ions, which would then be detected and quantitated by use of a mass spectrometer, ion-mobility spectrometer, or other suitable instrument (see figure).

The second proposed method calls for the use of another recently developed technique known as desorption atmospheric-pressure chemical ionization (DAPCI), in which an atmospheric-pressure corona discharge in the vapor of toluene or another suitable compound is used to generate projectile ions. In this case, the ions would be made to impinge on the substrate, with consequent ejection and ionization of stable hydrazine derivative ions as described above. Again, as described above, the hydrazine derivative ions would be detected and quantitated by use of a mass spectrometer, ion-mobility spectrometer, or other suitable instrument.

In the third proposed method, one would use yet another recently developed desorption-and-ionization technique known as direct analysis in real time (DART). In this technique, a plasma containing excited-state atoms and ions is formed in a gas (e.g., helium or nitrogen) that has a high ionization potential. The excited-state atoms and ions impinge on the surface of a solid sample, causing desorption of low-molecular weight molecules from the sample. In the proposed method, the sample would be the substrate, from which the hydrazine derivative molecules would be desorbed. The desorbed hydrazine derivative molecules would then be ionized and detected as described above.

This work was done by Timothy Griffin of Kennedy Space Center and Cristina Berger of ASRC Aerospace Corp. Further information is contained in a TSP (see page 1). KSC-13121/2/3

Crossed, Small-Deflection Energy Analyzer for Wind/ Temperature Spectrometer

This analyzer has application in improving the predictability of GPS operations.

Goddard Space Flight Center, Greenbelt, Maryland

Determination of neutral winds and ion drifts in low-Earth-orbit missions requires measurements of the angular and energy distributions of the flux of neutrals and ions entering the satellite from the ram direction. The magnitude and direction of the neutral-wind (or ion-drift) determine the location of the maximum in the angular distribution of the flux. Knowledge of the angle of maximum flux with respect to satellite coordinates (pointing) is essential to determine the wind (or ion-drift) vector.

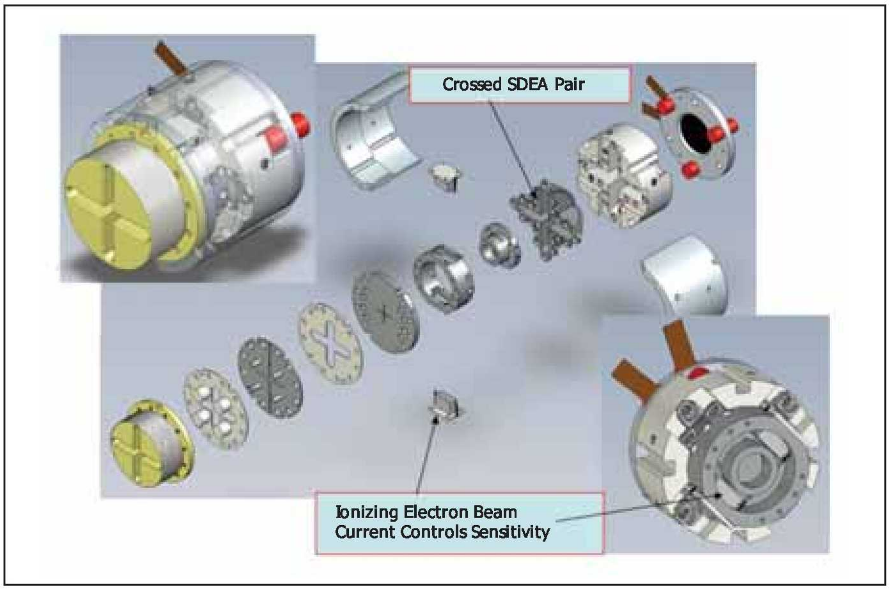

Figure 1. **Drawing of the Crossed SDEA WTS** assembled and in separate parts.

The crossed Small-Deflection Energy Analyzer (SDEA) spectrometer (see Figure 1) occupies minimal volume and consumes minimal power. Designed for upper atmosphere/ ionosphere investigations at Earth altitudes above 100 km, the spectrometer operates by detecting the angular and energy distributions of neutral atoms/ molecules and ions in two mutually perpendicular planes. In this configuration, the two detection planes actually cross at the spectrometer center. It is possible to merge two SDEAs so they share a common optical axis and alternate measurements between two perpendicular planes, and reduce the number of ion sources from two to one. This minimizes the volume and footprint significantly and reduces the ion source power by a factor of two. The area of the entrance aperture affects the number of ions detected/ second and also determines the energy resolution.

Thermionic emitters require heater power of about 100 mW to produce 1 mA of electron beam current. Typically, electron energy is about 100 eV and requires a 100-V supply for electron acceleration to supply an additional 100 mW of power. Thus, ion source power is at most 200 mW. If two ion sources were to be used, the ion source power would be, at most, 400 mW. Detector power, deflection voltage power, and microcontroller and other functions require less than 150 mW. A WTS (wind/ temperature spectrometer) with two separate optical axes would consume about 650 mW, while the crossed SDEA described here consumes about 350 mW.

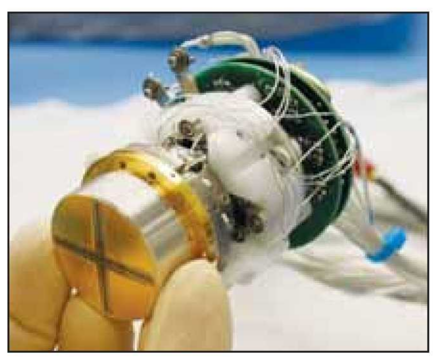

Figure 2. **Photo of the Actual Crossed SDEA WTS** when it was delivered for integration in NRL's ANDE Satellite.

The entrance aperture has a diameter of 0.004 in. (0.10 mm) to provide the required energy resolution between 0.05 and 0.15. This design (see Figure 2) provides a WTS occupying a volume less than 40 cm^3, on a footprint of diameter about 1.5 in. (38 mm).

The Crossed SDEA offers many advantages in the measurements of neutral wind and ion drifts in the Earth's thermosphere. As such, it will be useful in future commercial satellites dedicated to monitoring the ionosphere with a view to improving the integrity and predictability of GPS operations.

This work was done by Federico A. Herrero of Goddard Space Flight Center and Theodore T. Finne of the Naval Research Laboratory. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Goddard Space Flight Center, (301) 286-7351. Refer to GSC-15732-1.