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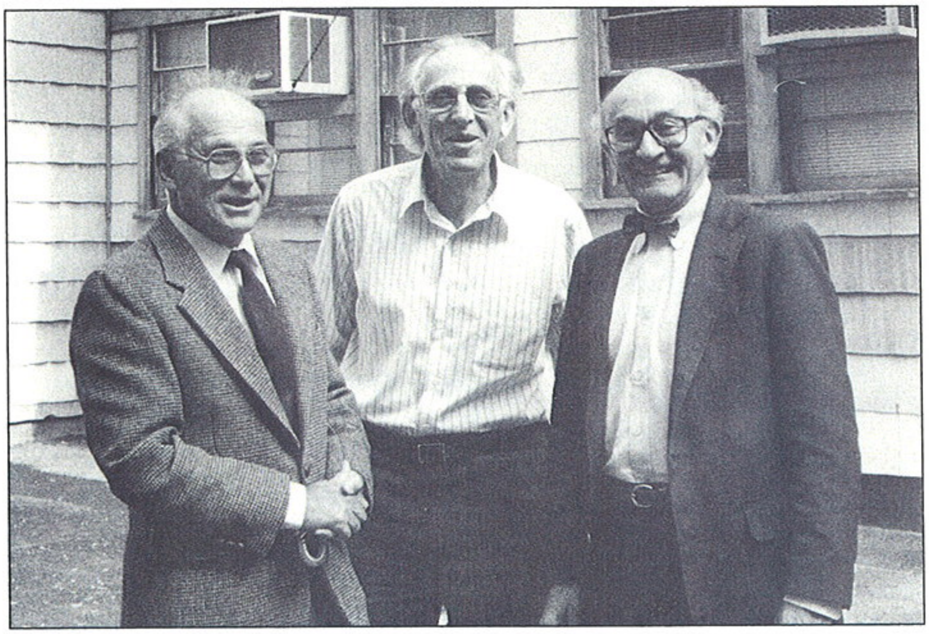
Discovering the Universal Importance of Plasmas at RLE



Senior faculty members of RLE's Plasma Physics Group reunite where it all began—at MIT's Building 20. With almost a century of MIT experience between them, Professors Bruno Coppi, George Bekefi, and Abraham Bers take a moment to reflect on the group's success and what is still to come in plasma science research. *(Photo by John F. Cook)*

In our universe, it is estimated that plasmas make up 99% of all the states of matter. The plasma state is most abundant in space, where interstellar and galactic plasmas comprise many of the stars and other heavenly phenomena in this and other galaxies. The sun (itself a star) is literally a hotbed of plasma activity with its seemingly limitless heat and light energy generated by potent atomic fusion reactions. Sunspots, solar prominences and flares, and the solar wind are all products of the sun's fusion process that affect the Earth's environment 150 million kilometers away. While the Earth's ionosphere is most sensitive to solar activity, our magnetosphere and its Van Allen belts also provide a rich geomagnetic environment for plasma activities that are visible in spectacular light and thermal energy reactions, including lightning bolts and breathtaking atmospheric auroras. Spaceborne objects entering Earth's atmosphere, such as space vehicles and satellites, also generate plasmas hot enough to melt their surfaces.

On Earth itself, plasma activity can be observed in the flames of a fire and from the glow of man-made neon and fluorescent lights. Imitating the sun's generation of powerful and abundant fusion energy on Earth has been the focus of many basic scientific studies and complex experiments since the start of the nuclear age. These investigations continue as both theorists and experimentalists seek to overcome the formidable difficulties associated with extremely high-temperature plasmas necessary to achieve one of the principal goals of plasma physics research — to create a thermonuclear fusion reactor that will produce electricity and serve as a source of plentiful energy.

From Gas to Plasma

The heating of a solid or liquid substance leads to events known as *phase transitions.* Molecules or atoms with enough energy to overcome what is called the *binding potential* will evap-

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