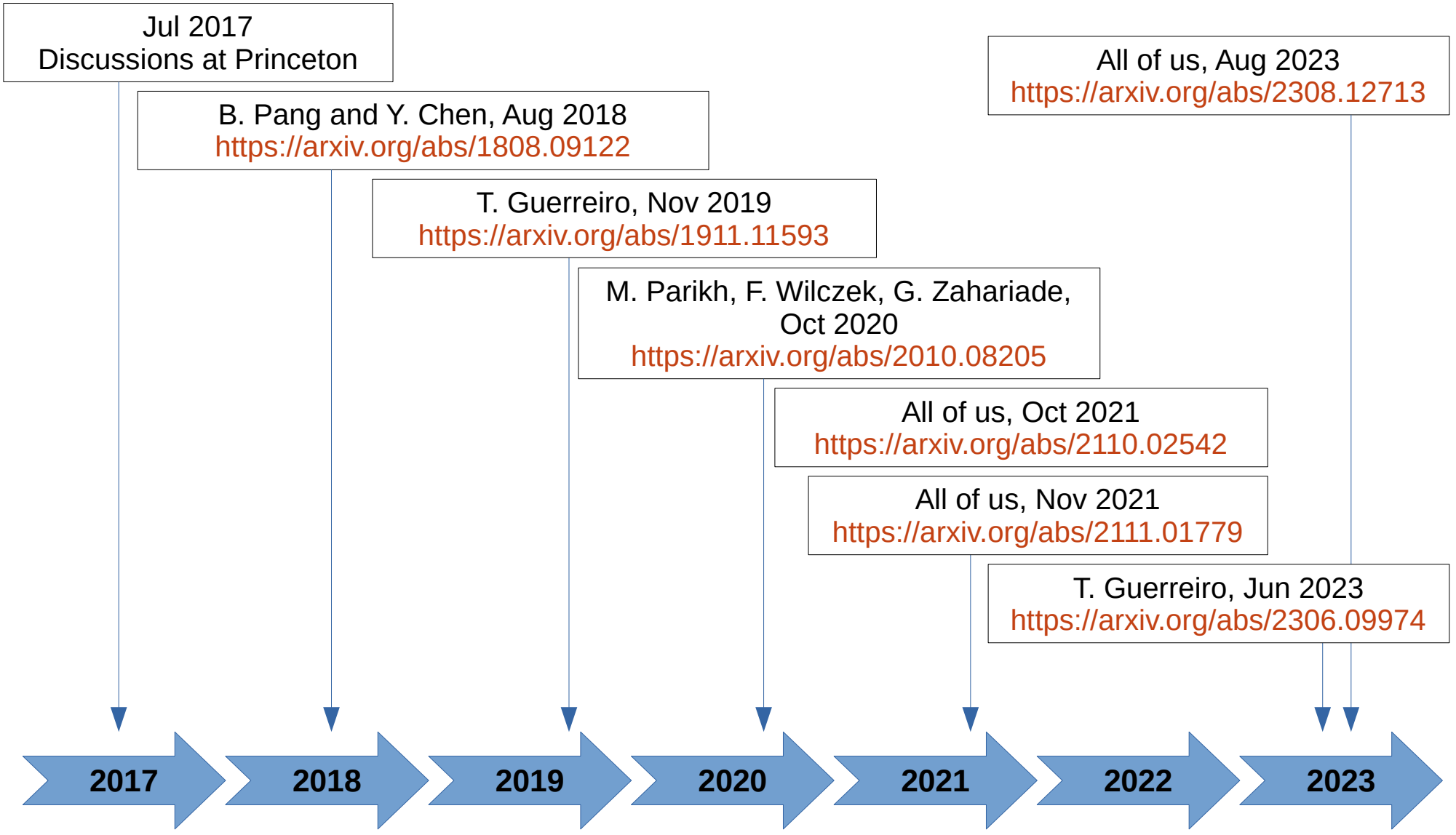
