*25 YEARS AFTER THE DISCOVERY: SOME CURRENT TOPICS ON LENSED QSOs*

**Santander (Spain), 15th-17th December 2004**

# Spectral analysis of quasar microlensing

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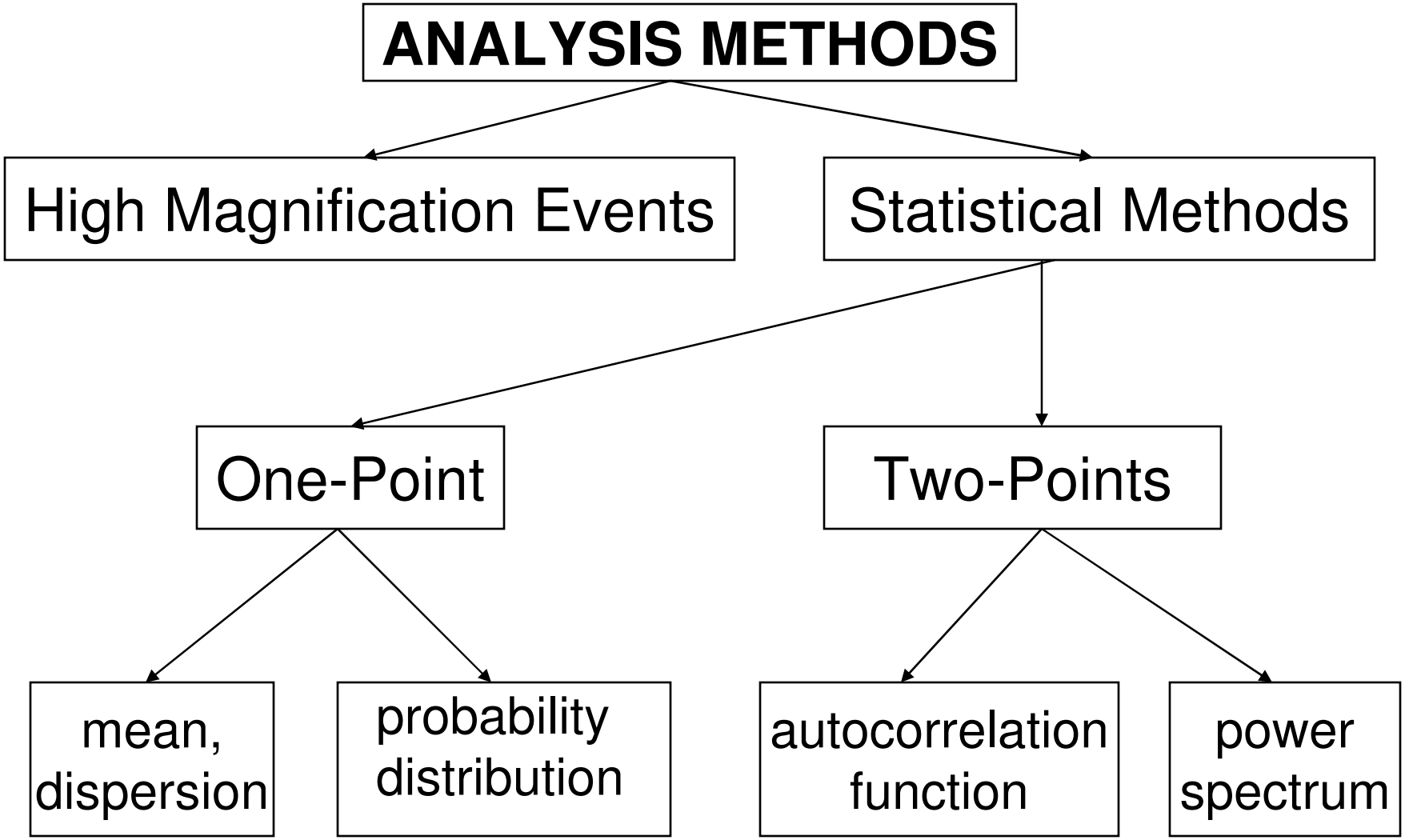

ANALYSIS METHODS
High Magnification Events
Statistical Methods
One-Point
Two-Points
mean, dispersion
probability distribution
autocorrelation function
power spectrum

# Autocorrelation function and power spectrum

$$p(\Delta \boldsymbol{r}) = \left\langle f(\boldsymbol{r}) f(\boldsymbol{r} + \Delta \boldsymbol{r}) \right\rangle$$ autocorrelation function

$$P(\boldsymbol{k}) = \left\langle \left| \int f(\boldsymbol{r}) \exp\left(-i 2\pi \boldsymbol{k} \boldsymbol{r}\right) d\boldsymbol{r} \right|^2 \right\rangle$$ power spectrum

$$P(\boldsymbol{k}) = \int p(\Delta \boldsymbol{r}) \exp\left(-i 2\pi \boldsymbol{k} \Delta \boldsymbol{r}\right) d\Delta \boldsymbol{r}$$ Wiener-Khinchin theorem

Coordinate smoothing

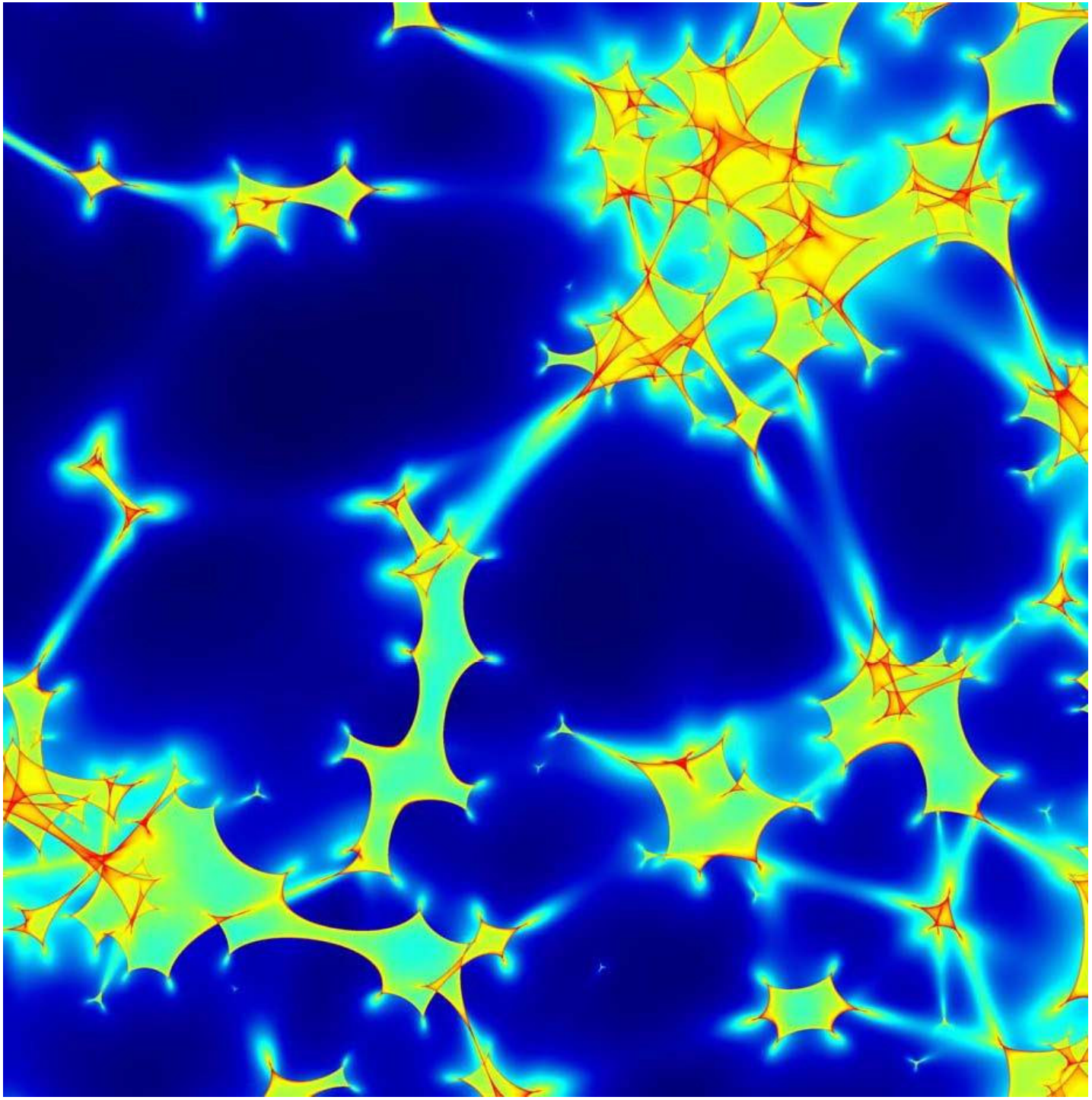
$$\int f\left(\boldsymbol{r}\right) h\left(\boldsymbol{\rho} - \boldsymbol{r}\right) d\boldsymbol{r}$$

$$\int p\left(\Delta \boldsymbol{r}\right) h\left(\Delta \boldsymbol{\rho} - \Delta \boldsymbol{r}\right) d\Delta \boldsymbol{r}$$

