

HIGH-RESOLUTION IMAGES OF IO FROM GALILEO SSI. A.S. McEwen¹, M.J.S. Belton², H.H. Breneman³, G. Collins⁴, P. Geissler¹, J.W. Head⁴, T.V. Johnson³, L. Keszthelyi¹, K.P. Klaasen³, R. Lopes-Gautier³, K.P. Magee³, M. Milazzo¹, J.M. Moore⁵, R.T. Pappalardo⁴, C.B. Phillips¹, J. Radebaugh¹, P. Schuster⁶, D.P. Simonelli⁷, E.P. Turtle¹, D.A. Williams⁸ and the Galileo SSI Team. ¹Lunar and Planetary Lab, (University of Arizona, Tucson, AZ 85711; mcewen@lpl.arizona.edu), ²NOAO, ³JPL, ⁴Brown U., ⁵NASA/Ames, ⁶DLR, Berlin, ⁷Cornell U., ⁸Arizona State U.

Introduction: The resilient Galileo spacecraft has completed two close flybys of Io, orbits I24 and I25 (Table 1), returning more than 100 useful images with resolutions from ~10 to 500 m/pixel (Table 2). These images reveal an active lava lake, an active curtain of lava, a variety of lava flow types, caldera morphologies, collapsing mountains, and intriguing surface textures. In this abstract we provide an overview of the encounters and science results, which are described in more detail in a series of presentations [1-9].

The Io Phase of Galileo: Saving the best science (and worst radiation) for last, Galileo began reducing perijove in the summer of 1999, leading to the Io encounters (Table 1). All of the new high-resolution images are on the anti-Jovian hemisphere (longitudes 70 to 245, except the Pele nightside image at longitude 256), whereas the best Voyager images (0.5-2 km/pixel) were acquired on the sub-Jovian hemisphere between longitudes 250-50. Galileo's best image of the sub-Jovian hemisphere (including Loki), from E26, has a scale of 3.4 km/pixel. Color coverage of the anti-Jovian hemisphere at 1.25 km/pixel was acquired in orbit C21, providing regional context for the I24-I25-I27 images and completing near-global coverage (along with Voyager images) at ~2 km/pixel. For detailed information on the images and other relevant information, see <http://pirlwww.lpl.arizona.edu/~turtle/ioplanning.html>.

Table 1. The Io Phase of Galileo

Orbit	Closest Approach to Io (km)	Date of Closest Approach to Io
C21	125,000	7/2/1999
I24	575	10/11/1999
I25	300	11/26/1999
E26	212,000	1/3/2000
I27	200	2/22/2000

Scrambled Summation Mode Images: The majority of the I24 images were acquired in a 2x2 pixel summation mode with a fast (2.6 s) readout time designed to minimize radiation noise. We

expected the radiation noise to be severe in images acquired close to Io, based on models and extrapolations, but were pleasantly surprised to find that noise levels were much less than expected, only ~20% worse than typical noise levels at Europa. Unfortunately the summation mode, which worked correctly through orbit C21, produced garbled images.

Greg Levanas and Ken Klaasen (JPL) developed a hypothesis that explains the data garbling. Rather than two pulses of the CCD serial clocks occurring per pixel sampling period as should happen for SSI summation modes, only one serial clock cycle is occurring per pixel sampling period. There are two types of resultant anomalies; most images are type 1. In the type 1 anomaly the left and right halves of each frame are summed together, but with a 7-pixel horizontal offset of alternate rows of data from the right-hand side. This offset enabled development of an innovative (or magical) reconstruction algorithm, developed at JPL using the LabVIEW software from National Instruments of Austin, TX.

Science Objectives and Results: Key observation goals and results for the close flybys include (1) high-resolution morphologies of key surface features, (2) high-resolution imaging of hot erupting lava, and (3) new constraints on the lava temperatures. We have had excellent results on objectives (1) and (2), but not (3). Both internally inflated lava flows and channelized flows appear common on Io as on Earth [3, 6]. The calderas on Io have several characteristics that are unusual compared to elsewhere in the Solar System [8], and many may be related to the formation of mountains [1]. The high-standing topography of Io is ubiquitously ridged and modified by mass-wasting processes [5]. Correlations with hot-spot mapping [9] and color images [2] show that calderas typically mark the main volcanoes where silicate lava erupts onto the surface, and are often associated with red deposits. Flows extending many kilometers from the calderas appear to be the sources of SO₂-rich plumes such as Prometheus. Subtle 50-m scale albedo lineations on the nearby plains point back to Prometheus [10]. We have confirmed the presence of an active lava lake at Pele and imaged an active curtain of fire in Tvashtar Catena [4].

Future Observations: I27 will hopefully be the very best Io encounter. Only the lower-resolution

half of the I25 images were acquired due to a spacecraft safing event, and many I24 images were degraded by the summation-mode anomalies. We now understand instrument performances at Io and can follow up on recent discoveries.

References: [1] Turtle, E.P. et al. (2000) LPS XXXI. [2] Geissler, P. et al. (2000) LPS XXXI. [3]

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Table 2. SSI Observations of Io from Orbits I24 and I25

I24 Observations

Name	No. of Frames	Resolution	Filter	Comments
PELE_01	12 + 1/3	14-30 m/pixel	CLR/GRN	Glowing margin of Pele lava lake in the dark
PILLAN01	12 + 1/3	9-19 m/pixel	CLR	2-year-old lava flows.
COLCHIS01	10 + 1/3	9-16 m/pixel	CLR	Strip over Ot Mons
ZAMAMA01	12 + 1/3	21-41 m/pixel	CLR	Strip over Zamama flow field
PROMTH01	14 + 2x1/3	36-105 m/pixel	CLR, GRN	Strips over Prometheus
COLCHS02	2	160 m/pixel	CLR	Oblique view of Ot Mons
TOHIL_01	6	181-195 m/pixel	CLR	Tohil Mons and surroundings, stereo with I27
PROMTH02	6 + 3x1/3	120-230 m/pixel	VLT, GRN, RED, 756, 889, 1MC	Discovery of caldera at Prometheus, no 889 absorption
ZAMAMA02	18	370-410 m/pixel	CLR	Mosaic over Isum, Donar, Volund, and Zamama
DORIAN01	4	450 m/pixel	CLR	Dorian Mons and surroundings
AMSKGI01	18	470-510 m/pixel	CLR	Mosaic over Amirani, Maui Skythia Mons, Euxine Mons, Gish-Bar Patera and Monan Mons.
TERMAP01	6 + 1/3	285-570 m/pixel	CLR	Topography of Hiiaka Mons
PILLAN02	1 + 1/3	1.3 km/pixel	RED, VLT	partial playback
STEREO01	12	1.5 km/pixel	CLR	Stereo with C21
GLOCOL01	6	6.5 km/pixel	VLT, GRN, RED, 756, 889, 1MC	Loki-Pillan region
ECLIPS01	6	15 km/pixel	CLR,1MC, GRN, RED, VLT	Loki, Pele, Pillan in eclipse.

I25 Observations

Name	No. of Frames	Resolution	Filters	Comments
EMAKNG02	1 + 2/3	147 m/pixel	CLR	Strip over Emakong caldera and sulfur? flows
GIANTS01	2	183 m/pixel	CLR	Active lava fountains in Tvashtar Catena
CULANN01	12	200-210 m/pixel	GRN, RED, VLT	Colorful flows and deposits around Culann
TERM_01	6	260-265 m/pixel	CLR	Topography of Zal Mons, Hiiaka Mons, and Shamshu Mons