Extended LOFAR and Particle Spectrum in Extragalactic Radio Sources

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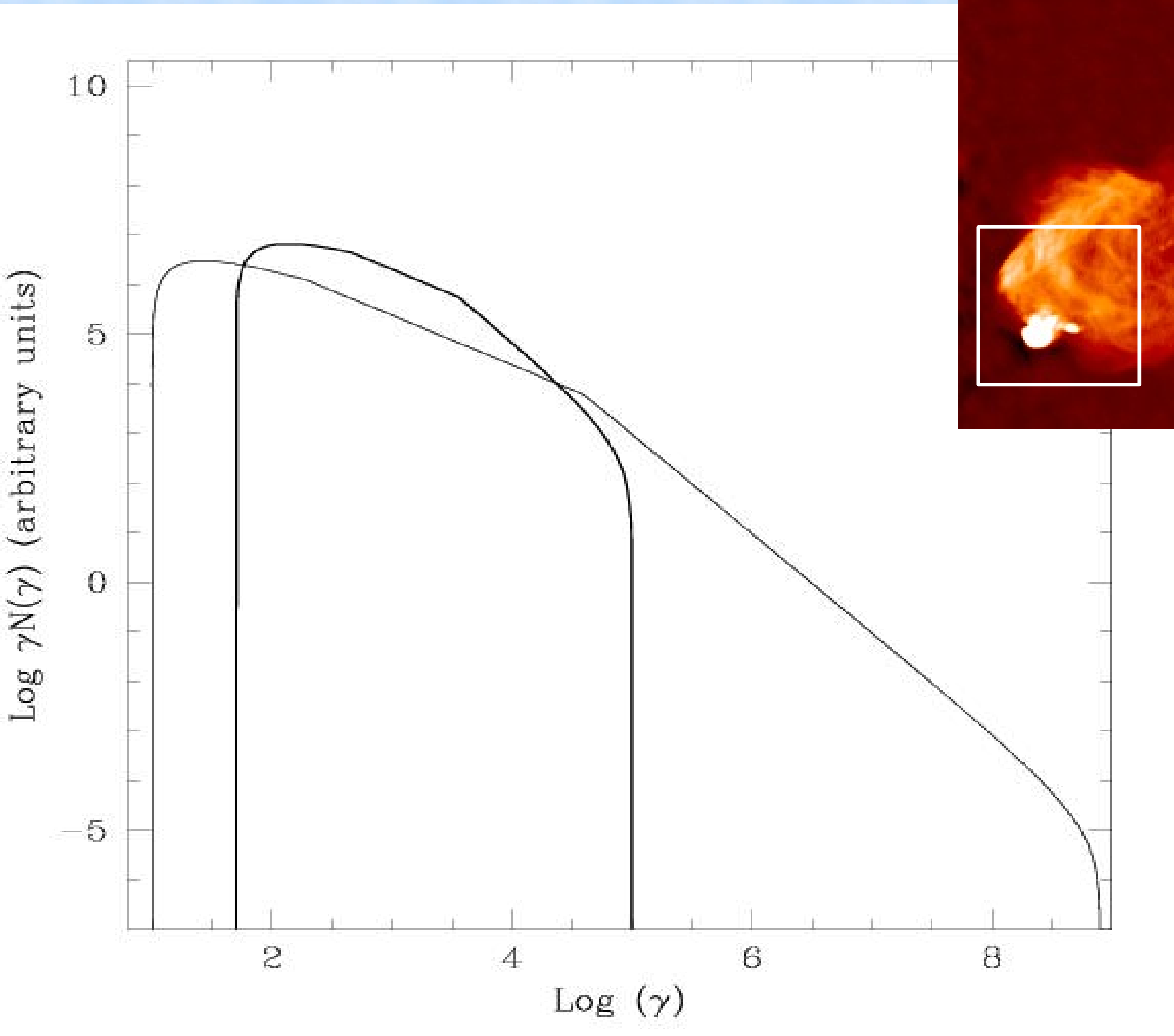
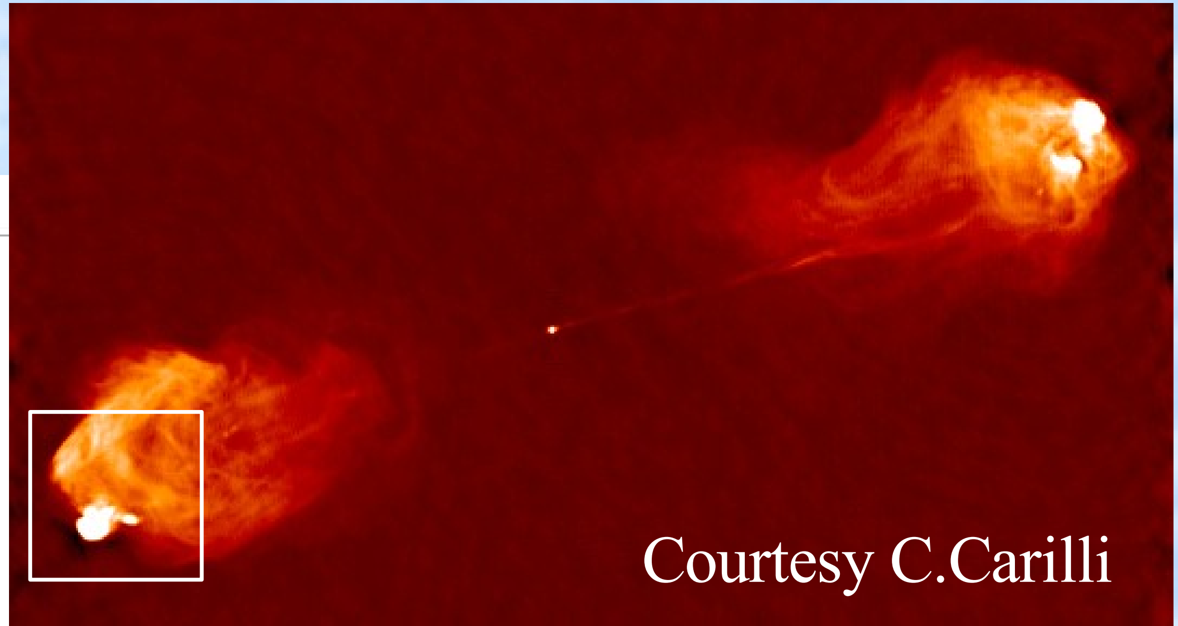
☺ **Low Frequency + High resolution**

