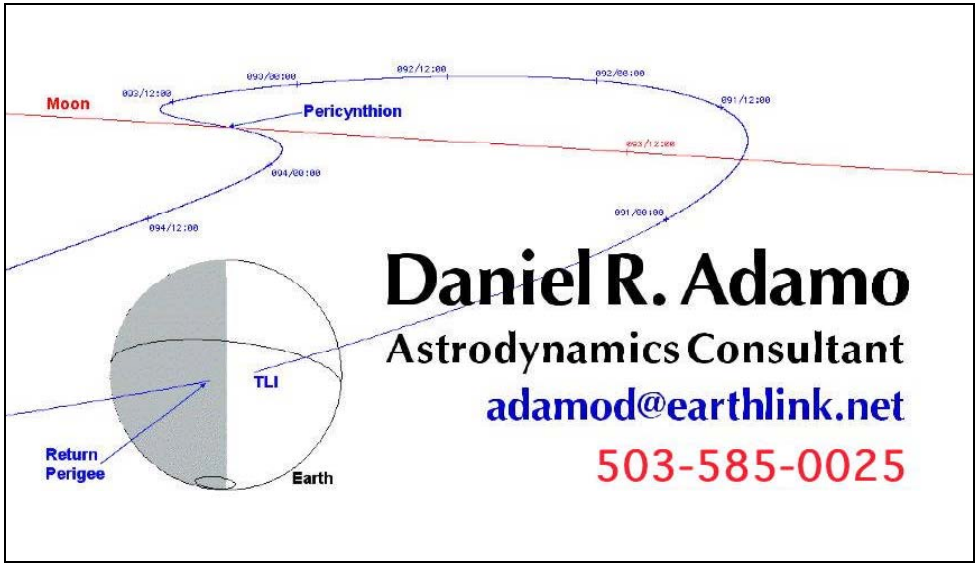
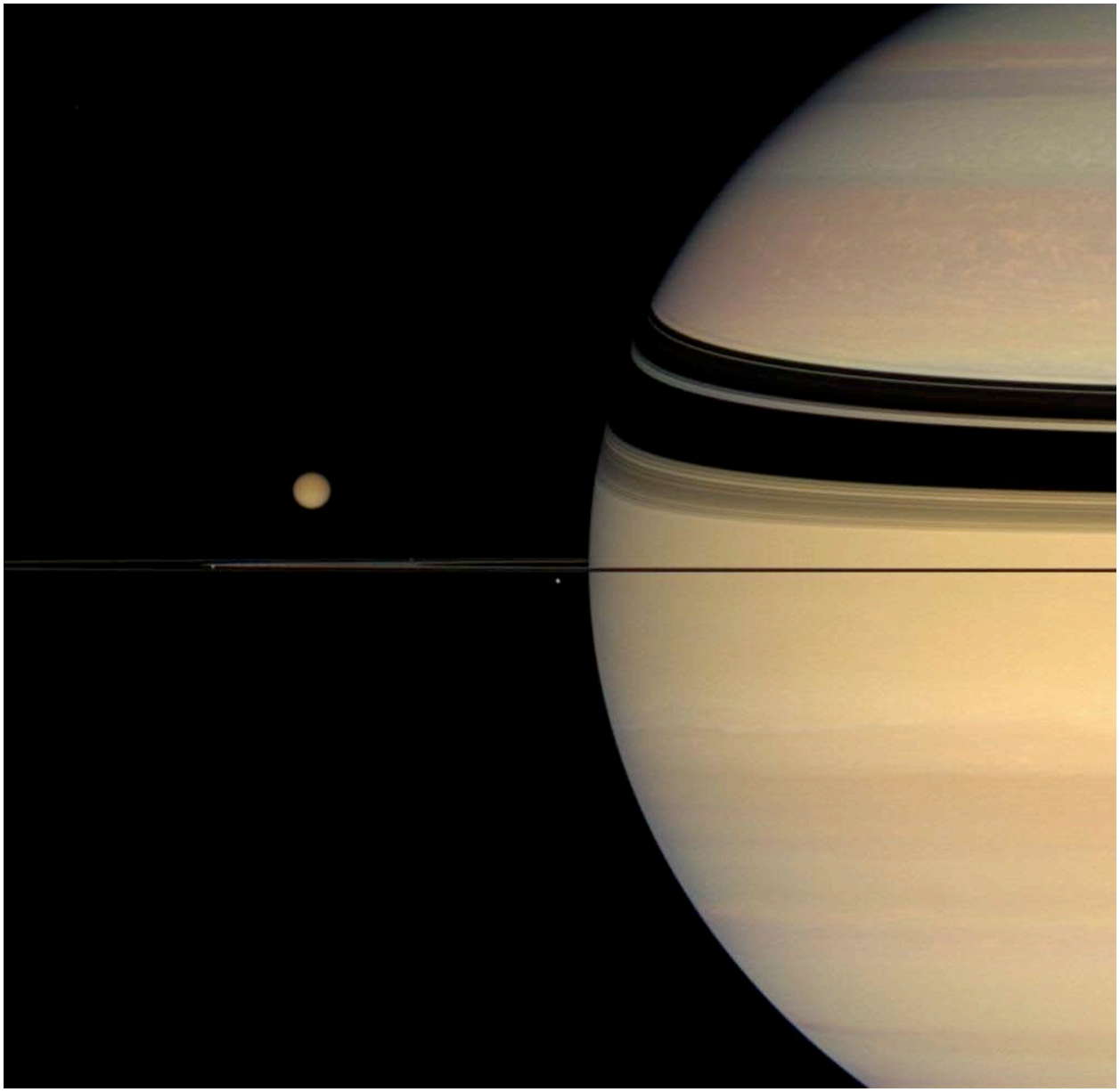
# *Exploring Saturn with Titan Gravity Assists (TGAs)*




