AFRL CALL FOR RESEARCH

1. Research Title: Transient Magnetic Field Measurements on an Aircraft Fuselage-like Platform

2. Individual Sponsor:

Dr. Daniel L. Schweickart
AFRL/PRPG/Bldg. 450
2645 Fifth St., Rm. D101
WPAFB, OH 45433
Daniel.Schweickart @wpafb.af.mil

3. Academic Area/Field and Education Level: Electrical and Computer Engineering; Engineering Physics/ Electromagnetic Field Measurements (MS or Ph.D. level)

4. Objectives: This topic is of joint interest to both the Propulsion and Directed Energy Directorates. Propulsion currently has a joint program with Directed Energy to develop compact pulsed power source technology hardware for airborne electronic attack. Directed Energy also has other programs to model electromagnetic effects from pulsed power sources, related to airborne HPM (high power microwave) applications. Since they have reviewed the results of the previous cooperative Propulsion/OSU work (see below), Directed Energy (W. Clark) had expressed interest in new work to enable verification of their computer models via a focused measurement program on the WPAFB fuselage-like cylinder.

5. **Description:** The Ohio State University has co-operatively worked with the Propulsion Directorate in an earlier program, to develop and verify the instrumentation and measurement methodology for making measurements of transient magnetic fields induced by pulsed power sources on a fuselage-like test platform in facilities here at WPAFB. (This work formed the basis for two masters theses under Prof. Steven Sebo.) Tests were performed in the High Bay Laboratory on an aluminum cylinder that has the full scale basic dimensions of an F-16 fuselage and is constructed with traditional aircraft grade aluminum type and thickness, offering the same electromagnetic shielding and conductive properties of an aircraft. The cylinder is part of a test setup that consists of a high current pulse generator, the cylinder and return leads, which form a complete electrical circuit that was originally set up to simulate an aircraft getting struck by lightning. The fuselage-like cylinder test setup in the High Bay Laboratory at WPAFB is a platform that can be used for full-scale verification of electromagnetic modeling codes, while considering relatively simple geometries. The platform consists of an aluminum cylinder that has the full-scale basic dimensions of a generic fighter fuselage, in conjunction with a high current pulse generator. It is constructed with traditional aircraft grade aluminum type and thickness, offering the same electromagnetic shielding and conductive properties of an aircraft. The geometries to be examined are to be kept simple and basic to maximize the confidence level of the test results. If an actual fuselage were used for this type of test, the currents and B-fields measured could not be used to generically describe the interaction of the transient generated currents and fields with the electrical and electronic systems of an aircraft or spacecraft. The relative simplicity of the relevant geometries enables the accurate evaluation of field models that can be used to predict the performance of complex geometries in actual airframes. The high current pulse generator enables measurements to be made using currents of the same order of magnitude (10's of kA) as are anticipated during operation of advanced power conditioning equipment driving future airborne defense systems. Specifically, transient current and dB/dt measurements using an approximately 10 meter long, 1 meter diameter aluminum cylinder test set-up in the High Bay Laboratory are to be conducted. Transient dB/dt measurements outside and inside the test cylinder are to be conducted for various connection cases, at numerous test points in each case. Some work for modifying the test setup will be needed. The connection cases, as well as the application of nonaluminum panels (graphite/composite lay-ups and/or special energy absorbing materials) open up many possibilities for a variety of measurements, simulating the impact of a transient energy source. In general, these measurements must cover:

- asymmetrical current measurements
- dB/dt measurements
- stringer current measurements

- the role and effects of apertures and windows.

It is anticipated that a 1-1.5 year measurement effort would result in 1 or 2 Masters theses. If advanced electromagnetic computer modeling of the more complicated cases were to be included in the program, a 3-year PhD dissertation is a possibility.

6. Research Classification/Restrictions: This research is FOUO.

7. Eligible Research Institutions:

[X] Universities (DAGSI) [X] AFIT [X] USAF