

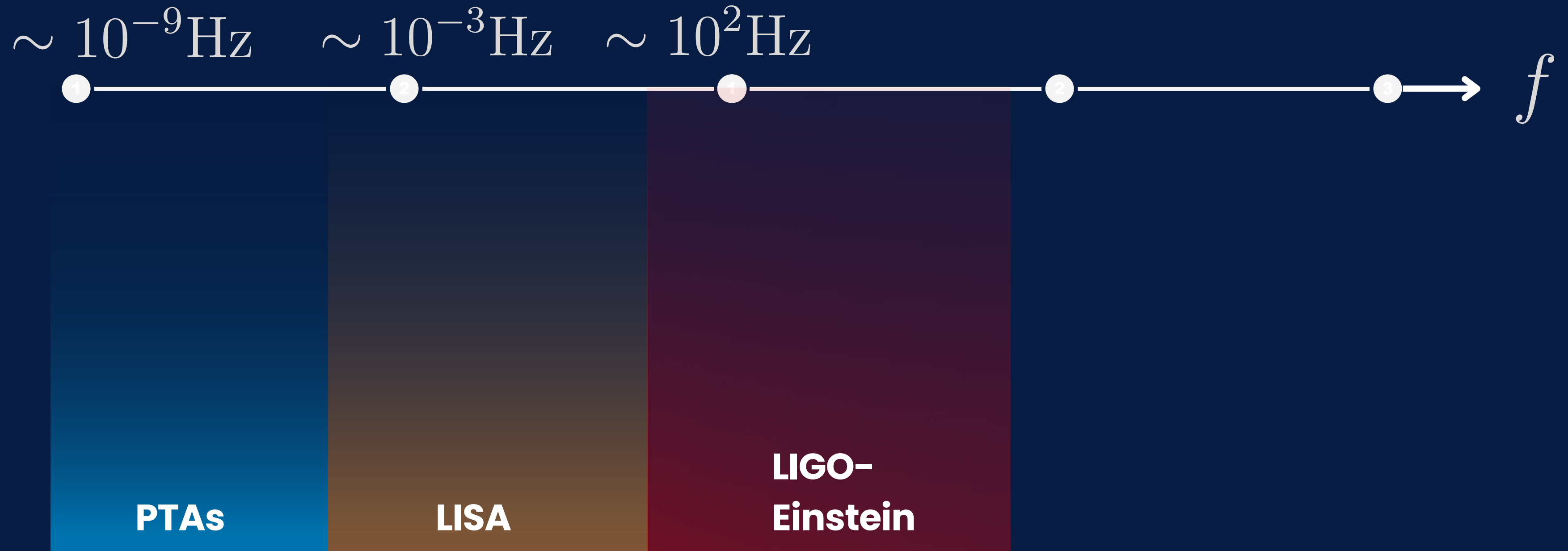
High Frequency GW Bounds from Galactic Neutron Stars

V.Dandoy, T.Bertolez, F. Costa

Based on Arxiv [2402.14092]

