33-120
Science & Science Fiction

Welcome!

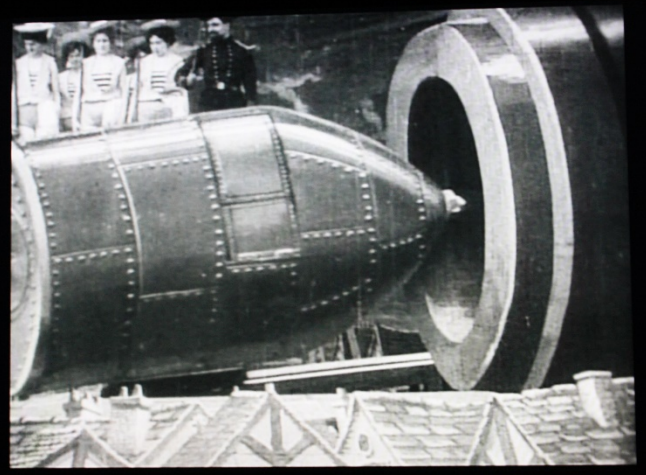
Today:

First Major Question…

What is the Nature of Space and Time?

- Today: Quiz on Chapter 1 (25 points)
  - Given on Canvas (30 minutes)
  - Available until midnight tomorrow
- Begin Major Question 1
  - **What is the nature of space & time?**
- Problem 1 due next Friday, September 8

Announcements for Friday, September 1



Le Voyage dans la Lune

Georges Méliès (1902)

Would the “astronomers” survive the launch?

Last time…
Human spaceflight as imagined in *A Trip to the Moon* (1902)

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Inertial Reference Frame:

- Not accelerating
- Constant speed in straight line
- Think of some examples…

Reference frames

Non-Inertial Reference Frame:

- Accelerating
- Changing speed or changing direction
- Think of some examples…

Reference frames

2001: A Space Odyssey

Warner Brothers (1968)

Directed by Stanley Kubrick

Screenplay by Stanley Kubrick

A good example of *realistic* sci-fi:
Moving and rotating reference frames

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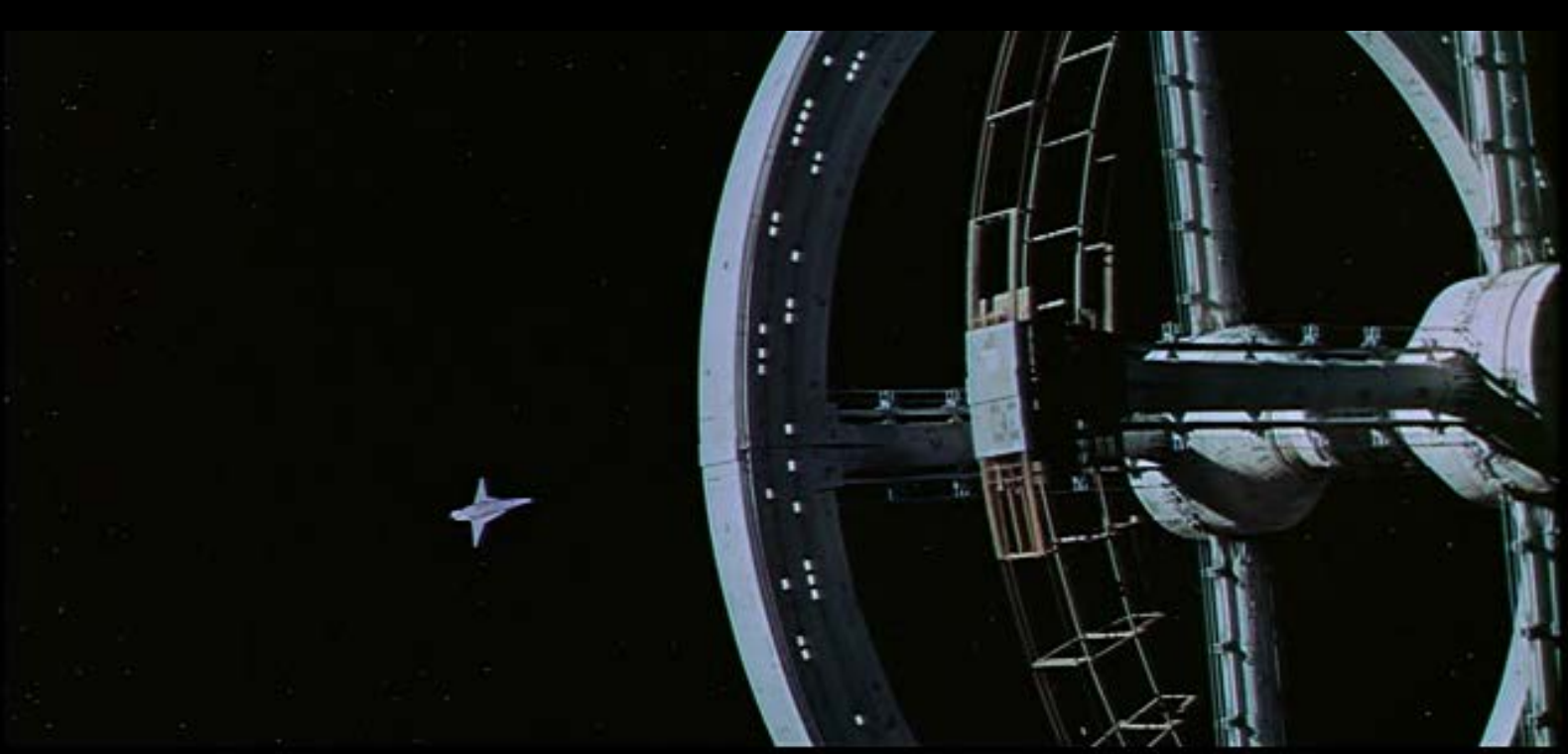