**Silverton High School Physical Science**

11 April 2017

# Exploring Saturn with Titan Gravity Assists (TGAs)

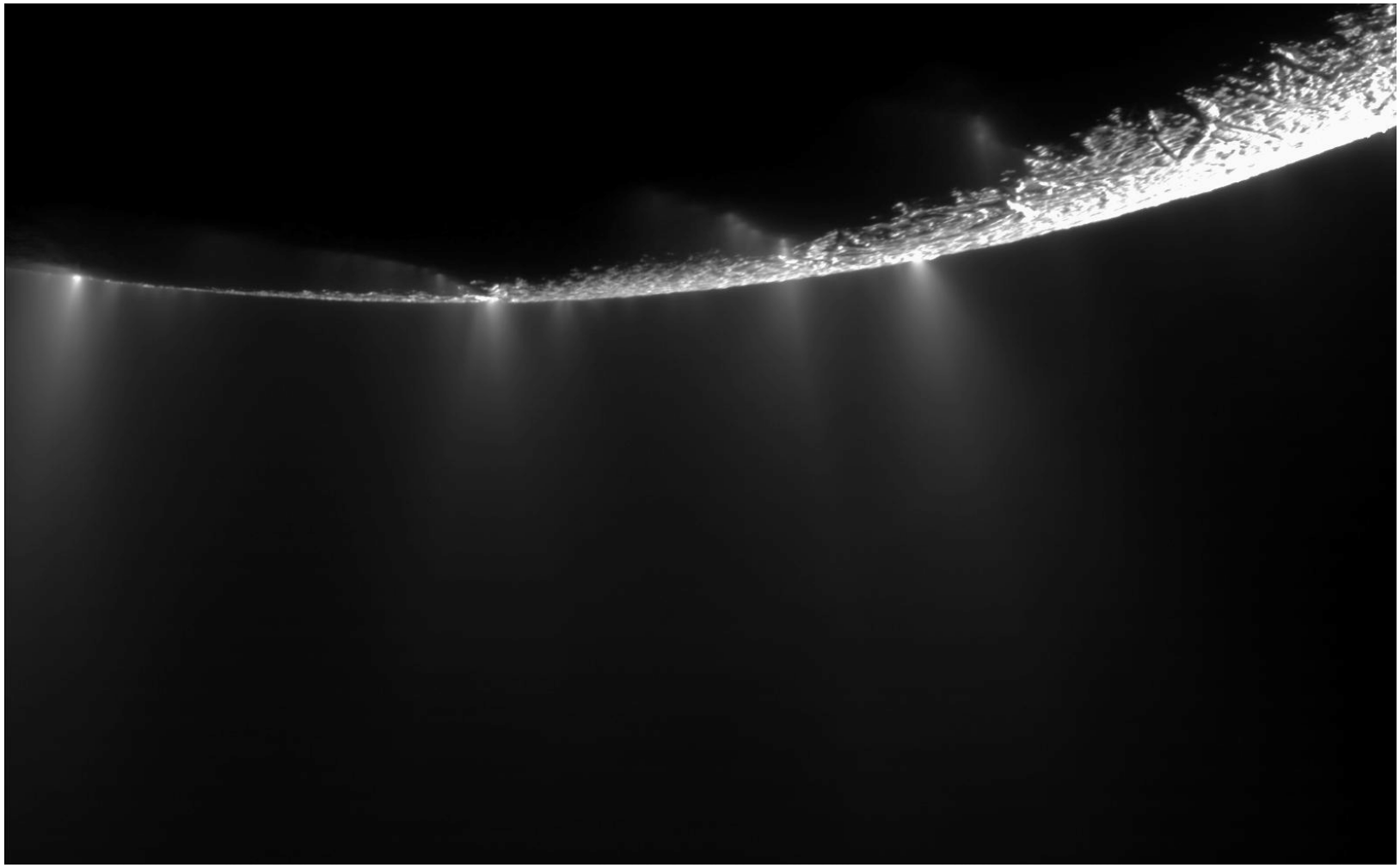


**Thanks to the moon Titan (at left, 5151 km in diameter), the *Cassini* spacecraft can observe Saturn (120,536 km in diameter) from a variety of perspectives, this example being