



# **Astronomy 350L**

**(Spring 2005)**



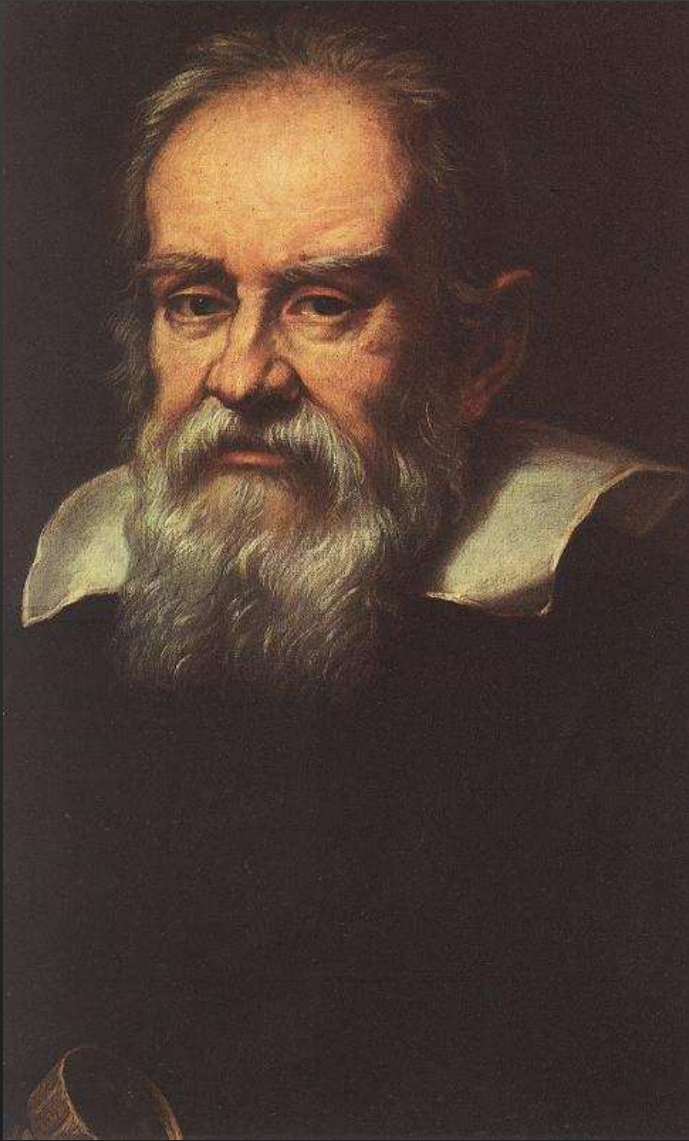
## **The History and Philosophy of Astronomy**

