Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

The Discovery of a New Class of Magnetic Superhalogens P. JENA, M.M. WU, H. WANG, Y. KO, Q. WANG, Q. SUN, B. KIRAN, A. KANDALAM, K. BOWEN, VIRGINIA COMMONWEALTH UNIVERSITY TEAM, PEKING UNIVERSITY COLLABORATION, JOHNS HOPKINS UNIVERSITY COLLABORATION, MCNEESE STATE UNIVERSITY COLLABORATION — We report the discovery of a new class of magnetic superhalogens and their unusually stable molecular anions. These are formed when a hot plume of manganese atoms is cooled through collisions with an inert gas in the presence of chlorine atoms. The anions, with a composition of $(Mn_xCl_{2x+1})^-$ (x = 1, 2, 3. . .), appear as prominent (magic) peaks in mass spectra. Using calculations based on density functional theory and experiments utilizing anion photoelectron spectroscopy, we traced the origin of their unusual stability to the half-filled d-shell of the Mn atoms in anionic clusters and the large electron affinities of their neutral counterparts. The calculated and measured electron affinities are almost twice as high as that of the chlorine atom. However, unlike conventional superhalogens which are non-magnetic and consist of a single metal atom at the core surrounded by halogen atoms, the superhalogens discovered here are magnetic and have $(MnCl_2)_x$ moiety as a core to which a chlorine atom is attached. In addition, our calculations show that Mn atoms carry large magnetic moments and Mn_xCl_{2x+1} superhalogen moieties can serve as building blocks of a new category of salts with magnetic properties.

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Date submitted: 04 Jan 2011 Electronic form version 1.4