Model A of critical dynamics: 5-loop ε expansion study

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Goal

- Obtaining of numerical estimates for the dynamics critical exponent z

Description of the model

$\tau \propto \xi^z$ - typical time of fluctuations

The nonrenormalized action of the model A of critical dynamics is defined by a set of two n-component fields $\phi_0 = [\psi_0, \psi_0']$:

$$S_0(\phi_0) = \lambda_0 \psi_0' \psi_0' + \psi_0'[-\partial_t \psi_0 + \lambda_0(\partial^2 \psi_0 - m_0 \psi_0 - \frac{1}{3!} g_0 \psi_0^3)]$$

Borel resummation

Asymptotic expansion: $A(\varepsilon) = \sum_{k=0}^{\infty} A_k \varepsilon^k$; High-order asymptotic behaviour:
$A_k \xrightarrow[k\to\infty]{} ck! k^{b_0} (-a)^k$. For A model $a = \frac{3}{n+8}$, $b = b_0 + n/2$

$$A^N(\varepsilon) = \sum_{k=0}^{N} A_k \varepsilon^k = \int_0^{\infty} dt e^{-t} t^b \sum_{k=0}^{N} B_k^b (\varepsilon t)^k = \int_0^{\infty} dt e^{-t} t^b F_b^N(\varepsilon t)$$

$B_k^b = \frac{(-1)^k A_k}{\Gamma(k+b+1)}$ F_b^N - Borel image with a finite radius of convergence 1/a which formally does not allow to perform integration. In order to overcome this problem, it is necessary to find an analytic continuation for the function $F_b(x)$ beyond the circle of convergence with conformal mapping $w(x) = \frac{\sqrt{1+ax}-1}{\sqrt{1+ax}+1}$

$$A(\varepsilon) = \int_0^{\infty} dt e^{-t} t^b \left(\frac{\varepsilon t}{w(\varepsilon t)}\right)^{\lambda} \sum_{k=0}^{N} q_k (w(\varepsilon t))^k$$

$A(\varepsilon) \sim \varepsilon^{\lambda}$; for $\varepsilon \longrightarrow \infty$ λ determines the strong coupling asymptotic

- **KP 17**

$$A(\varepsilon) = \int_0^{\infty} dt e^{-t} t^b G^N_{b,\lambda,q}\left(\frac{\varepsilon t}{1 - q\varepsilon}\right)$$

Parameters b, q, λ are defined in such a way that in the vicinity of the selected values the estimate of a physical observable would be the least sensitive to their variation

- **Free boundary conditions**

$$A(\varepsilon) = A_b + (\varepsilon_b - \varepsilon) \sum_{k=0}^{\infty} B_k \varepsilon^k$$

