

Anisotropies in the stochastic gravitational-wave background

ACJ & Sakellariadou, *PRD* 2018, arXiv:1802.06046

ACJ+, *PRD* 2018, arXiv:1806.01718

ACJ+, arXiv:1810.03435

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19 December 2018

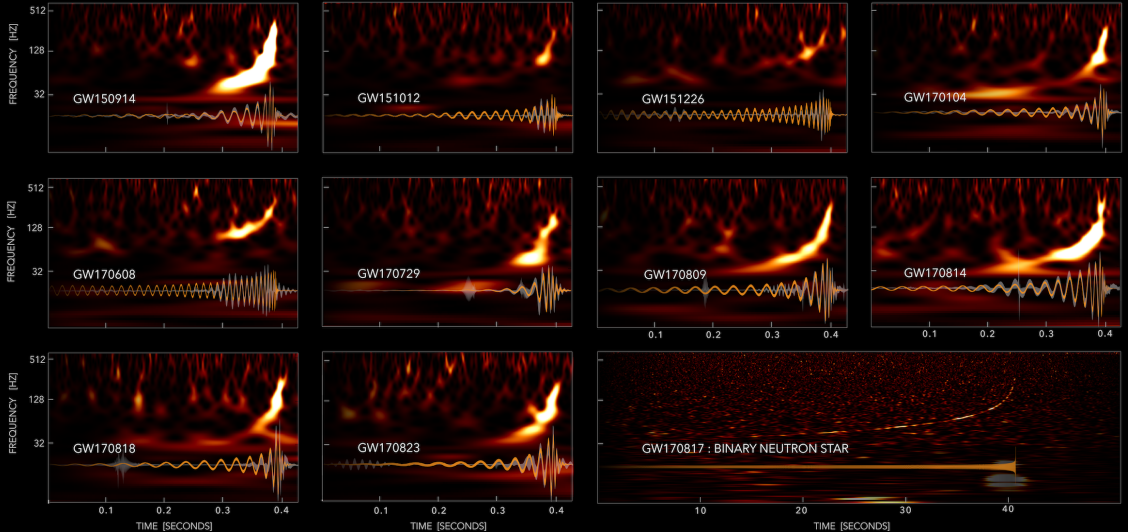
1 The stochastic gravitational-wave background

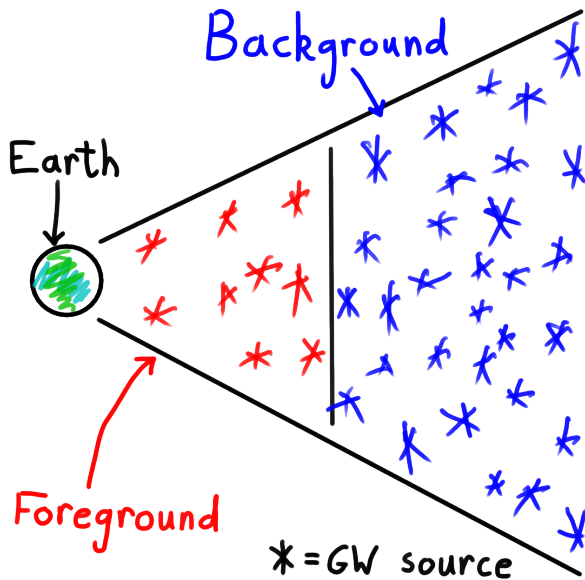
2 Formalism

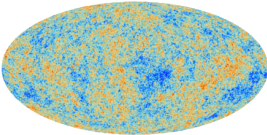
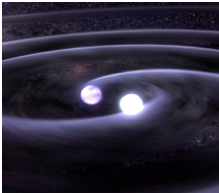
3 Cosmic strings