Frequency weighting

$$F\left(\boldsymbol{k}\right) H\left(\boldsymbol{k}\right)$$

$$P\left(\boldsymbol{k}\right) H\left(\boldsymbol{k}\right)$$

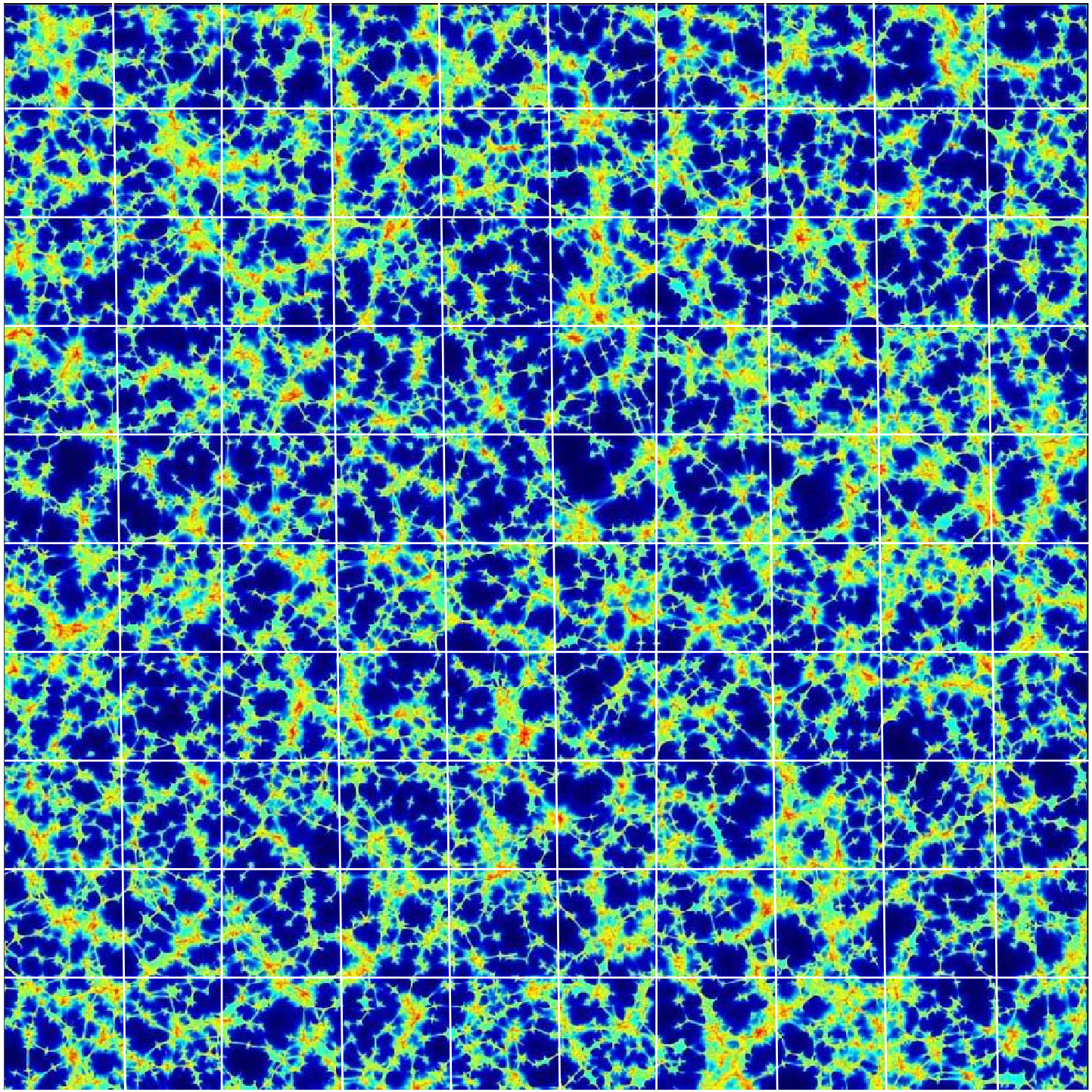


Magnification pattern

$k = 0.4$

$\gamma = 0$

