JUICE: A European Mission to Jupiter and its Icy Moons

JUICE Science Working Team and the JUICE Project Team

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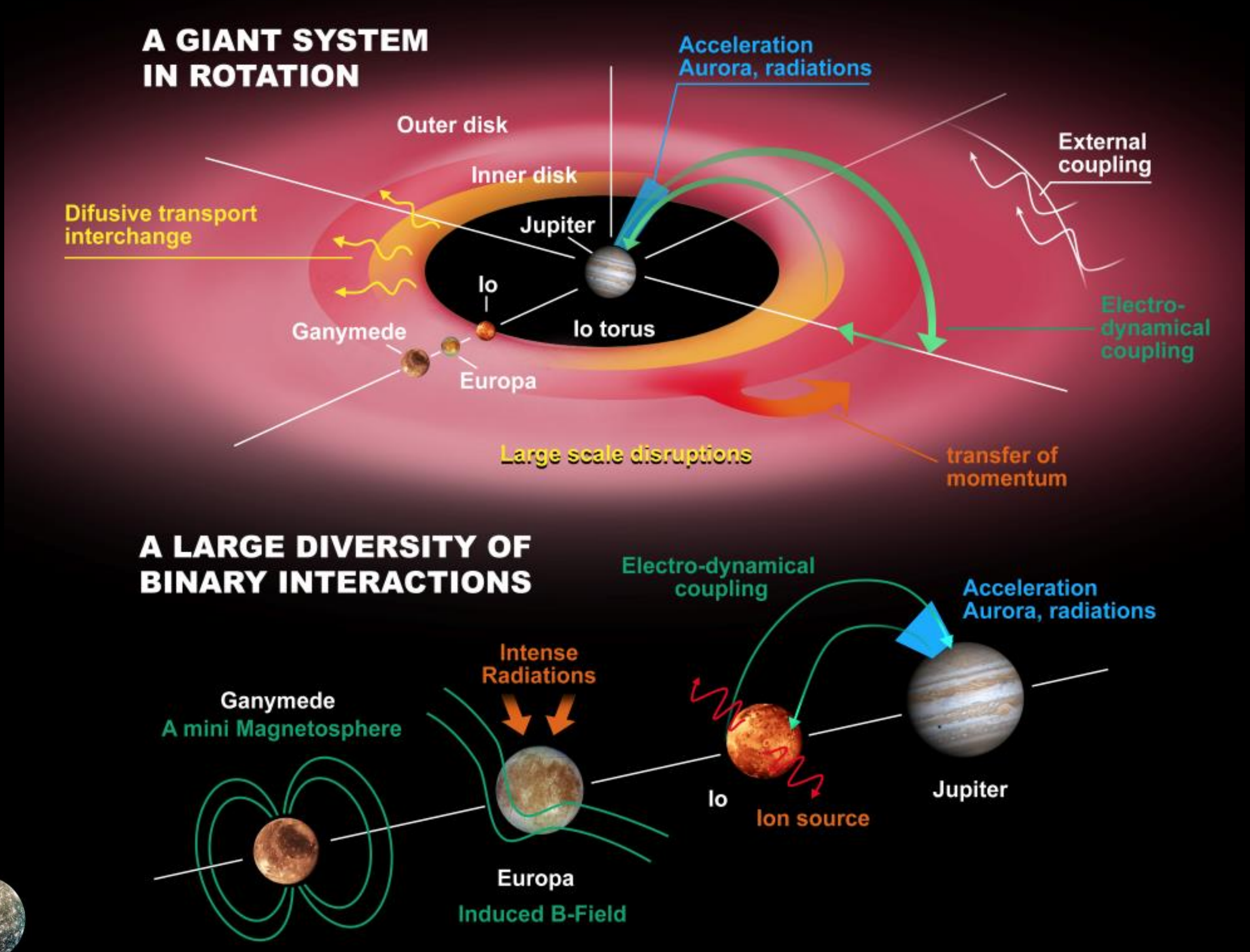
ESLAB51, ESTEC

JUICE science themes: Emergence of habitable worlds around gas giants and the Jupiter system as an archetype for gas giants



