Possible topics for your optional presentation

1. **BLACK HOLES**
   - Classic tests of GR: precession of the perihelion of Mercury
   - Classic tests of GR: Gravitational lensing
   - BH’s: Shapiro time delay (orbits)
   - BH’s: Birkhoff’s theorem
   - BH’s: Interior solutions
   - BH’s: Two views on falling in
   - BH’s and astrophysics: Accretion disks
   - Kruskal extension
   - Rotating BH’s: Kerr-Neumann solution
   - Rotating BH’s: Penrose process (after Kerr-Neumann)
   - BH’s: Visualization of BH’s ‘in’ the movie “Intersetllar” (after Kerr-Neumann also orbits)
   - BH’s: Frame Dragging - Fun effects on objects outside a rotating mass such as Earth - Gravity Probe B experiment
   - BH’s: Quantum effects - Hawking and Unruh radiation
   - BH’s: Primordial, white, and black holes - quantum ideas
   - Sagittaruis A*: supermassive Bh’s and the event horizon telescope

2. **GRAVITATIONAL WAVES**
   - Filling in: The calculations we skipped like the one for Riemann
   - Binary systems: as source (BH-BH, NS-BH, etc.)
   - GW150914 - the first detection!
   - The Hulse-Taylor binary pulsar - the first indirect detection

3. **COSMOLOGY**
   - CMBR - the details
   - Different matter content and the Universes evolution - why can you neglect certain types of matter at different cosmological epochs?
   - Taylor your sims to roughly match existing data. Play with the content including curvature. What can you discover about the freedom in content.
   - Magnitude-redshift relation and observing the universe.
   - All the observations: Review the major relevant datasets that restrict our possible models. This is an update of e.g. the plot on page 360.

And other interesting physics, once we talk through your idea.