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**Fusion Physics Toward ITER**[1]

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Stars are powered by fusion, the energy released by fusing together light nuclei, using gravitational confinement of plasma. Fusion on earth will be done in a 100 million degree plasma made of deuterium and tritium and confined by magnetic fields or inertia. The worldwide fusion research community will construct ITER, the first experiment that will burn a DT plasma by copious fusion reactions. ITER's nominal goal is to create 500 MW of fusion power. An energy gain of 10 will mean the plasma is dominantly self-heated by the fusion-produced alpha particles. ITER's all superconducting magnet technology and steady-state heat removal technology will enable nominal 400 s pulses to allow the study of burning plasmas on the longest intrinsic timescale of the confined plasma - diffusive redistribution of the electrical currents in the plasma. The advances in magnetic confinement physics that have led to this opportunity will be described, as well as the research opportunities afforded by ITER. The physics of confining stable plasmas and heating them will produce the high gain state in ITER. Sustained burn will come from the physics of controlling currents in plasmas and how the hot plasma is interfaced to its room temperature surroundings. ITER will provide our first experience with how fusion plasma self-heating will profoundly affect the complex, interlinked physical processes that occur in confined plasmas.

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