**(Lecture 11: Galileo II)**

Instructor: Volker Bromm  
TA: Amanda Bauer

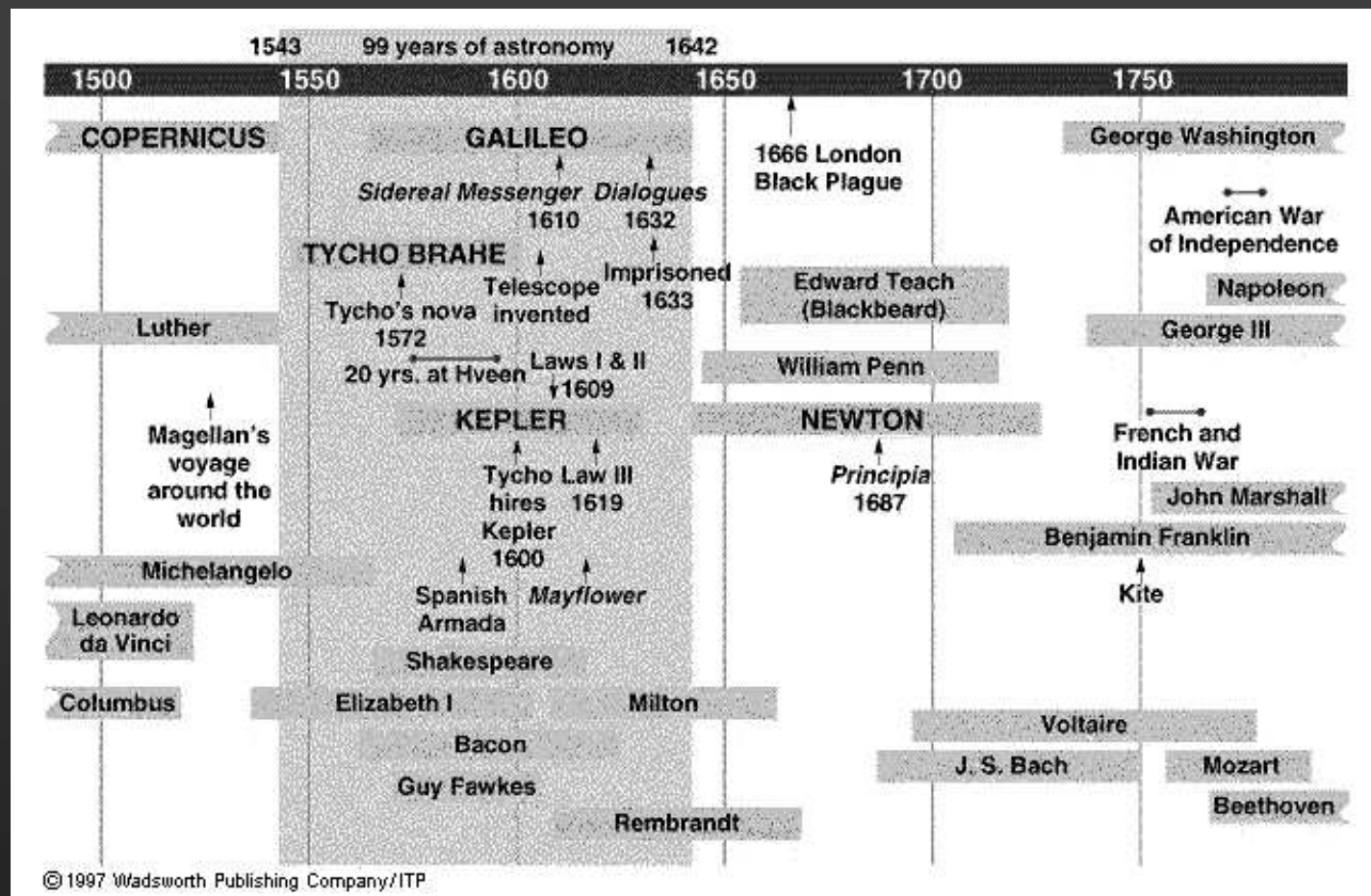
The University of Texas at Austin

# Galileo Galilei: The First Scientist



- 1564 (Pisa) – 1642 (Arcetri)
- founder of modern physics
  - law of inertia
  - law of free fall
- first astronomer to use telescope
- The “Trial of Galileo”  
(conflict with Catholic Church)

# Galileo: Timeline and Context



- between Copernicus and Newton
- contemporary of Kepler and Tycho

# Court Mathematician in Florence (1610-42)



- Florence: capital of Tuscany (Grand Duchy)
- high-point of his career



# The Opposition Rears Its Ugly Head (1612-15)



- Dominican friars of San Marco in Florence:
  - gather evidence against Galileo
  - denounce him to Roman Inquisition

# The Roman Inquisition



- Founded as Instrument of Counter Reformation (1542)
  - administered by the Holy Office
  - allows torture to force confession

# Index of Forbidden Books



- *Index Librorum Prohibitorum*
- Organized censorship
- Introduced in 1559
- Abolished in 1966



# Giordano Bruno: Victim of the Inquisition



- 1548 (Nola) – 1600 (Rome)
- proponent of infinite universe
  - infinitude of Suns/stars
  - infinitude of inhabited planets
- adherent of Hermetism
  - occult sect based on alleged ancient Egyptian texts
  - Hermes Trismegistos
- was burned at the stake



# Giordano Bruno: Victim of the Inquisition



- burned at stake on Campo dei Fiori (Rome, 1600)

# Galileo in Rome (1616): Defending Copernicanism



- conversations with Cardinal Robert Bellarmine (1542-1621)
- Galileo fails to prevent official Church ban of Copernicanism
- Copernicus *De Revolutionibus* placed on Index of Forbidden Books (until 1835)

