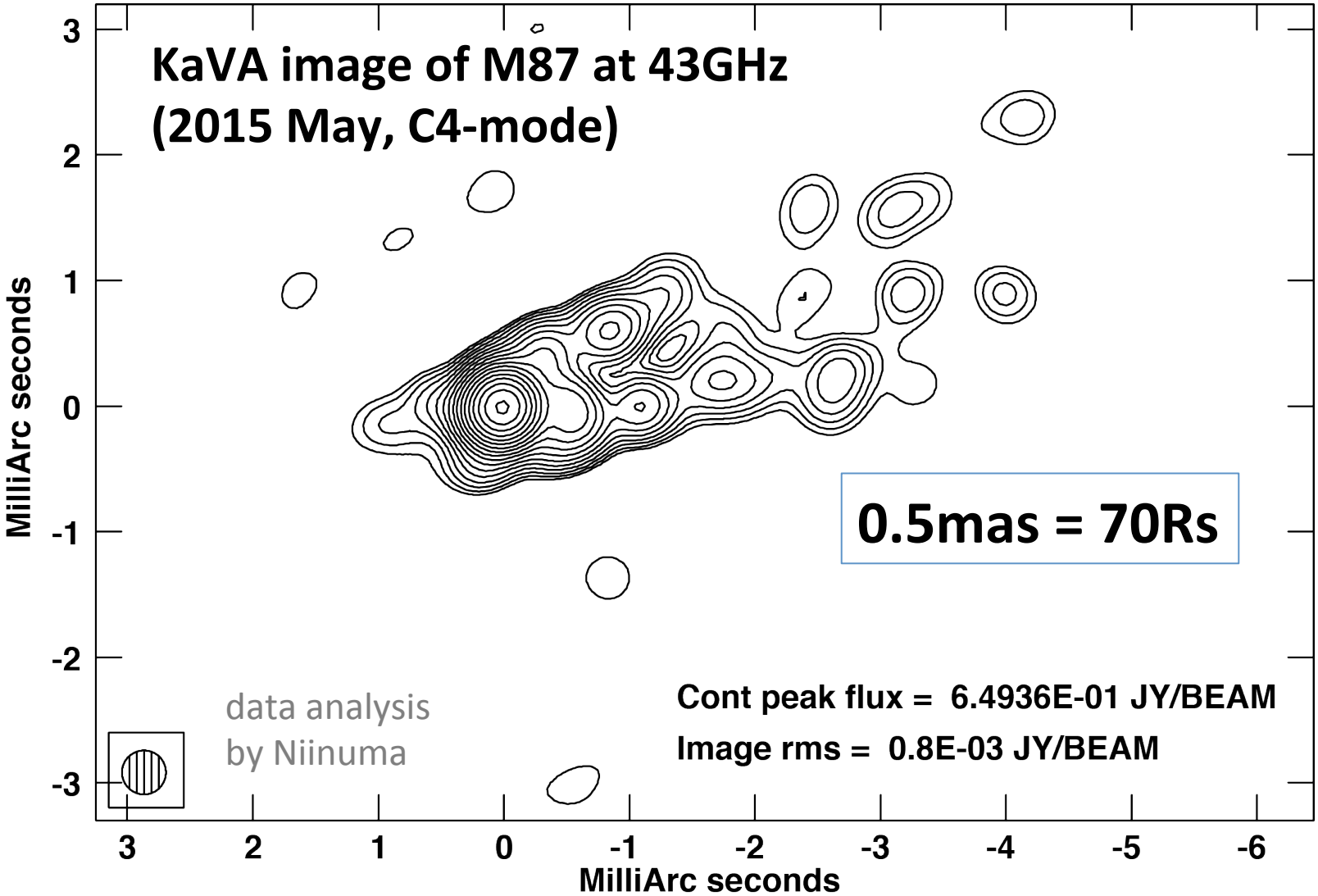
More realistic case for M87 will be presented by Akiyama-san!



I will also show you the importance of Nobeyama 45m!



Importance KaVA monitoring at 22/43GHz will be presented by Hada-san!



Summary

- The issues "BH-shadow" and "jet-launching" are tightly connected. SSA-thick (*B*-dominated) region **@230GHz** might partially hide "BH-shadow".