⇩

Low energy end of the electron spectrum in RS

Particle Spectrum in Post-Shock Regions





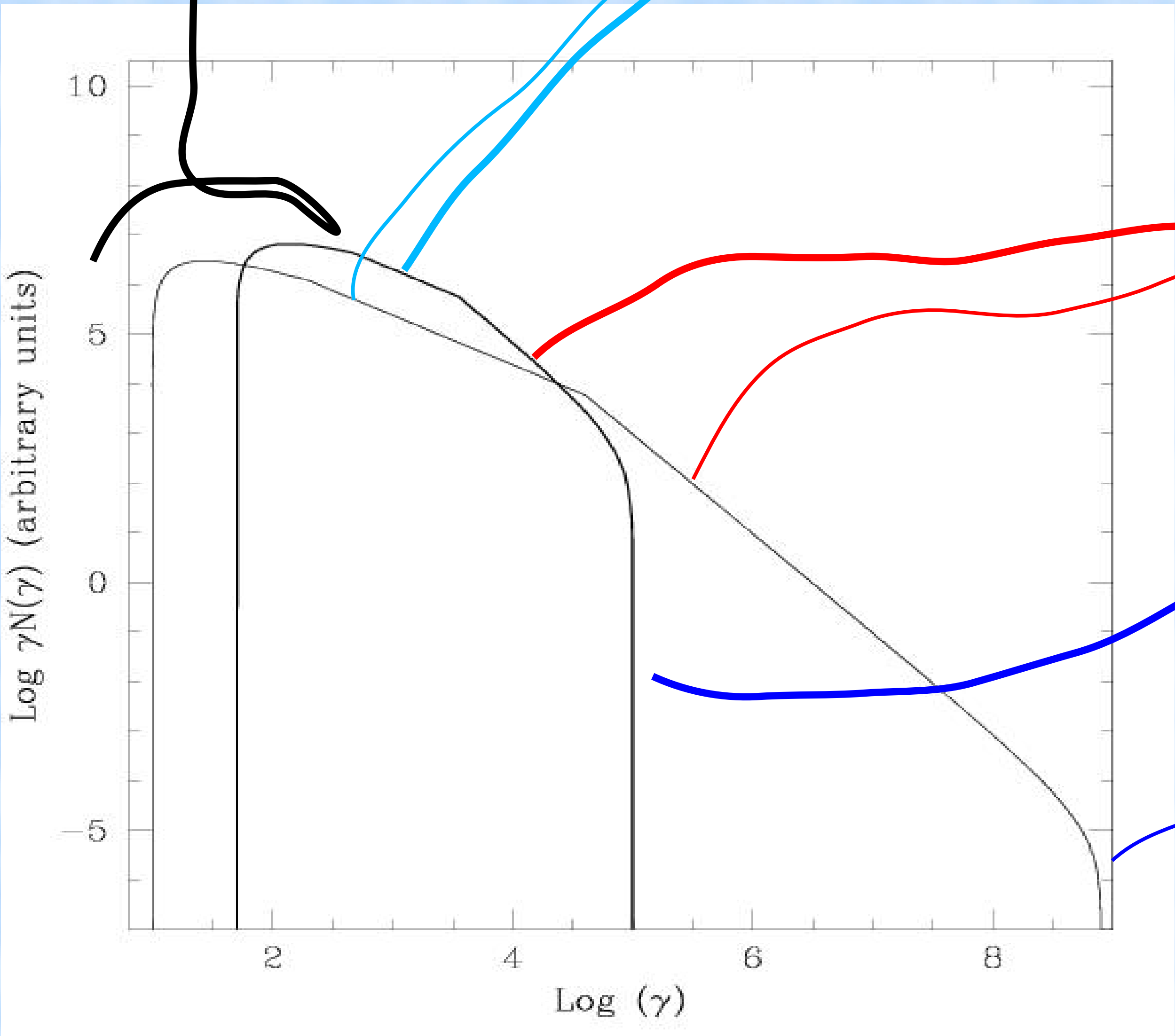
Particle Spectrum in Post-Shock Regions

Injection Problem

Diffusive Fermi

Spatial Diffusion and post-shock losses

Acceleration efficiency losses @ shock



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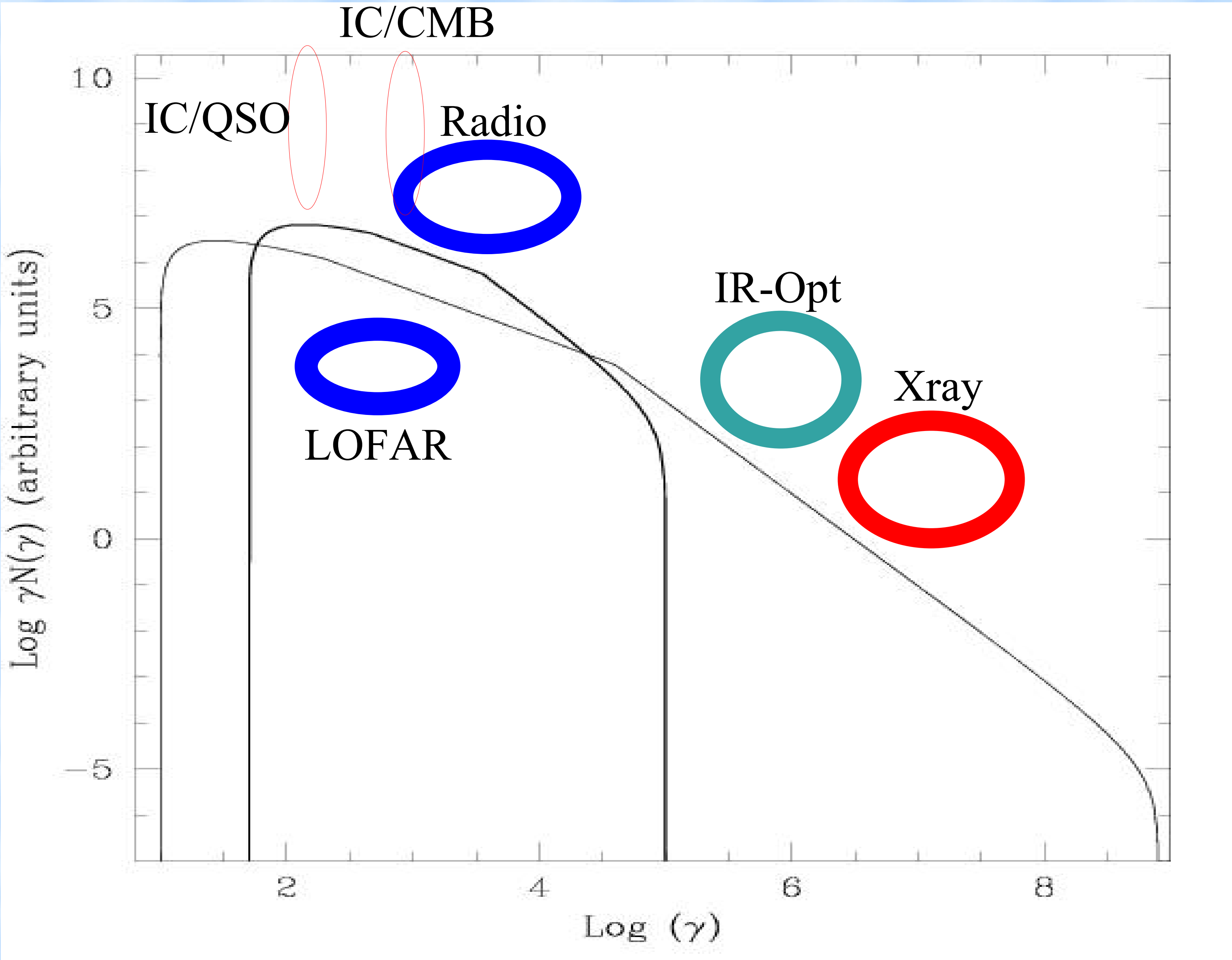

Scalings in Radio Hot-Spots

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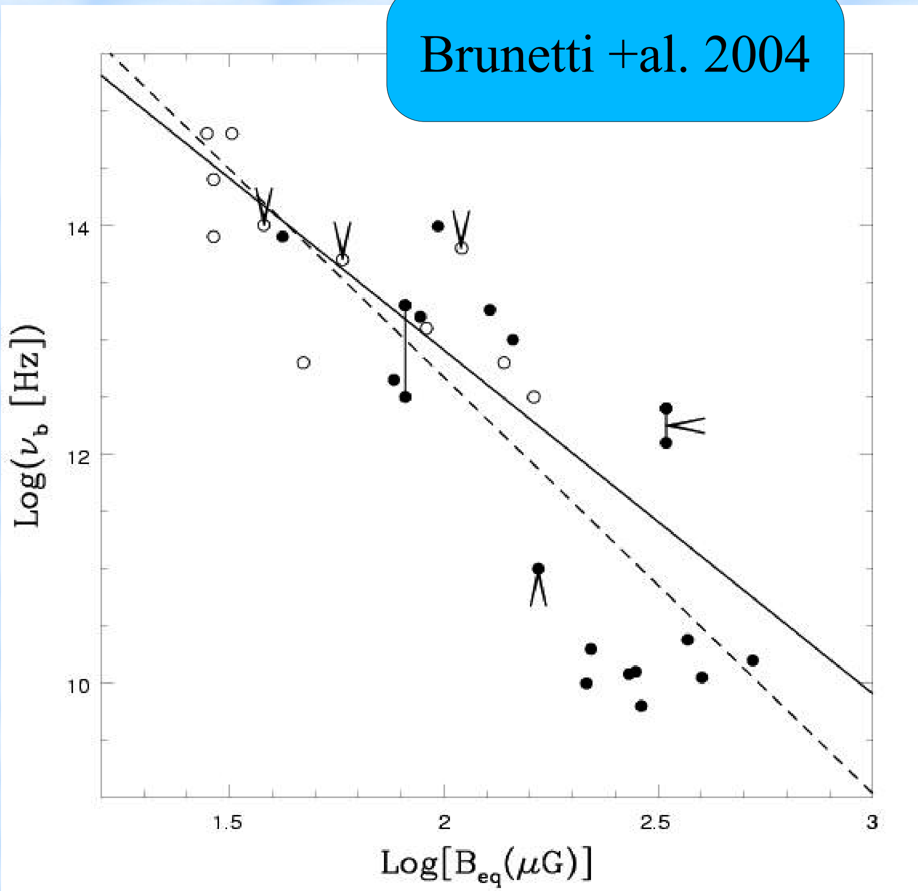
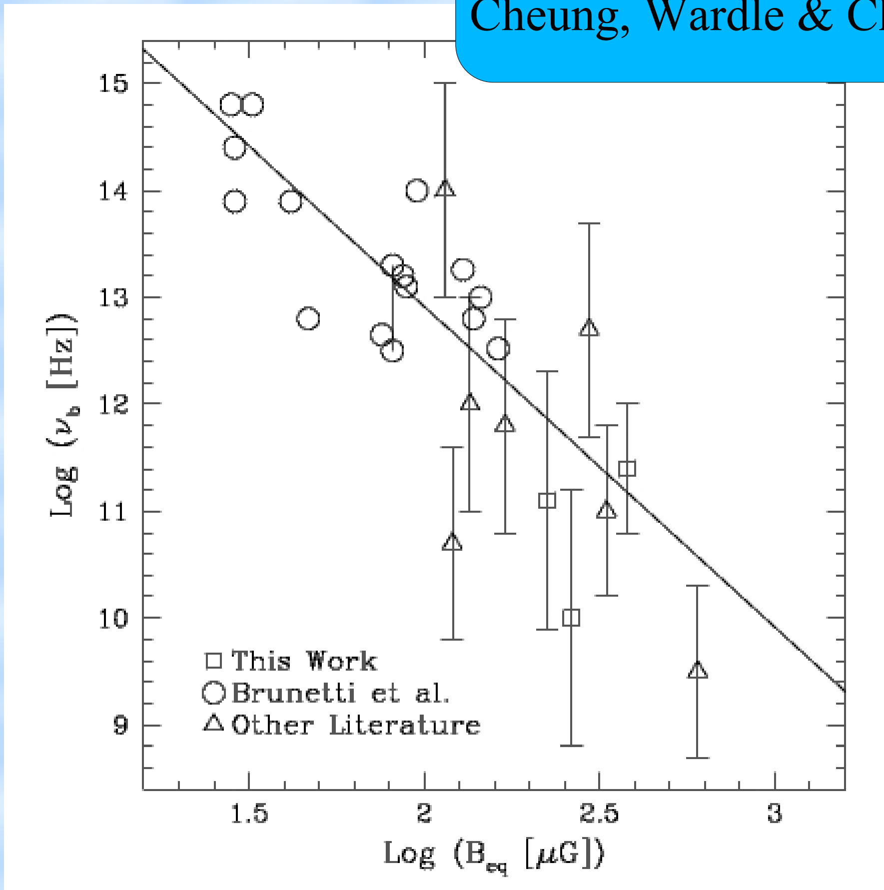
Brunetti +al. 2004



