

Dyakonov-Perel Effect on Spin Dephasing in n-Type GaAs

A paper presents a study of the contribution of the Dyakonov-Perel (DP) effect to spin dephasing in electron-donor-doped bulk GaAs in the presence of an applied steady, moderate magnetic field perpendicular to the growth axis of the GaAs crystal. (The DP effect is an electron-wave-vector-dependent spin-state splitting of the conduction band, caused by a spin/orbit interaction in a crystal without an inversion center.) The applicable Bloch equations of kinetics were constructed to include terms accounting for longitudinal optical and acoustic phonon scattering as well as impurity scattering. The contributions of the aforementioned scattering mechanisms to spin-dephasing time in the presence of DP effect were examined by solving the equations numerically. Spin-dephasing time was obtained from the temporal evolution of the incoherently summed spin coherence. Effects of temperature, impurity level, magnetic field, and electron density on spin-dephasing time were investigated. Spin-dephasing time was found to increase with increasing magnetic field. Contrary to predictions of previous simplified treatments of the DP effect, spin-dephasing time was found to increase with temperature in the presence of impurity scattering. These results were found to agree qualitatively with results of recent experiments.

*This work was done by C. Z. Ning of **Ames Research Center** and M. W. Wu of the University of California. Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Ames Research Center, (650) 604-5104. Refer to ARC-15067-1.

Update on Area Production in Mixing of Supercritical Fluids

The paper "Turbulence and Area Production in Binary-Species, Supercritical Transitional Mixing Layers" presents a more recent account of the research summarized at an earlier stage in "Area Production in Supercritical, Transitional Mixing Layers" (NPO-30425), *NASA Tech Briefs*, Vol. 26, No. 5 (May 2002) page 79. The focus of this research is on supercritical C_7H_{16}/N_2 and O_2/H_2 mixing layers undergoing transitions to turbulence. The C_7H_{16}/N_2 system serves as a simplified model of hydrocarbon/air systems in gas-turbine and diesel engines; the O_2/H_2 system is representative of liquid rocket engines. One goal of this research is to identify ways of controlling area production to increase disintegration of fluids and enhance combustion in such engines. As used in this research, "area production" signifies the fractional rate of change of surface area oriented perpendicular to the mass-fraction gradient of a mixing layer. In the study, a database of transitional states obtained from direct numerical simulations of the aforementioned mixing layers was analyzed to investigate global layer characteristics, phenomena in regions of high density-gradient magnitude (HDGM), irreversible entropy production and its relationship to the HDGM regions, and mechanisms leading to area production.

*This work was done by Nora Okong'o and Josette Bellan of Caltech for **NASA's Jet Propulsion Laboratory**. Further information is contained in a TSP (see page 1). NPO-40030*

Quasi-Sun-Pointing of Spacecraft Using Radiation Pressure

A report proposes a method of utilizing solar-radiation pressure to keep the axis of rotation of a small spin-stabilized spacecraft pointed approximately (typically, within an angle of 10° to 20°) toward the Sun. Axisymmetry is not required. Simple tilted planar vanes would be attached to the outer surface of the body, so that the resulting spacecraft would vaguely resemble a rotary fan, windmill, or propeller. The vanes would be painted black for absorption of Solar radiation. A theoretical analysis based on principles of geometric optics and mechanics has shown that torques produced by Solar-radiation pressure would cause the axis of rotation to precess toward Sun-pointing. The required vane size would be a function of the angular momentum of the spacecraft and the maximum acceptable angular deviation from Sun-pointing. The analysis also shows that the torques produced by the vanes would slowly despin the spacecraft — an effect that could be counteracted by adding specularly reflecting "spin-up" vanes.

*This work was done by Thomas Spilker of Caltech for **NASA's Jet Propulsion Laboratory**. Further information is contained in a TSP (see page 1). NPO-40047*