

# MAGIC, A Proposed Geophysical Mission to Jupiter's Icy Moon, Callisto

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## Abstract

What we presently know about Callisto is almost exclusively from the Galileo mission from a number of flybys in the late 1990's. Gravity and magnetic observations suggest it may have an ocean beneath its ice shell but, in contrast to the other icy moons of Jupiter, Europa and Callisto, it is not fully differentiated. Imaging revealed a near-spherical impact saturated surface that suggests there has been no, or very little, endogenic activity since the time of its formation around 4 billion years ago, shortly after the formation of Jupiter.

## Introduction

But the Galileo gravity and magnetic observations were not conclusive. The conclusion that Callisto's differentiation was incomplete was based upon the moment of inertia derived from the degree 2 gravitational flattening and required the assumption of hydrostatic equilibrium that could not be confirmed by the data. In addition, the induced magnetic field detected by the Galileo mission was compromised on all but one flyby as a result of the presence of an ionosphere that could have produced the observed signal. Further, Callisto was formed at the same time as Europa and Ganymede, in the same Jupiter environment, and both are fully differentiated with oceans beneath an ice shell with rock/metal cores.

## MAGIC

MAGIC (Magnetics, Altimetry, Gravity and Imaging of Callisto) is a high performance low altitude orbital mission that will investigate Callisto for over a year and address questions of Callisto's differentiation, state of hydrostatic equilibrium, the presence of an ocean, the age of its surface, and the conditions at the

time of its formation. After a 7-year cruise to Jupiter and a series of flybys the proposed spacecraft will enter into a 100 km circular orbit for a few months to obtain imagery, magnetics, altimetry and gravity before lowering into a 50-km near circular polar orbit for its primary mapping phase of 1 year to obtain four global datasets: imagery, altimetry, magnetometry, and gravity.

Solving the mystery of why Callisto is different from Europa and Ganymede will provide answers to how all the Galilean satellites were formed. Even if Callisto is found to be fully differentiated, like Europa and Ganymede, we still need to answer why Callisto does not have a core magnetic field and why there is little or no evidence of endogenic activity on Callisto's surface. Callisto is a time capsule from the formation of Jupiter and its icy moons.