# Galileo in Rome (1616): Ban on Copernicanism

- Galileo has to promise “not to hold or defend” Copernican theory
- But: he may still talk about Copernican model in hypothetical sense (as a mathematical convenience to describe observations)
- He obtains signed letter from Bellarmine as proof (crucial during trial of 1633)



# Galileo Antagonizes the Jesuits I

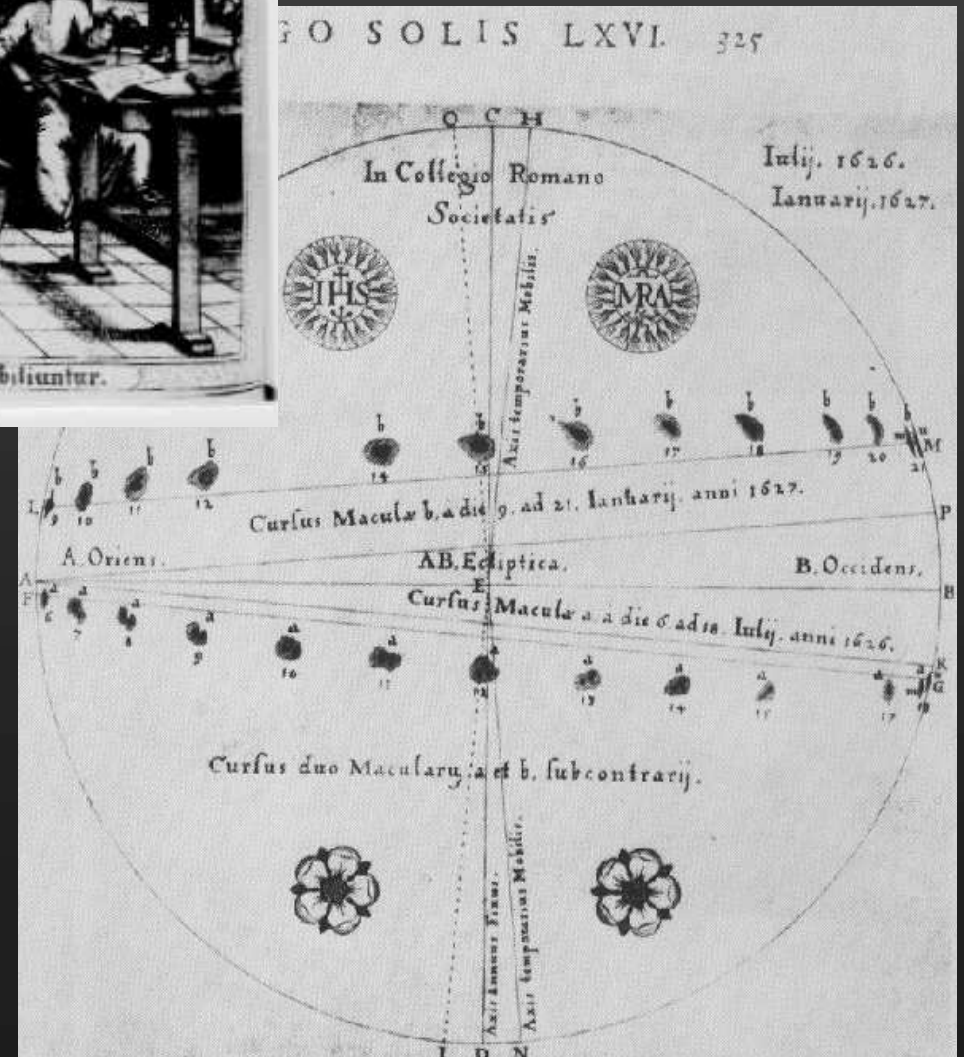


- Christoph Scheiner
- Controversy over priority in discovery of sunspots

# Galileo Antagonizes the Jesuits I



- Scheiner interprets spots as satellites moving around Sun
- Galileo ridicules this



# Galileo Antagonizes the Jesuits II



- *Il Saggiatore*  
(The Assayer, 1623)
- polemic against Jesuit  
Orazio Grassi's theory of  
comets
- same pattern: Galileo ridicules  
Grassi, who would not forget
- made arch-enemies of Jesuits



## ***Il Saggiatore: The Book of Nature***

“Philosophy is written in this very great book which always lies before our eyes (I mean the Universe), but one cannot understand it unless one first learns to ... recognise the characters in which it is written. It is written in mathematical language...[and without] it is ... impossible to understand a word of it.”