equatorial**

Reference image PIA10487 at https://saturn.jpl.nasa.gov/resources/4256/.

# Exploring Saturn with Titan Gravity Assists (TGAs)

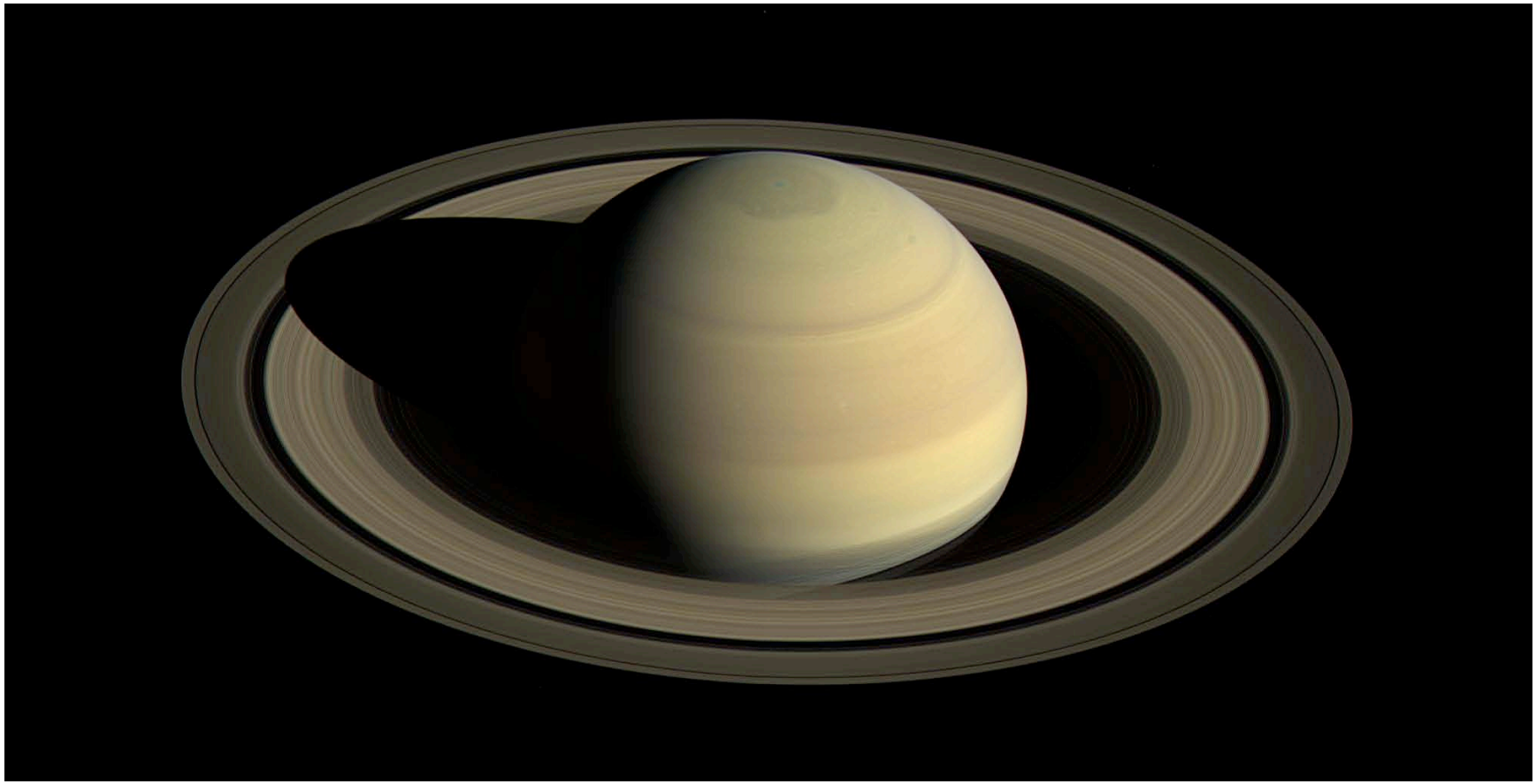
**Orbiting near Saturn's equator, *Cassini* can closely approach Saturn moons other than Titan, like Enceladus (505 km diameter) and its briny ice plumes**