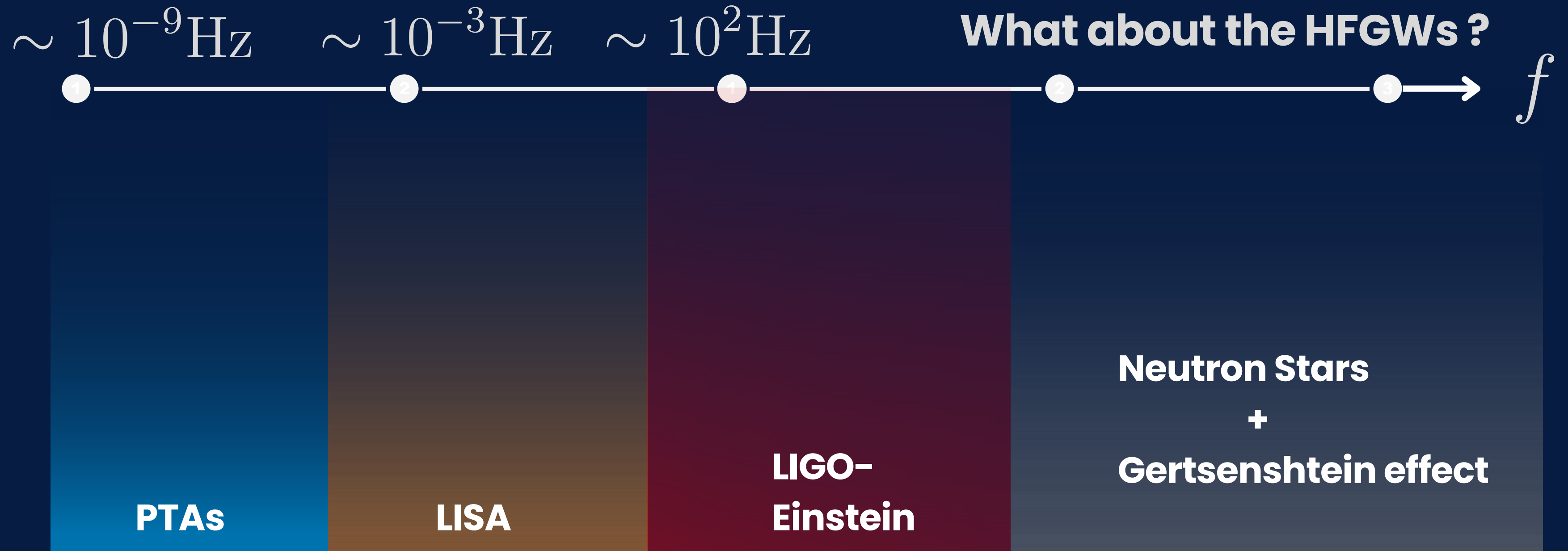
The Situation

What do we know about
the GW spectrum ?