Callisto

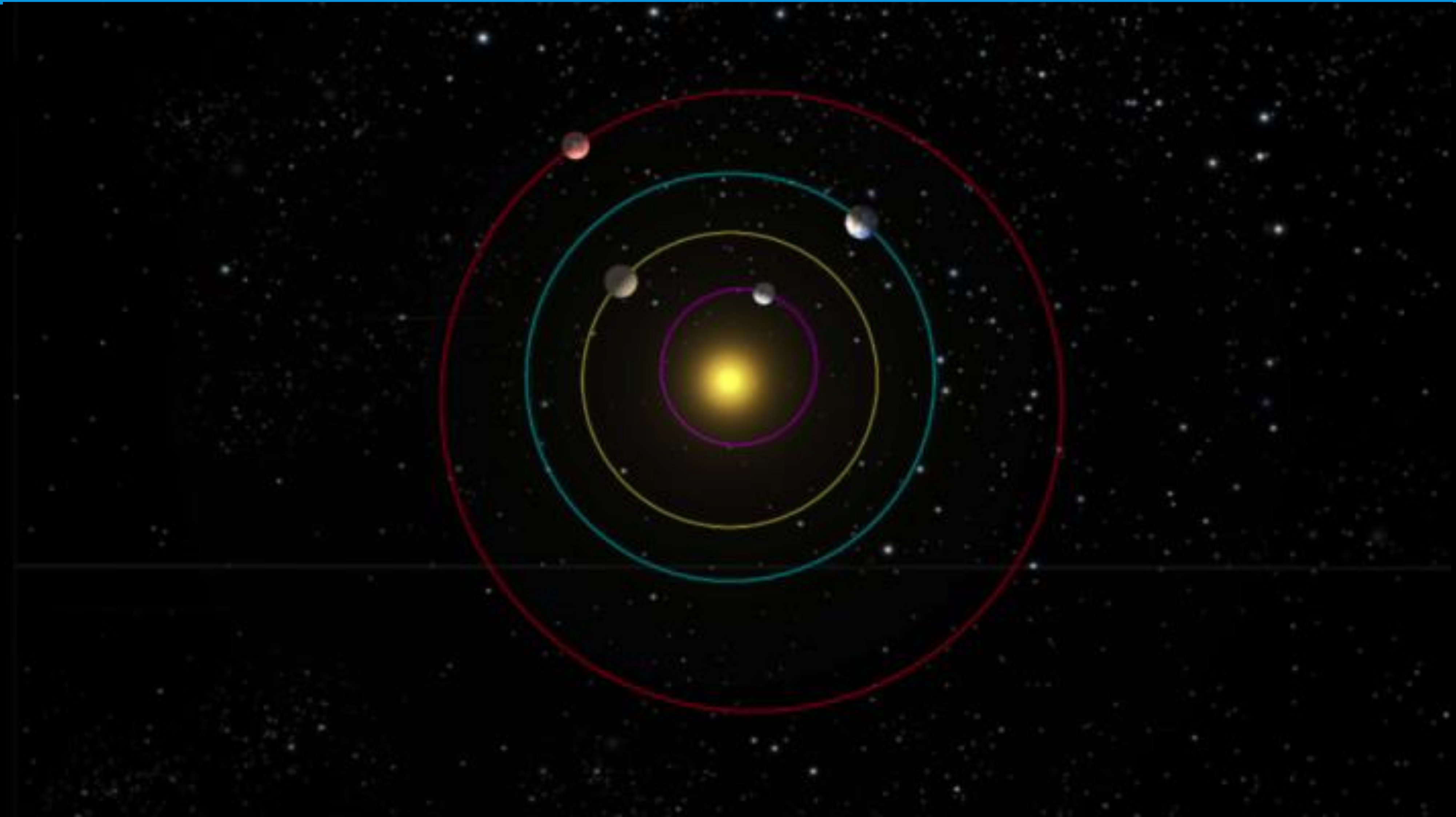
Schedule and milestones

- March 2007: ESA call for proposals
- May 2012: Mission selected
- February 2013: Payload selected
- July 2015: Prime industrial contractor selected
- June 2022: Launch from Kourou (Ariane 5)
- October 2029: Jupiter orbit insertion
- August 2032: Ganymede orbit insertion
- September 2033: End of mission