Cheung, Wardle & Chen 2005



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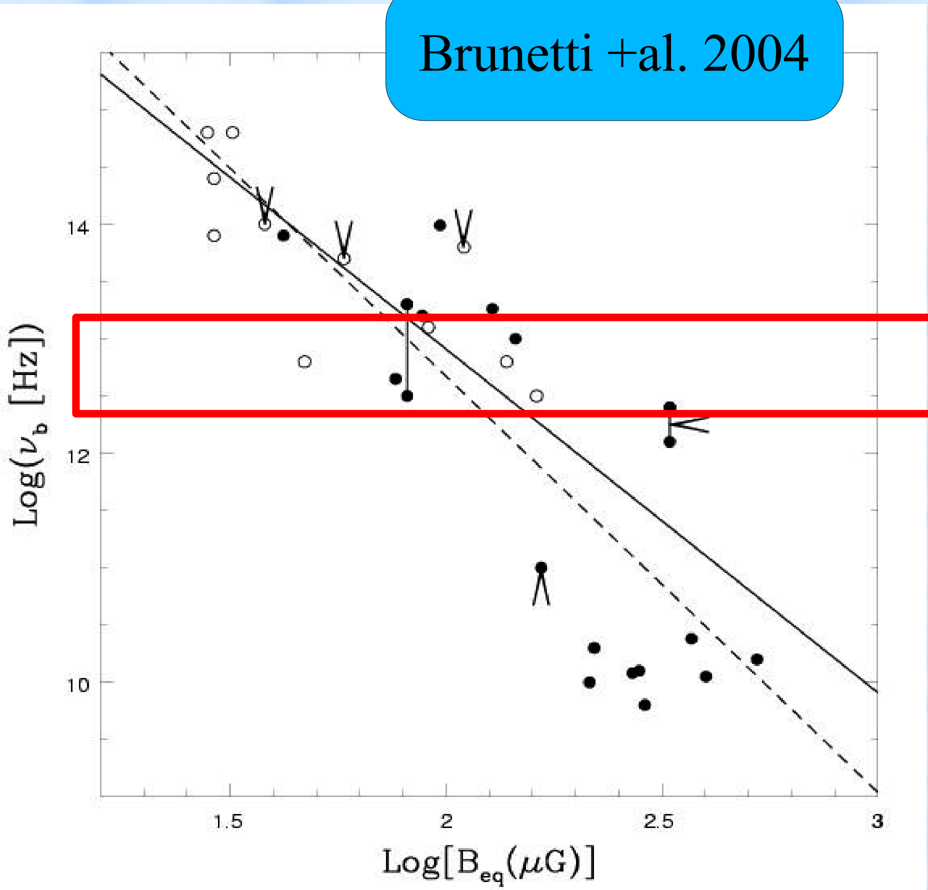

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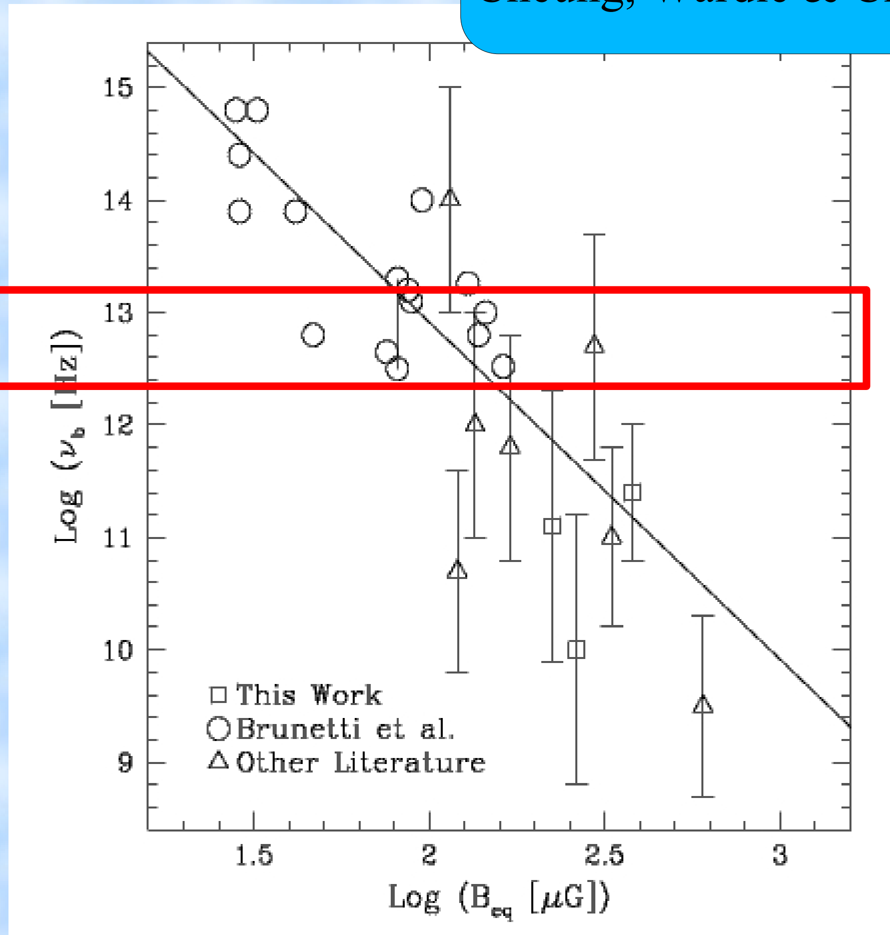

Unique/simple electron population ➔ **bulk of radiation** in the IR band

Catching the bulk of synchrotron radiation with Spitzer

(M. Bondi, GB, G. Setti, K.-H. Mack)

Table 1: Hot-spot list: (1) name; (2) redshift; (3) expected flux at 8 μm; (4) on-source integration time with IRAC; (5) expected flux at 24 μm; (6) on-source integration time with MIPS

Name	z	Exp. Flux 8 μm	Time	Exp. Flux 24 μm	Time
		μJy	s	μJy	s
3C 20 West	0.1740	250 – 400	48	800 – 1400	120
3C 33 South	0.0592	150 – 270	90	500 – 1100	250
3C 111 East	0.0485	450 – 750	48	1000 – 2200	100
3C 303	0.1410	40 – 200	600	140 – 600	400
3C 351 North	0.3719	25 – 100	800	80 – 260	500
3C390.3 South	0.0561	40 – 85	600	100 – 290	500
PICTOR A West	0.0350	1900 – 2700	48	2000 – 6500	100