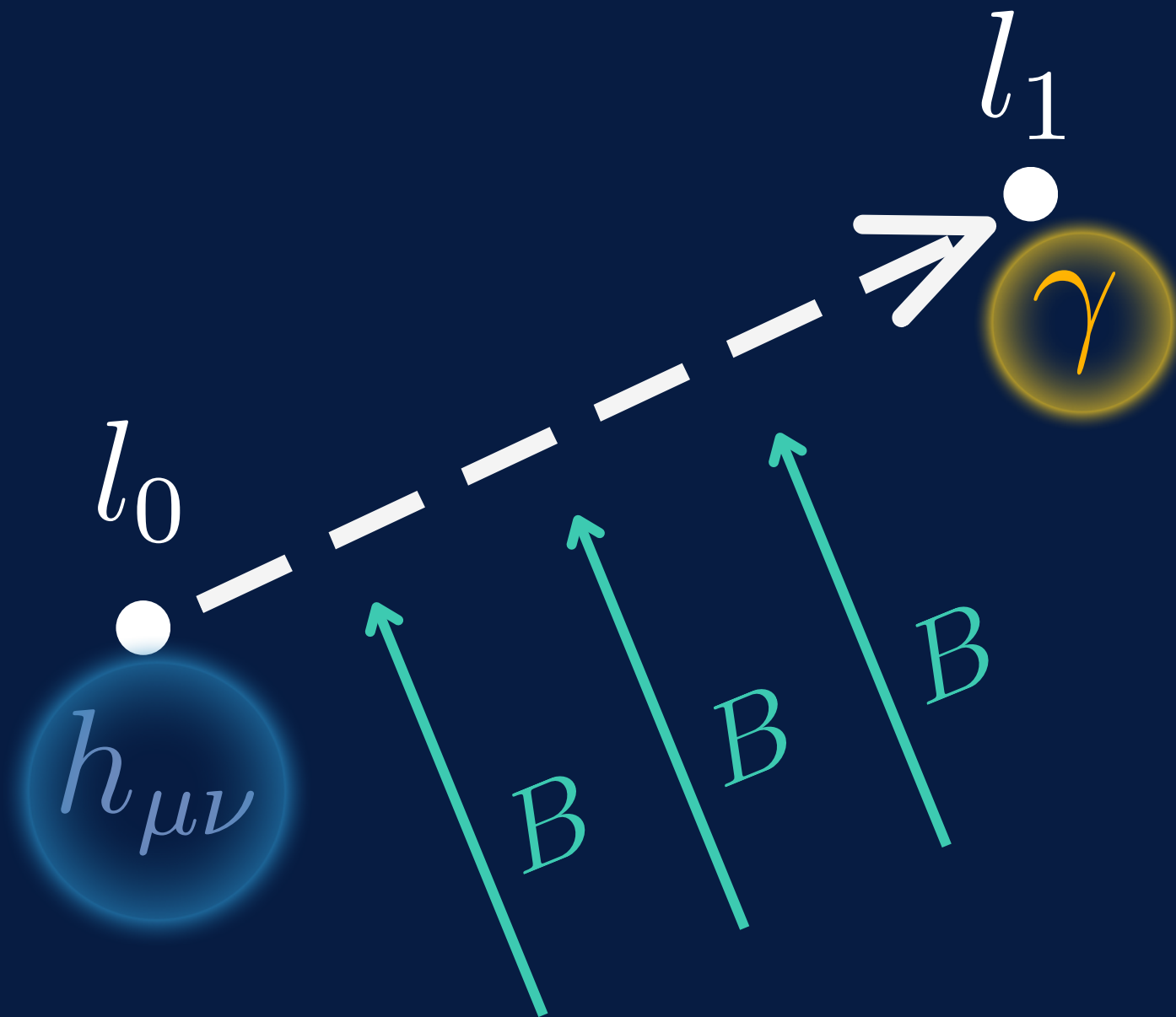


The Situation

What do we know about
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The Gertsenshtein Effect



- GWs convert into photons in a strong magnetic field

Conversion probability for gravitons travelling from l_0 to l_1 :