The spacecraft

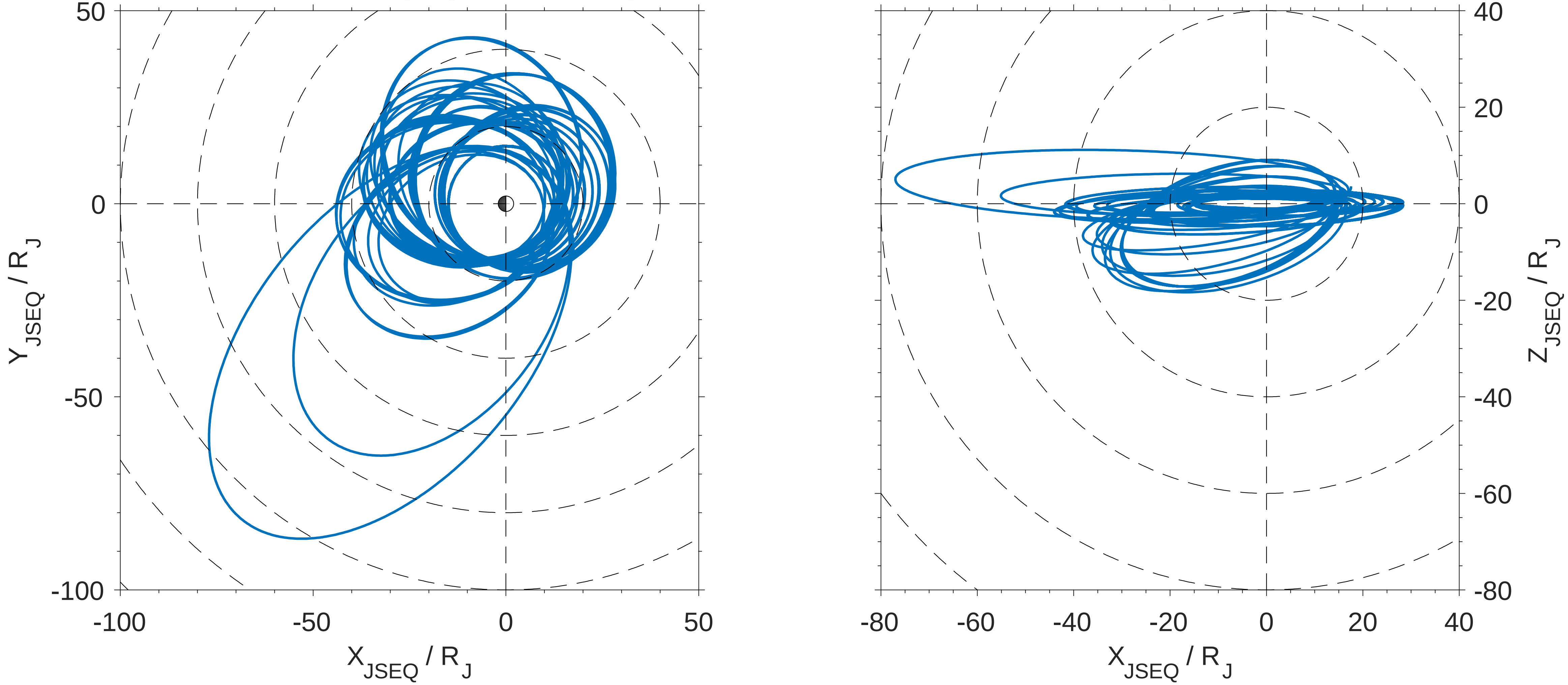
- 3-axis stabilised
- Mass:
  - Launch mass: 5264 kg
  - Instruments: 219 kg
  - Propellant: 2857 kg
- Solar array 97 m² [Power ~850 W at Jupiter]
- Fixed High Gain Antenna and Steerable Medium Gain Antenna (X, Ka Bands)
- Data Volume ~ 1.4 Gb per day