Reference image PIA11688 at https://saturn.jpl.nasa.gov/resources/4852/.

# Exploring Saturn with Titan Gravity Assists (TGAs)

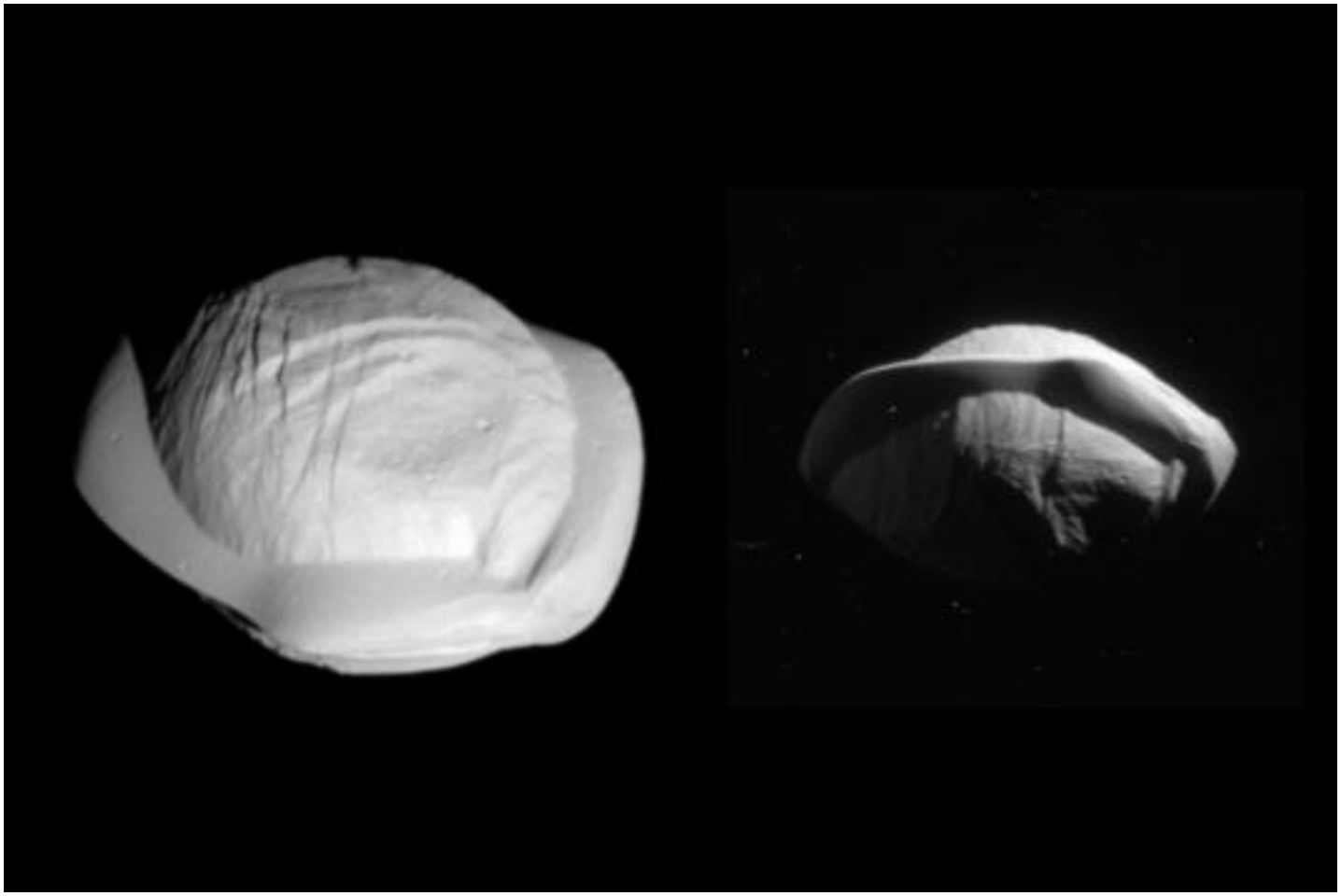
## With TGAs, *Cassini*'s orbit inclination can be increased to bring Saturn's rings and poles into view