$L = 20\ R_e$

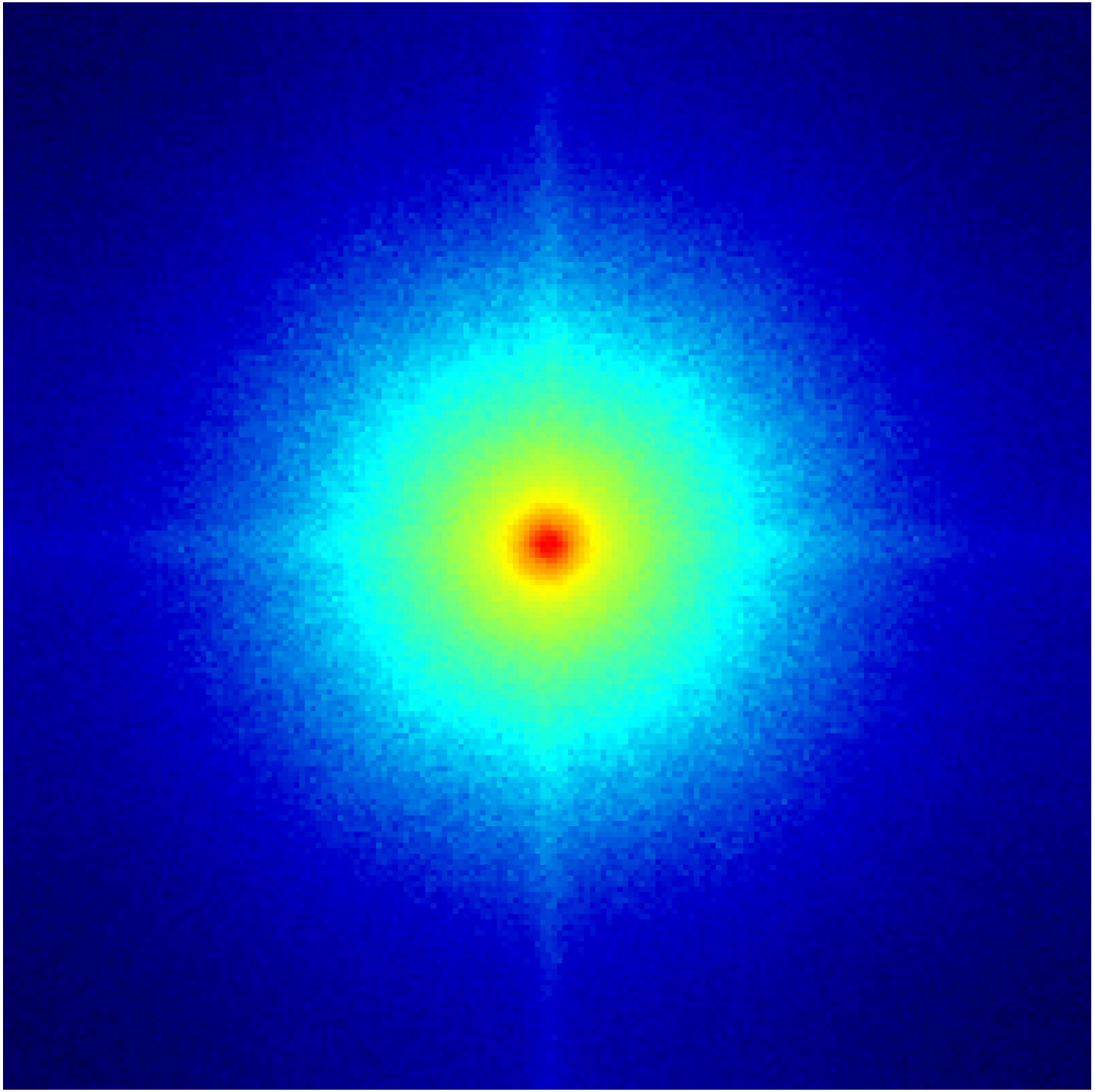


Magnification pattern

$k = 0.4$

$\gamma = 0$

$L = 200\ R_e$



Spectrum

$k = 0.4$

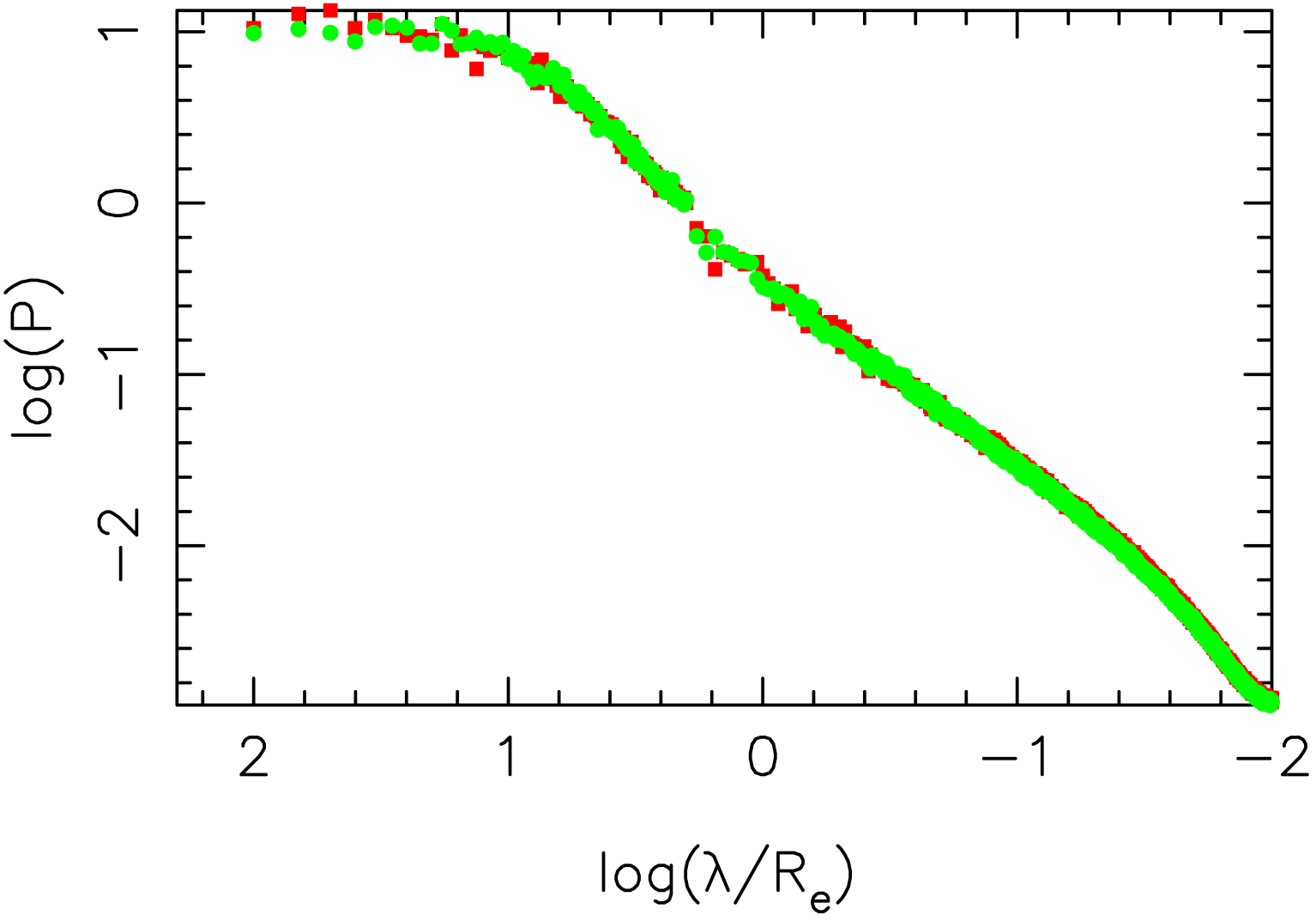
$\gamma = 0$

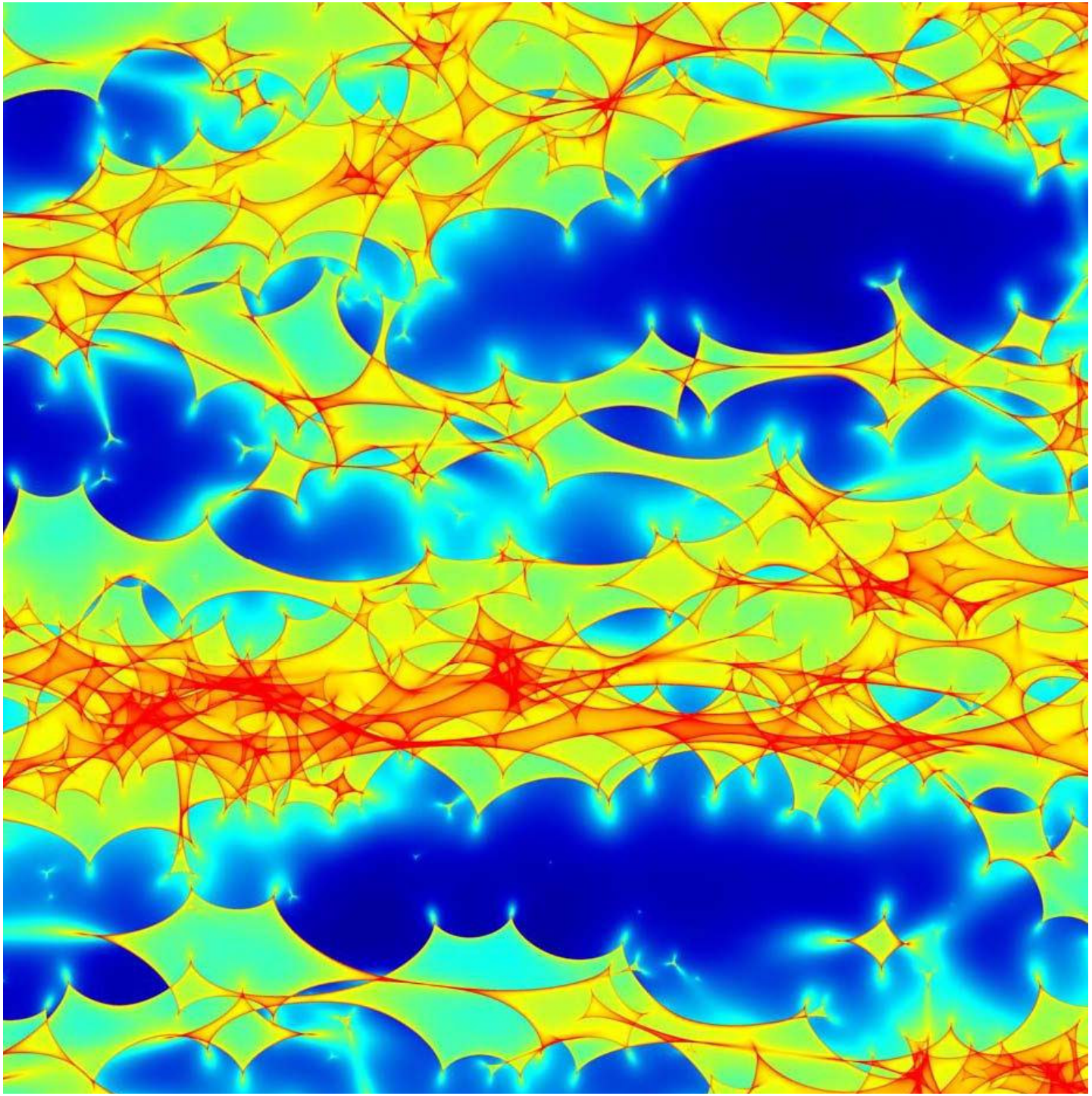