# Galileo and the Barberini: Friendship and Hate



Triton's Fountain,  
Rome  
(Lorenzo Bernini)

- The Barberini family: powerful and wealthy

# Galileo and the Barberini: Friendship and Hate



(Portrait by Caravaggio, 1599)

- Maffeo Barberini (1568-1644)
- Sophisticated clergyman
  - open to new ideas in arts, sciences, and philosophy
- Friendly Ties with Galileo



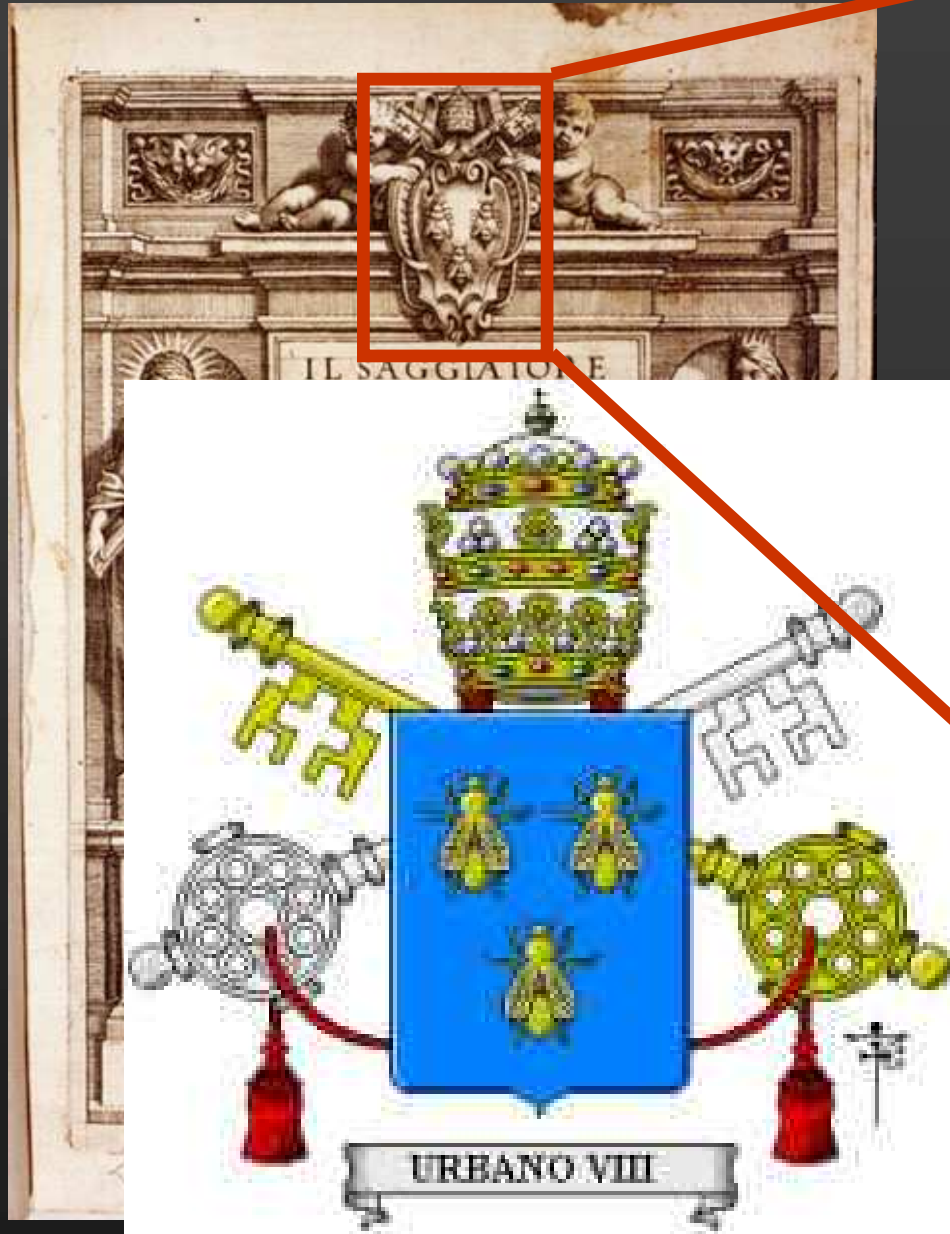
# Galileo and the Barberini: Friendship and Hate