Trajectory during the cruise phase

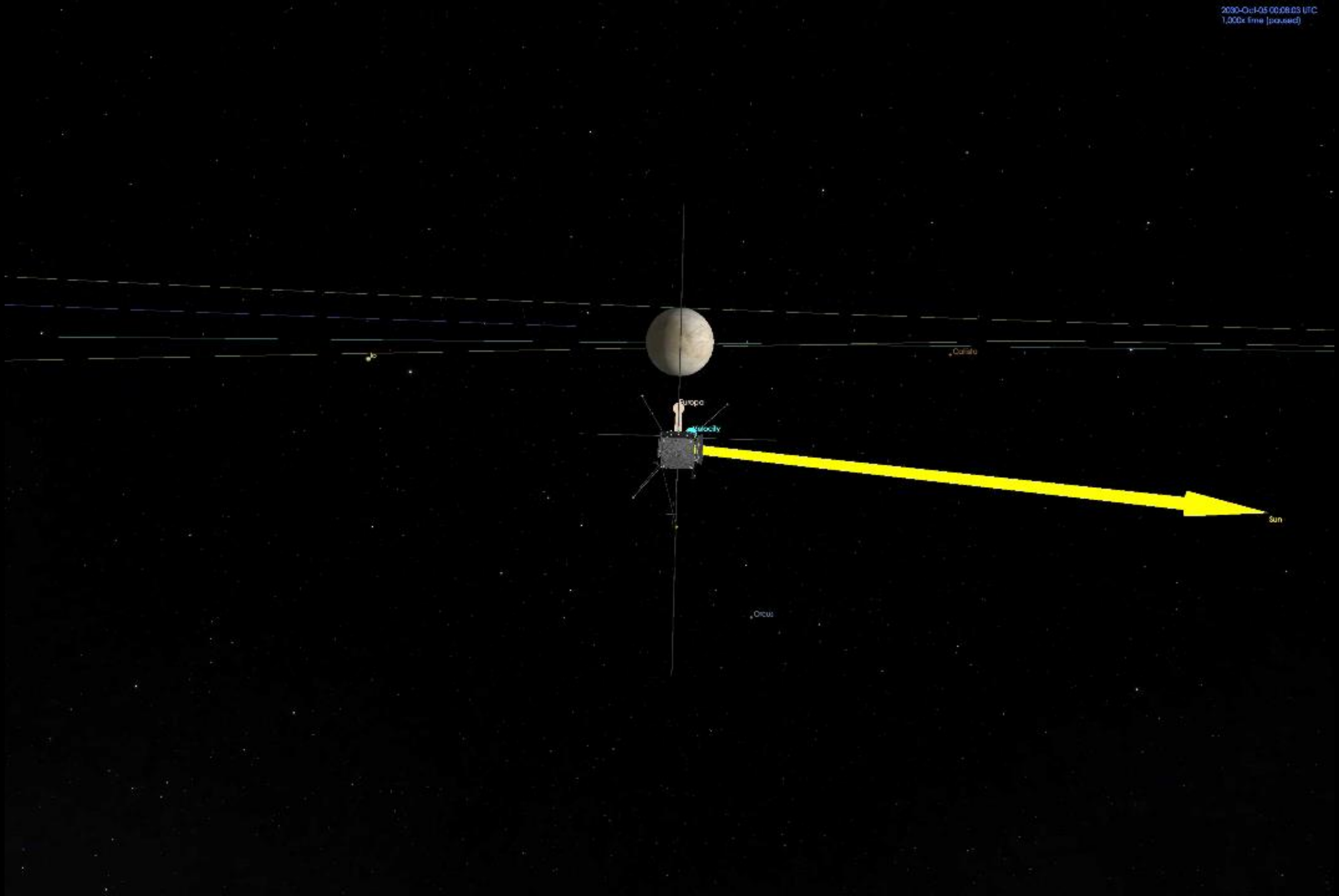


Trajectory during the “Jupiter tour”

