

The Hubble Helix

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Abstract

For the 14 hours of peak Leonid meteoroid flux in November 2002, the *Hubble Space Telescope* was pointed away from the radiant, and the solar arrays were oriented to minimize their cross-section. By coincidence, one of the nearest and largest planetary nebulae, the Helix Nebula (NGC 7293), was nearly opposite the incoming Leonids and could be observed.

A "Hubble Helix Team" of volunteers led by M. Meixner (STScI) organized a nine-orbit campaign to observe the Helix with the ACS, WFPC2, NICMOS, and STIS. A contiguous 3 by 3 grid of 4kx4k-pixel ACS images covering much but not all of the Helix was exposed in two filters, H α + [N II] (F658N) and [O III] (F502N)

(F502N). A few of the WFPC2 images, obtained in parallel, covered portions of the nebula in [O I] (F631N), He II (F469N), or H α (F656N). NICMOS/NIC3 observations were obtained at two locations on the nebula and two off, in H $_2$ (F212N) and Paschen- α (F187N). A few of the STIS parallel observations in [O II] (F28X500II) were located on the nebula.

The main purpose of this presentation is to advertise to all interested parties the availability of the non-proprietary data via the *HST* archive. Initial data analysis by the Hubble Helix Team will be presented in this poster.

Fig. 4. Detail of a composite of ACS images in H α + [N II] (F658N) in red-orange and [O III] (F502N) in cyan (blue-green).

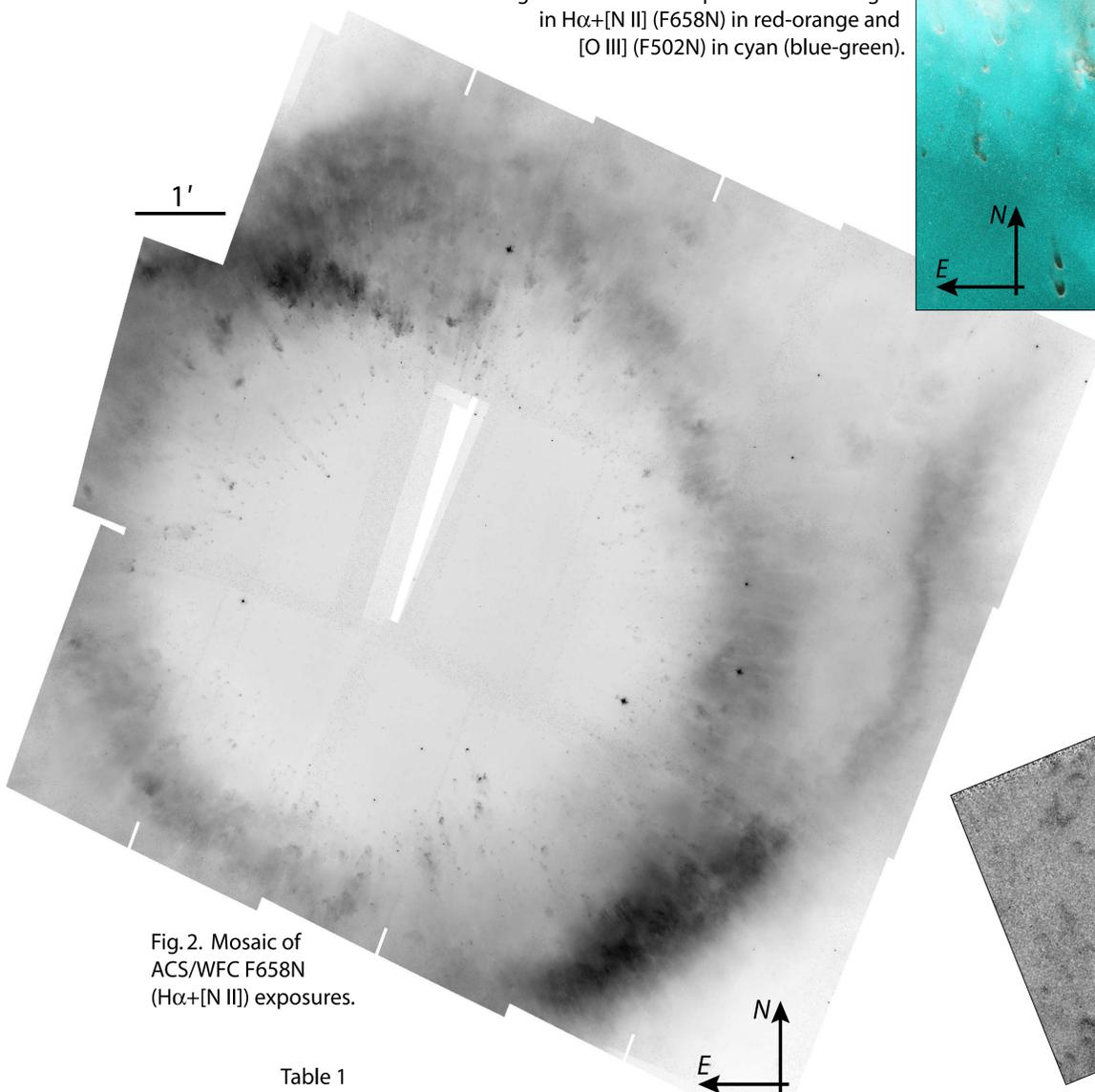
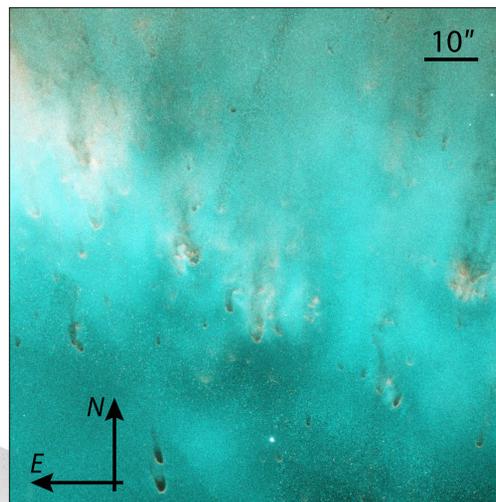


