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N75 17249

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THE MARINER JUPITER/SATURN VISUAL IMAGING SYSTEM

In the interest of saving time, I will try to be brief. Many of the objectives that Chuck Lillie mentioned (see preceding contribution) are also objectives of interest to the imaging science team. The principal difference between imaging and photopolarimetry is that we have very much higher spatial resolution while the photopolarimeter has higher photometric accuracy.

Let me describe the optics that are presently included in our baseline system. These are a so-called "narrow-angle" camera, which has a focal length of 0.5 m, and a "wide-angle" camera, with a focal length of 100 cm. The television image format contains approximately 800 × 800 picture elements (pixels) in its 1-cm² scanning area.

This means that for the baseline optical systems, one line pair corresponds to a resolution of about 10 seconds of arc for the narrow-angle camera and five times that for the wide-angle camera. Our choice would be for longer focal lengths, but we have been given an inherited hardware design. Our narrow-angle camera is, in fact, the narrow-angle camera that was flown on Mariner 9. We presently have a request[1] into the MJS project office and the NASA program office to change this baseline design by increasing the focal length of our narrow-angle camera to 1.5 m and the wide-angle camera to 200 cm. This would get us down in the range of 3 seconds of arc or so per TV line pair.

The spectral response of the narrow-angle camera ranges from about 315 nm, I believe, to about 600 nm. Essentially, the red cutoff is established by that fact that we are running out of vidicon response. The wide-angle optics are still open to question, and we are attempting to come up with an optical design that will allow us to go further out into the ultraviolet, perhaps as far down as 200 nm, if the vidicon is still holding up at that wavelength. The vidicon response in the ultraviolet is not known at this time. We have eight filter positions for each of the two cameras, and these filters have not yet been selected.

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[1] Approval was subsequently received for the longer focal-length optics.

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Chuck Lillie showed you some figures that give the geometry of the trajectory past the rings of Saturn. The observations we could make might be, for example, the radial distribution and phase function of material in the rings as we fly past the ring system and perhaps the vertical distribution (that is, the geometric thickness of the rings) as we go through the ring plane. Let's assume that we are able to make a close pass to the rings, and I think this almost certainly means crossing the ring plane through the orbit of Mimas unless the question of the D′ ring is settled between now and then. We could, with the 1.5-m system, get just about close enough to the rings so we could see particles on the order of, say, 0.3 km to 1 km, and this of course has considerable impact on the monolayer model or perhaps Jim's source particles [2] floating around on the edge of ring A.

We can also look for Janus and determine whether or not it exists. Parenthetically, I might add that we made a search for Janus at New Mexico State University last winter with a limiting magnitude of about 14.6 or 14.7, visual. This is about 0.7 of a magnitude fainter than Dollfus had estimated for Janus. This search was, incidentally, unsuccessful.

This doesn't necessarily mean that Janus does not exist. Dollfus could easily have been off that far in estimating the brightness of the satellite. However, there will be other passages through the ring plane. They occur about 1980 and, I think, before the MJS spacecraft reaches Saturn.

In 1966 there were not many observatories that were prepared for, or even thought of looking for, additional satellites inside the orbit of Mimas. I think Dollfus was the only one who planned his observations in that way. The material in the D′ ring still seems to be subject to question, but with intensifier devices and better observing techniques in 1980 we should be able to answer some of these questions before MJS arrival at Saturn.

In the past we have had little success in trying to do photometry with vidicons. I think there is no reason to be terribly optimistic for MJS, except for two additional factors that have not been present in previous television experiments on Mariner spacecraft. The first is that we expect to have some sort of inflight calibration, and the second is the photopolarimeter which will also help us calibrate the vidicon.

We expect, then, to get both the spatial distribution of material in the rings and brightness measurements. This would allow us to meet many of the objectives that Lillie mentioned while discussing the photopolarimeter.

[2] See contribution by Pollack for a discussion of these "parent" or "source" particles.

DISCUSSION

James Pollack What is the minimum thickness of the rings you could measure if you go through the ring plane at the orbit of Mimas?

Brad Smith About 1 km at a distance of 40 000 km from the outer edge of ring A, if we have the 1.5-m system. That would be roughly 1.5 TV lines.

Hugh Kieffer For an extended object, you ought to be able to get down to a resolution of perhaps even less than a TV line.

Smith Yes, and we can do extensive processing, of course, with multiple frames.