Statistical analyses of bright ray craters on Ganymede: implications from Galileo and Voyager images

Statistical analyses of bright ray craters on Ganymede: implications from Galileo and Voyager images

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Ray craters are impact craters surrounded by radial rays or ejecta patterns (both bright and dark) and prominent on Ganymede, the biggest satellite of Jupiter. Bright ray craters are recognized to be the youngest features on Ganymede [1], and represent the most recent impact cratering [2]. Also, being susceptible to destruction by various processes [1-3], bright ray craters may inform on the most recent geologic processes on Ganymede.
Passey and Shoemaker [4] identified 84 bright ray craters D>30 km and obtained several preliminary results and conclusions using the image data of Voyager. However, since Voyager 1 and 2 only have sufficient resolution (better than 2 km/pixel) images limiting to the subjovian and antijovian surroundings [4, 5], the analysis of Galileo images could fill in this gap. Also, the revised global geologic map [5] and advanced cratering impact model [2] make a more accurate distribution and a more comprehensive understanding of bright ray craters of Ganymede possible.
In this study, we used the raw images of both Voyager and Galileo images (825 Voyager images and 314 Galileo images) to identify ray craters. Since the crater rays are sensitive to solar illuminations [2] and the coverage limitation of images, we only measured the ray craters at high sun conditions and in the latitudinal range 70°N-70°S [5]. Also considering the identifiable sizes of ray craters are highly dependent on spatial resolution of images, we initially examined the influence of image resolution on the density distribution of ray craters.
Ultimately, our work resulted in a revised density distribution of bright ray craters corresponding to spatial resolution, latitude, angular apex distance, and different terrain types, finding that the crater density of bright ray craters on Bright Terrain of Ganymede is at least ~4x from apex (the center of the leading hemisphere) to antapex (the center of the trailing hemisphere), and the bright rays are likely to be erased at a higher rate with increasing latitudes. Based on our results, we reconsidered the possible reasons for cratering asymmetry on Ganymede [2], and confirmed the influence of latitude-related factors, which might include thermal-driven sublimation [6] and plasma-induced sputtering [7].
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