$$P_{g \rightarrow \gamma}(f) = \left| \int_{l_0}^{l_1} d\ell \Delta_M(\ell) \exp \left\{ -i \int_{l_0}^{\ell} d\ell' \Delta_\gamma(\ell') \right\} \right|^2$$

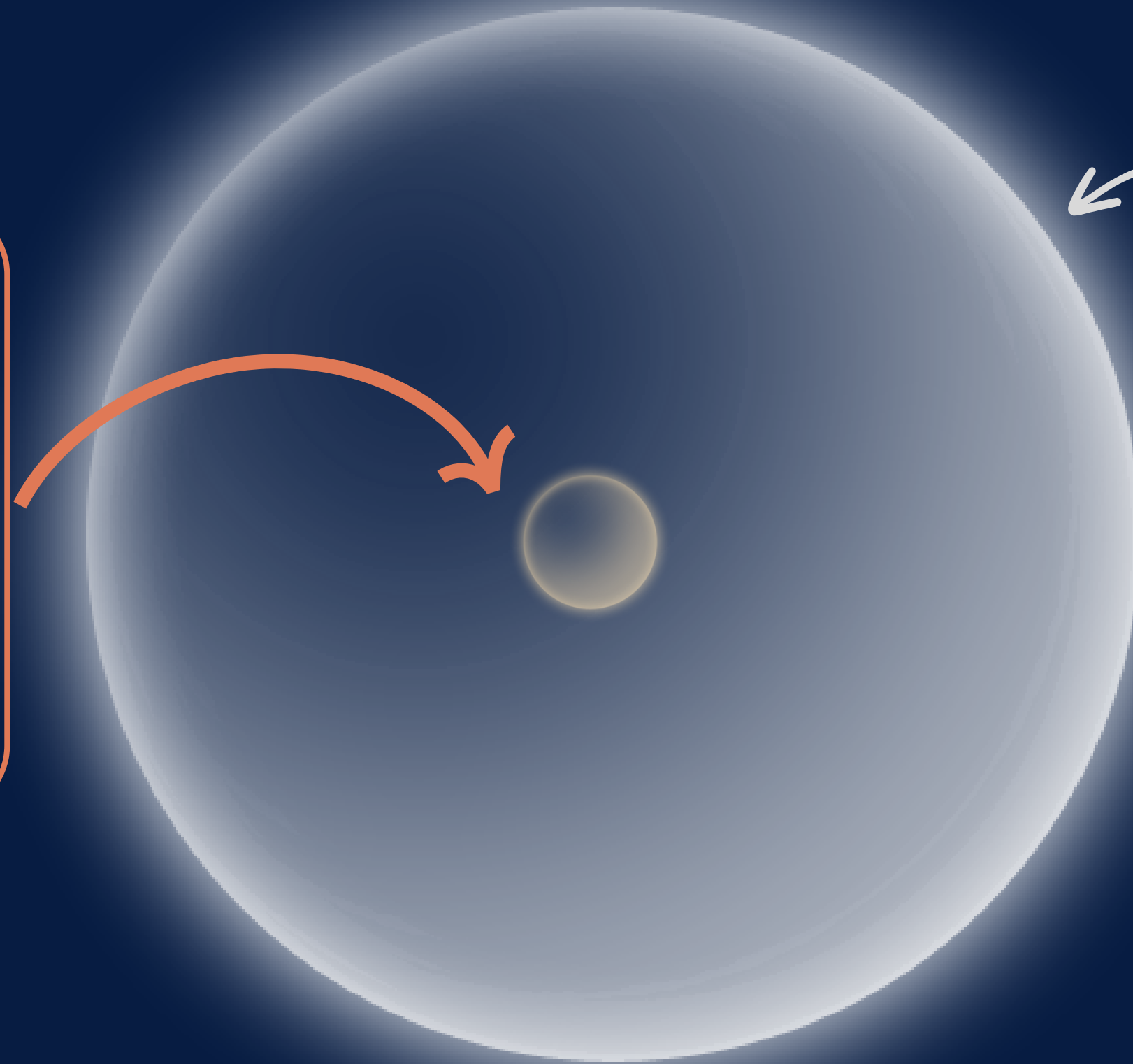
- The mixing term is $\Delta_M \sim B$
- Effective photon mass Δ_γ