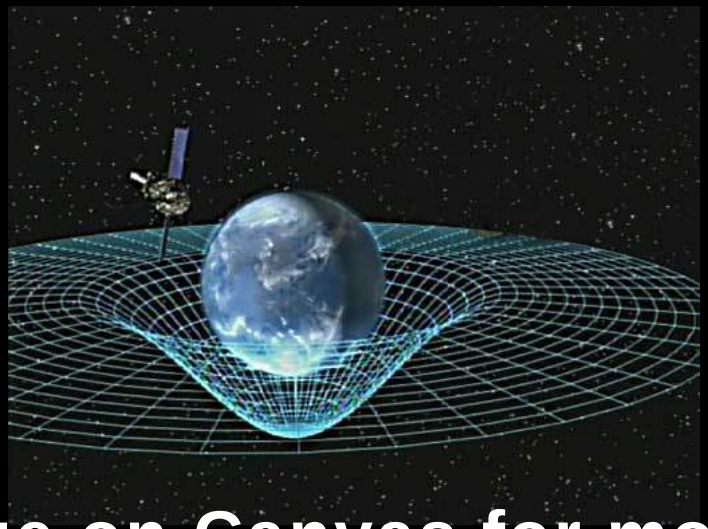
Why does the space station rotate?

Artificial gravity around the rim

A good example of *realistic* sci-fi:
Moving and rotating reference frames
(preview of Einstein's Principle of Equivalence)

What is the nature of space and time?

(Chapter 2 in the text)



(Click the image on Canvas for more information)

First Major Question in the course…

Star Trek: The Next Generation

“Descent, Part I”

Written by Alexander Singer

Paramount (1993)

First Major Question:
What is the nature of space and time?
(changing perspectives through history)

- **Classical Physics: Newton's Laws**
- **Modern Physics: Einstein and Relativity**
  - **Time dilation and distortions of *spacetime***
  - **Black holes**
  - **Gravitational waves**
  - **Warp drive and "FTL" space travel**

What is the nature of space and time?
(changing perspectives through history)

- **Future Physics: Quantum gravity (?)**
  - **Wormholes and quantum foam**
- **Time travel into the past?**
- **The multiverse hypothesis**

What is the nature of space and time?
(changing perspectives through history)

- **Newton's Laws of Motion**
  1. **Inertia**
  2. **F = dp/dt**
  3. **Action and Reaction**
- **Newton's Law of Gravitation**

What is the nature of space and time?

A. Classical physics and Newton's Laws

- **Newton's 1st Law of Motion: *Inertia***

  "Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it."

  - Isaac Newton
    Principia Mathematica
    (1687)

What is the nature of space and time?

A. Classical physics and Newton's Laws

- **Newton's 1st Law of Motion: *Inertia***
  An object will continue in its state of uniform motion or rest, unless acted upon by an outside force.
  - **Key concepts:**
    - ✓ **Uniform motion (no acceleration)**
    - ✓ **Outside force (external to the system)**

The Essence of Newton's First Law of Motion

Guest Lecture for University of Ljubljana, Slovenia, 9 December 2022

X-Men III: The Last Stand

Directed by Brett Ratner

20th Century Fox (2006)

Illustration of Newton's 1st Law of Motion

Inertia: **External force needed to change an object's state of motion or rest.**

Next time…
Further discussion of Newton's Laws; Begin discussion of Einstein & Relativity

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