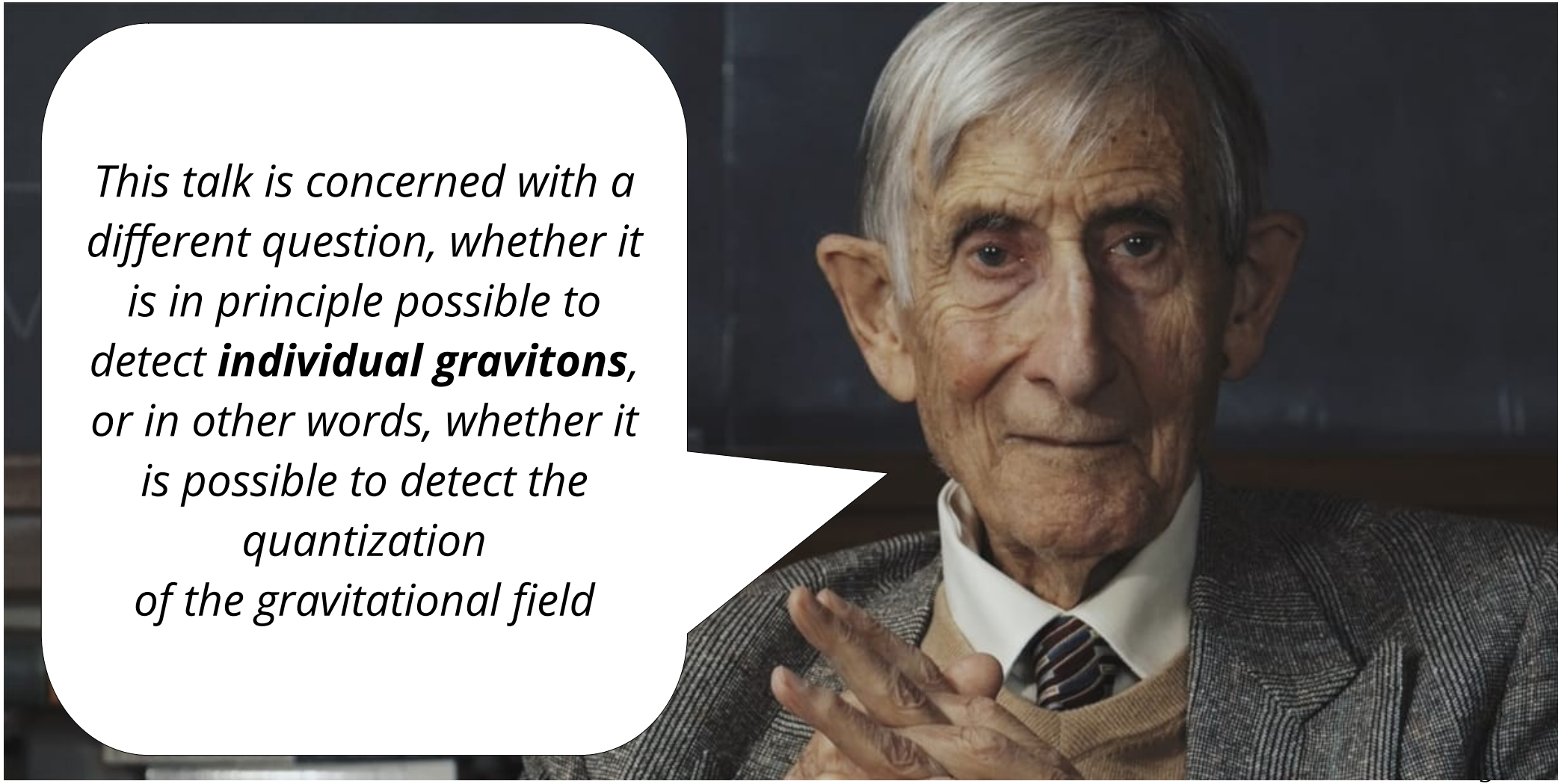
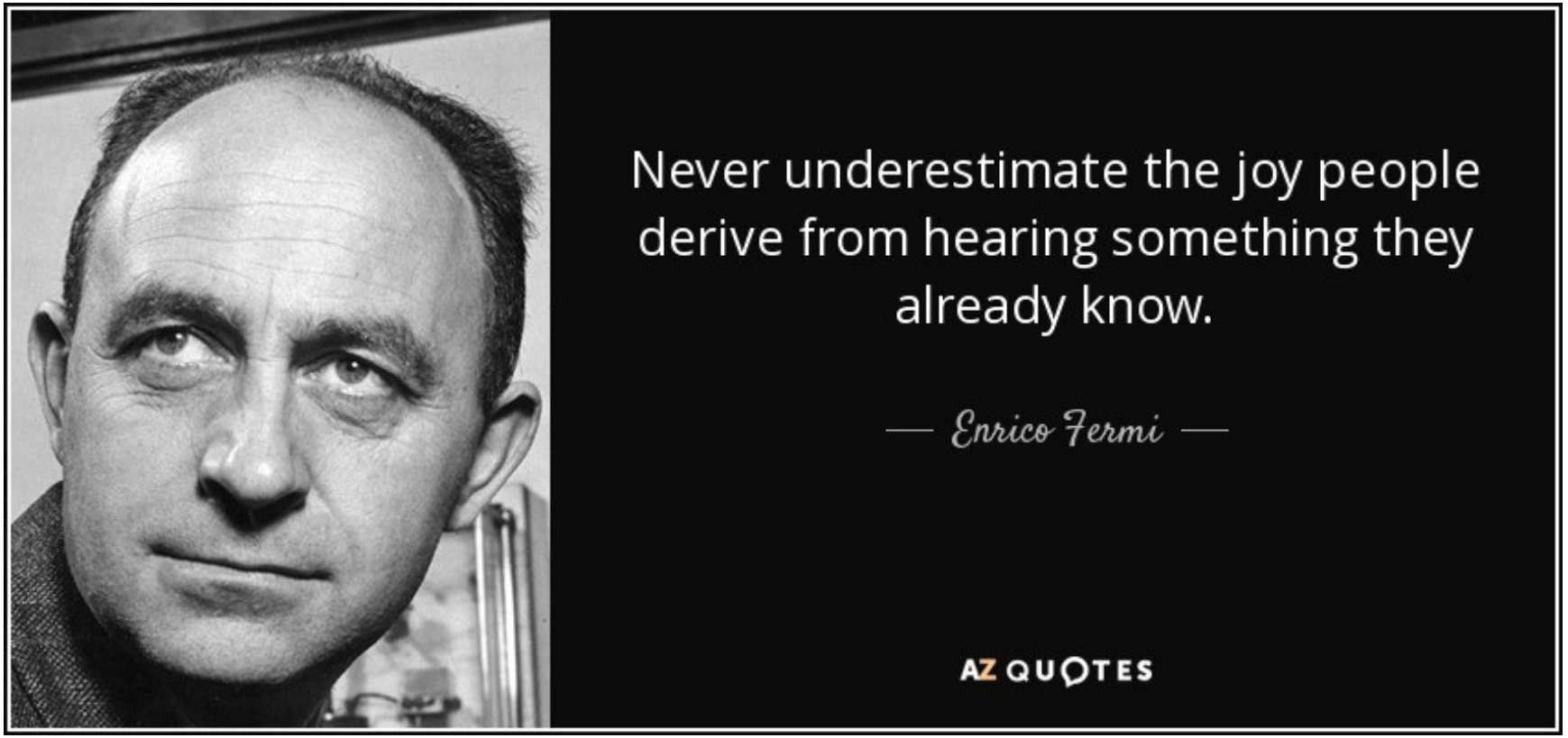
The quantum optics of gravitational waves

