Measurements of Correlations in a Recirculating fibre loop

Elias Charnay, Adrien Escoubet, Alvise Bastianello, François Copie, Stéphane Randoux, Thibault Bonnemain, Benjamin Doyon, Pierre Suret

- Focusing Nonlinear Schrödinger Equation :

$$i\partial_t\psi + \frac{1}{2}\partial_{xx}\psi + |\psi|^2\psi = 0$$

- Thermodynamics of soliton gases
- Infinitely many conserved quantities / constraints

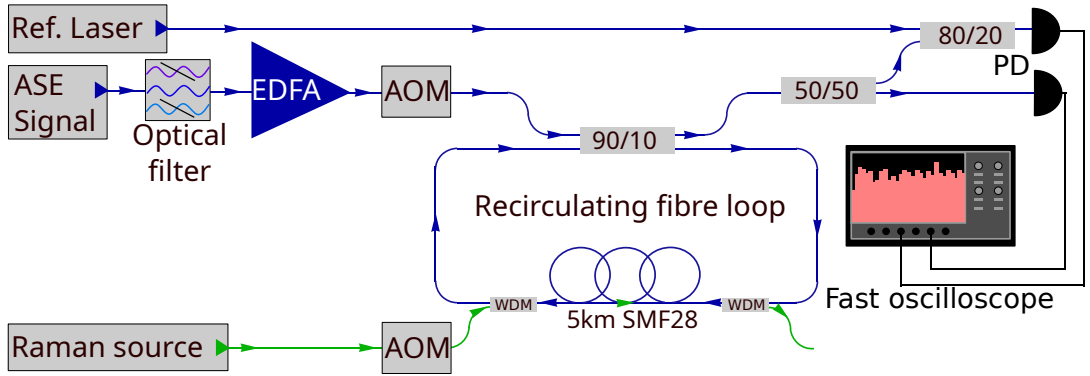
$$e^{-\beta(H-\mu N)} \Longrightarrow e^{-\sum_{j=1}^{\infty}\beta_j Q_j}$$

- **Ballistic correlations of conserved quantities**

$$t\,C(x,t) = t\langle|\psi(x,t)|^2|\psi(0,0)|^2\rangle_c$$

$$= \int \mathrm{d}^2\lambda\,\delta(x/t - v^{\mathrm{eff}}(\lambda))\rho(\lambda)\left([4\mathfrak{I}(\lambda)]^{\mathrm{dr}}\right)^2$$

R. Koch, J-S. Caux, A. Bastianello, J. Phys. A : Math. Theor., 55, 134001 (2022).



- Experimental setup : recirculating optical fibre loop
- Single-shot measurement of both intensity and phase

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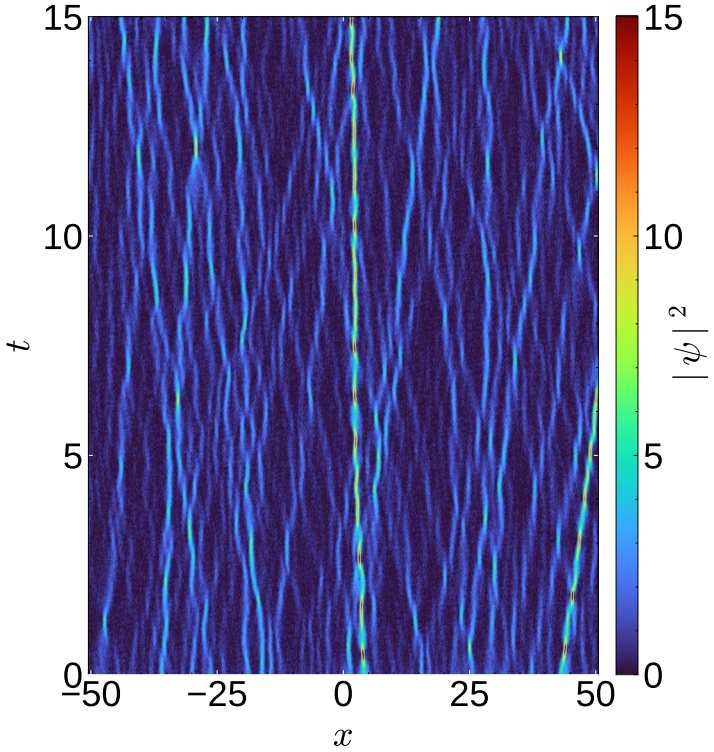
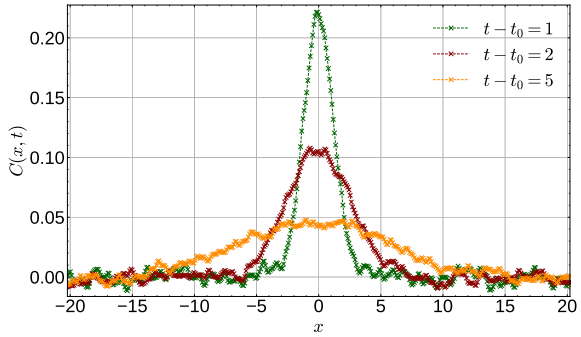
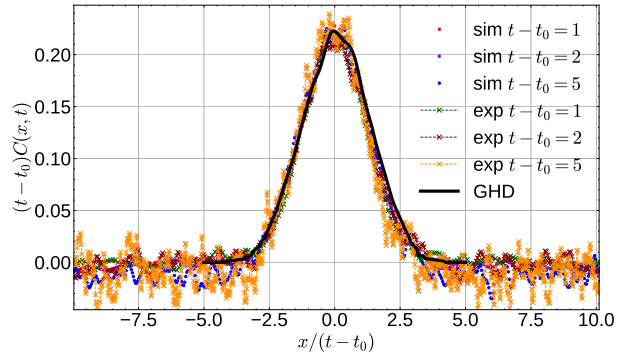


- Full space-time reconstruction of the optical field
- Space-time correlations display a ballistic behaviour
- Total agreement between experiments, numerics and theory





x
$C(x,t)$

Ballistic rescaling

x/t
$t\,C(x,t)$

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