Reference image PIA21046 at https://saturn.jpl.nasa.gov/resources/7504/.

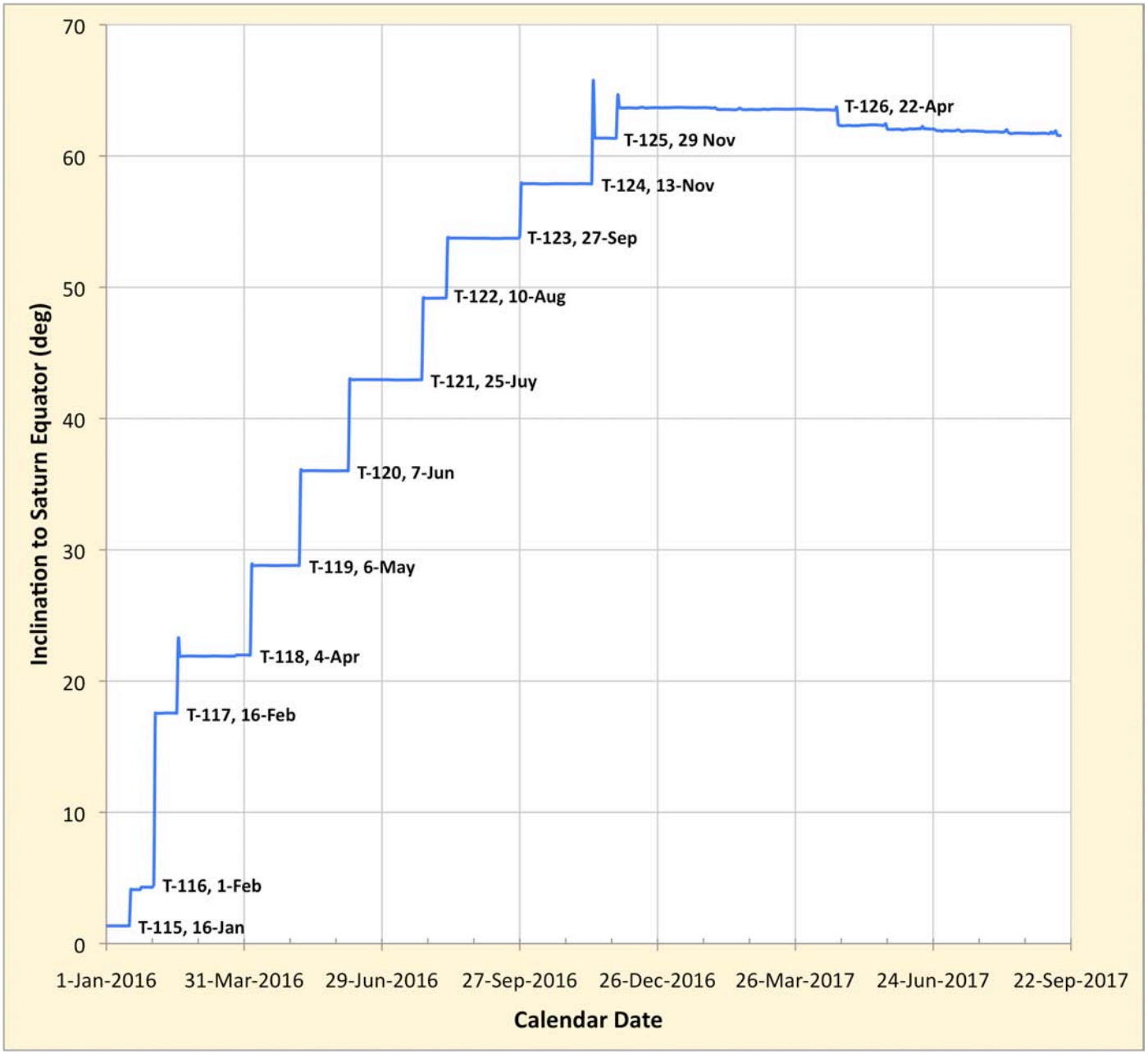
# Exploring Saturn with Titan Gravity Assists (TGAs)