Fig. 2. Mosaic of ACS/WFC F658N (H α + [N II]) exposures.

Table 1

| Config. | Filter | Spectral Lines | Number of Exposures On / Off | Exposure Time On / Off (hours) |
|---------|-----------|---------------------------------|------------------------------|--------------------------------|
| ACS/WFC | F658N | H α 6562Å + [N II] 6584Å | 46 / 0 | 5.12 / --- |
| ACS/WFC | F502N | [O III] 5007Å | 46 / 0 | 4.92 / --- |
| WFPC2 | F656N | H α 6563Å | 20 / 0 | 2.56 / --- |
| WFPC2 | F631N | [O I] 6300Å | 18 / 0 | 2.35 / --- |
| WFPC2 | F469N | He II 4686Å | 2 / 0 | 0.24 / --- |
| NIC3 | F212N | H $_2$ 2.12 μ m | 12 / 4 | 2.20 / 0.71 |
| NIC3 | F187N | Pa α 1.87 μ m | 4 / 2 | 0.43 / 0.21 |
| STIS | F28X500II | [O II] 3727Å | 8 / 12 | 1.00 / 1.50 |

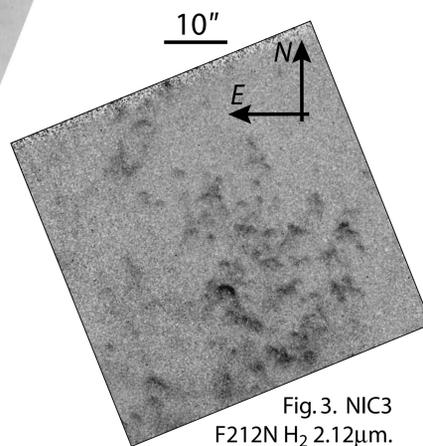


Fig. 3. NIC3 F212N H $_2$ 2.12 μ m.