$L = 20\ R_e$

# Spectral projections $k = 0.4, \gamma = 0$

$$P_x(k_x) = \int P(k_x, k_y) dk_y$$

$$P_y(k_y) = \int P(k_x, k_y) dk_x$$



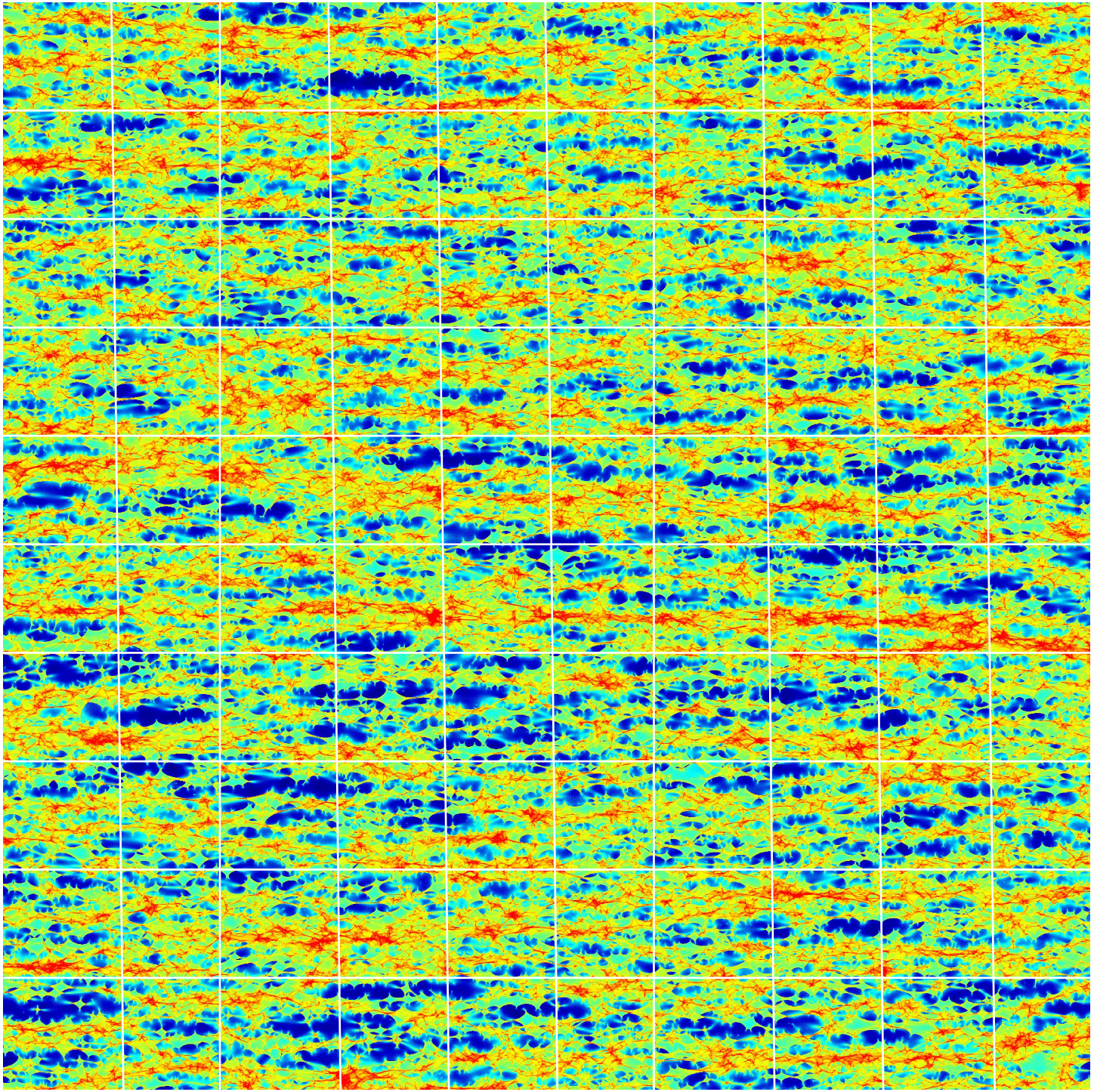


Magnification pattern

$k = 0.4$

$\gamma = 0.4$

