Critical phenomena in the vicinity of the SU(3) symmetric tri-critical point of a spin-1 chain

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論 文 名　：　Critical phenomena in the vicinity of the SU(3) symmetric tri-critical point of a spin-1 chain
(一次元 *S*=1 量子スピン系の SU(3)対称な三重臨界点近傍での臨界現象)

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論　文　内　容　の　要　旨

Critical phenomena in low dimensional and continuously symmetric quantum systems have been important research subjects, where strong quantum fluctuation causes a variety of non-trivial physical properties. In the SU(3) symmetric case, several researchers have tried to reveal the critical properties, although with conventional numerical methods, it has been difficult to deal with it, due to the logarithmic corrections. In our works, we investigate the critical phenomena near the SU(3) symmetric critical point by numerically diagonalizing the Hamiltonian of a spin-1 chain

$$\hat{H} \equiv \cos\phi\, \hat{H}_{\mathrm{BLBQ}} + \sin\phi\, \hat{H}_{\mathrm{trimer}}$$

In the above equation, we combine the bilinear-biquadratic (BLBQ) Hamiltonian with the trimer Hamiltonian. We analyze numerical results utilizing the perturbative renormalization group of the conformal field theory (CFT) to overcome the logarithmic corrections. We then obtain conclusions both in the SU(3) symmetric case and non-SU(3) symmetric case as follows.

Firstly, for the SU(3) symmetric system, we find the phase transition between a massless trimer liquid (TL) phase and a long-range ordered trimer phase. We then calculate the critical exponents, the central charge c and the scaling dimension x. From these numerical results, we identify that the universality class of the TL phase is illustrated with the level-1 SU(3) Wess–Zumino–Witten [$SU(3)_1$ WZW] model. Secondly, we performed numerical calculations expanding to the non-SU(3) symmetric case. We here confirm that the SU(3) symmetric critical point is the tri-critical point among the TL phase, the trimer phase, and the Haldane phase. For the TL–trimer transition and TL–Haldane transition, we specify that the critical phenomena around this tri-critical point belong to the same universality class as that of the $SU(3)_1$ WZW model. Moreover, we find that the boundary between the Haldane phase and the trimer phase is explained with the self-dual sine-Gordon (SDSG) model of the massive spin current. These results are applicable to experiments of ultracold SU(ν) symmetric atomic systems in an optical lattice.

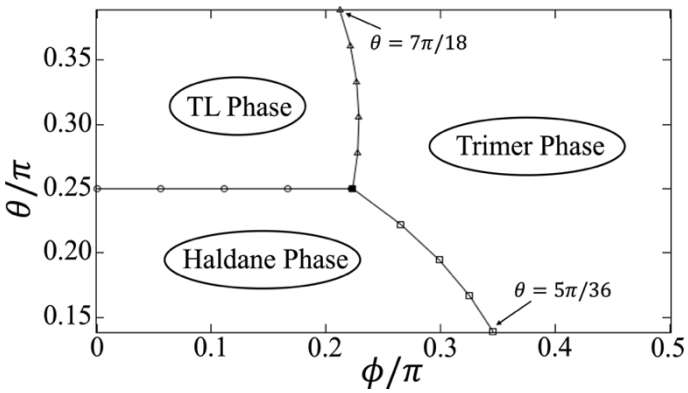

Fig. 1. Phase diagram around the SU(3) symmetric tri-critical point.