## The exotic moon Pan (28 km diameter) lurks within the rings' Encke Gap



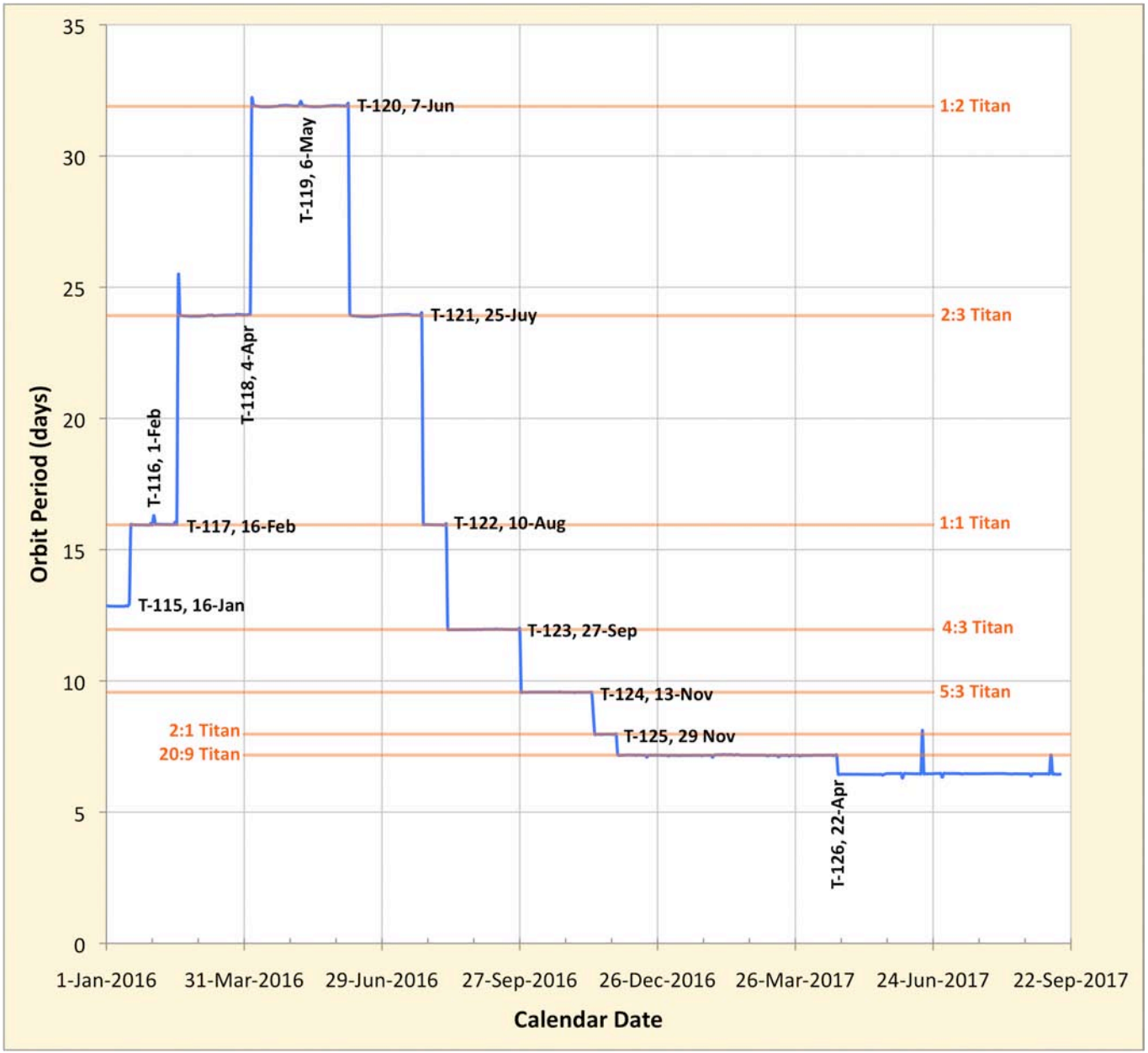
Reference image PIA21436 at https://saturn.jpl.nasa.gov/resources/7616/.