(Bronze Bust by Lorenzo Bernini)

- Maffeo Barberini (1568-1644)
- 1623 (year of the *Assayer*):
  - elected Pope Urban VIII
- Friendly Ties with Galileo persist:
  - series of meetings
  - Galileo feels encouraged to explore Copernicanism (if only as a hypothesis)

# Galileo and the Barberini: Friendship and Hate



- Il Saggiatore (1623):
  - Pope's coat-of-arms on titlepage

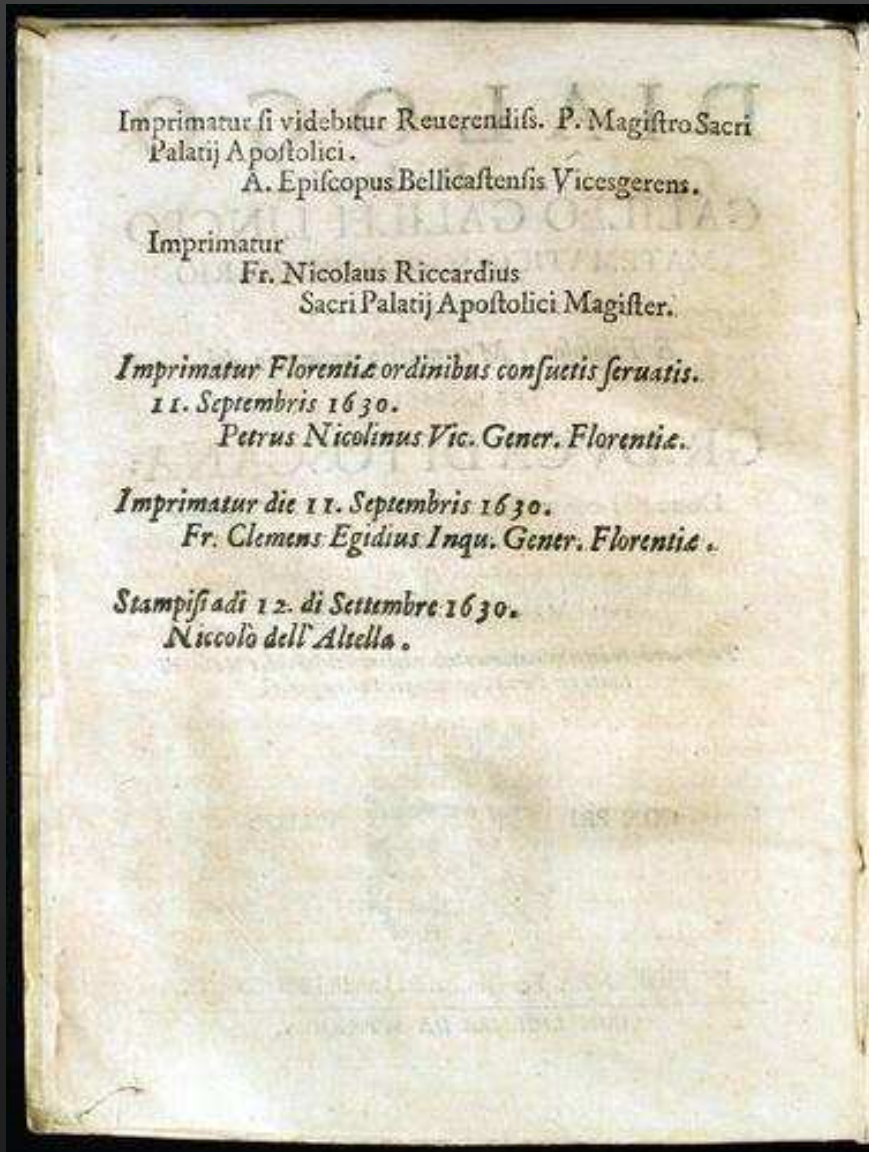
# Galileo's Copernican Manifest: The Dialogue



