Axions detection with LIGO

by article 'Spinning black holes could fling off clouds of dark matter particles' by Adrian Cho, Science Magazine, 22 Feb 2017

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Agenda

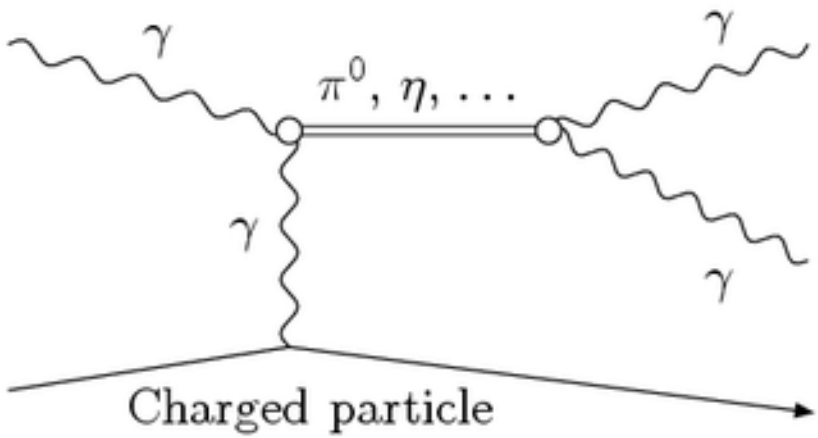
- What are axions
- How they can be detected
- How they possibly emerge near black holes
- How LIGO can detect axions

Axion

- Hypothetical elementary particle
- Postulated in 1977 o resolve the strong CP problem in QCD (Peccei-Quinn theory).
- Uncharged
- Very light ($m = 10^{-6} \ldots 1eV$)
- Possible component of dark matter

Atempts to detext axions (since 2003)

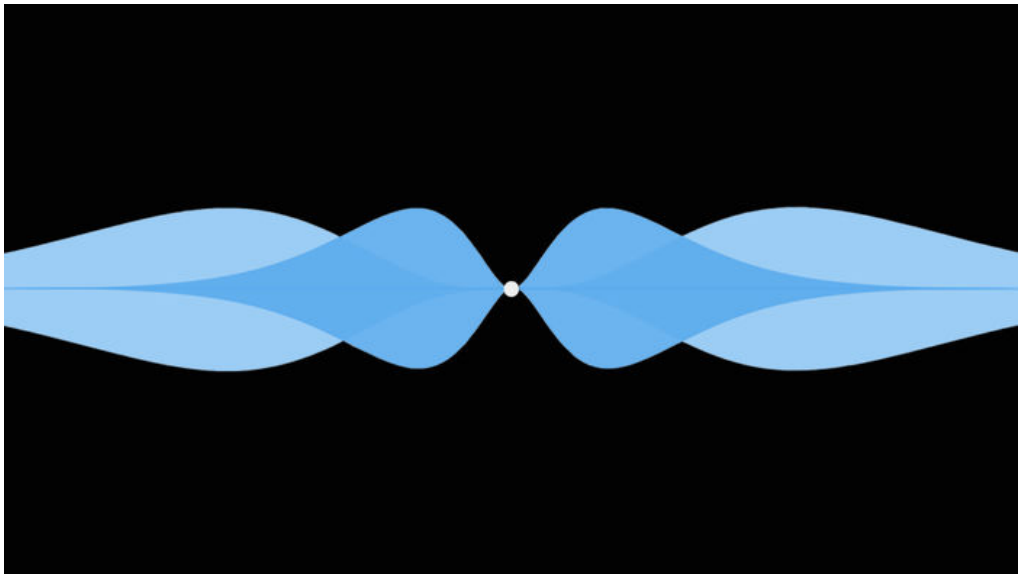
- From Sun radiation: Primakoff effect



- From our galaxy: if they actually are dark matter
- No verified positive results yet