$L = 20\ R_e$

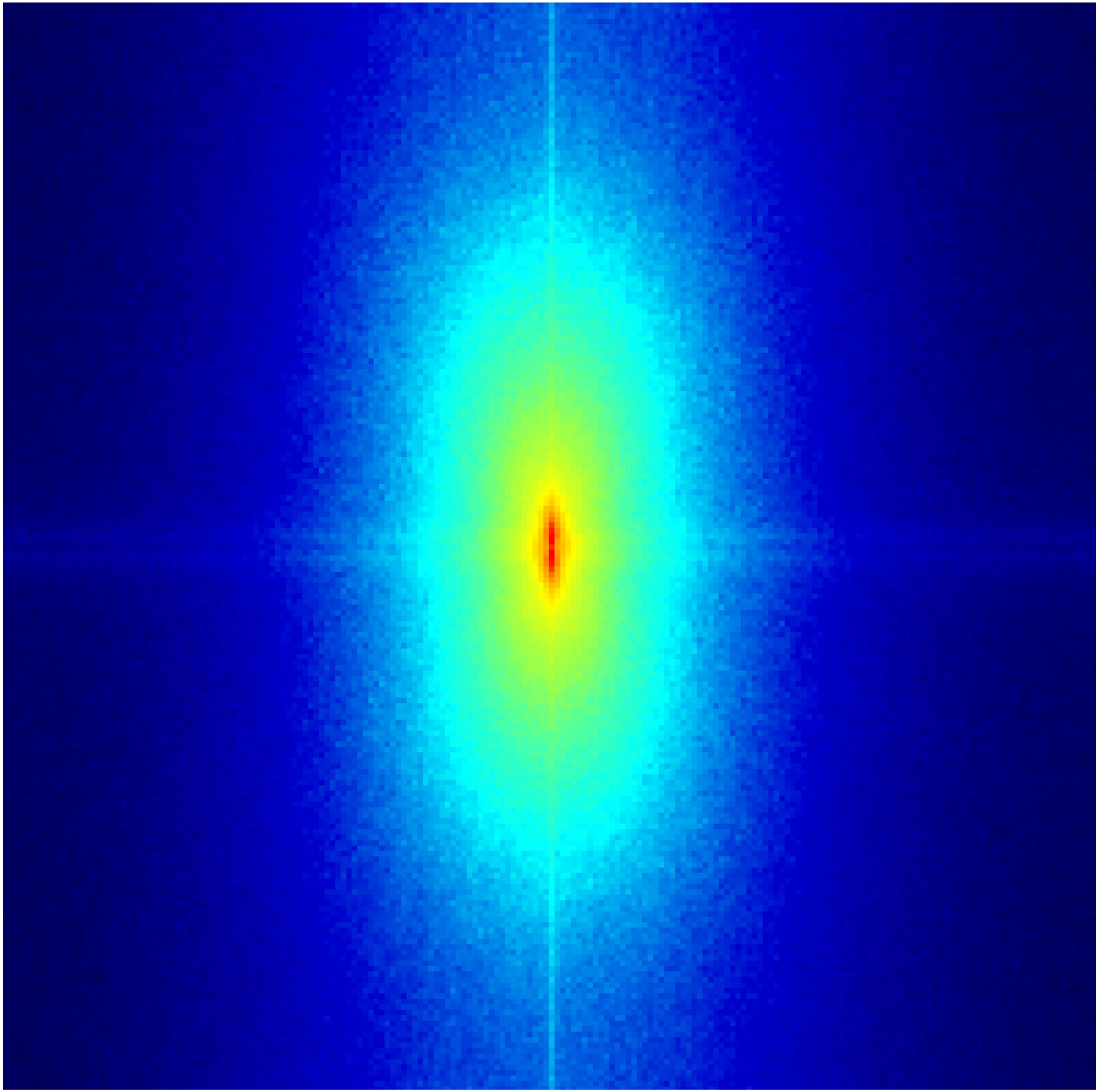


Magnification pattern

$k = 0.4$

$\gamma = 0.4$

$L = 200\ R_e$



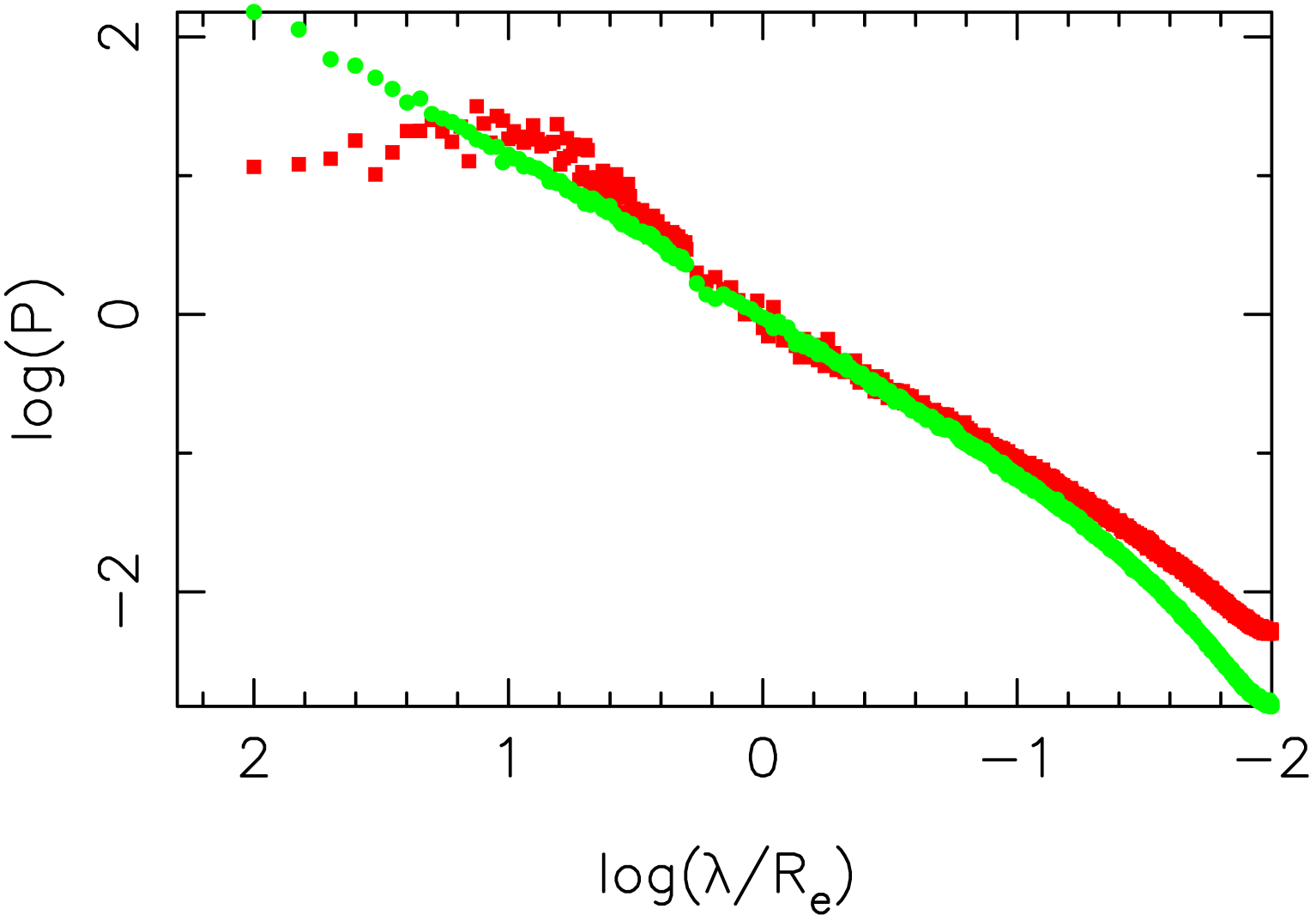
Spectrum

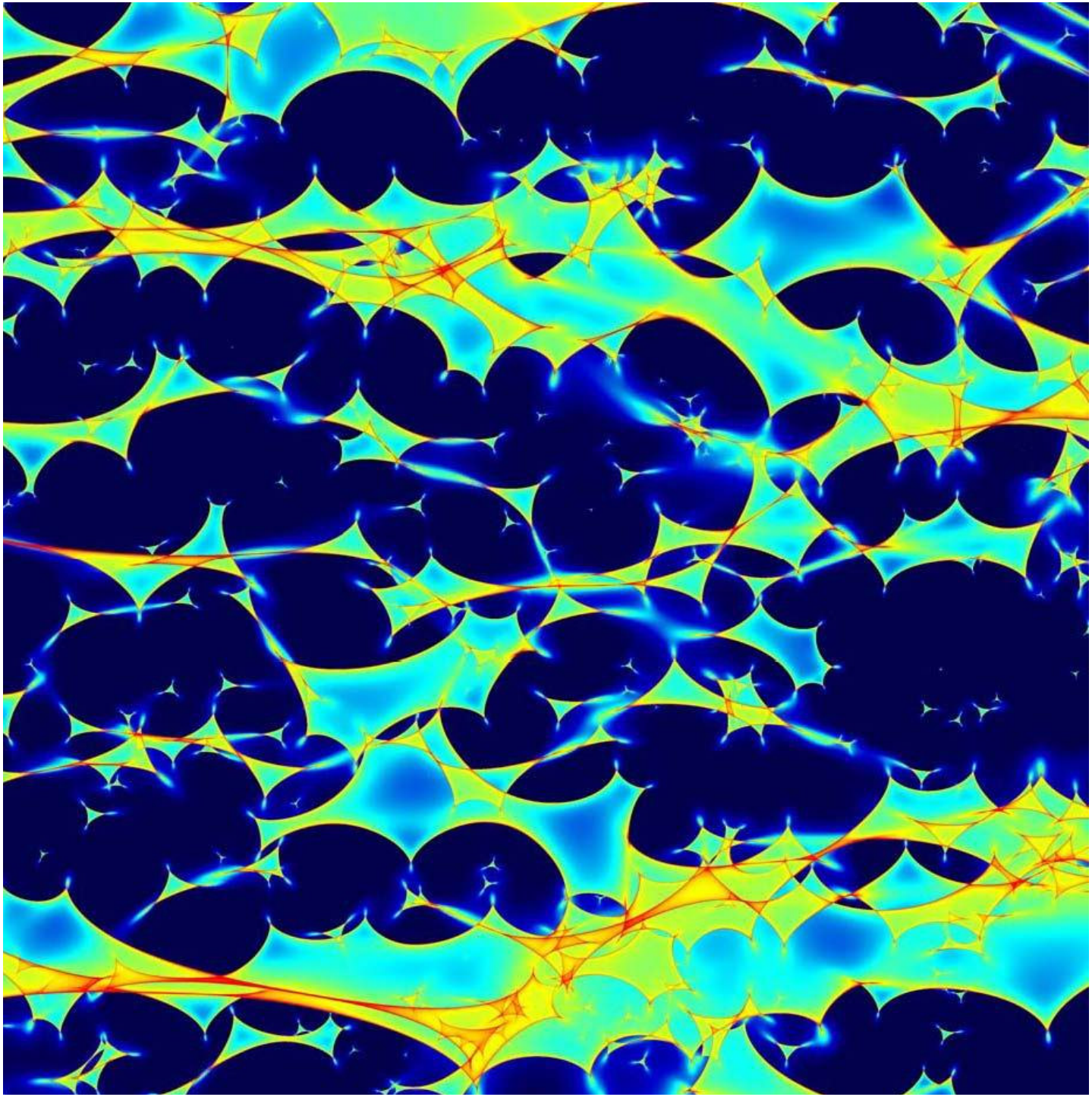
$k = 0.4$

$\gamma = 0.4$