4 Compact binaries

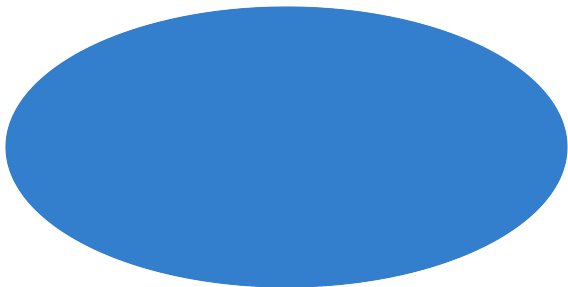
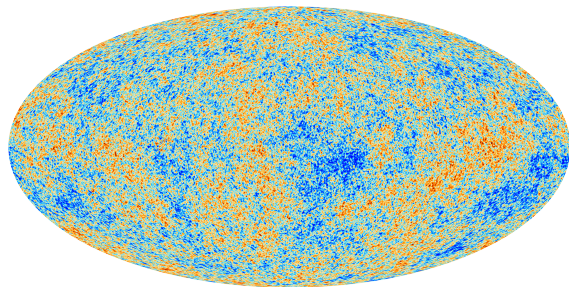
GRAVITATIONAL-WAVE TRANSIENT CATALOG-1





	Fore- ground	Back- ground
EM		
GW		SGWB?

CMB lesson: anisotropies are important



1 The stochastic gravitational-wave background

2 **Formalism**

3 Cosmic strings

4 Compact binaries

GW density parameter

$$\Omega_{\text{gw}}(\nu_o, \hat{\mathbf{e}}_o) \equiv \frac{1}{\rho_c} \frac{d^3 \rho_{\text{gw}}}{d(\ln \nu_o) d^2 \sigma_o}$$

GW density parameter

Observation direction

GW energy density

$$\Omega_{\text{gw}}(\nu_o, \hat{\mathbf{e}}_o) \equiv \frac{1}{\rho_c} \frac{d^3 \rho_{\text{gw}}}{d(\ln \nu_o) d^2 \sigma_o}$$

Observed frequency

Critical density

Solid angle

Two-Point Correlator

$$\delta_{\text{gw}} \equiv \frac{\Omega_{\text{gw}} - \bar{\Omega}_{\text{gw}}}{\bar{\Omega}_{\text{gw}}}$$

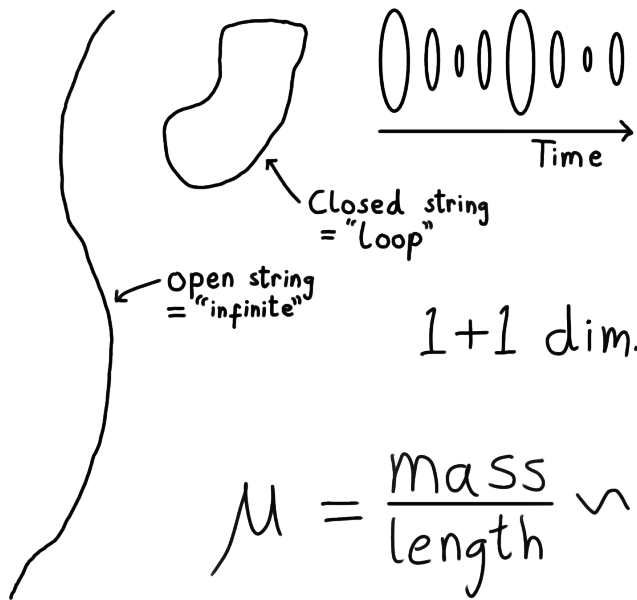
$$C_{\text{gw}}(\theta) \equiv \langle \delta_{\text{gw}} \delta_{\text{gw}} \rangle = \sum_{\ell} \frac{2\ell + 1}{4\pi} C_{\ell} P_{\ell}(\cos \theta)$$

1 The stochastic gravitational-wave background

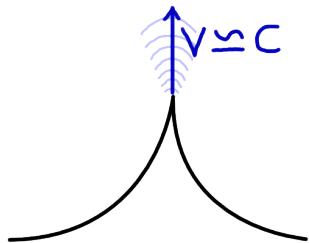
2 Formalism

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$$\mu = \frac{\text{mass}}{\text{length}} \sim E^2$$