- *Dialogo dei Massimi Sistemi* (Dialogue concerning the two chief world systems: Ptolemaic and Copernican)
- 1632: Printed in Florence (in vernacular: Italian)
- Approved by official Church censor



# Galileo's Copernican Manifest: The Dialogue



- *Dialogo dei Massimi Sistemi*  
(Dialogue concerning the two chief world systems: Ptolemaic and Copernican)
- Imprimatur (official licence to print) obtained

# Galileo's Copernican Manifest: The Dialogue



- Arsenal (shipyard) of Venice

# Galileo's Copernican Manifest: The Dialogue

- Dialogue between three characters
  - Salviati: An intellectual who seems to speak for Galileo
  - Sagredo: Wealthy nobleman who is seeking truth
  - Simplicio: Aristotelian philosopher
- Simplicio: proposes ineffectual arguments for Salviati/Galileo to knock down
- Simplicio named after 6<sup>th</sup> cent commentator of Aristotle, but also Simplicio = simpleton ?!



# Galileo's Fatal Mistake: To Offend a Pope



(Pope Urban VIII)

- Pope Urban VIII had told Galileo his views on God's omnipotence:  
"Man cannot presume to know how the world really is, since God could have brought about the same effects in ways unimagined by humans. It is not proper to restrict God's omnipotence"
- Galileo has Simplicio (simpleton) state this view in *Dialogue*



# Galileo's Fatal Mistake: To Offend a Pope



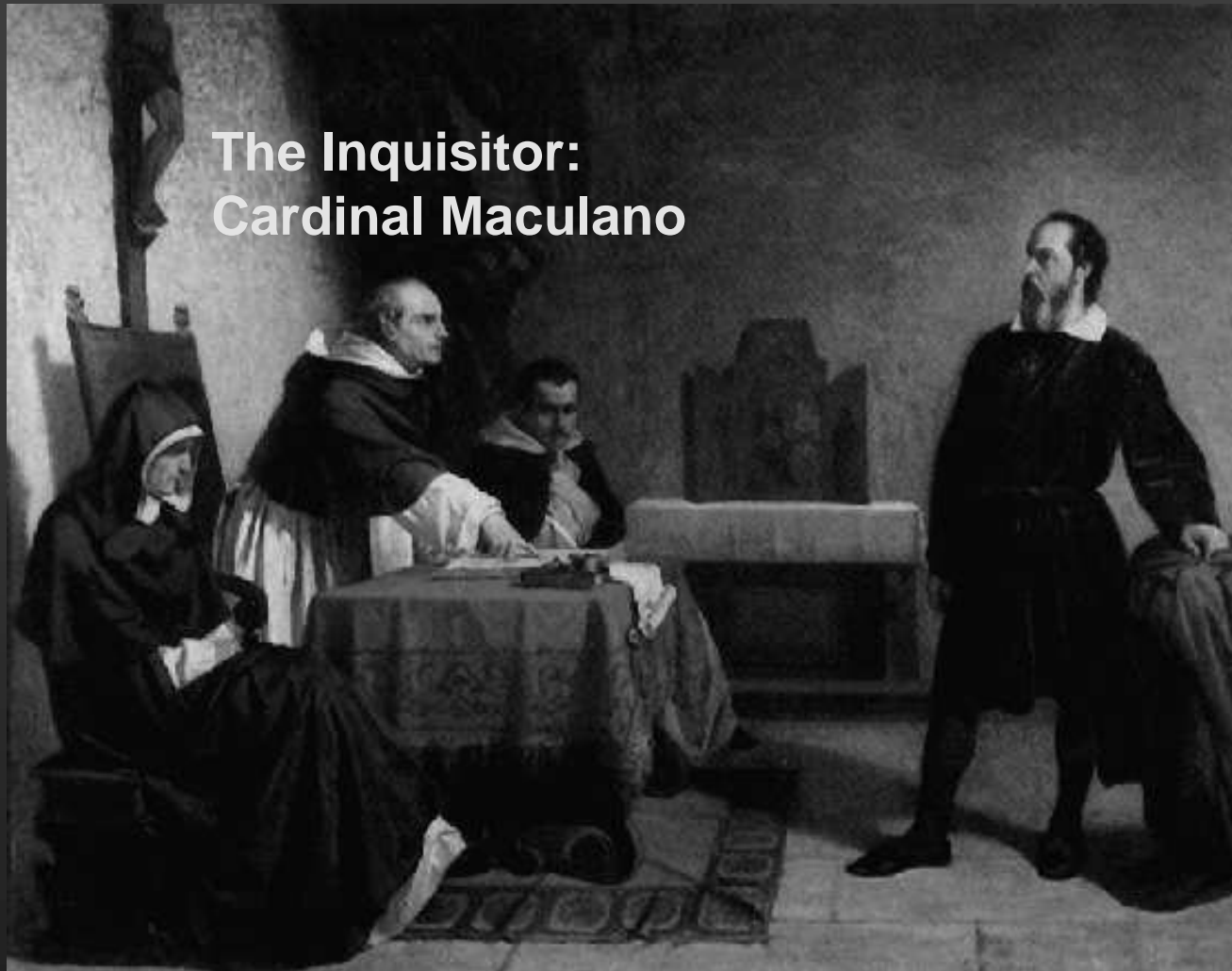
(Il Gesu, Rome)