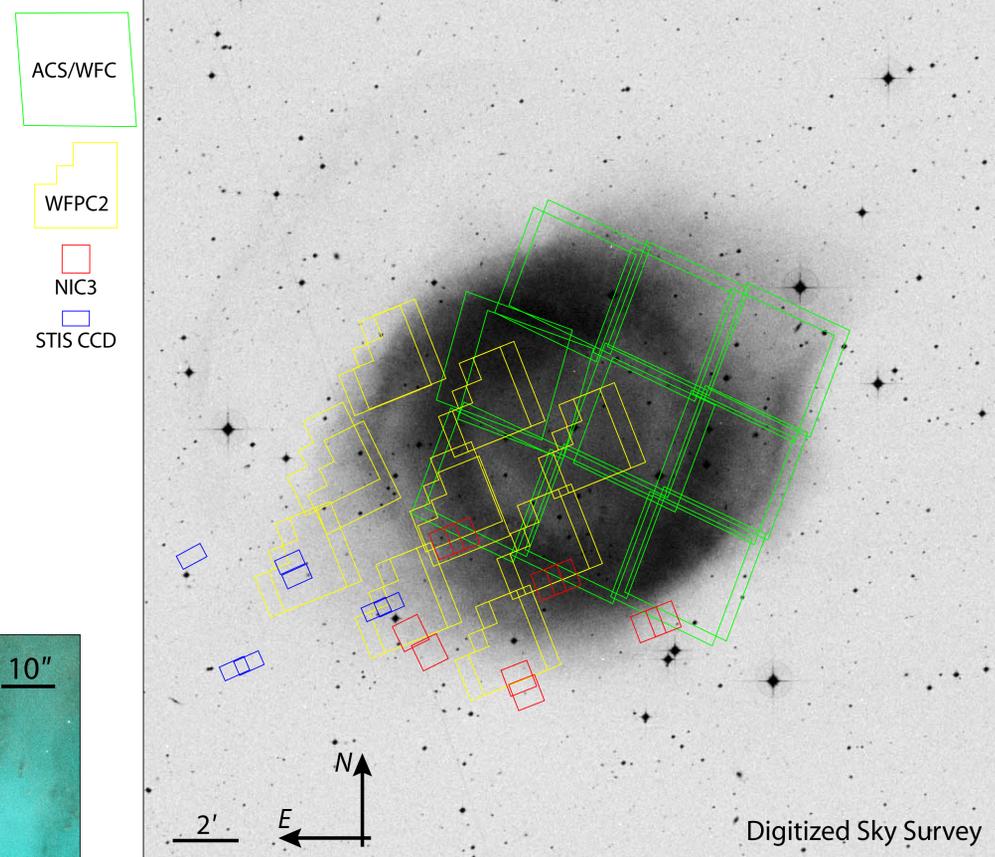


Fig. 1. *HST* fields of view superposed on DSS image of the Helix Nebula.

Introduction

Following the prediction of a large flux of Leonid meteoroids during the November 2002 shower, the *Hubble Space Telescope* Project directed that *HST* be pointed directly away from the radiant during the expected peak, so as to minimize the exposed cross-section to the meteoroids.

Fortuitously, the anti-radiant point lies within 1°3' of the Helix Nebula (NGC 7293), one of the nearest and angularly largest of all planetary nebulae. Thus, our team at the Space Telescope Science Institute (STScI) took the opportunity to carry out an imaging campaign on the Helix Nebula during the nine-orbit Leonid stand-down. The resulting images have all been placed immediately in the *HST* Archive, where they are available for analysis by any interested astronomers. This poster gives an overview of the wide variety of information that is available.

For safety's sake the MAMA detectors could not be used and the spacecraft's roll angle was fixed in order to minimize the solar panels' cross-section.

Observations

We were able to operate all four *HST* cameras simultaneously: the newly installed Advanced Camera for Surveys (ACS), the Wide Field Planetary Camera 2 (WFPC2), the Space Telescope Imaging Spectrograph (STIS), and the Near Infrared Camera and Multiobject Spectrograph (NICMOS). The nine pointings were optimized for contiguous coverage with ACS, leaving the other imagers pointing at adjacent sky regions (Figure 1). Table 1 summarizes the observations, including an itemization of exposures that were pointed "On" or "Off" the nebula.

Since the Helix Nebula is too large to be covered completely, even in nine ACS pointings, we chose to image the nebula's core and northwest side (Figure 2). The gap in the middle of the ACS mosaic occurred

because of an unexpected interaction between the "SAME POS AS" special requirement and the use of a subarray for the central star of the planetary nebula.

Results

The ACS images provide higher resolution and greater angular coverage of the nebula than ever before. The WFPC2 images supplement the ACS images with additional wavelength and sky coverage. The NICMOS images detect the 2.12 μ m line of H $_2$ quite well at many positions (Figures 1 and 3). Very cursory visual inspection reveals no nebulosity in any of the NICMOS Paschen- α 1.87 μ m images and the STIS [O II] 3727Å images.

Interested scientists may access all of the individual "Hubble Helix" images from the *HST* Archive. The STScI Office of Public Outreach will release a color image in the near future, a representative detail of which is shown in Figure 4.

Acknowledgments

We thank the many people at GSFC and STScI who schedule and operate the telescope for making this opportunity available to the astronomical community. In particular we thank Keith Kalinowski and Dave Scheve who approved pointing the *HST* at the Helix during the Leonids stand-down period.

*The Hubble Helix Team refers to those people who contributed to planning the observations and analyzing the data: H.E. Bond, G. Chapman, Y.H. Chu, P. Cox, W. Crothers, L.M. Frattare, R. Gilliland, M. Guerrero, R. Gruendl, F. Hamilton, R. Hook, P. Huggins, I. Jordan, C.D. Keyes, A. Koekemoer, K. Kwitter, Z.G. Levay, P.R. McCullough, M. Meixner, M. Mutchler, K. Noll, C.R. O'Dell, N. Panagia, M. Reinhart, M. Robberto, K. Sahu, D. Soderblom, L. Stanghellini, C. Tyler, J. Valenti, A. Welty, and B. Williams.