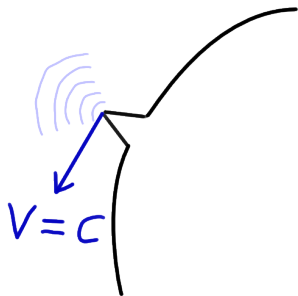


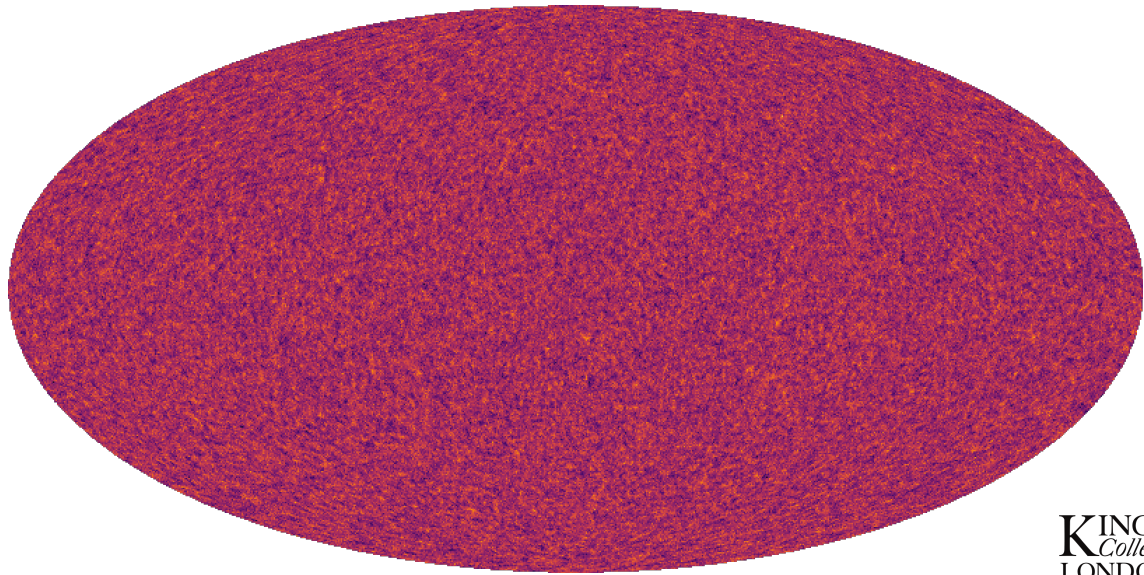
Cusp

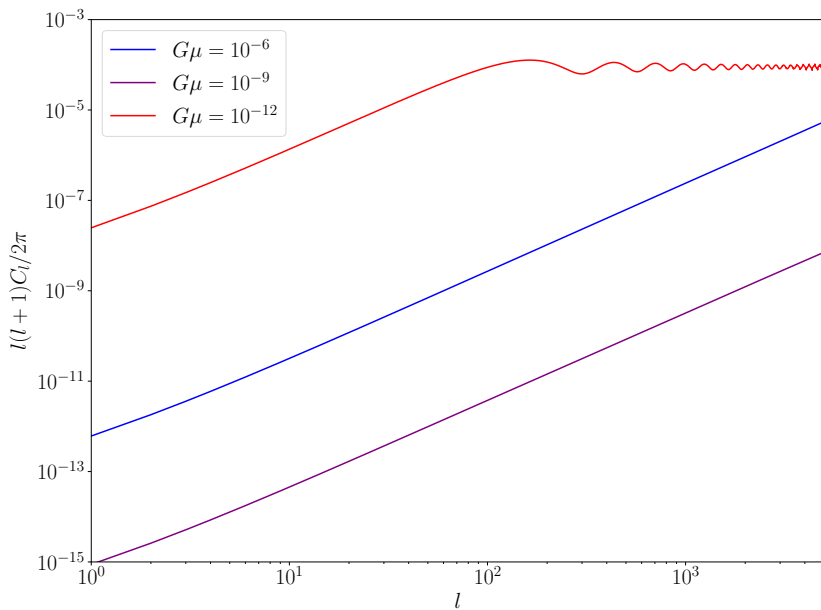
$$\tilde{h} \sim v^{-4/3}$$

Kink

$$\tilde{h} \sim v^{-5/3}$$







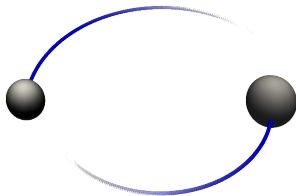
1 The stochastic gravitational-wave background