- Galileo's Jesuit enemies spread rumour:

Simplicio = Urban VIII

- Urban VIII is mortally offended and turns into irreconcilable enemy
- The wheels of Roman Inquisition are set into motion!

# The Trial of Galileo (1633)



- Initial interview: Galileo charged with suspicion of heresy

# The Trial of Galileo (1633)

- Prosecutions case:
  - Galileo violated papal injunction of 1616 banning Copernicanism
  - primary evidence: An unsigned document stating that Galileo was told “not to hold, defend, and *teach*” Copernicus
- Galileo’s case:
  - Galileo did *not* violate papal injunction of 1616
  - primary evidence: The *signed* letter from Cardinal Bellarmine stating that he was told “not to hold or defend” Copernicus
  - in addition: Galileo had obtained Imprimatur for Dialogue according to the rules!

# The Trial of Galileo (1633)

- But: Vatican needed to assert its authority!
  - age of Counter Reformation
  - Thirty Years War (Catholics vs Protestants)
- Set a warning example to possible dissenters
- Galileo had to be found guilty of heresy!
- Threaten Galileo with “*rigorous examination*”



Threat of torture!



# The Trial of Galileo (1633)



- Threat of torture! → Galileo accepts plea bargain!

# The Trial of Galileo: Sentence and Recantation



- Venue for final show trial: Santa Maria sopra Minerva

# The Trial of Galileo: Sentence



- Verdict: Guilty of vehement suspicion of heresy (2<sup>nd</sup> most severe crime)
- Sentence: Life imprisonment (later commuted to strict house arrest)

# The Trial of Galileo: Recantation



- Abjures believe in motion of the Earth!



# The Trial of Galileo: Recantation

422  
io eccaduto in qualche parte come ho già detto presento questa  
dichiarazione con una fede aggiunta del giorno 22 d'Aprile 1633  
mimo scritto di propria mano del medesimo Galileo della quale già  
presentai una copia di mia mano. Del rimanente mi rimetto in  
tutto, e per tutto alla solita pietà, e clemenza di questo Tribunale  
et habitaculo subvixione fuit remittit ad domum suph.  
Orti Ley Magni. Quis modo et formidiam h'ci notifi'atij.  
Io Galileo Galilei manu pp.

“With sincere heart and unfeigned faith, I abjure, curse and detest my errors. I swear that in future, I will never again say or assert, verbally or in writing, anything to encourage this suspicion.”

## House Arrest in Arcetri (1633-42)



# House Arrest in Arcetri (1633-42)



- John Milton visits Galileo in late 1630s
- references in Milton's epic poem *Paradise Lost*



# Journey's end: Death in 1642



- 1736: Reburial in main nave of Santa Croce



## Galileo (part 2)

- Galileo Galilei:
  - founder of modern physics
  - first telescopic observations of heavens
  - 17<sup>th</sup> cent. Bestseller: *The Starry Messenger*
- Dialogue (The Two Chief World Systems)
  - Debates relative merits of Copernican and Ptolemaic system
  - Notice: No mention of Tycho's (compromise) model
  - Antagonizes Church (in particular Pope Urban VIII)
- Trial of 1633
  - Galileo has to abjure Copernicanism
  - sentenced to strict house arrest until his death in 1642