(Gertsenshtein, 1962)
(Raffelt, Stodolsky 1987)

Conversion in NS magnetosphere

Typical Neutron Star

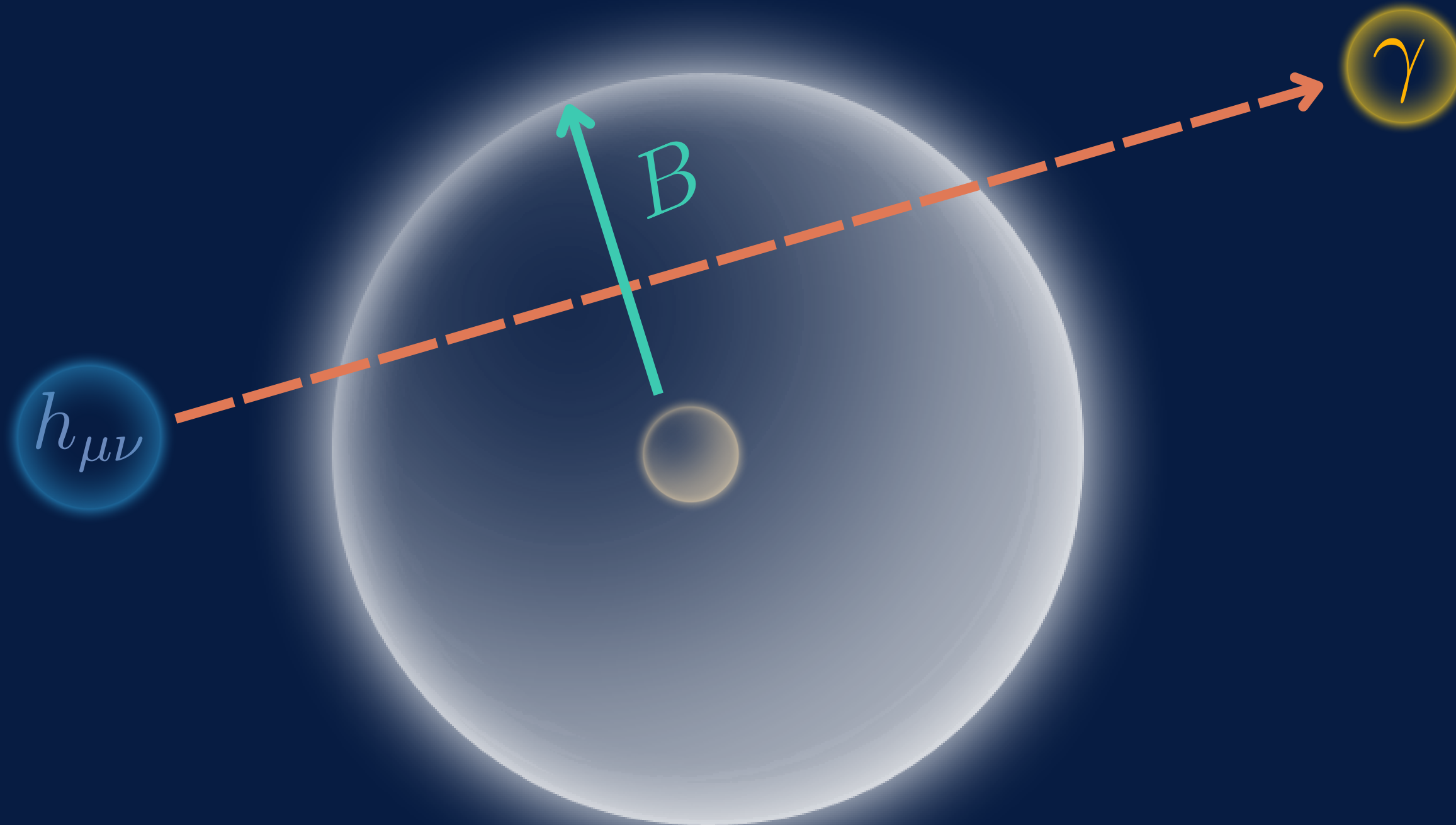
$$T \approx \mathcal{O}(1) \text{ s}$$
$$R \approx 10 \text{ km}$$