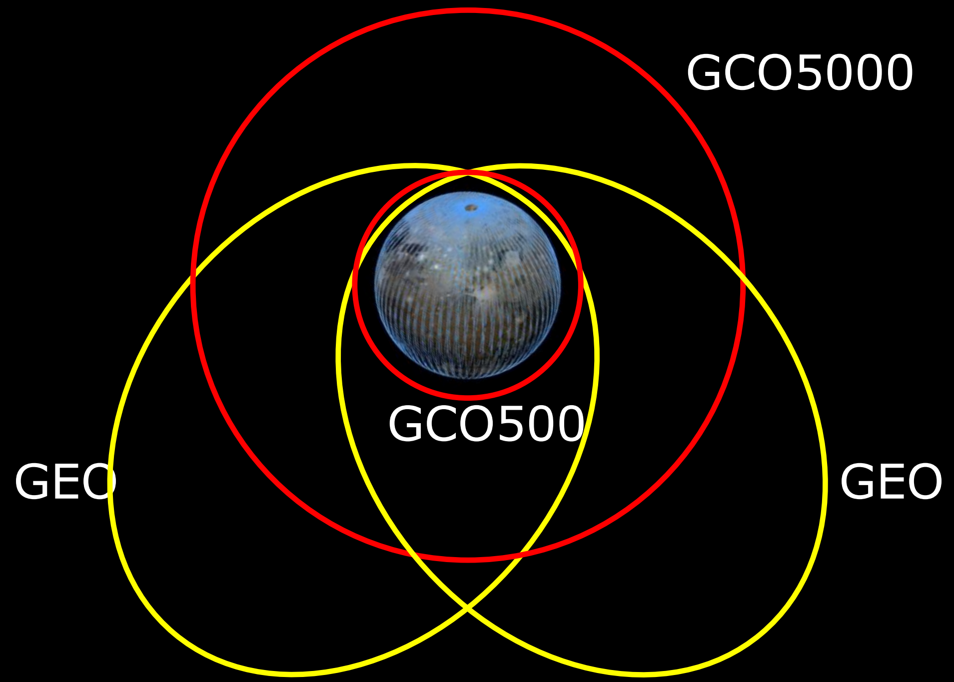
Moon flybys: 2 Europa, 12-13 Callisto, 12-15 Ganymede



A flyby of Europa



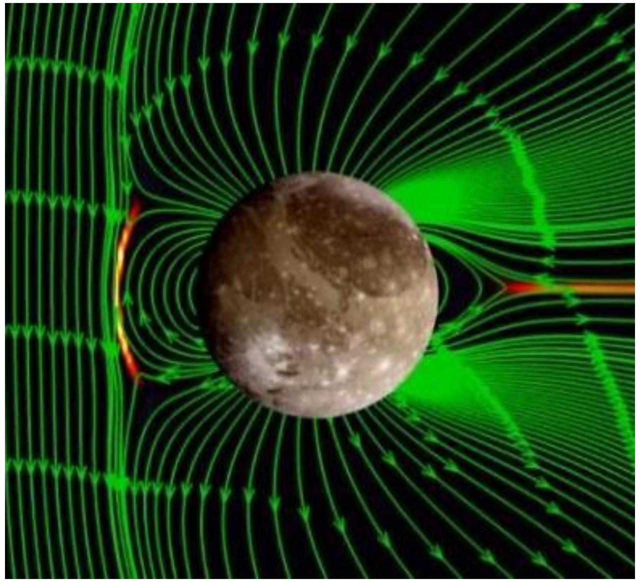
Orbital phase around Ganymede



How to detect and characterise oceans ?

How to detect and characterise oceans (1)

Magnetic induction: Electrical currents in salty oceans can generate secondary magnetic and electric fields in response to the external rotating Jupiter magnetic field. Measurements at multiple frequencies with the J-MAG and RPWI instruments will constrain the electrical conductivity and extent of the ocean.