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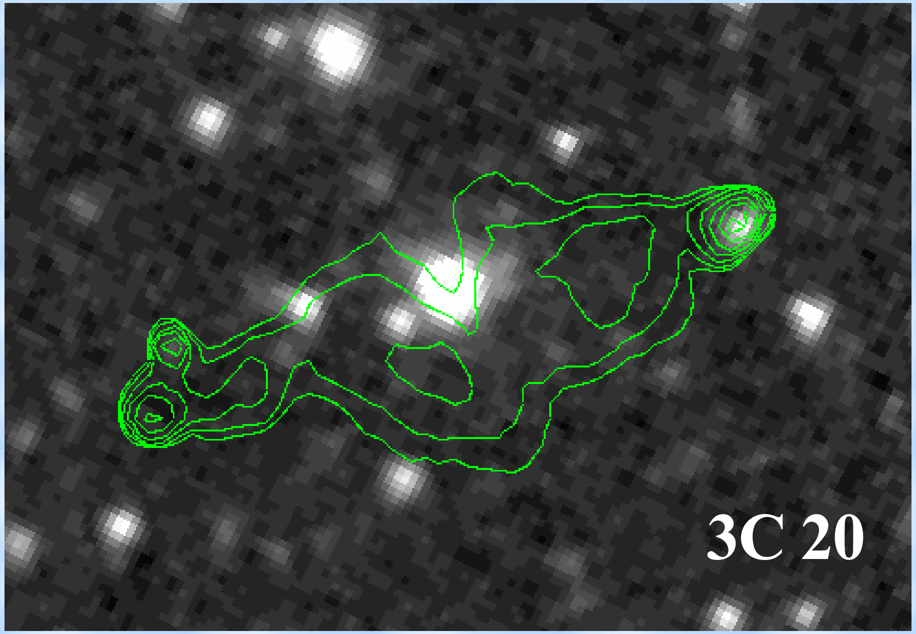
~ 3 hrs

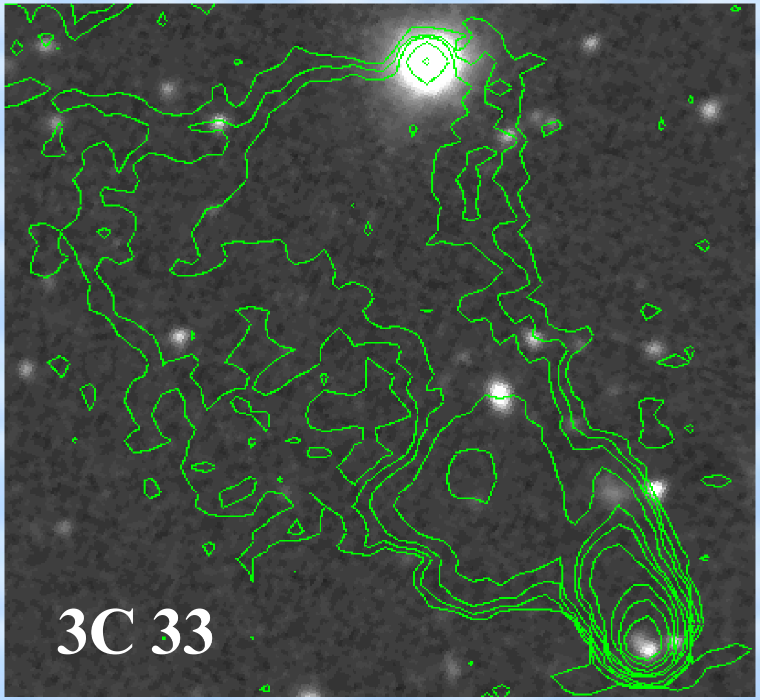
Observations carried out at :

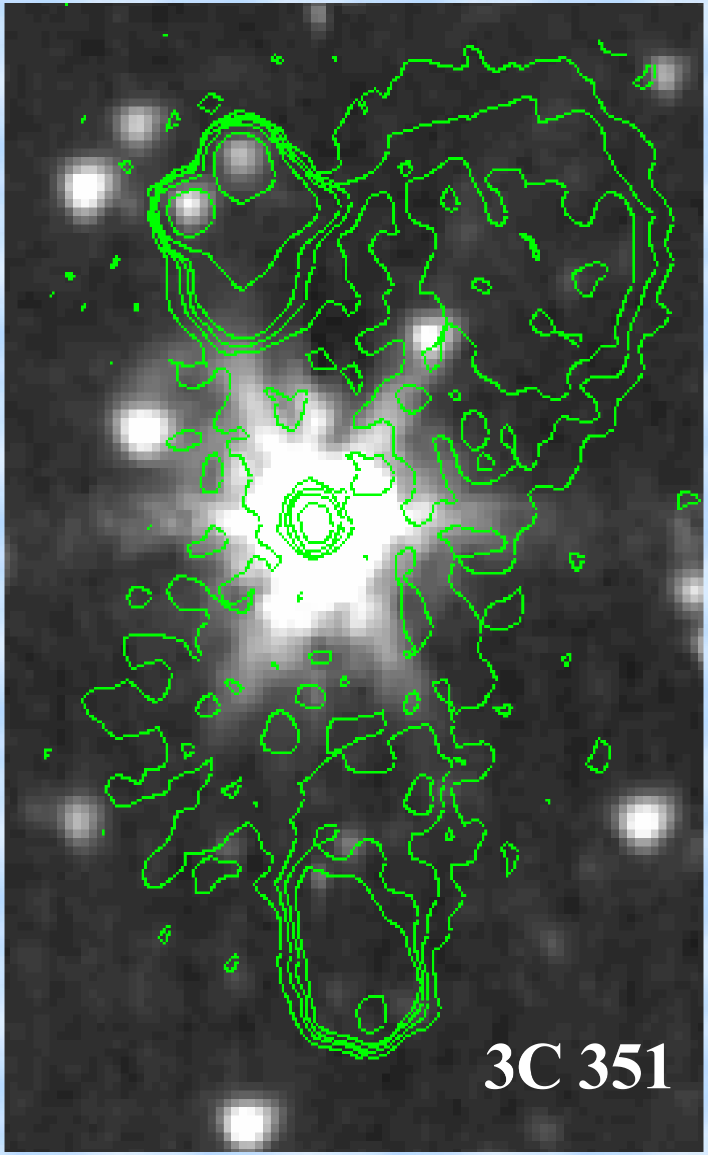
3.6, 4.5, 5.8, 8.0 μm (IRAC) +

24 μm (MIPS)