Magnetosphere

$$B(r) = B_0 (r/R)^{-3}$$
$$B_0 \approx 10^{13} \text{ Gauss}$$

Conversion in NS magnetosphere



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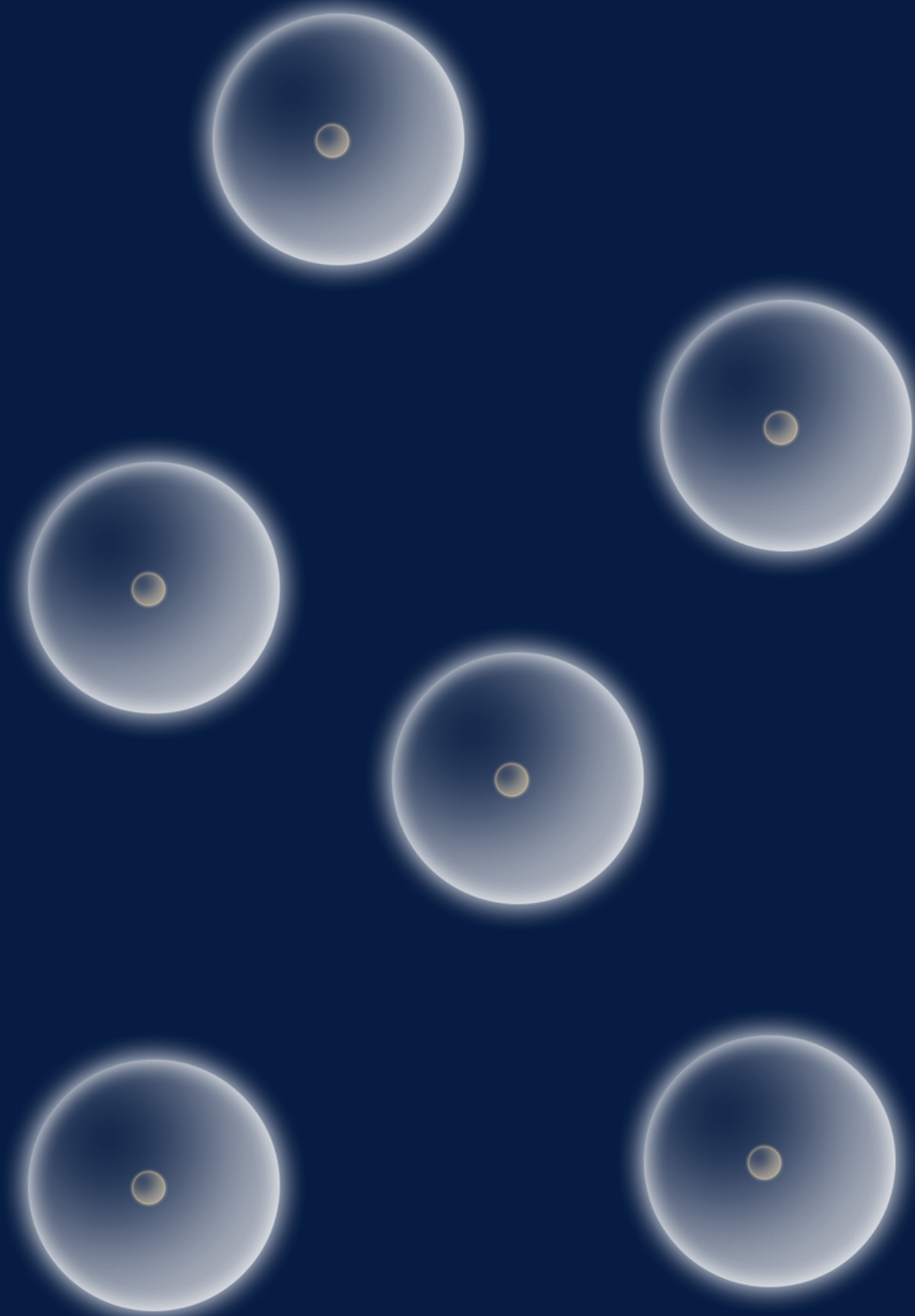
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The Idea

