Prof. Bambi on General Relativity

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This is a note about Prof. Cosimo Bambi's lecture on general relativity on February 25 and March 3, 2022.

This lecture is about the 1-2 chapters in [1]. Nothing quite interesting. [1] itself is very detailed and it seems I don't really need to take much notes.

1 The Christoffel symbols of spherical coordinates

The Christoffel symbol of spherical coordinates, given in (1.83) in [1], can be calculated automatically in this Mathematica notebook.

2 Derivation of special relativity

Section 2.1 and 2.2 seem to be based on Chapter 1 and 2 of Landau's book about field theory. The arguments have been summarized in Section 1.1.2 in this note.

Section 2.3 derives the Lorentz transformations by Wick rotation of Euclidean rotation in $d = 4$ – (2.18) is actually just $\tau = it$ in condensed matter physics. A rotation on xy has the form of (2.20) and we have $C_4^2 = 6$ rotations. Adding 4 translations, we get the total 10 generators of the rotation group in $\mathbb{R}^4$, and hence the Lorentz transformations in the (3+1)-dimensional Minkowski spacetime.

Equations from (2.22) to (2.27) are trying to relate the parameter of $\mathbb{R}^4$ rotations to the relative velocity of the two reference frames.

3 Aberration of light and superluminal motion

We should note that *Lorentz contraction* of length (see for example (2.43)) is often not the (2.48) to (2.57)

References

[1] Cosimo Bambi. *Introduction to General Relativity: A Course for Undergraduate Students of Physics*. Springer, 2018.