IRAC Images

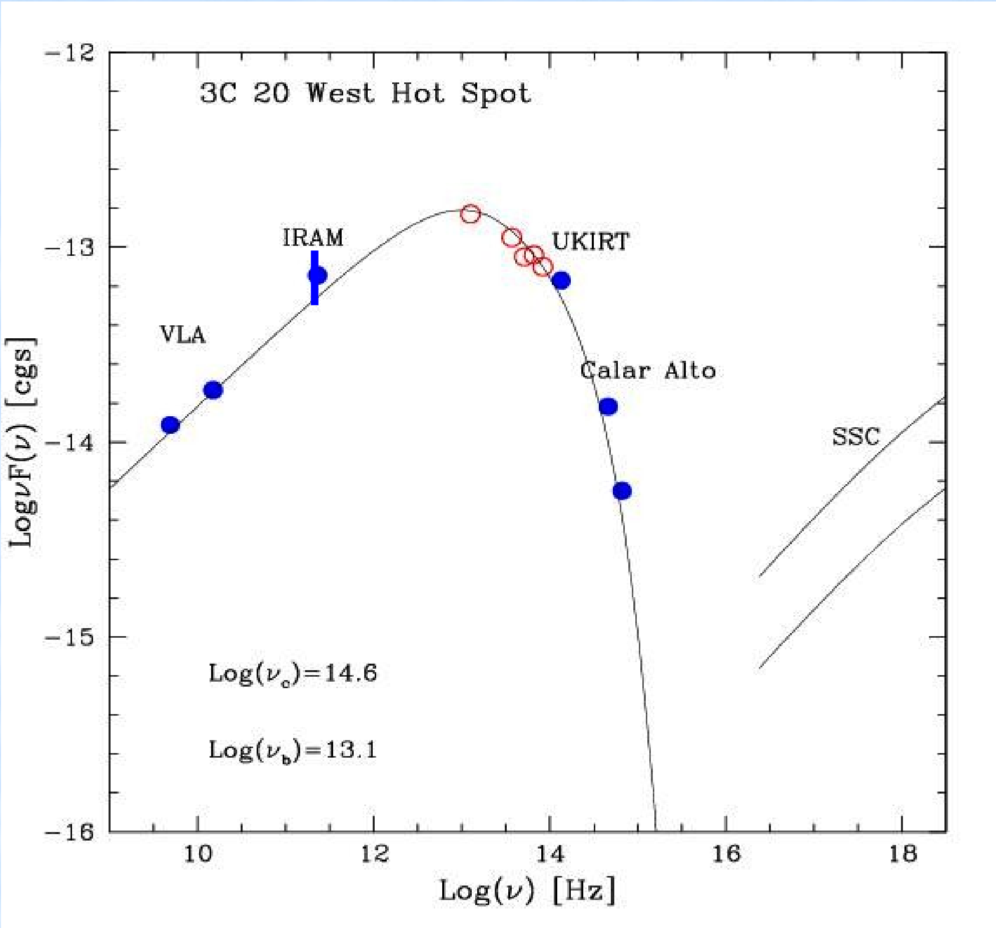


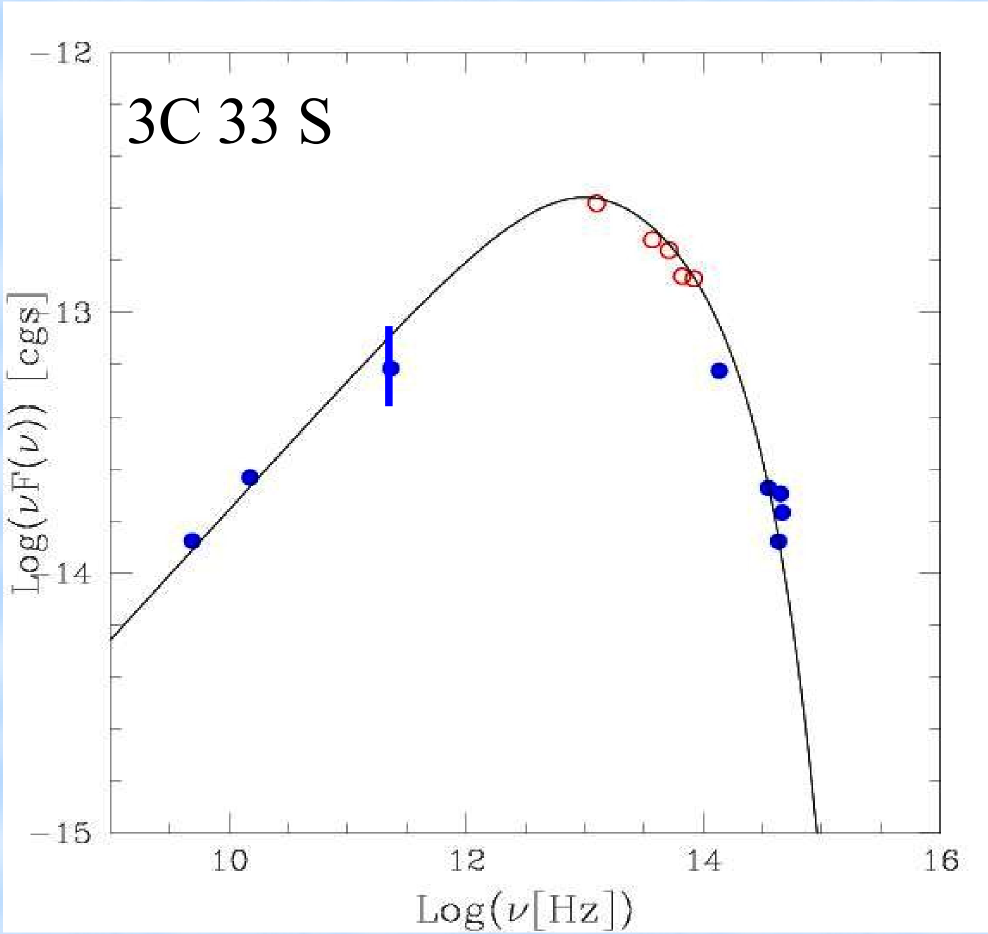




Bondi, GB, et al. 2006, in prep

A Selected Result





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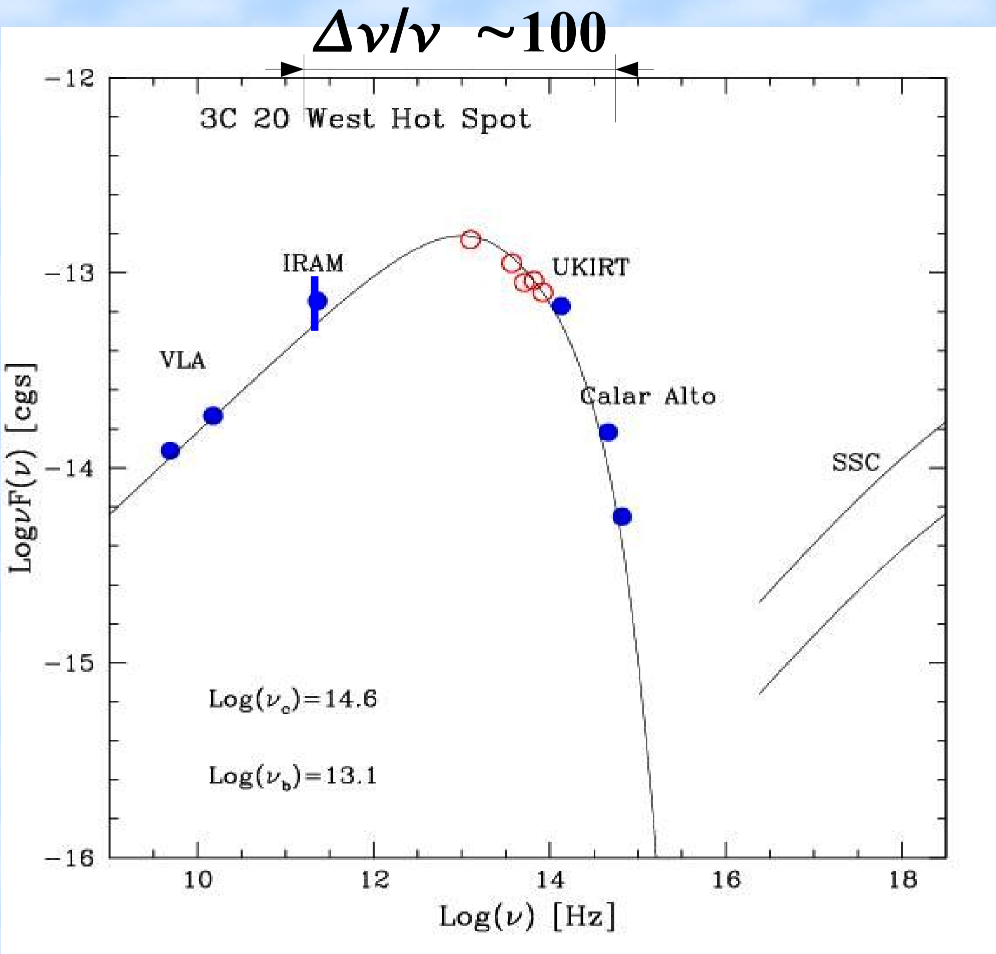