- **Criterion of convergence**

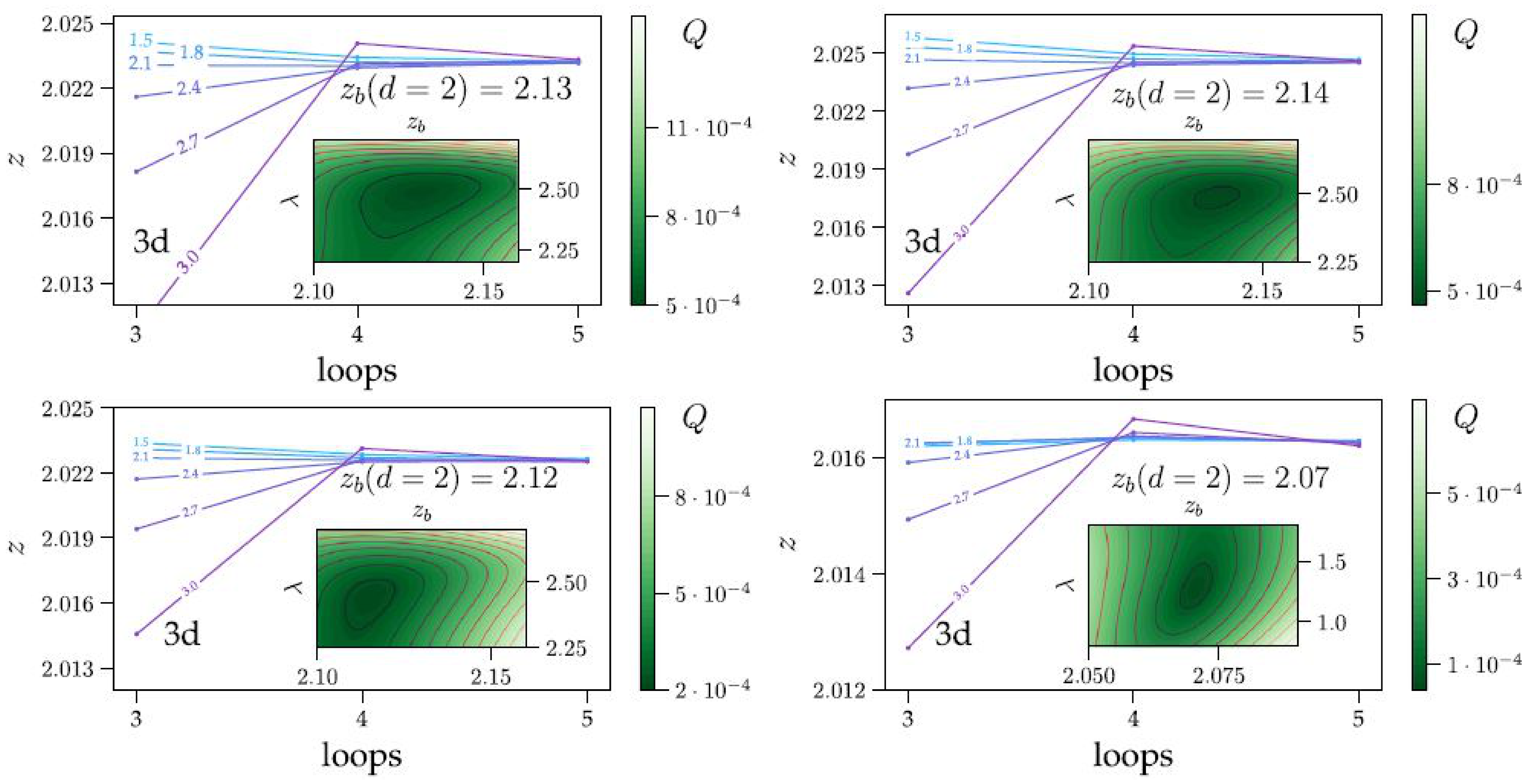
$$z(l) = a(\lambda)(l-5) + b(\lambda); \quad a(\lambda) = z^{(5)} - z^{(4)}; \quad b(\lambda) = z^{(5)}$$

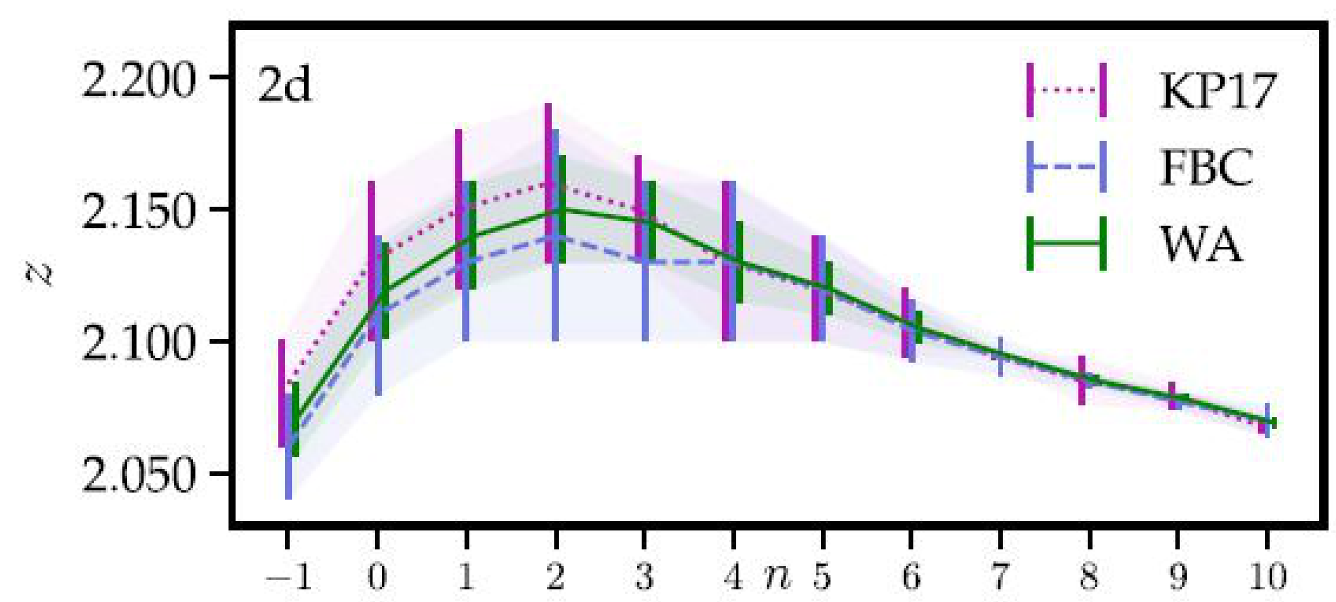
Equation of the straight line passing through the points of four and five loop approximations