Enrico Jr. Schioppa[1] in collaboration with Thiago Guerreiro[2], Francesco Coradeschi[3], Antonia Micol Frassino[4], Jennifer Rittenhouse West[5]

[1] *enrico.junior.schioppa@chimicifisici.it*
[2] *Department of Physics, Pontifical Catholic University of Rio de Janeiro*
[3] *Istituto del Consiglio Nazionale delle Ricerche, OVI*
[4] *Departament de Fisica Quantica i Astrofisica, Institut de Ciencies del Cosmos, Universitat de Barcelona*
[5] *Lawrence Berkeley National Laboratory*


Jul 2017
Discussions at Princeton
B. Pang and Y. Chen, Aug 2018
https://arxiv.org/abs/1808.09122
T. Guerreiro, Nov 2019
https://arxiv.org/abs/1911.11593
M. Parikh, F. Wilczek, G. Zahariade,
Oct 2020
https://arxiv.org/abs/2010.08205
All of us, Oct 2021
https://arxiv.org/abs/2110.02542
All of us, Nov 2021
https://arxiv.org/abs/2111.01779
All of us, Aug 2023
https://arxiv.org/abs/2308.12713
T. Guerreiro, Jun 2023
https://arxiv.org/abs/2306.09974
2017
2018
2019
2020
2021
2022
2023


This talk is concerned with a different question, whether it is in principle possible to detect ***individual gravitons****, or in other words, whether it is possible to detect the quantization of the gravitational field*


Never underestimate the joy people derive from hearing something they already know.
— Enrico Fermi —
AZ QUOTES

canonical /kəˈnɑːnɪkəl/ *adjective*

Britannica Dictionary definition of CANONICAL

[more canonical; most canonical]

1 : connected with or allowed by the laws of the Christian church

- *canonical* procedures

2 a : of or relating to the books that are considered to be part of a religion's official text

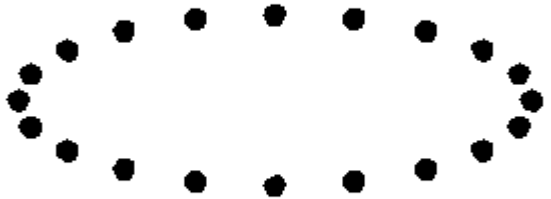
- *canonical* scriptures
- the Jewish *canonical* texts

b : of or relating to the group of books, plays, poems, etc., that are traditionally considered to be very important