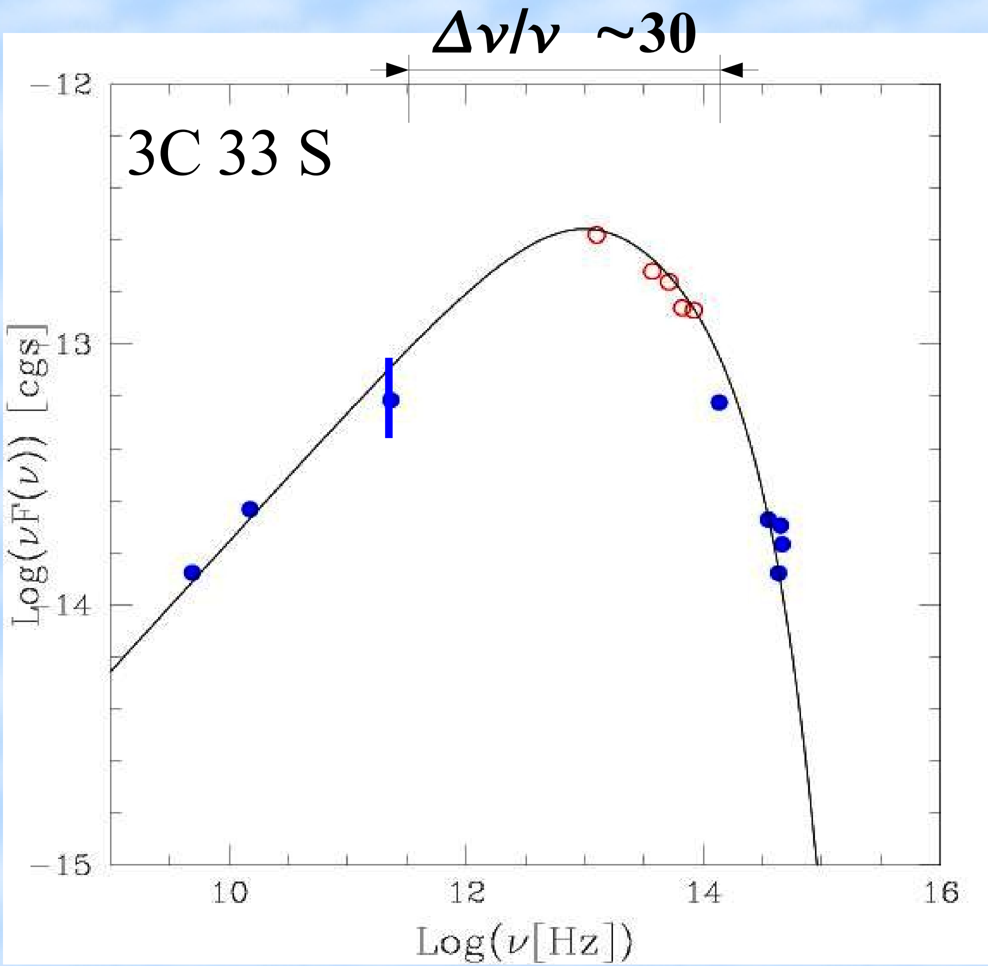

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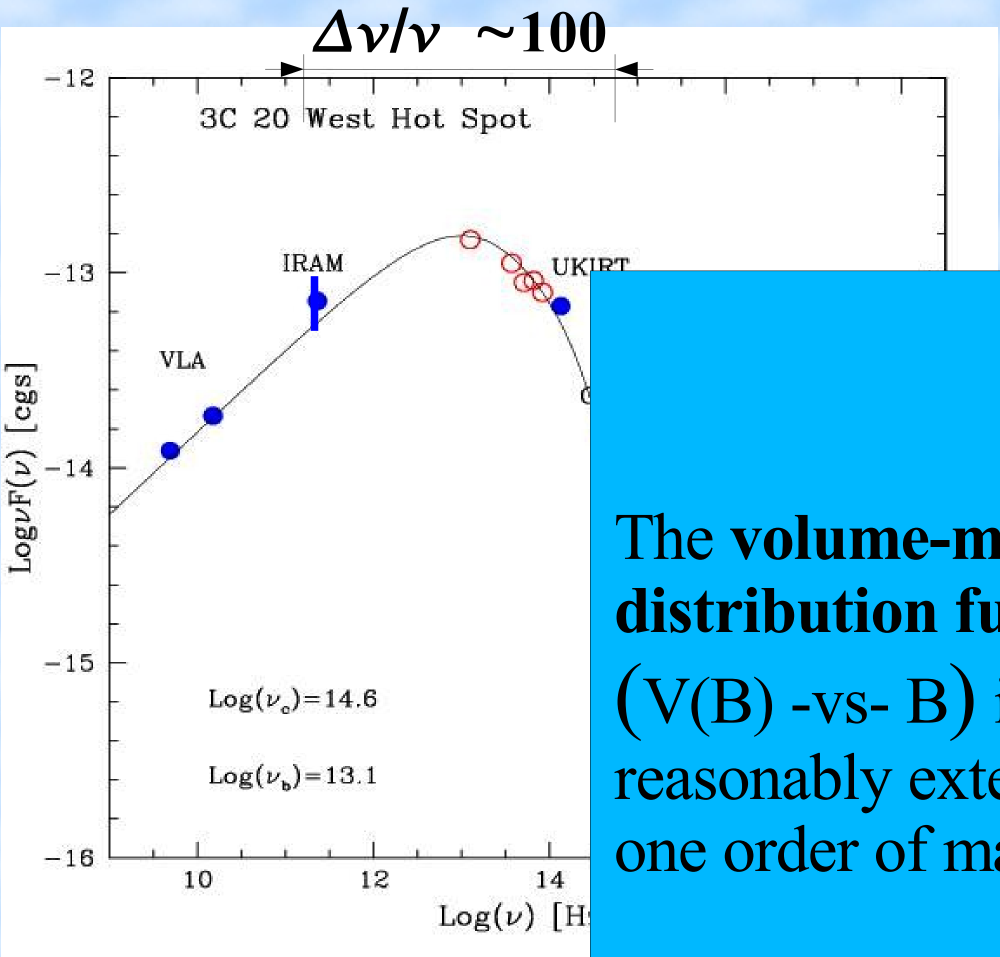
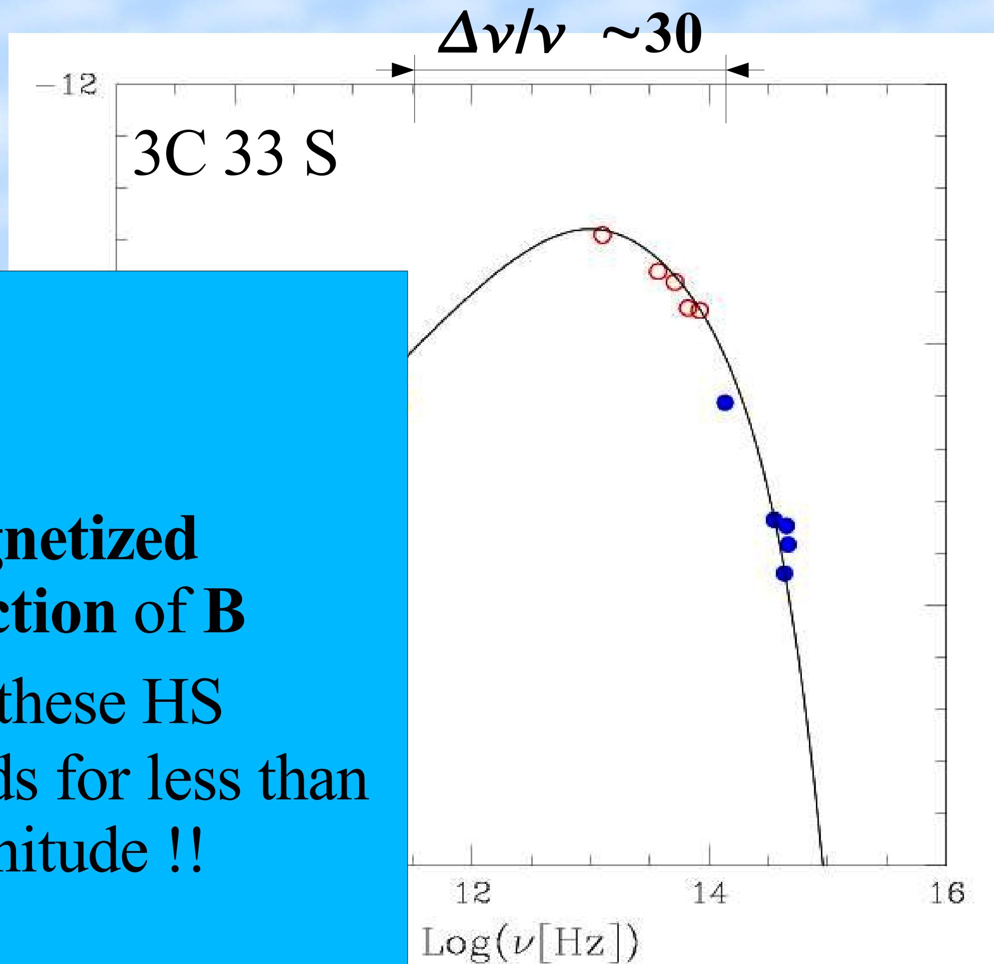




The **volume-magnetized distribution function** of **B** (V(B) -vs- B) in these HS reasonably extends for less than one order of magnitude !!

Basic Approach :

Compact regions should be resolved in the optically thin regime.

$$l \geq \theta_{res} \frac{D_L(1+z)^{-2}}{C_\theta}$$

Resolution

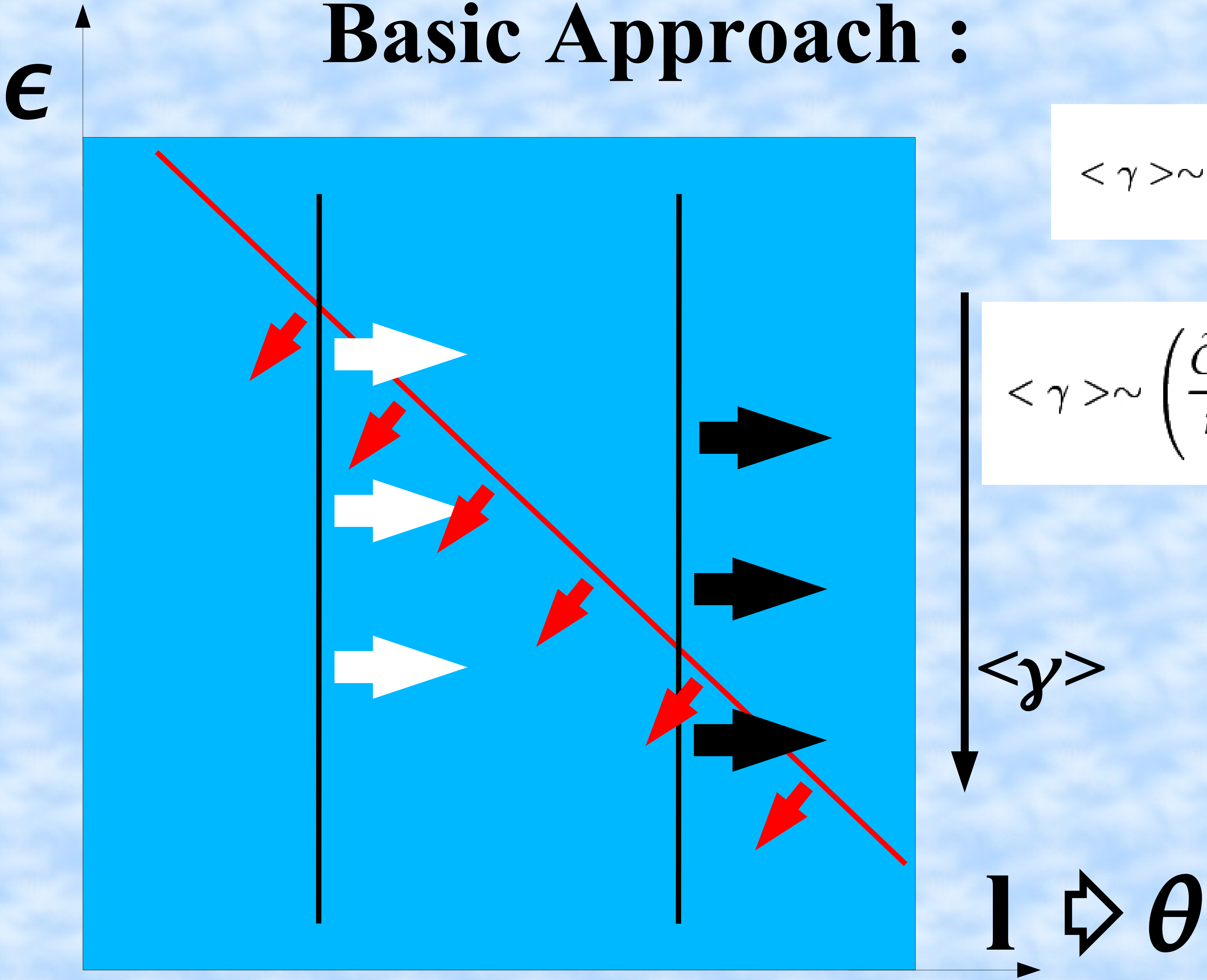
$$\nu^{SA} \sim (\epsilon_\nu l)^{\frac{2}{5}} (1+z)^{\frac{9}{5}} B^{\frac{1}{5}}$$