# Exploring Saturn with Titan Gravity Assists (TGAs)



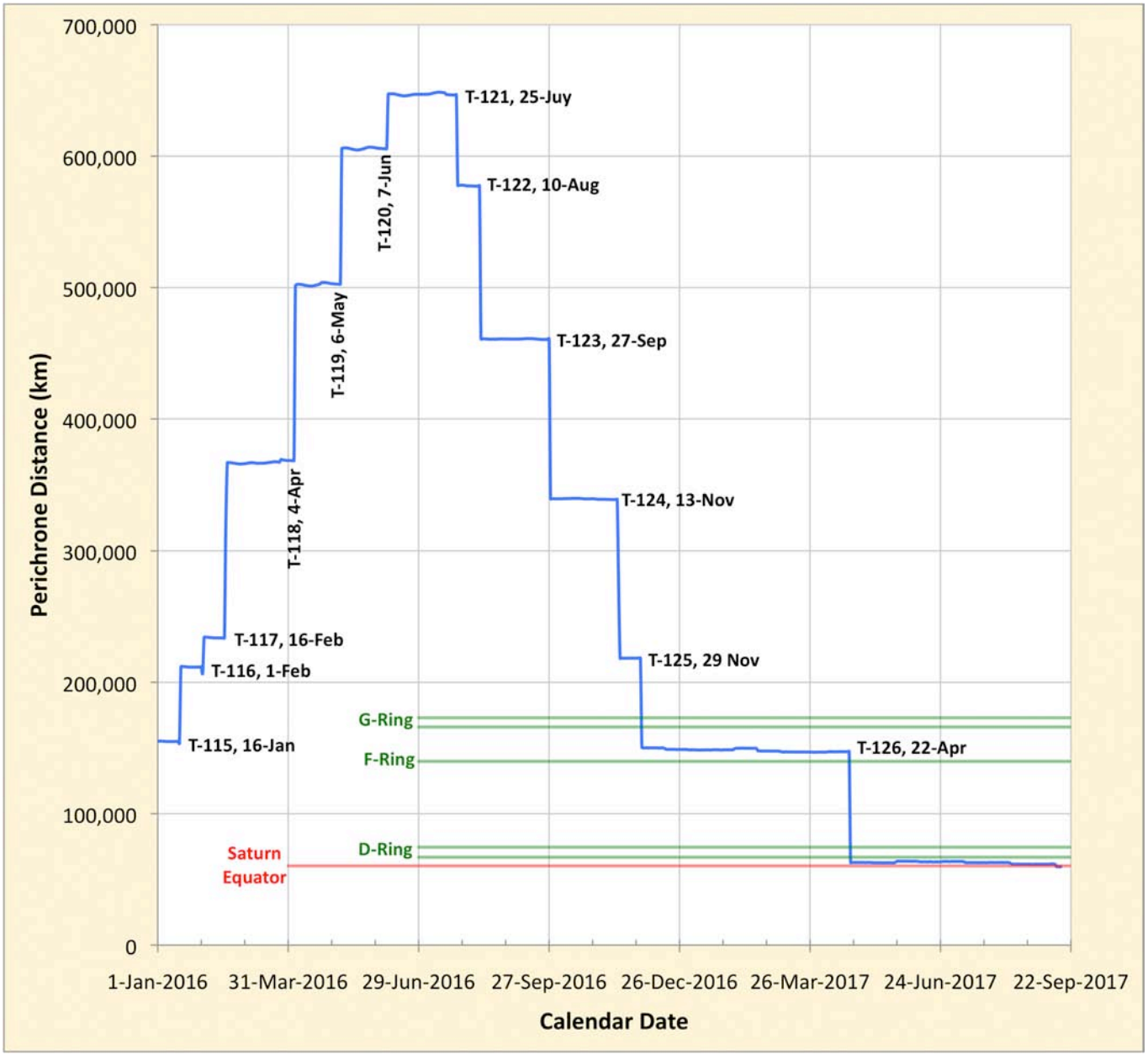

**Here is a partial *Cassini* orbit inclination history as enabled by TGAs T-115 through T-126**

# Exploring Saturn with Titan Gravity Assists (TGAs)




**To achieve regular TGAs, *Cassini* must orbit Saturn in some period-resonance with Titan ("1 : 2" means *Cassini* orbits Saturn once during the time Titan orbits Saturn exactly twice)**

