Figure 10.15   Roll-out arrays used on the Hubble space telescope. (Photo courtesy of NASA)

LILT environments. The technical issues in using concentrating arrays are precision pointing, thermal dissipation, nonuniform illumination, optical contamination, environmental interactions, and complexity of deployment. They can also decrease overall spacecraft reliability because a loss of pointing may cause significant power loss to the spacecraft.

Reflective systems can have concentration ratios from 1.6X to over 1000X, with a practical limit of around 100X. Refractive designs are generally limited to the range of about 5X to 100X, with a practical limit of around 20X. Solar energy may be focused on a plane, line, or point depending on the geometry of the concentrator design. These concentrators may be small and numerous if used in a distributed focus design or they may be a single large concentrator as in a centralized focus design.

AstroEdge™ array on the NRO STEX spacecraft, launched in October 1998, was the first spacecraft to use a concentrator as its main power source. This system used a reflective trough design with a nominal 1.5X concentration. The arrays were successfully deployed and cell currents were slightly higher than predicted. Thermal problems did occur on some of the panels owing to the higher concentrator operating temperature.

The Deep Space 1 spacecraft launched in October 1998 used SCARLET concentrator arrays to provide power to its ion propulsion engines (see Figure 10.16) [14]. Its two arrays were capable of producing 2.5 kW at 100VDC. The Scarlet array was developed by AEC-ABLE under a program sponsored by BMDO.

The SCARLET array has a refractive linear distributed focus with a 7.5X concentration ratio. The array has 720 lenses to focus sunlight onto 3600 solar cells. Deep Space 1 has two SCARLET solar array wing assemblies. Each assembly is made up of a composite yoke standoff structure, four composite honeycomb panel assemblies, and four lens frame assemblies. High-efficiency triple-junction $GaInP_2/GaAs/Ge$ cells were used in this array.