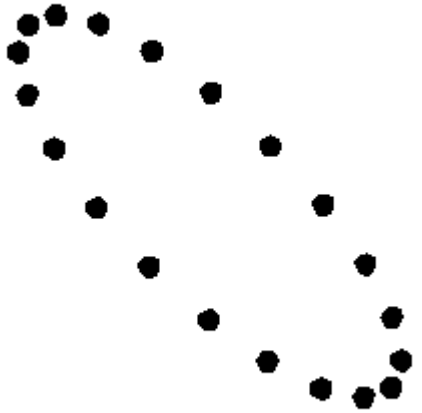
- *canonical* literature

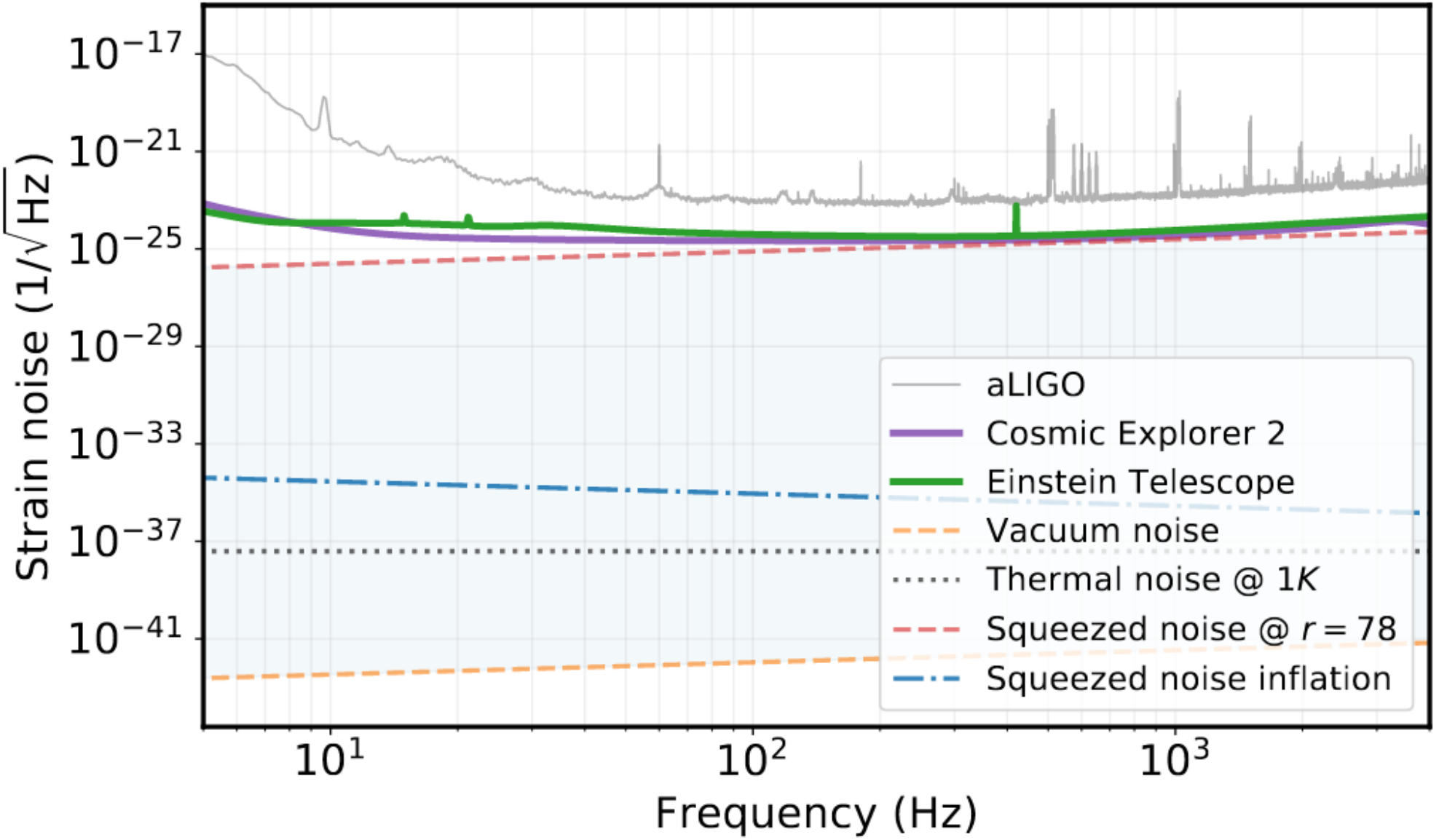
— canonically /kəˈnɑːnɪkli/ *adverb*

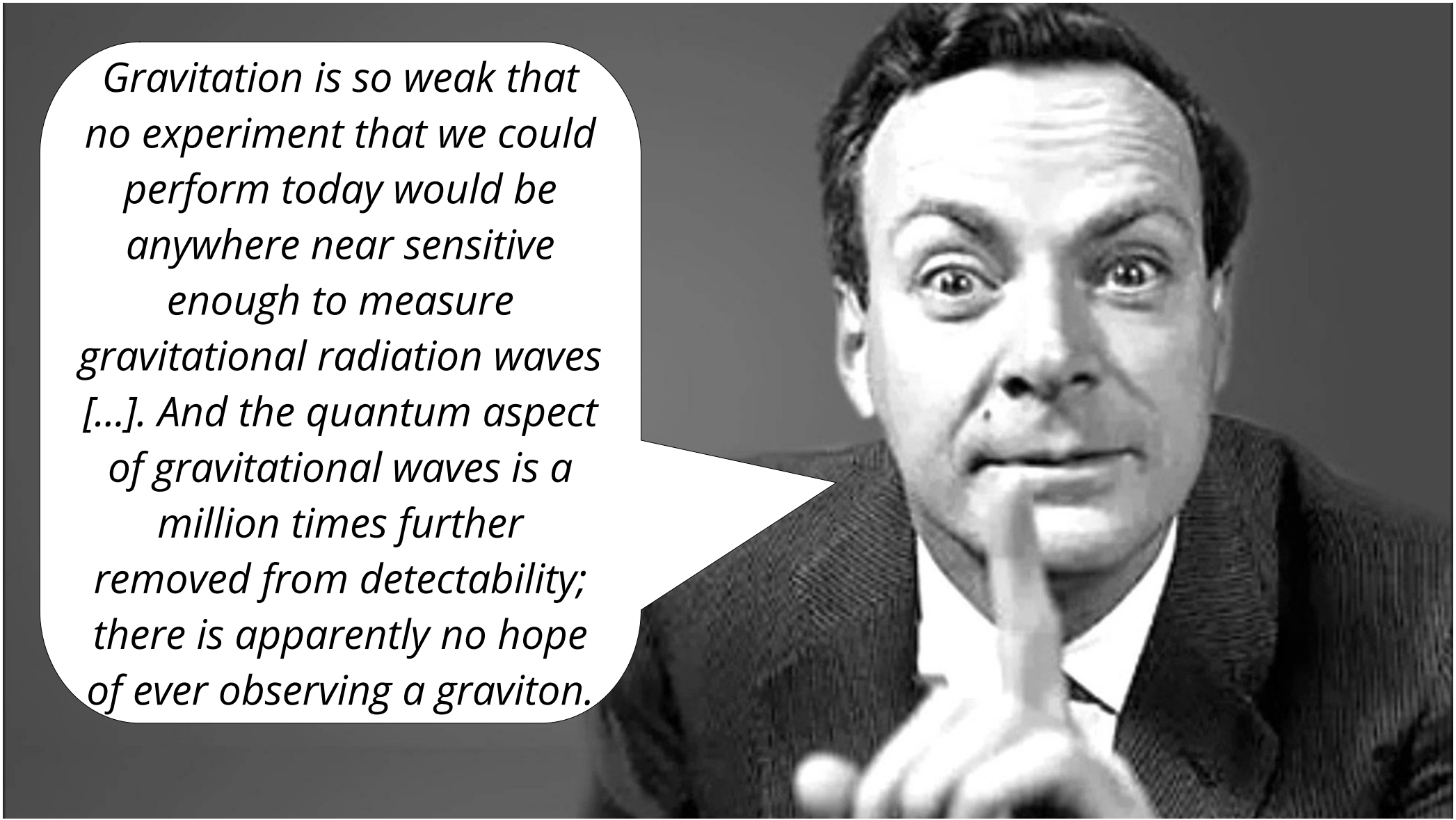
+ polarization



x polarization




10^{-17}
10^{-21}
10^{-25}
10^{-29}
10^{-33}
10^{-37}
10^{-41}
Strain noise ($1/\sqrt{\text{Hz}}$)
10^{1}
10^{2}
10^{3}
Frequency (Hz)
aLIGO
Cosmic Explorer 2
Einstein Telescope
Vacuum noise
Thermal noise @ 1K
Squeezed noise @ $r = 78$
Squeezed noise inflation


Gravitation is so weak that no experiment that we could perform today would be anywhere near sensitive enough to measure gravitational radiation waves [...]. And the quantum aspect of gravitational waves is a million times further removed from detectability; there is apparently no hope of ever observing a graviton.