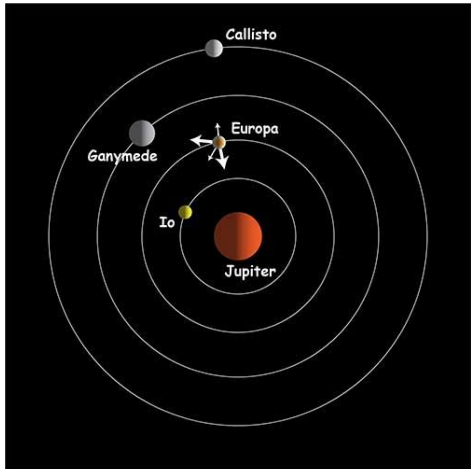


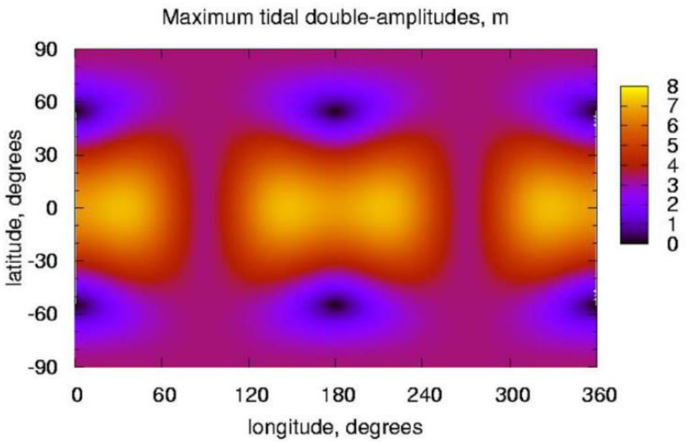
Credits: X.Jia (Univ. Michigan) and M. Kivelson (UCLA).

How to detect and characterise oceans (2)

Tides

- The tidal response of the icy shells depends on the presence of ocean: ice shell decoupled from the interior. The amplitudes of surface deformation will be measured by the laser altimeter.