Conversion in NS magnetosphere

(Kaspi et al 2006)

(Popov et al 2010)



$$n_{\text{NS}}(\mathbf{r}) \quad P(T) \quad P(B_0)$$

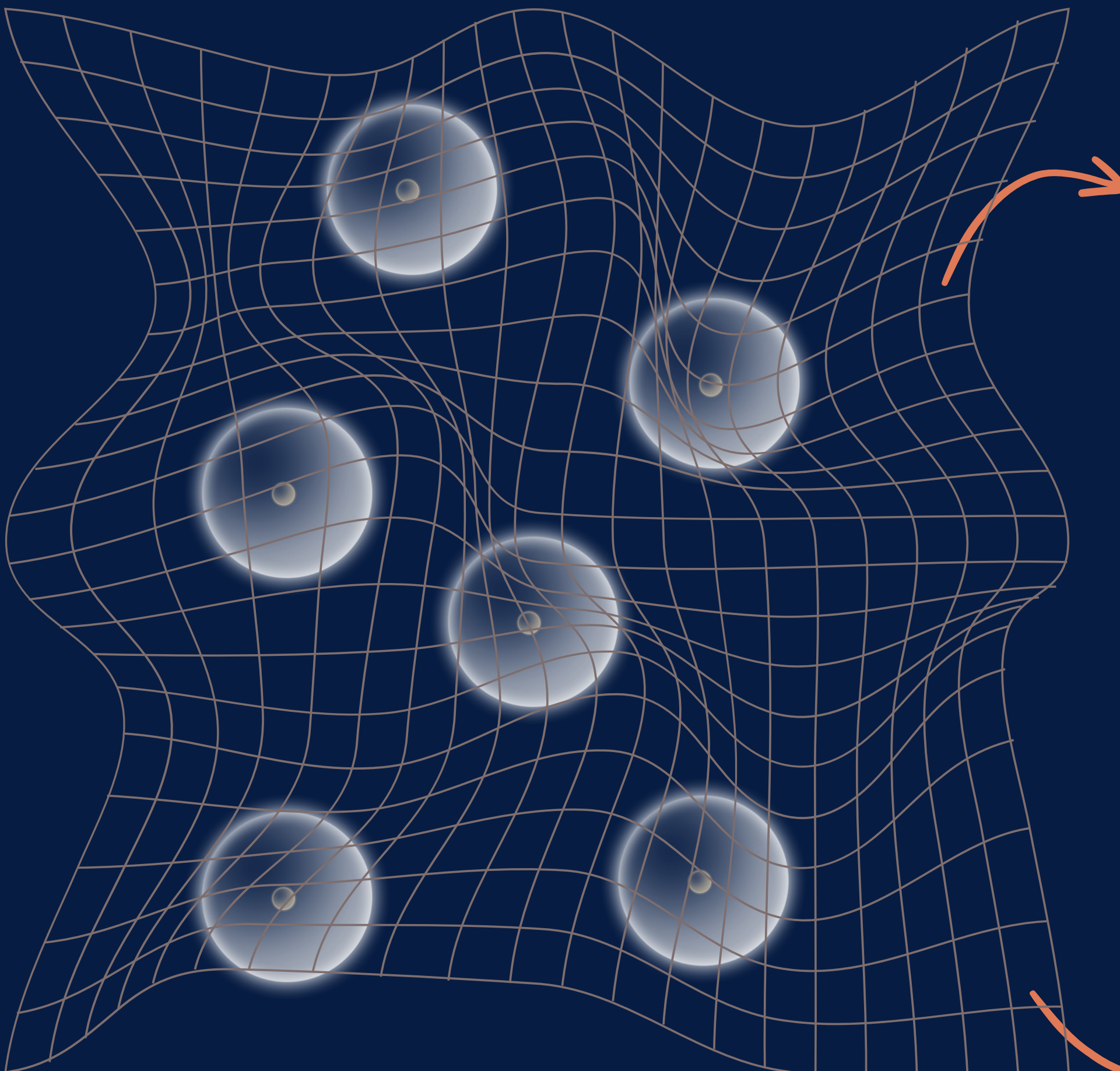
Assuming a model for the galactic neutron stars