$L = 20\ R_e$

# Spectral projections $k = 0.4, \gamma = 0.4$



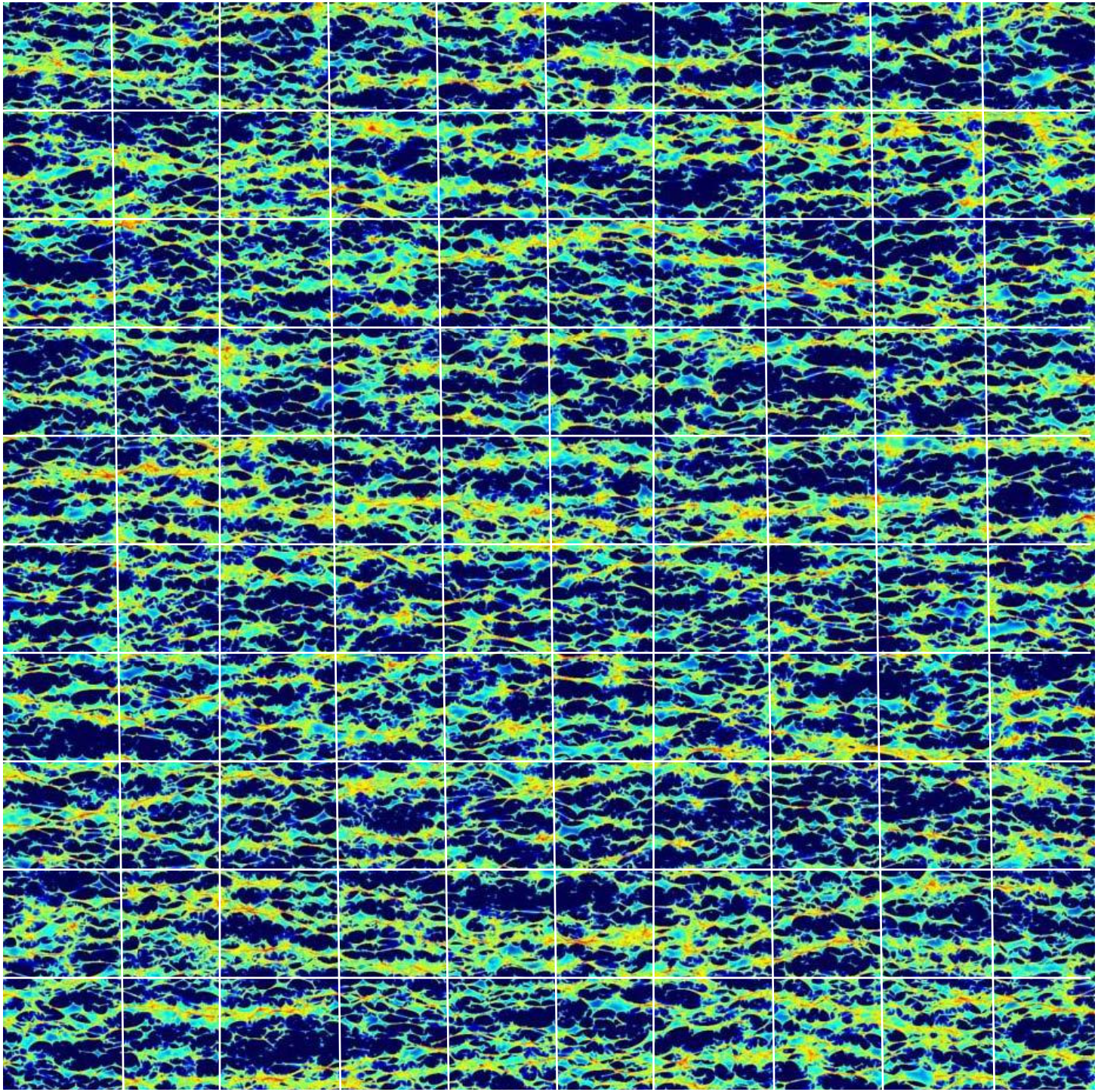


Magnification pattern

$k = 0.7$

$\gamma = 0.7$

$L = 20\ R_e$

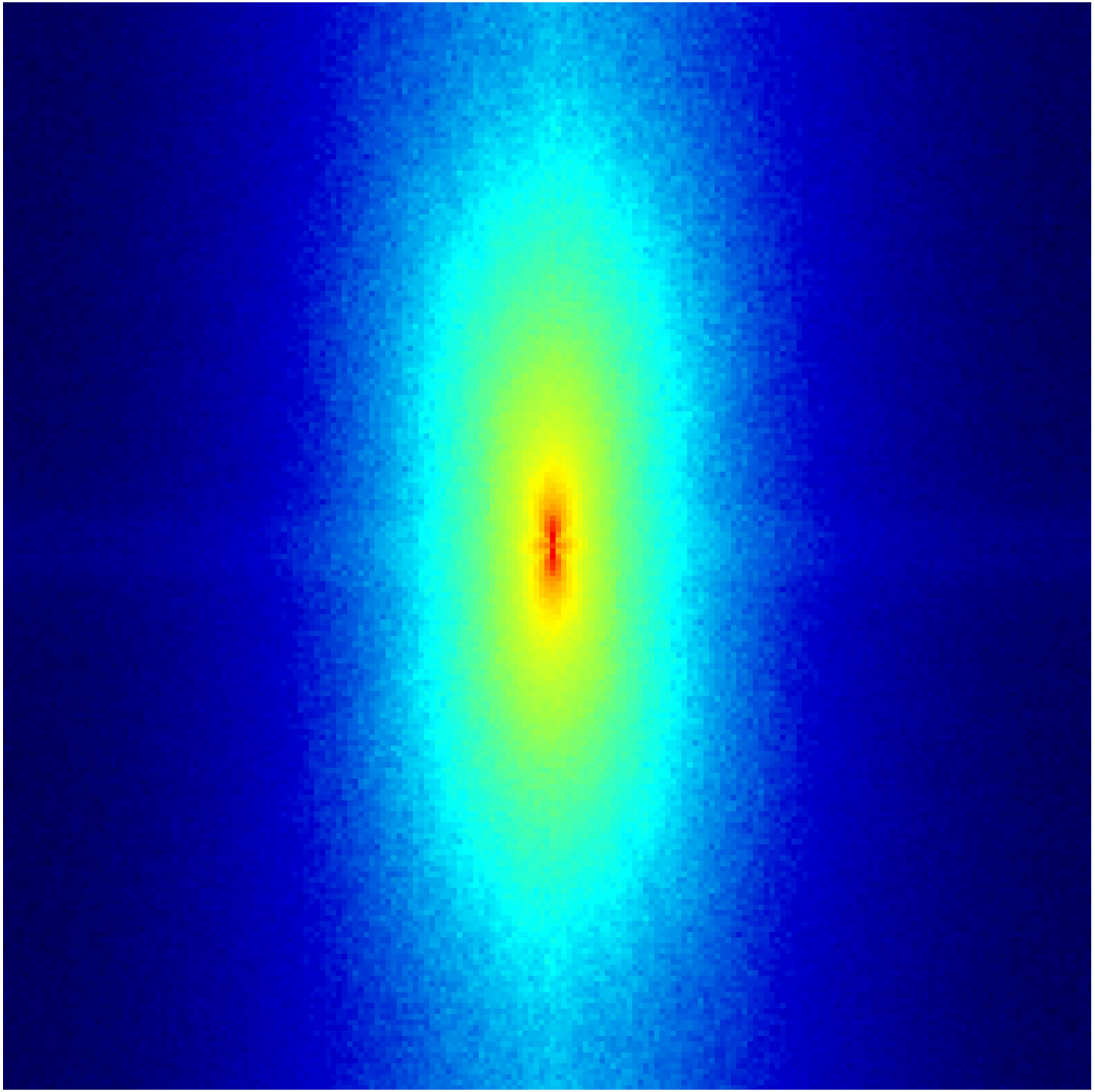


Magnification pattern