$$B_{eq} \sim [C_\delta(1+F)\nu^\alpha \epsilon_\nu]^{\frac{1}{3+\alpha}} \gamma_{min}^{\frac{1-2\alpha}{\alpha+3}}$$

$$l \geq C_l(\nu, \gamma_{min}, \alpha)(1+z)^{-\frac{9}{2}} \epsilon_\nu^{-\frac{7+2\alpha}{2(3+\alpha)}}$$

Brunetti +al. (1997)
Beck & Krause (2005)

Basic Approach :



$$< \gamma > \sim \left(\frac{C_\nu}{\nu B} \right)^{1/2}$$

$$< \gamma > \sim \left(\frac{\tilde{C}_\nu}{\nu} \right)^{1/2} \epsilon_\nu^{-\frac{1}{2(3+\alpha)}}$$

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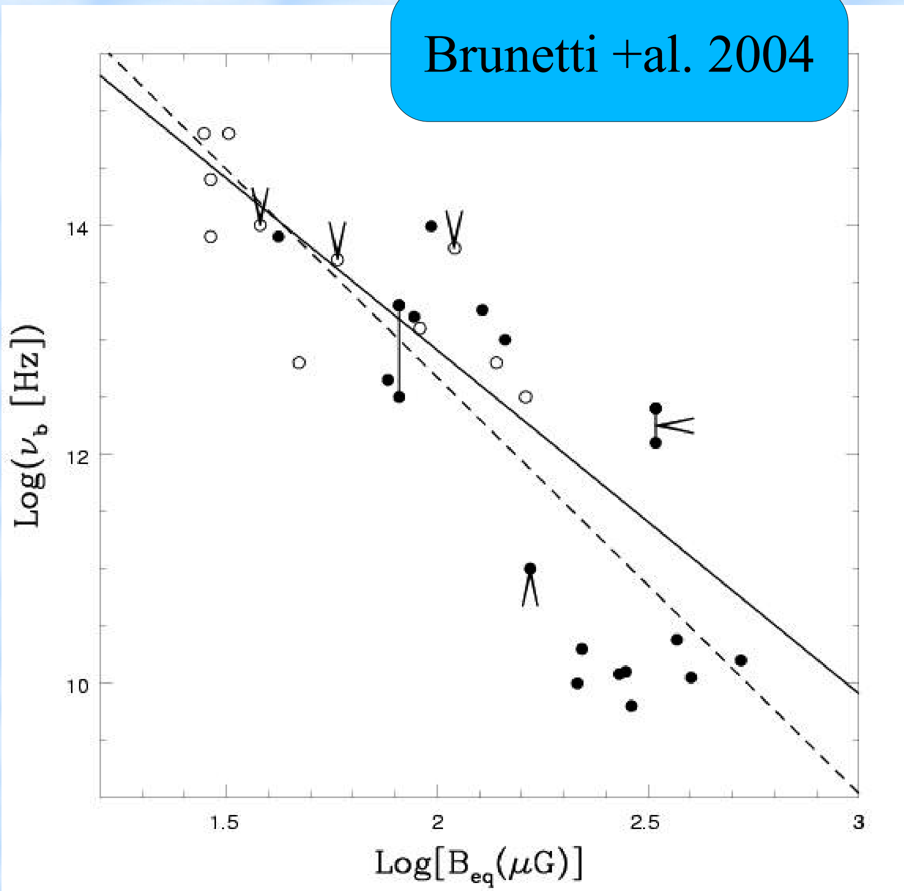
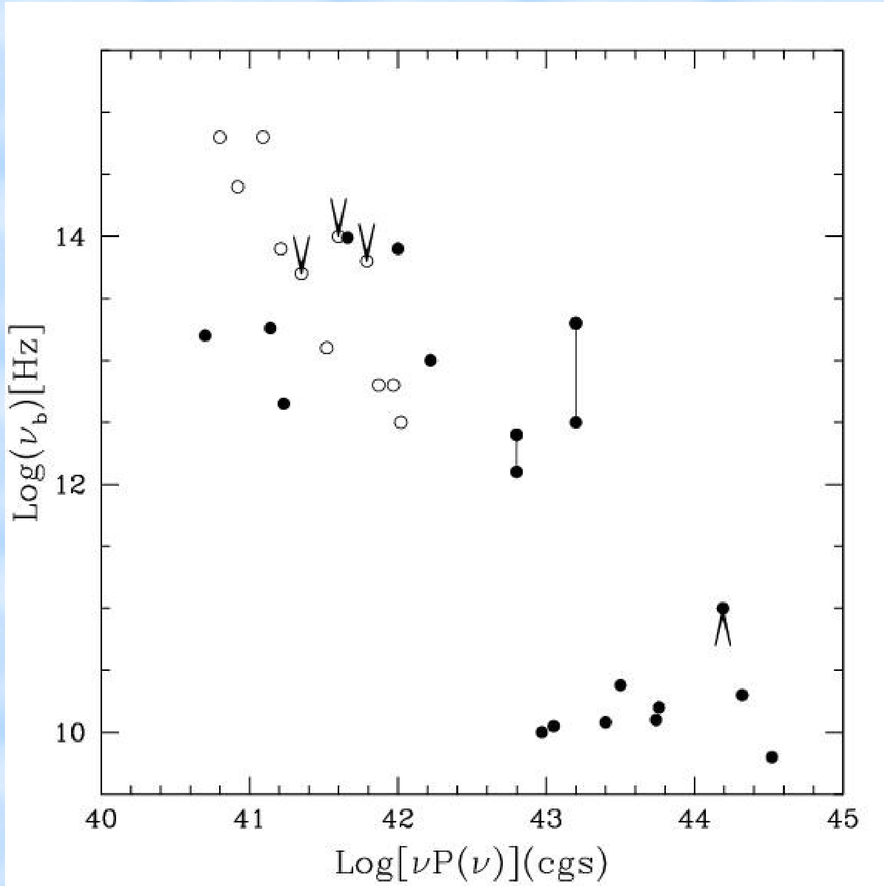
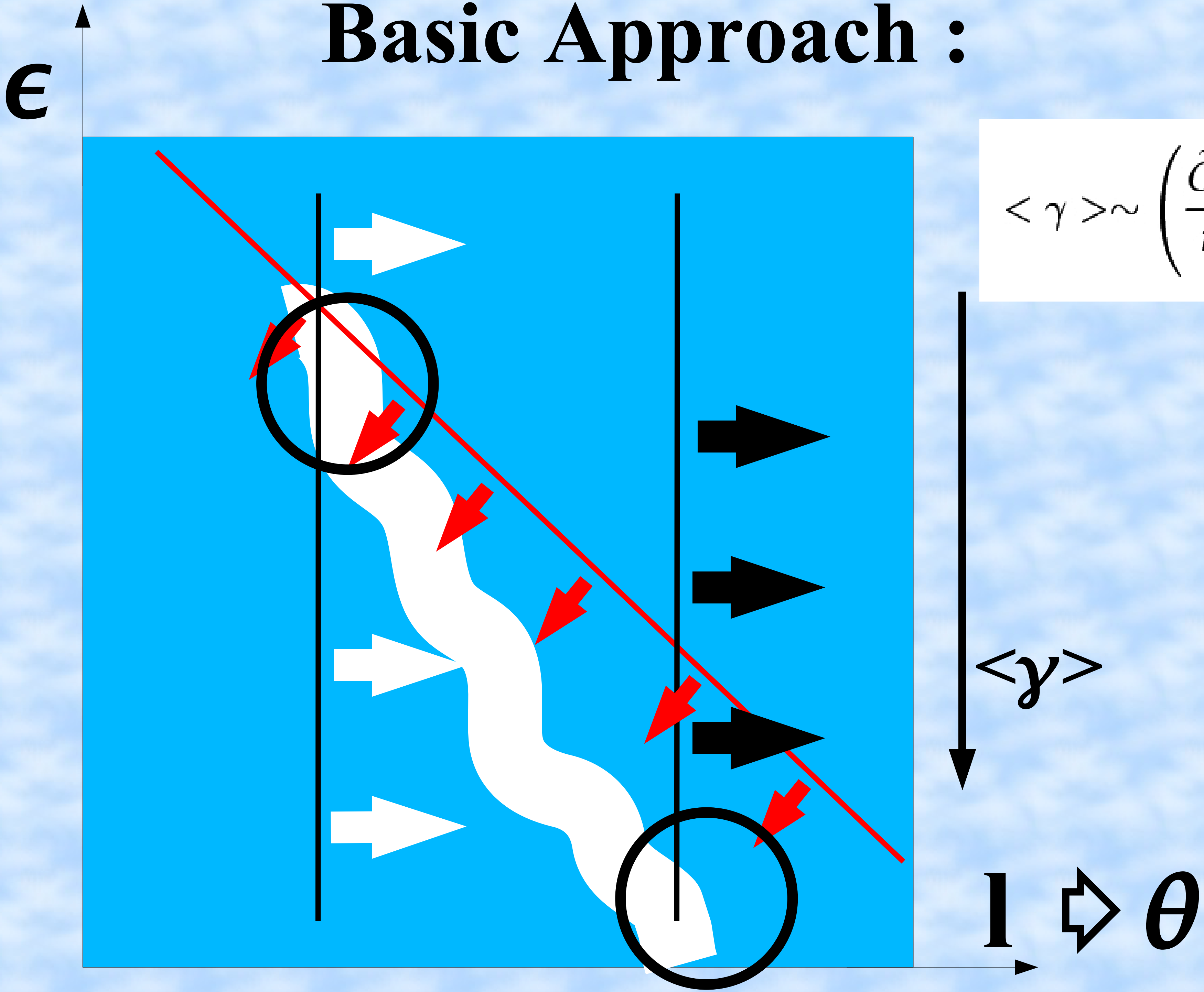