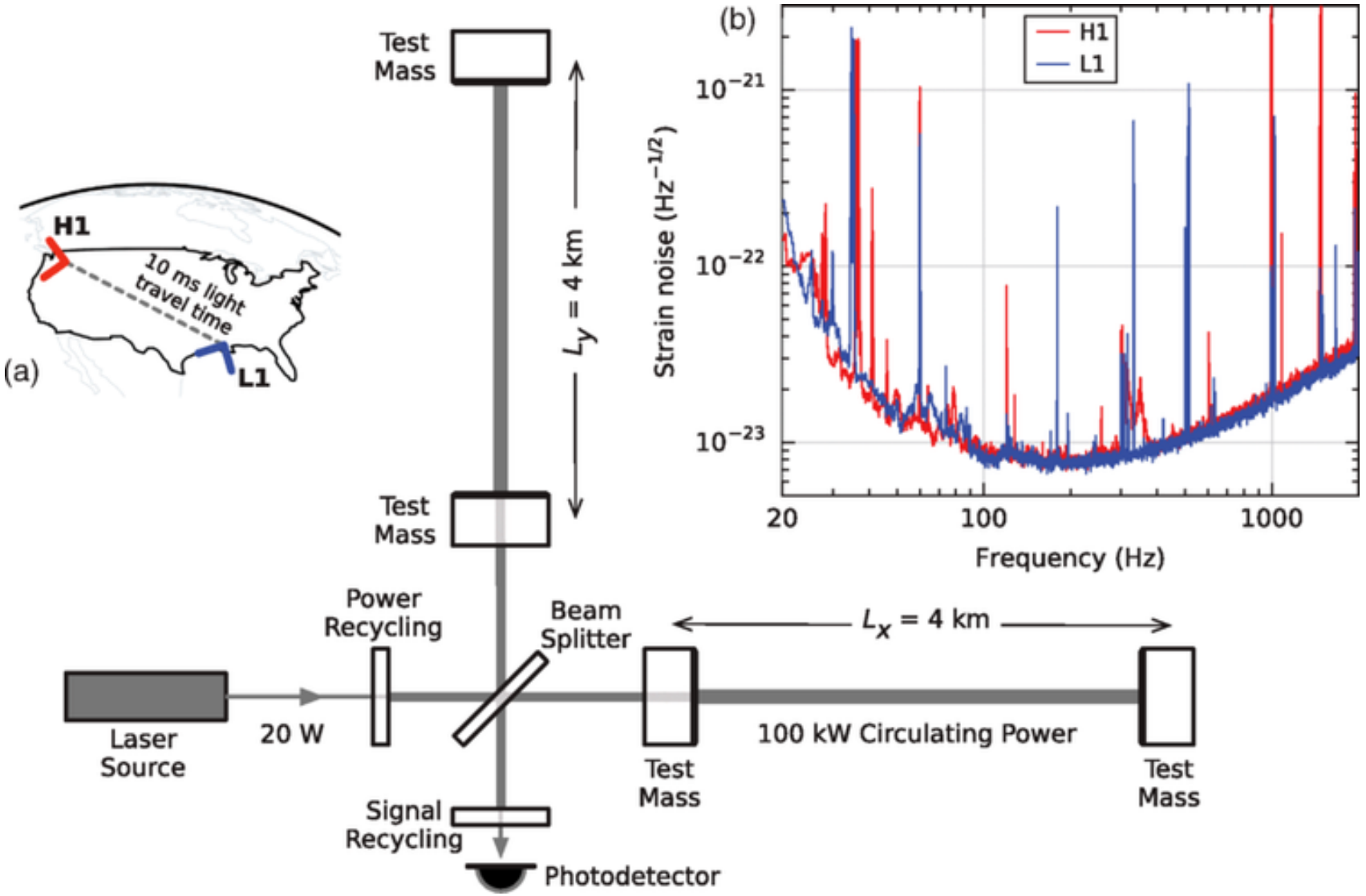
Superradiation

- Spinning black hole $\rightarrow$ accelerating axion
- Resonance if axion's wavelength is equal to diameter of BH
- Annihilation of axion $\rightarrow$ gravitons