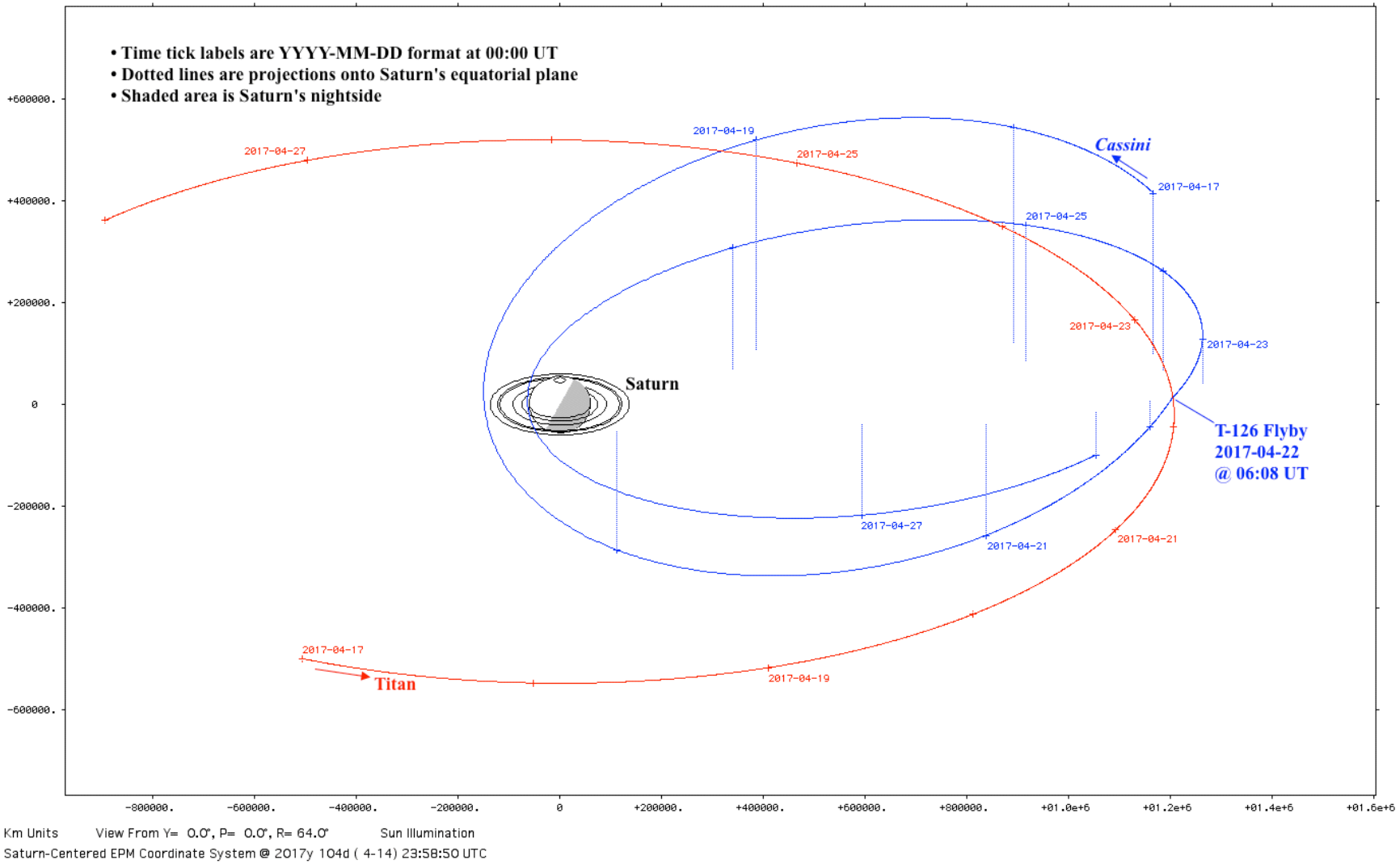
# Exploring Saturn with Titan Gravity Assists (TGAs)




***Cassini*** **perichrone (orbit low point to Saturn) evades obstacles until the mission's planned termination in Saturn's atmosphere on 15 September 2017**

# Exploring Saturn with Titan Gravity Assists (TGAs)

## *Cassini*'s final TGA is T-126, during which perichrone "jumps the rings"



# Exploring Saturn with Titan Gravity Assists (TGAs)

**During T-126, inbound & outbound speeds relative Titan are equal (as always), but speed relative Saturn is reduced from 3.290 km/s to 2.349 km/s**