- VLBI may provide complementary information on the shape of the moon.
- Time variability of the gravitational potential of the moon because of the formation of the tidal bulge, to be measured by radio-science.

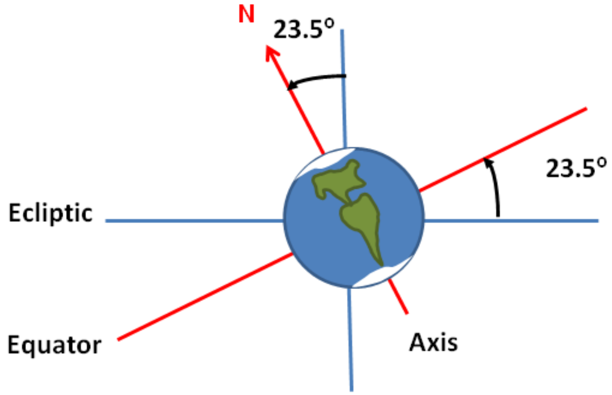




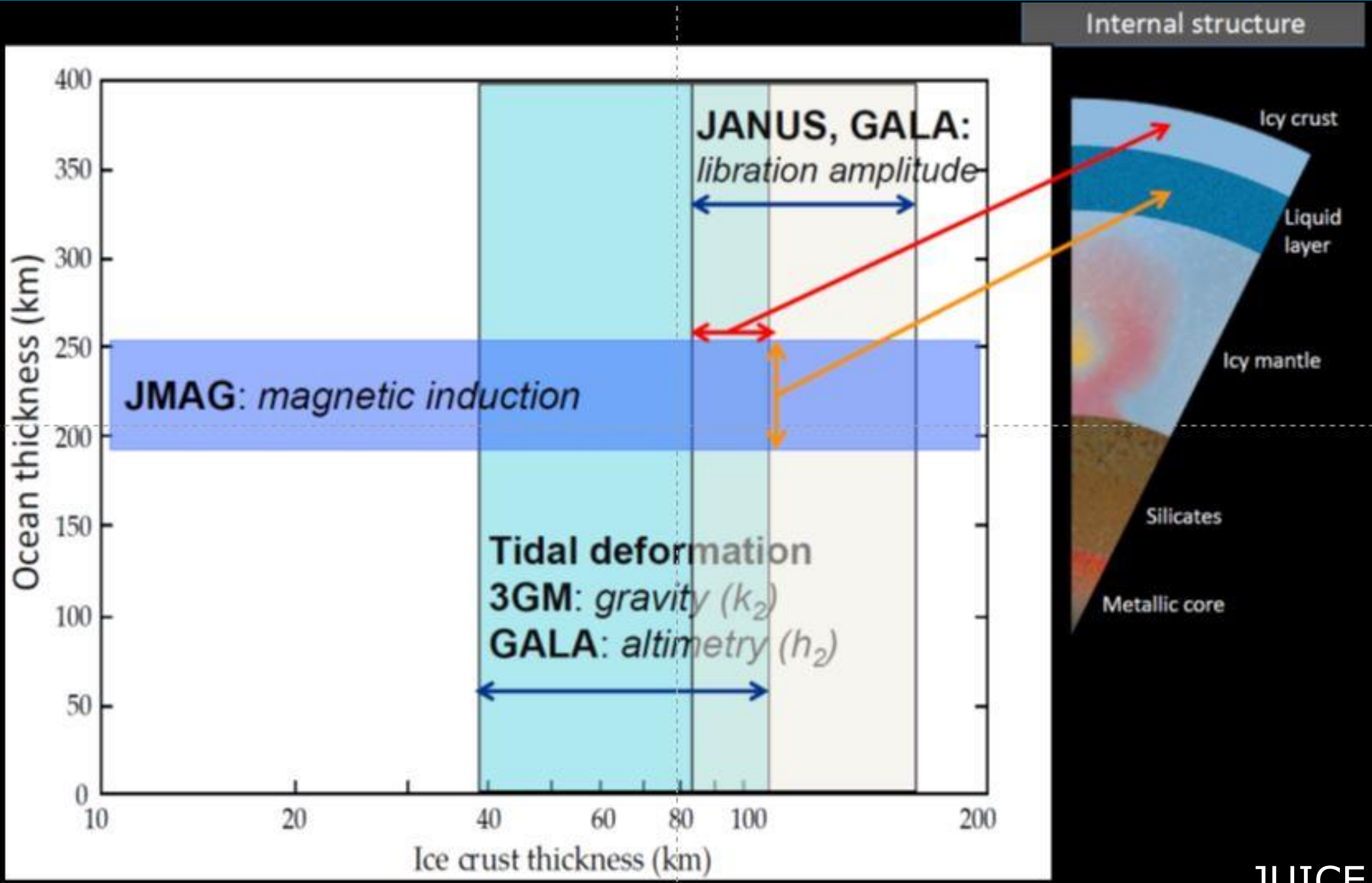
How to detect and characterise oceans (3)