  Kino, Takahara, Hada et al. ApJ (2015)

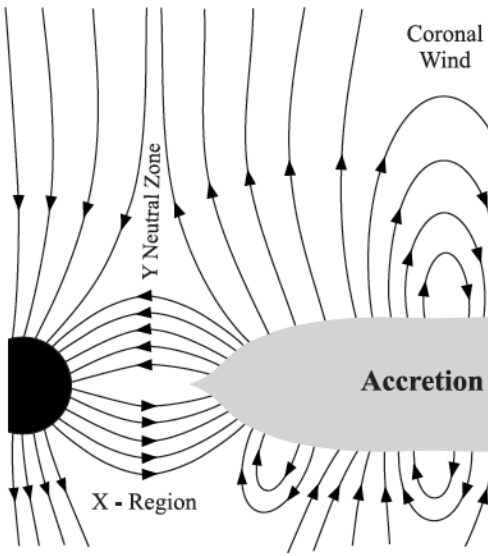
- **JVN/KVN-Hawaii** baselines are essential for discriminating "BH-shadow" models **@230GHz**.

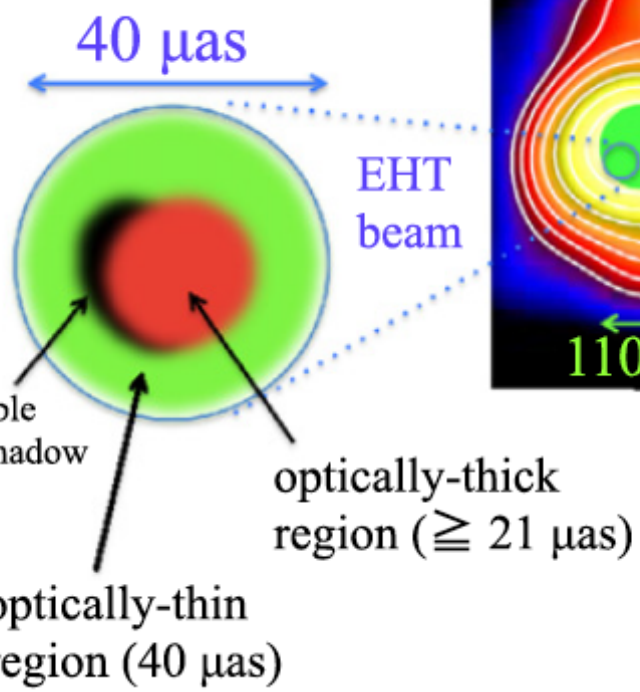
  Akiyama-san's talk

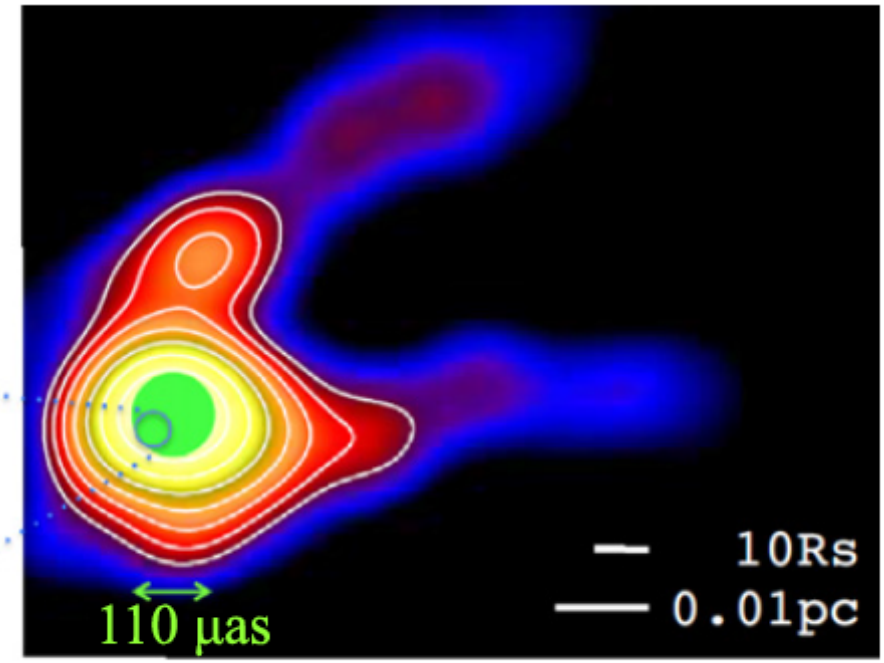
- **KaVA@22/43GHz** is a strong tool to prove "jet-launching/acceleration" in the range 70 Rs – 1400 Rs.

  Hada-san's talk

“Central Engine” and “BH-shadow” are inside!
This is why theorists also get excited!







jet base of M87
(VLBA at 43GHz)

Allowed log ($U_{\pm}/U_B$), B_{tot} , $\gamma_{\pm,min}$ in the SSA-thick region