1046-65-1656 **Qiya Hu** (hqy@lsec.cc.ac.cn), ISEC, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, 100080, Peoples Rep of China, **Jinchao Xu** (xu@math.psu.edu), Department of Mathematics, Penn State University, University Park, PA 16802, and **Bin Zheng*** (zheng@math.psu.edu), Department of Mathematics, Penn State University, University Park, PA 16802. *New Finite Element Methods for Fourth Order Curl Equations.*

Developing accurate and efficient numerical approximations of solutions of high order PDEs is a challenging research topic. There are several difficulties that may be encountered in the finite element approximations of high order PDEs. For example, the conforming finite element methods would require high smoothness of the approximating functions and a large number of degrees of freedom, thus increasing the computational cost significantly. An alternative approach is to use nonconforming methods.

This talk will present two new finite element methods that directly discretize the fourth order curl equations (involving $(\nabla\times)^4$) in three dimensions arising from magnetohydrodynamics (MHD) models. These elements provide nonconforming approximations for which the number of degrees of freedom is very small. The inter-element continuity is imposed weakly along the tangential directions which is appropriate for the approximation of the magnetic field. We will also show the detailed construction of basis functions and optimal error estimates for model problems containing both second order and fourth order terms. (Received September 16, 2008)