$$l_{HS} \propto \epsilon_{\nu}^{-\frac{\alpha+3/4}{3(3+\alpha)}}$$

Basic Approach :

$$<\gamma>\sim\left(\frac{\tilde{C}_\nu}{\nu}\right)^{1/2}\epsilon_\nu^{-\frac{1}{2(3+\alpha)}}$$



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l ⇨ θ

$$< \gamma > \propto \theta^{\frac{3/2}{1+\alpha}}$$

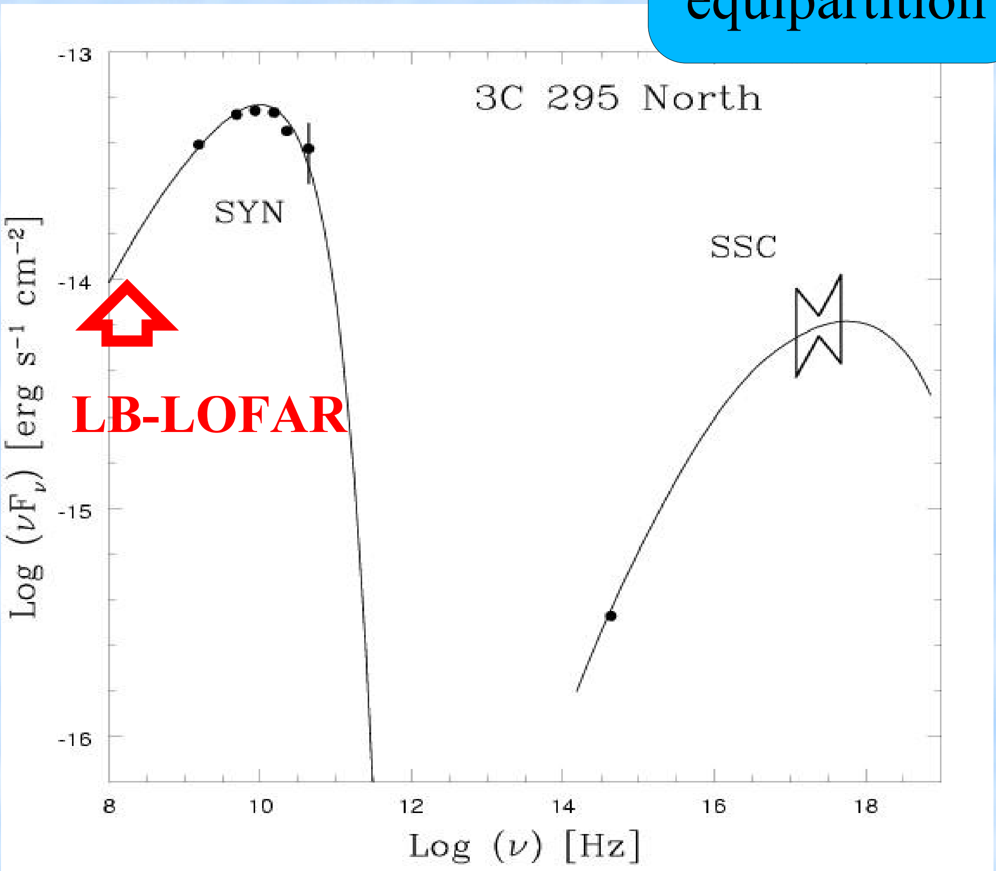
$$\frac{\delta\theta}{\theta} \sim 0.1$$

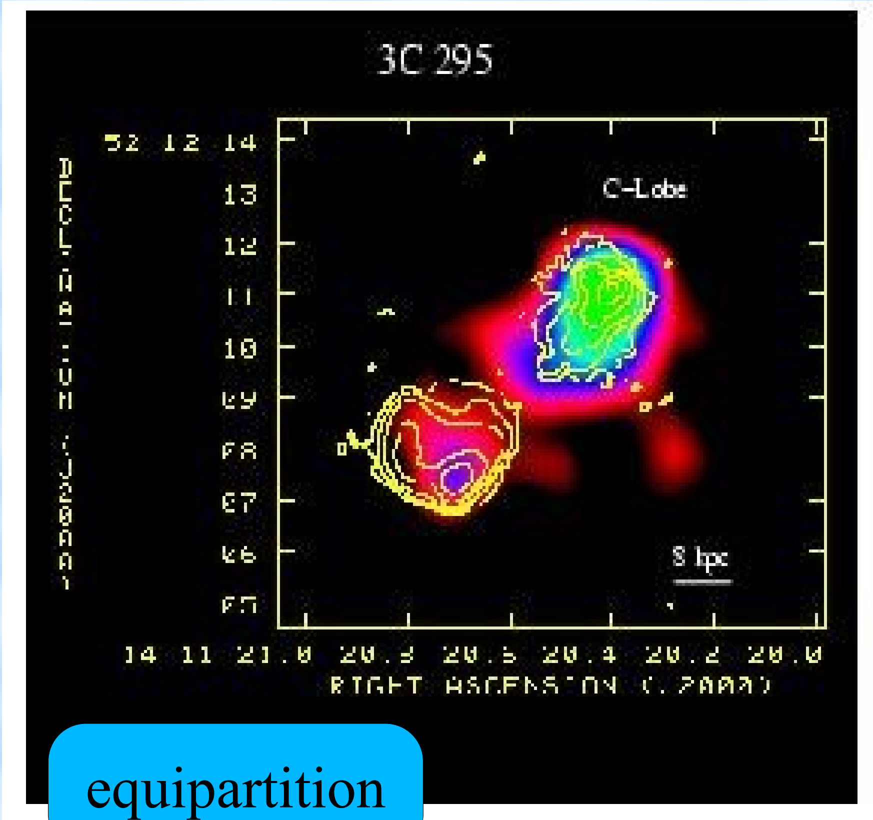
⇨

$$\frac{\delta\gamma}{\gamma} \sim 0.2 - 0.1$$

A particular case : 3C 295 NW-HS

equipartition





equipartition

compact source ~ 0.2 arcsec

ν^{sa} ~ 45 MHz ⇨ **sub-arcsec LOFAR: <γ> ~ 200**

B_{eq} ~ 0.58 mG

Conclusion ⇨ **long baseline LOFAR**

LOFAR ⇨ $\boldsymbol{\gamma} \sim \mathbf{10^3}$ electrons

⇩

⇨ Compact Sources (~0.3-3 kpc regions: **HS & CSS**)
⇨ Larger B (~ mG)

⇩

~100 MHz with ~0.3-0.5 arcsec resolution

⇨ $\boldsymbol{\gamma} \sim \mathbf{100\text{-}300}$