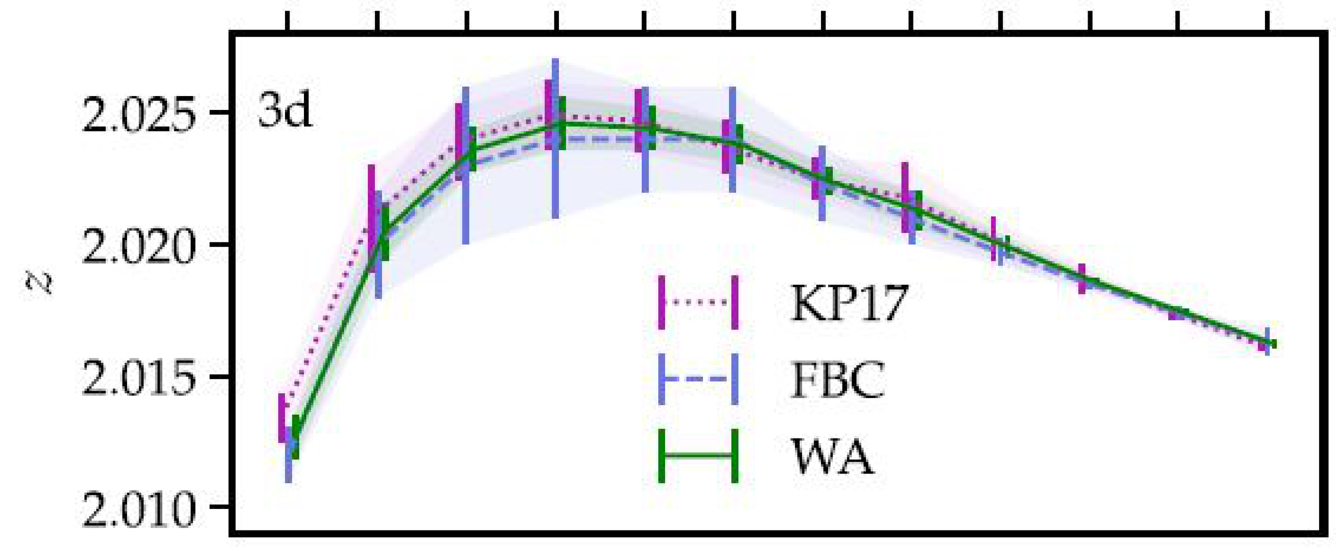
$$Q = \sqrt{(\partial_\lambda a)^2 + (\partial_\lambda b)^2 + (\partial_\lambda^2 b)^2} \quad \text{criterion of convergence}$$

Results

n	Dim.	Free b.c.	KP17	W.A.
$n=0$	d=2	2.11(3)	2.13(3)	2.119(18)
	d=3	2.020(2)	2.021(2)	2.0205(11)
$n=1$	d=2	2.13(4)	2.15(3)	2.14(2)
	d=3	2.023(2)	2.0239(14)	2.0236(8)
$n=2$	d=2	2.14(4)	2.16(3)	2.15(2)
	d=3	2.024(3)	2.0249(13)	2.0246(10)
$n=3$	d=2	2.13(3)	2.15(2)	2.145(15)
	d=3	2.024(2)	2.0247(12)	2.0244(8)







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