2 Formalism

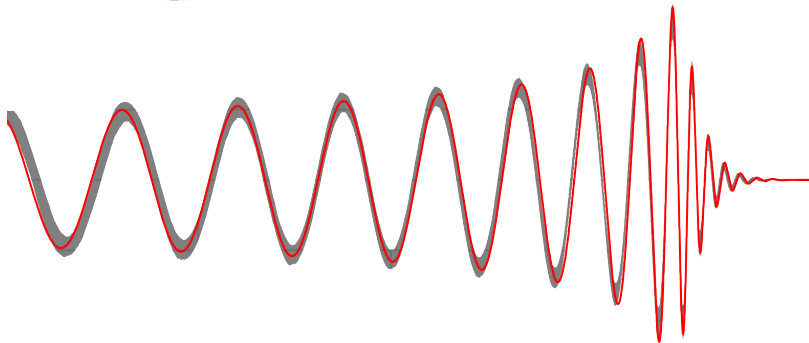
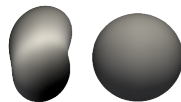
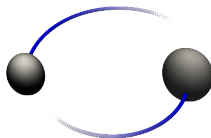
3 Cosmic strings

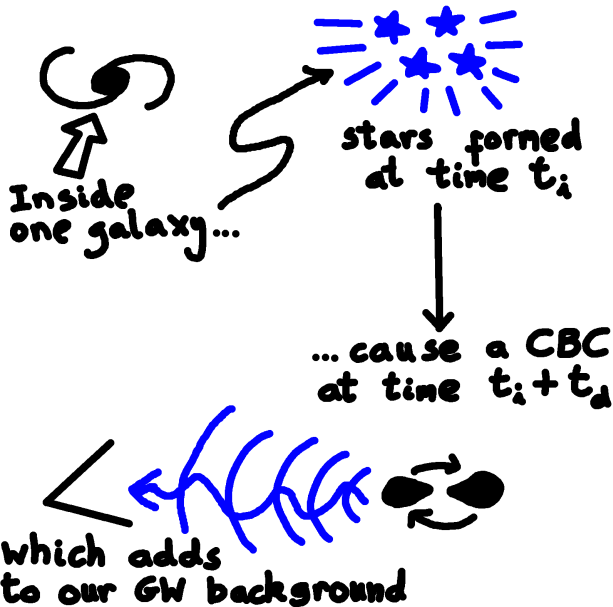
4 Compact binaries

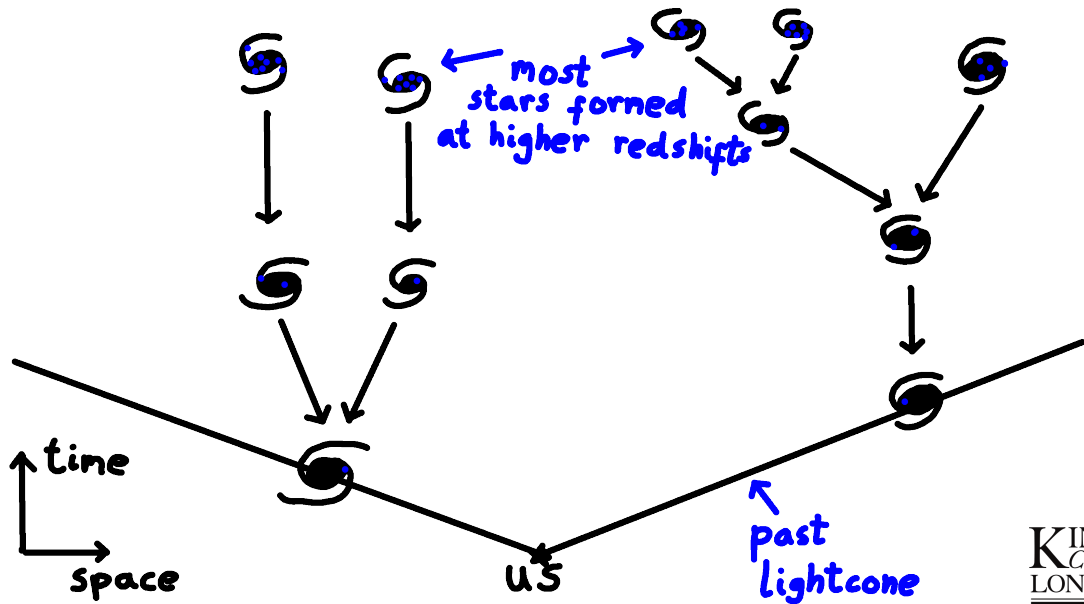
Inspiral

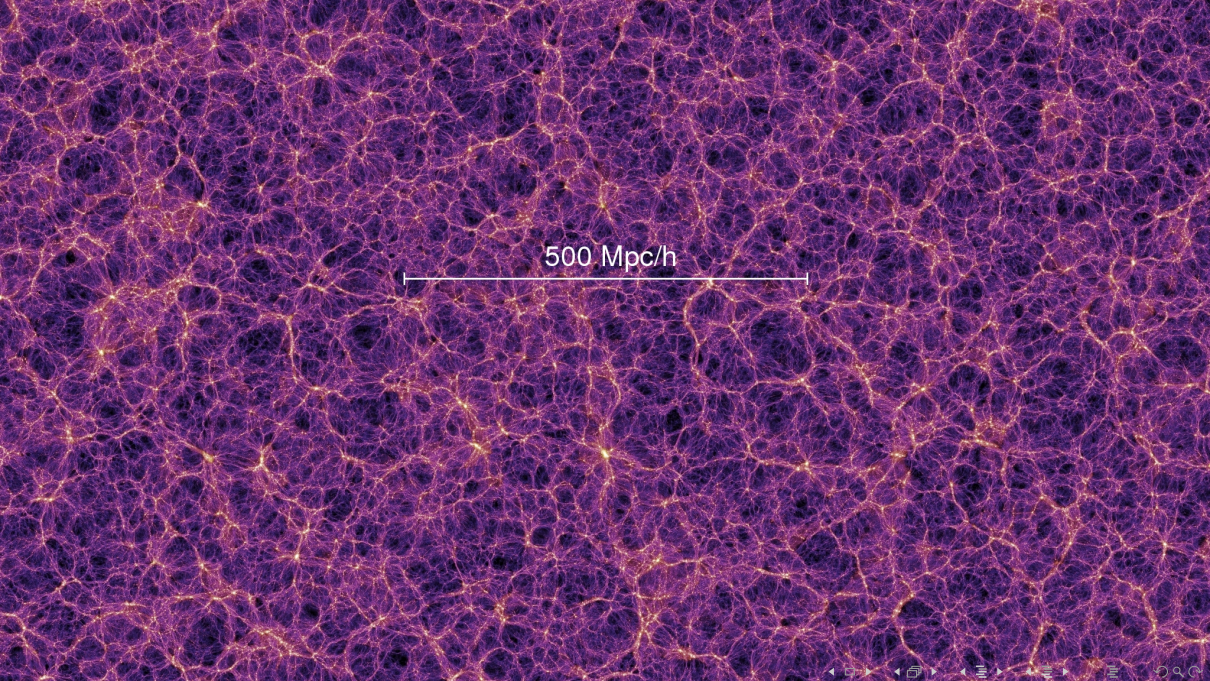


Merger Ring-down

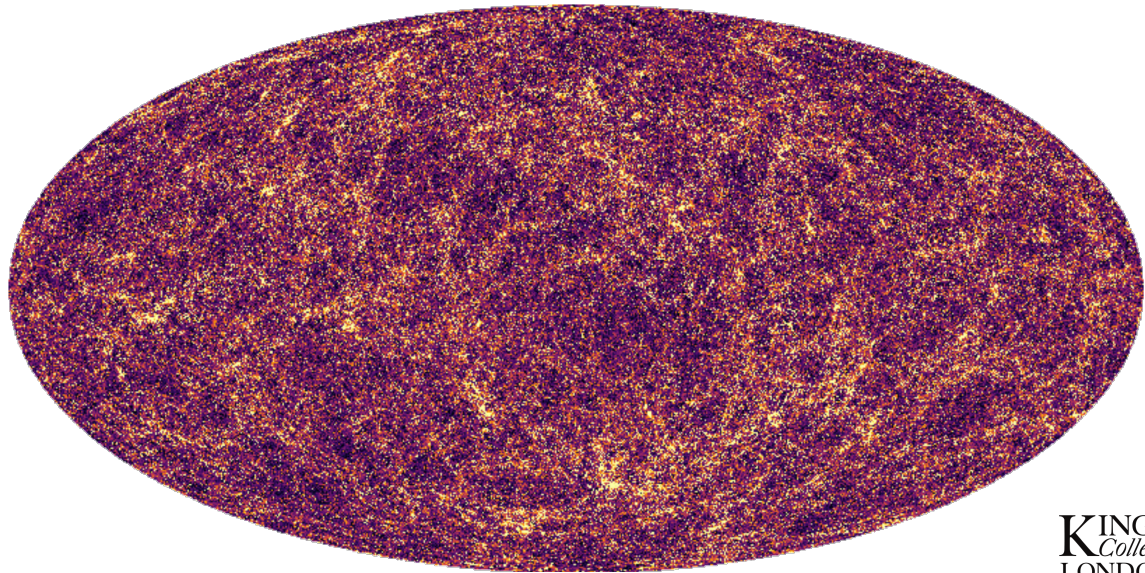