Librations and obliquity: The Galilean moons are locked in a stable 1:1 spin-orbit resonance. However, slight periodic variations in the rotation rate (physical librations) and the amplitudes associated with these librations can provide further evidence for a subsurface ocean. Obliquity varies also with a decoupled ice shell.

Radio-Science, laser altimeter and camera will measure precisely the rotation rate, pole-position, obliquity, and libration amplitude.



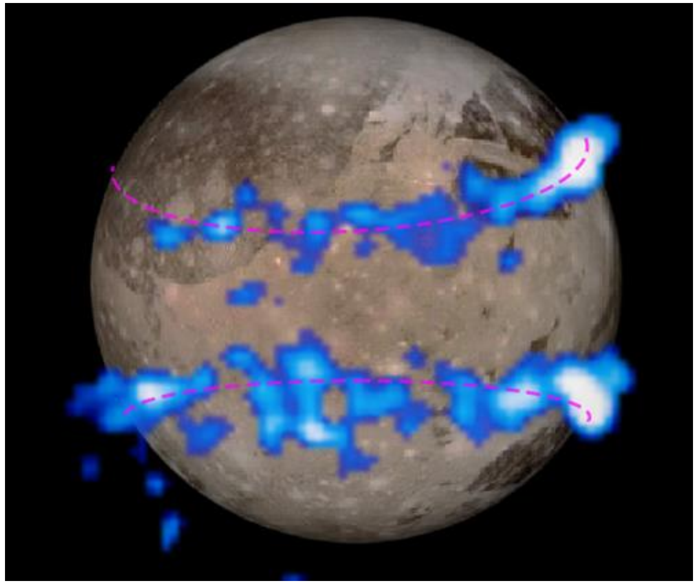
Ganymede interior structure

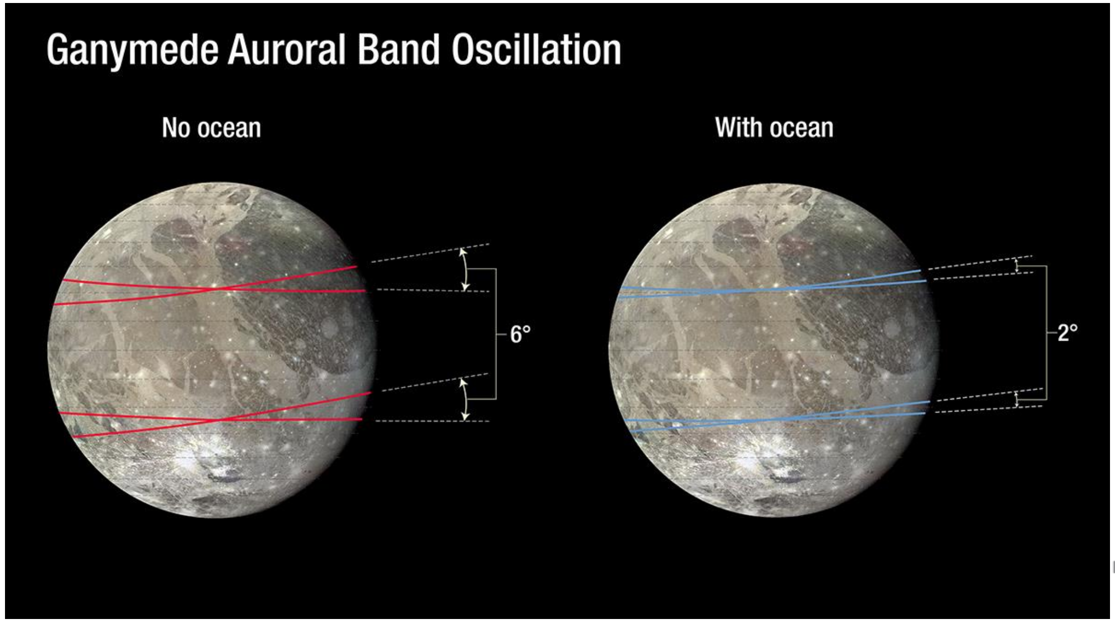


JUICE red book, 2014

How to detect and characterise oceans (4)

Ganymede auroral oval: The locations of the auroral ovals oscillate due to Jupiter's time-varying magnetospheric field seen in the rest frame of Ganymede. If an electrically conductive ocean is present, the external time-varying magnetic field is reduced due to induction within the ocean and the oscillation amplitude of the ovals decreases. The remote sensing and plasma/field instruments will characterise the auroral oval.

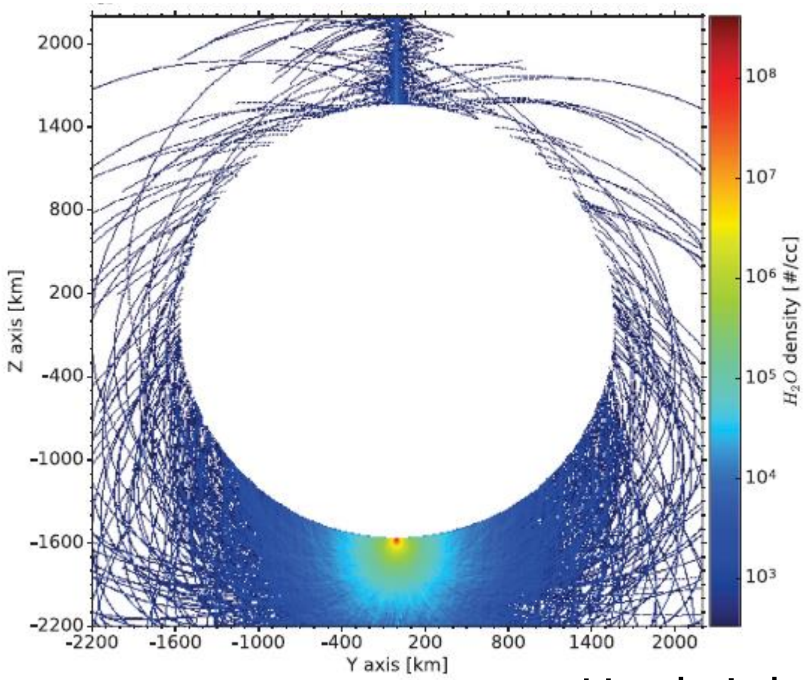




Saur et al., 2015

How to detect and characterise oceans (5)

Analysis of the exosphere: analysis of the Moons' tiny atmosphere issued from plumes, sputtering and sublimation of surface material, diffusion from the interior, as well as sub-surface breaching of ocean material, with PEP, SWI, J-MAG, RPWI, JANUS, MAJIS, UVS.



Huybrighs et al., 2017

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Stay tuned!

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