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A topological classification of gapped spin chains by quantized Berry phases: VBS picture and the fractionalization TAKAAKI HIRANO, HOSHO KATSURA, Department of Applied Physics, The University of Tokyo, YASUHIRO HATSUGAI, Department of Applied Physics, The University of Tokyo; Institute of Physics, University of Tsukuba — We define a local order parameter of gapped integer spin chains by the Berry phase, where a local spin twist is used as a cyclic parameter to define the Berry connection of the ground state[1]. It is topologically stable against small perturbations unless the level crossing occurs since the Berry phase is quantized to 0 or π if the system has the time reversal symmetry. We calculate this Berry phase for the $S = 1, 2$ dimerized Heisenberg model and the $S = 2$ Heisenberg model with D-term. The Berry phases of the generalized valence bond solid states are also evaluated analytically. The results are consistently understood by the valence bond pictures. It implies fundamental objects of the gapped integer spin systems are of spin 1/2 (fractionalization)[2]. [1] Y. Hatsugai, J. Phys. Soc. Jpn. 75, 123601 (2006), arXiv:cond-mat/ 0603230. [2] T. Hirano, H. Katsura, and Y. Hatsugai, arXiv:0710.4198 (2007).

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