The Hamiltonian of the model is explicitly given by

$$H = J\sum_{j=1}^{N}\left(s_j^x s_{j+1}^x + s_j^y s_{j+1}^y\right) \quad \frac{I}{N}\sum_{j,k=1}^{N} s_j^z s_k^z - h\sum_{j=1}^{N} s_j^z,$$

where the $s^{x,y,z}$ are half the Pauli spin matrices. The model is exactly solved by applying the Jordan-Wigner fermionization [1], followed by a Gaussian transformation. In the absence of long-range interactions ($I = 0$), the model, which reduces to the isotropic XY model, is known to exhibit a second-order quantum phase transition driven by the field at zero temperature [2]. It is shown that in the presence of the long-range interactions ($I \neq 0$) the nature of the transition is strongly affected. For $I > 0$, which favours the ordering of the transverse components of the spins, the transition is changed from second- to first-order, due to the competition between transverse and xy couplings. On the other hand, for $I < 0$, which induces complete frustration of the spins, a second-order transition is still present, although the system is driven out of its usual universality class, and its critical exponents assume typical mean-field values.

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1S-22. MAGNETISM OF NANOSIZED METALLIC CO-CLUSTERS. Patricio Vargas (Universidad Tecnica Federico Santa Maria, Departamento de Fisica, Avenida Espana, 1680, Valparaiso, POBox 110V, Switzerland) and Dora Altbir (Universidad de Santiago de Chile, Physics Department, Correo 2, Santiago, RM, Switzerland) and José d'Albuquerque Castro (Universidade Federal do Rio de Janeiro, Instituto de Física, Rio de Janeiro, RJ, 21945-970, Brazil)

The magnetization of a small 2D and 3D Co-cluster is numerically investigated. Zero field cooled magnetization curves as a function of temperature were obtained. Exchange, dipolar interaction and anisotropy were taken into account. The results suggest that magnetic nanosized particles in granular metals are not saturated even at room temperature. Moreover, the evolution of the system toward equilibrium is studied, and the occurrence of vortexlike excitations within the cluster is pointed out.

1S-23. STRONG COUPLING OF MAGNETIC AND MECHANICAL FINITE ELEMENT ANALYSIS. Koen Delaere, Kay Hameyer, Ronnie Belmans (Katholieke Universiteit Leuven, ESAT-ELEN, Kardinaal Mercierlaan 94, Leuven, B 3000, Belgium)

The strong-coupled magneto-mechanical system provides a natural context for magnetic forces and magnetostriction. It is the environment of choice to analyse magnetostrictive motors and actuators, where the specific non-linear material behaviour is dominant. In the strong coupling between magnetic and mechanical 2D finite element analysis, every node in the mesh has three unknowns connected to it: vector potential Az and 2D displacement a=[x y]. The global finite element matrix consists of four parts: the magnetic matrix M, the mechanical stiffness matrix K, and two coupling terms C and D. The coupling matrix C is based upon a) the vector potential Az and b) the partial derivatives of M with respect to mechanical displacement. It yields a distribution of nodal magnetic forces using Fmag = -C*Az. The coupling matrix D is based upon a) the mechanical displacement a=[x y] and b) the partial derivative of elastic energy with respect to a change in the magnetic vector potential. It produces a current density distribution Ims = -D*a which indicates how the magnetostriction of each element influences the magnetic field in order to minimize the total energy, which is the sum of magnetic and elastic energy. The total matrix is asymmetric. A successive substitution (SS) technique was used to solve problems for both isotropic and anisotropic magnetostrictive materials. For both these test cases, convergence is usually obtained within 15 SS steps using a relaxation factor of 0.2 to 0.6. Since this problem is highly non-linear, a good starting solution is needed. In this case, a zero starting solution was taken for the displacement, while the vector potential was set equal to the solution of the magnetic system only (no coupling). In order to obtain an equal order of magnitude for vector potential Az and displacement a, a scaling of 10^{+1} is performed on the displacement a. Once the total system is solved, the nodal distribution of magnetic forces is obtained directly using Fmag = -C*Az and does not require post-processing as such. In the same way the current density Ims = -D*a indicates which element's deformation causes the biggest change in the magnetic field. This assessment can also be done after any iteration step using the intermediate solution. This strong coupling scheme is a valuable tool in design and optimisation of devices incorporating important magnetostrictive effects, since it allows to localize magnetostriction as well as magnetic forces, which is very important in order to calculate the vibrations and noise of these devices.

1S-24. QUANTUM MONTE-CARLO STUDY OF PHASE TRANSITIONS IN HEISENBERG CHAINS WITH LONG-RANGE INTERACTIONS. Oleg N. Vassiliev, Michael G. Cottam (University of Western Ontario, Department of Physics and Astronomy, London, Ontario, N6A 3K7, Canada) and Igor V. Rojdestvenski (Umea University, Department of Plant Physiology, Umea, 90187, Sweden)

This study concerns quantum spin 1/2 ferromagnetic chains with a power law decrease $J(r) = J_0/r^p$ of the spin coupling parameter with distance r. In the case of $p = 2$ the exact thermodynamic behavior is known [1], the system being disordered at finite temperatures. For smaller p an ordering transition is predicted at a finite temperature according to a modified spin wave theory using a mean field theory and Green's function decoupling [2]. Systems of this type have also been studied using a Monte-Carlo method limited to classical spins. The Handscomb Monte Carlo method for quantum systems has been used within the nearest neighbor model of interaction [3]. In the present work the Handscomb method is applied to Heisenberg chains in the range $1 < p < 2$. The focus is on the phase transition. The case of $p = 2$ was included to test our numerical procedures. Chains of 500, 1000, 1500 and, when necessary, more spins have been considered for each p. The finite size effects are examined. The spin correlation function is calculated using an estimate reported in Ref.3. A three-parameter model is suggested that provides reliable best-fit functions for the entire set of calculated correlation functions. The temperature dependence of the distance-independent part of the correlation function is used to determine the critical temperature T_c. The susceptibility is calculated using a summation of the correlation functions, and its temperature dependence is employed in an alternative method for estimating T_c. Our results agree qualitatively with the previous approximate theories and indicate the existence of a phase transition at finite temperatures in the case $p < 2$. However, our calculated critical temperatures are 10-20% lower than the theoretical predictions [2] for some p values. Critical exponents for the correlation functions, magnetization, and susceptibility are also estimated.

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1S-25. MIXED MAGNETIC COBALT/NICKEL CHLORIDE DIHYDRATE: COMPOSITION DEPENDENT METAMAGNETISM. Gary C. DeFotis, Matthew J. Wilkens, Andrew C. Beveridge, Amy A. Narducci, Heather A. King, Robert B. Jeffers (College of William and Mary, Chemistry Dept., P.O. Box 8795, Williamsburg, VA, 23187-8795, US)

The pure components of this mixed magnet are three-dimensional Ising (Co system) and Heisenberg (Ni system) antiferromagnets ordering at 17.2 K and 7.25 K, respectively, with a spin reorientation transition also occurring in the Ni system at 6.3 K. The structures are not identical but are characterized by $MCl_2(2)MCl_2(2)M\ldots$ chemical chains, along which the exchange is ferromagnetic in both pure materials, with interchain exchange antiferromagnetic. Homogeneous mixtures have been obtained and examined over the entire composition range. The Curie constant, from fits to paramagnetic data, exhibits a regular and expected composition dependence. The Weiss theta exhibits a regular but unconventional composition dependence. Antiferromagnetic maxima in the low temperature suscep- tibilities of powder samples evolve in form