

The Gravity Field of the Saturnian System

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We have used Saturnian satellite astrometric observations together with the data acquired during the spacecraft flybys of Saturn (Pioneer 11, Voyager 1, and Voyager 2) to develop new satellite and spacecraft ephemerides and a revised gravity field for the Saturnian system. The astrometric data are from the time period 1966 to 2003. The spacecraft data are more extensive than those Campbell and Anderson (1989 *AJ* **97**, 1485) used in their determination of the gravity field. We also included a priori information on Saturn's zonal harmonics from the ringlet constraint devised by Nicholson and Porco (1988 *JGR* **93**, 10209). The gravity parameters found in our analysis are:

Parameter [†]	Value	Parameter [†]	Value
GM_{system}	$37940683. \pm 58.$	GM_{Phoebe}	$0.48 \pm 0.23^{\ddagger}$
GM_{Mimas}	2.56 ± 0.05	J_2	$16294. \pm 6.$
$GM_{\text{Enceladus}}$	5.76 ± 1.30	J_4	$-921. \pm 27.$
GM_{Tethys}	41.21 ± 0.05	J_6	$99. \pm 28.$
GM_{Dione}	73.13 ± 0.02	J_8	$-10.^{\ddagger}$
GM_{Rhea}	154.53 ± 3.78	α_p	$40.59550 \pm 0.00360^{\ddagger}$
GM_{Titan}	8978.09 ± 0.88	δ_p	$83.53812 \pm 0.00018^{\ddagger}$
GM_{Hyperion}	$0.72 \pm 0.35^{\ddagger}$	$\dot{\alpha}_p$	-0.04229^{\ddagger}
GM_{Iapetus}	131.73 ± 15.08	$\dot{\delta}_p$	-0.00444^{\ddagger}

[†]units: $GM(\text{km}^3\text{sec}^{-2})$, $\alpha_p, \delta_p(\text{deg})$, $\dot{\alpha}_p, \dot{\delta}_p(\text{deg century}^{-1})$

[‡]not estimated

The GM s of Hyperion and Phoebe are based on assumed densities of 1.1 ± 0.5 and $1.3 \pm 0.5 \text{ gm/cm}^3$, respectively. The Saturn pole right ascension α_p and declination δ_p are from French *et al.* (1993 *Icarus*, **103**, 163) and their rates are computed from the precession rate of Nicholson *et al.* (1999 *BAAS* **31**, 1140).