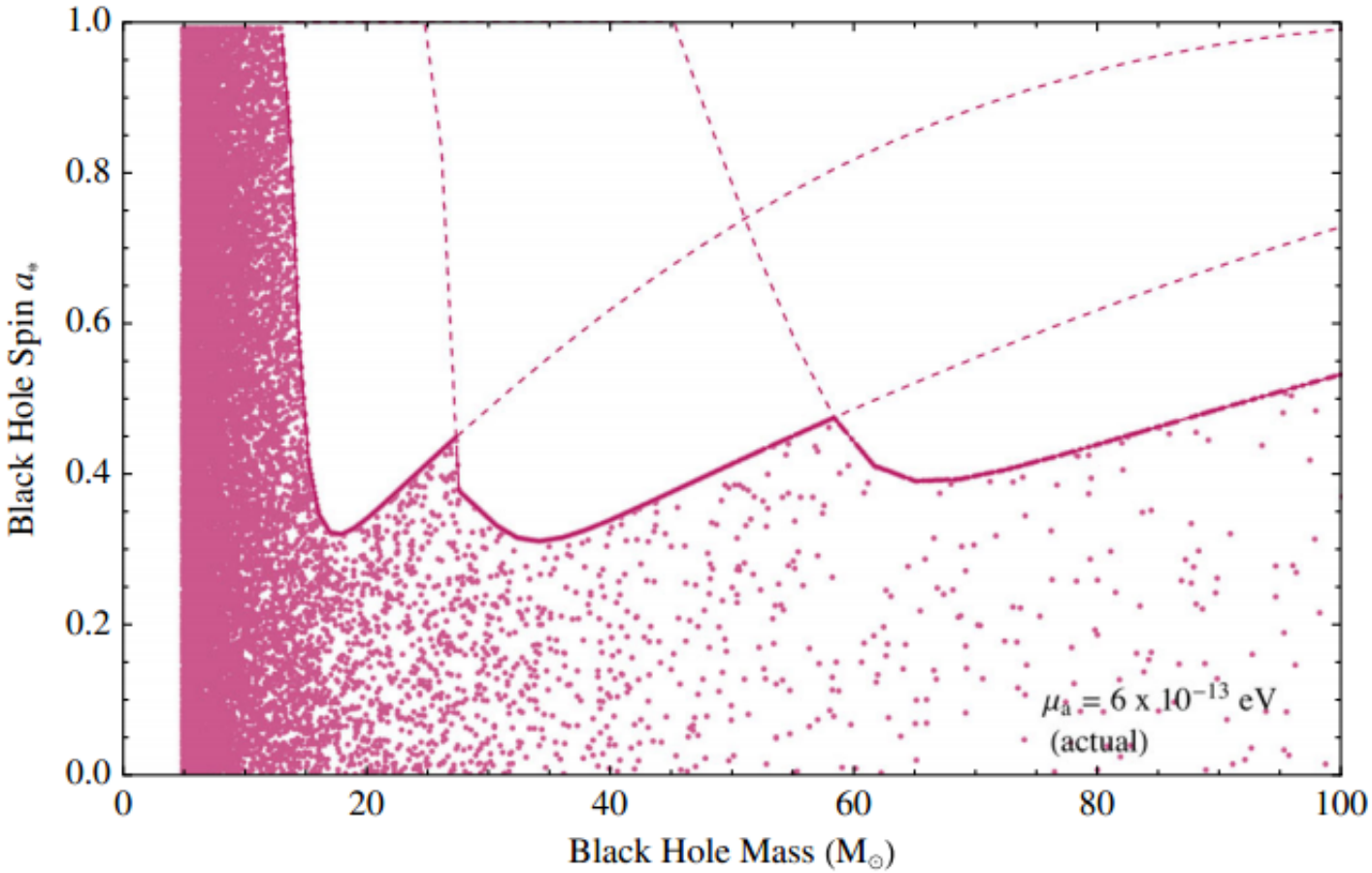


Asimina Arvanitaki, Masha Baryakhtar, Perimeter Institute for Theoretical Physics in Waterloo

Laser Interferometer Gravitational-Wave Observatory



Possible axion detection with LIGO



Spin and mass distribution of merging BH if axions are present

Summary

- Axion is hypothetical, neutral, extremely light particle, needed by QCD
- Existence of axions isn't proven or refuted yet
- LIGO can possibly prove their existence

References

- Spinning black holes could fling off clouds of dark matter particles,
  Adrian Cho, Feb 22, 2017,

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- Black hole mergers and the QCD axion at Advanced LIGO,
  Asimina Arvanitaki, Masha Baryakhtar, Savas Dimopoulos, Sergei Dubovsky, and Robert Lasenby, Phys. Rev. D 95, 043001 – Published 8 February 2017,

  `https://journals.aps.org/prd/abstract/10.1103/PhysRevD.95.043001`
- `https://en.wikipedia.org/wiki/Axion`
- `https://ru.wikipedia.org/wiki/LIGO`