$k = 0.7$

$\gamma = 0.7$

$L = 200\ R_e$



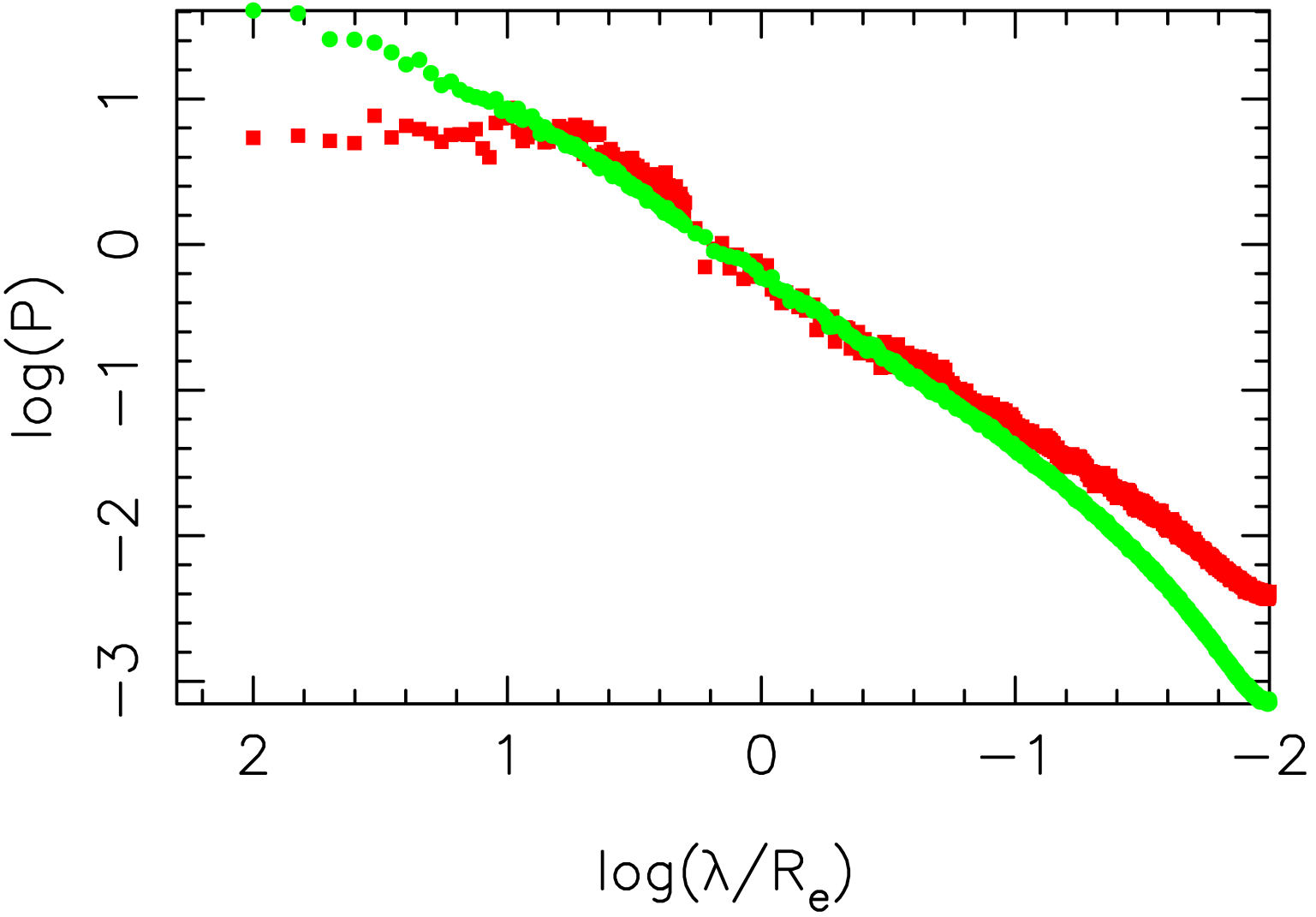
Spectrum

$k = 0.7$

$\gamma = 0.7$

$L = 20\ R_e$

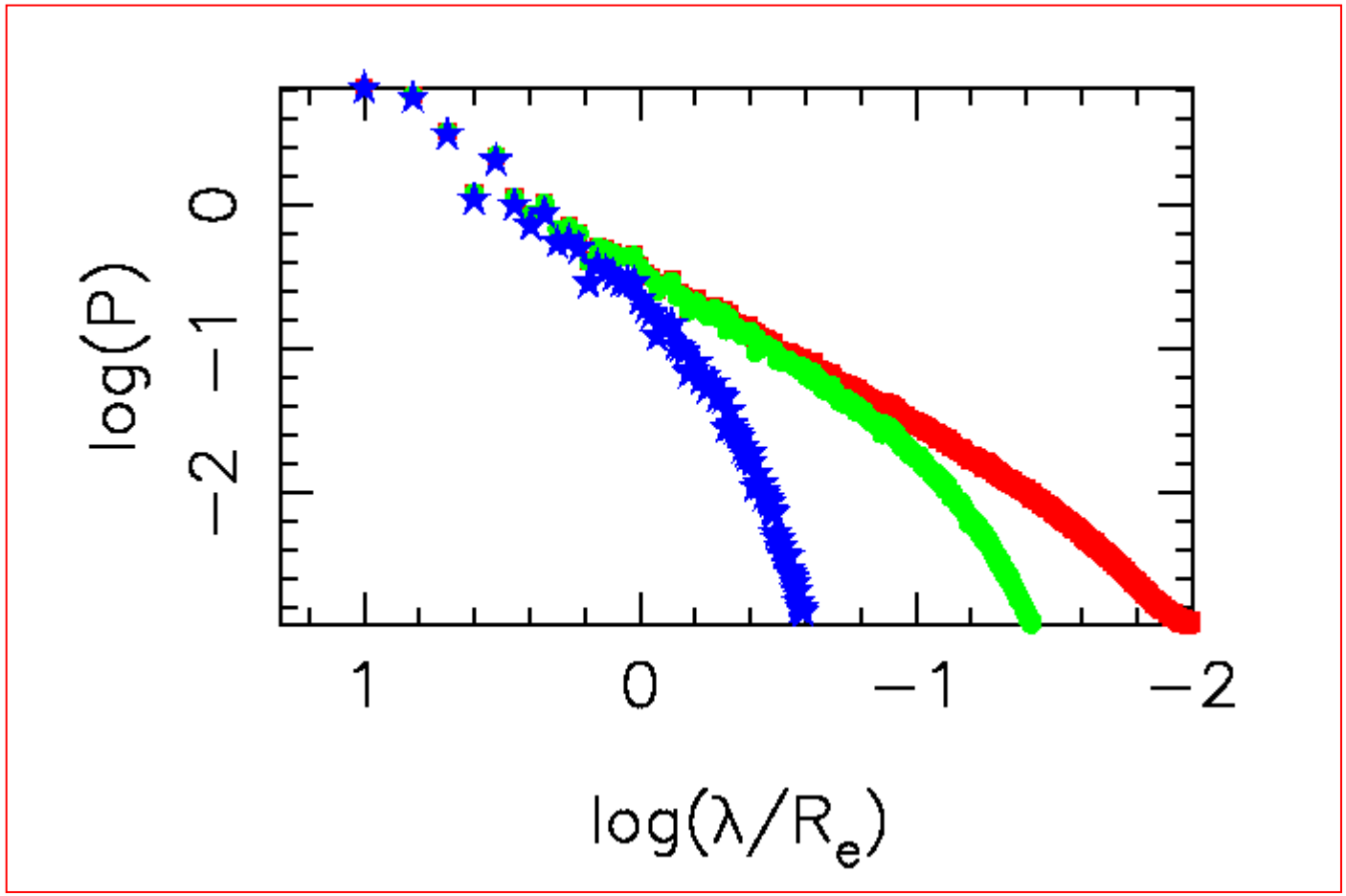
# Spectral projections $k = 0.7, \gamma = 0.7$