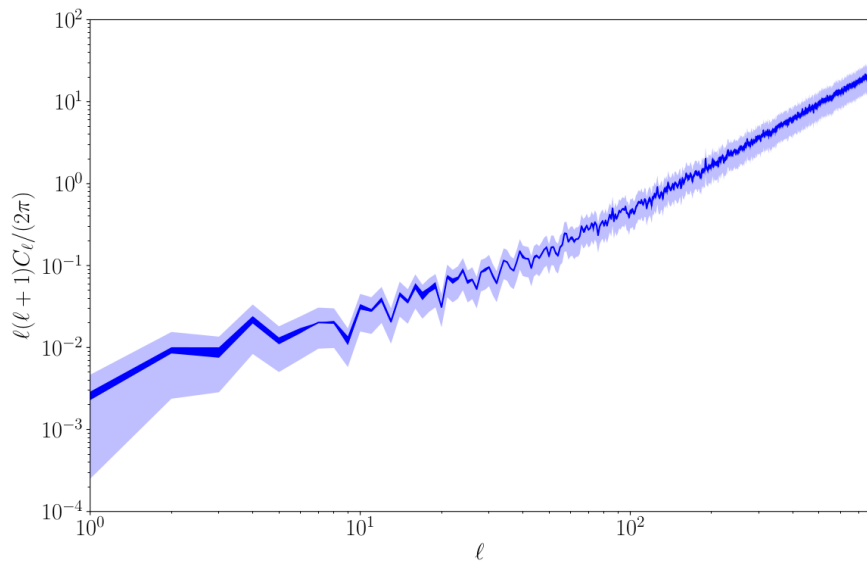






500 Mpc/h

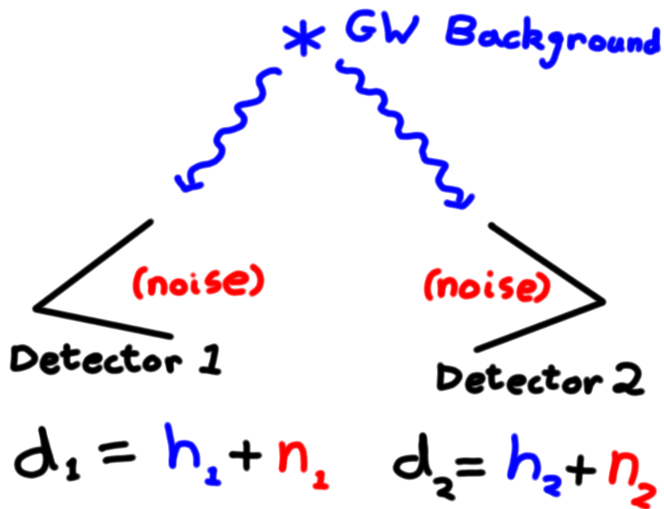




Summary and outlook

- GW background anisotropies are important
- Interesting constraints for cosmic strings
- New frontier for large-scale structure
- Next, more sources!
 - ▶ Primordial BHs
 - ▶ Phase transitions
 - ▶ Supermassive BHs

Extra slides



Extra slides

$$\langle d_1 d_2 \rangle = \langle h_1 h_2 \rangle + \langle h_1 n_2 \rangle + \langle n_1 h_2 \rangle + \langle n_1 n_2 \rangle$$

Extra slides

$$\langle d_1 d_2 \rangle = \langle h_1 h_2 \rangle + \cancel{\langle h_1 n_2 \rangle} + \cancel{\langle n_1 h_2 \rangle} + \cancel{\langle n_1 n_2 \rangle}$$
$$\approx \langle h_1 h_2 \rangle$$