The Idea

Conversion in NS magnetosphere

(Kaspi et al 2006)

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$$n_{\text{NS}}(\mathbf{r}) \quad P(T) \quad P(B_0)$$

Assuming a model for the galactic neutron stars

GW background

$$f, h_c$$

The Idea

Conversion in NS magnetosphere

(Kaspi et al 2006)

(Popov et al 2010)



The diagram illustrates the conversion in the magnetosphere of neutron stars. It features a grid of spacetime curvature representing the magnetosphere, with several neutron stars (represented as glowing spheres) embedded within it. Orange wavy lines represent photon fluxes emanating from the stars. An orange arrow points from the diagram to a rounded box containing the mathematical expression $n_{\text{NS}}(\mathbf{r}) P(T) P(B_0)$.

$$n_{\text{NS}}(\mathbf{r}) P(T) P(B_0)$$

Photon flux induced by the
Gertsenshtein in each
neutron star !

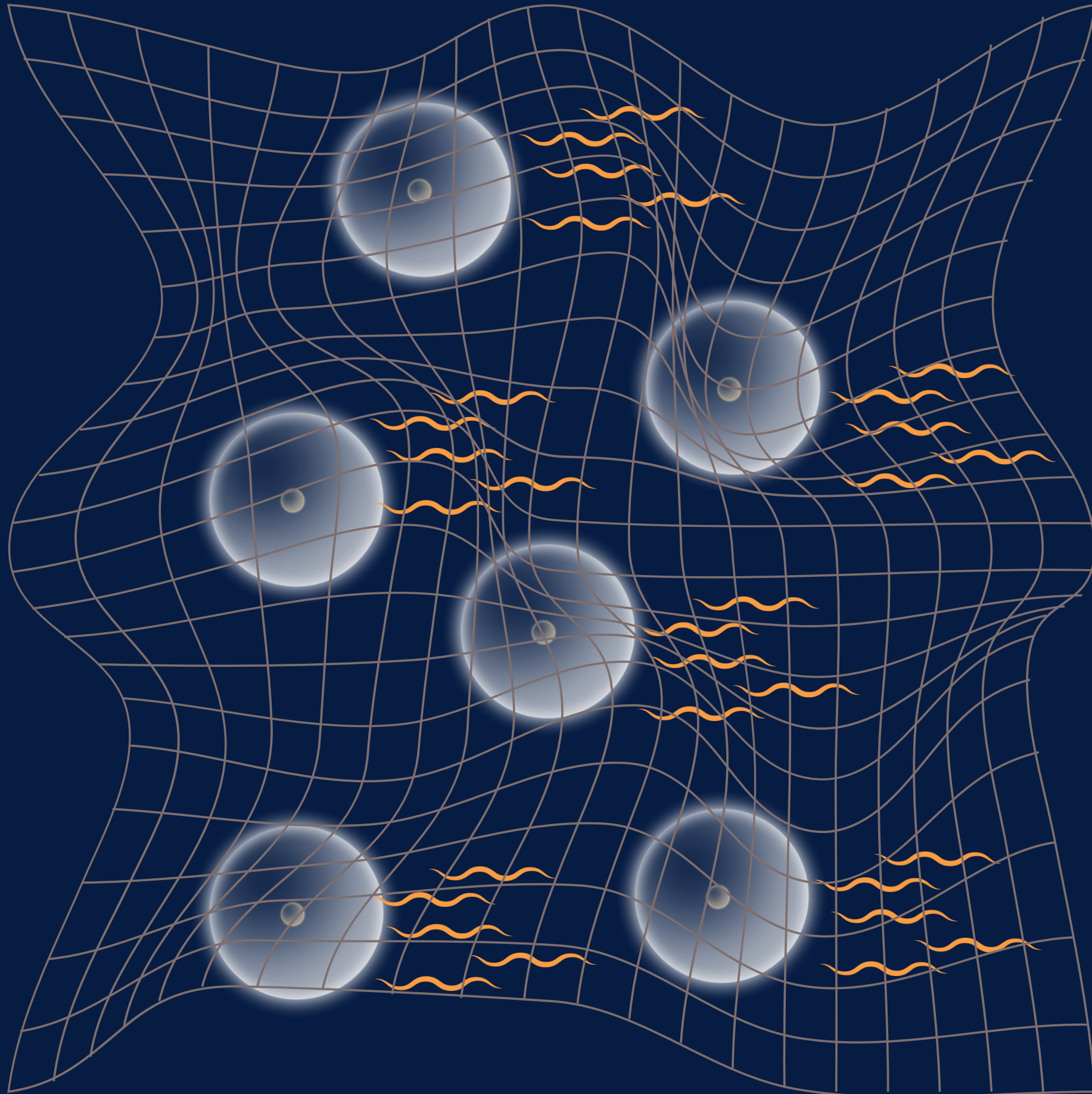


A rounded box containing the mathematical expression f, h_c . An orange arrow points from the diagram towards this box.

$$f, h_c$$

The Idea

Conversion in NS magnetosphere

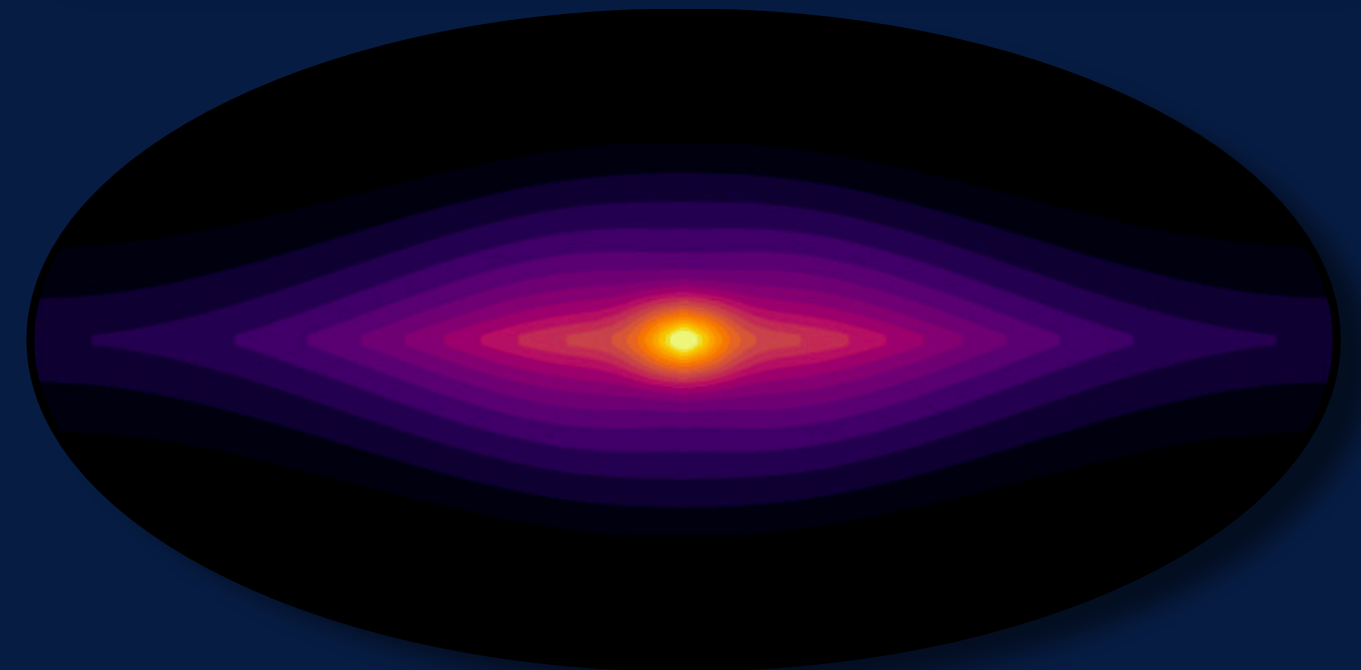


$$f = 10^{15} \text{ Hz}$$

$$h_c = 10^{-25}$$

$$\log \left(f \times \frac{\partial F_{\gamma}^{\text{galac.}}}{\partial f} \right) [\text{erg}/(\text{cm}^2 \text{s sr})]$$

-18.5 -18.0 -17.5 -17.0 -16.5



Constraints on the HFGW spectrum