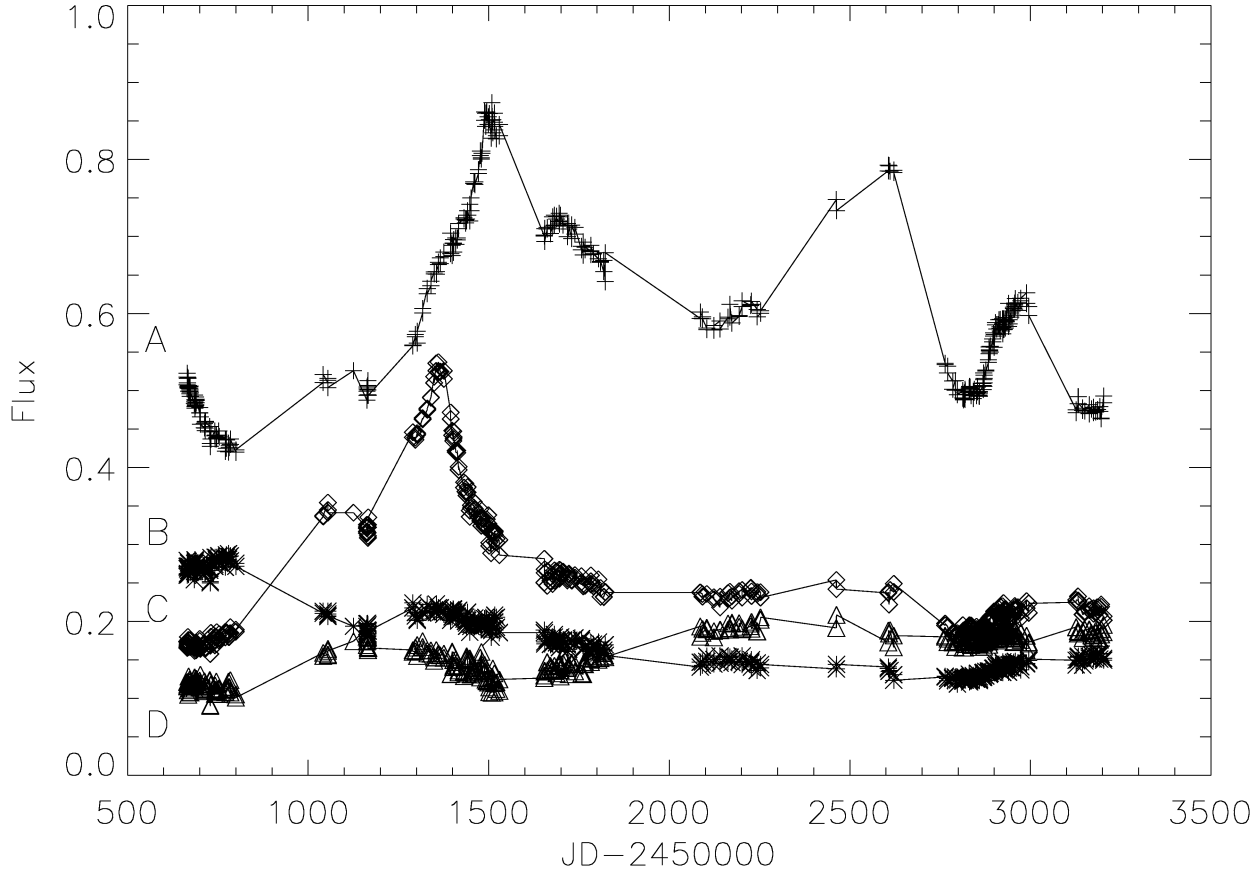
# Extended source effect (k=0.4, γ=0, L=20$R_e$)

$P_{ext}(\boldsymbol{k}) = P_{mag}(\boldsymbol{k})Q(\boldsymbol{k})$ $\quad Q(k): \left|\exp\left[-\left(R_S k\right)^2\right]\right|^2$ $\quad R_S$ – a source size

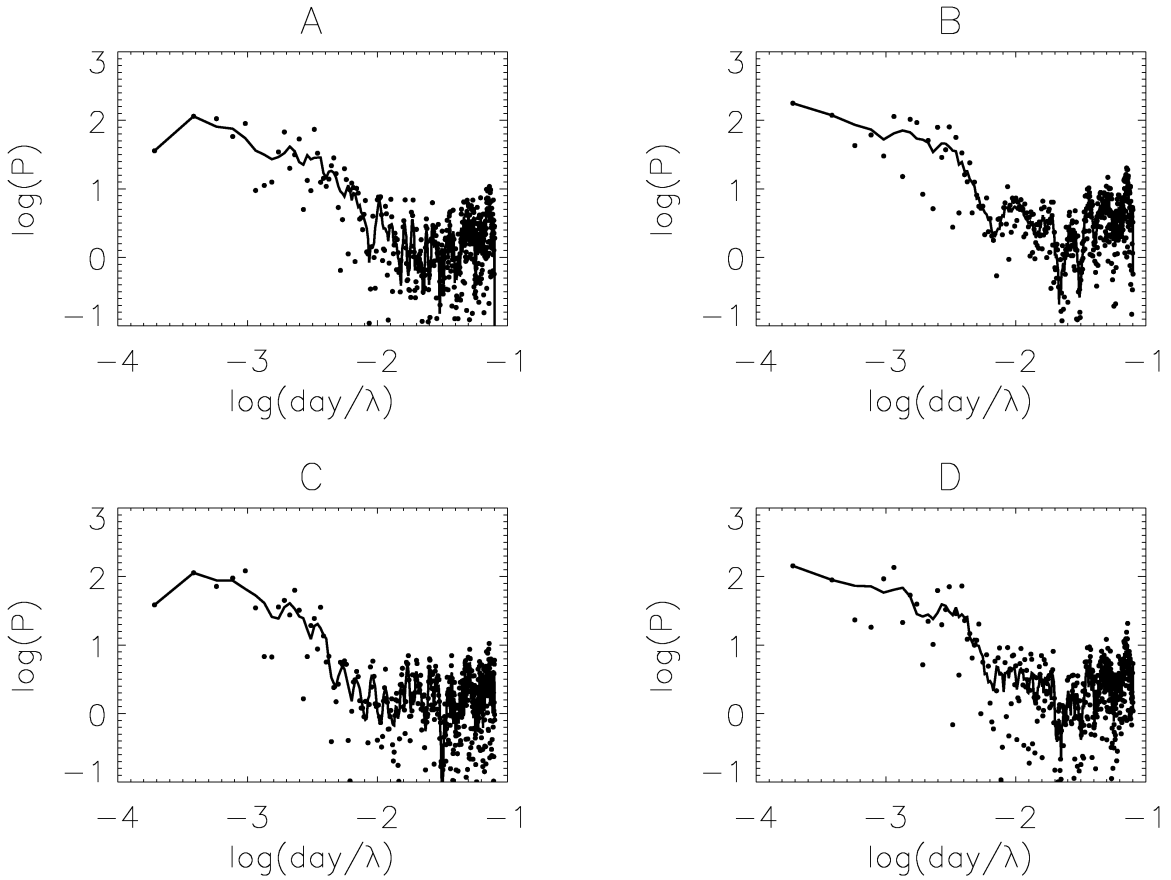
- a point source $\quad R_S = 0.01R_e \quad R_S = 0.1R_e$



# OGLE monitoring of Q22337+0305



# Periodogram of Q2237+0305




## Properties of the power spectrum

- a constant at $\lambda \geq 10\ R_e$; $\log(day/\lambda) \leq -3.8$, $\lambda \geq 10^{3.8}$, $R_e \geq 10^{2.8} \approx 600$ days
- a linear decreasing ~ $R_e$ ;
- a drastic drop at $\lambda \approx 10 R_s$ ; $\log(day/\lambda) \approx -2.5$, $\lambda \approx 10^{2.5}$, $R_s \approx 10^{1.5} \approx 30$ days