

# Water wave experiments

## Tourbillonne

A. Maurel  
Institut Langevin – Paris

V. Pagneux  
LAUM – Le Mans

P. Petitjeans  
PMMH – Paris

Students:  
P. Cobelli, A. Prazda,  
M. Chekroun, G. Lagubeau

# Water wave experiments Tourbillonne

A. Maurel  
Institut Langevin – Paris

V. Pagneux  
LAUM – Le Mans

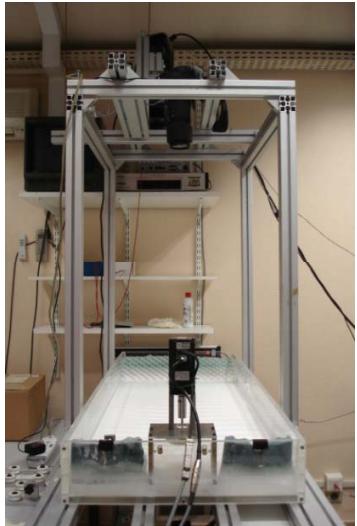
P. Petitjeans  
PMMH – Paris

Students:  
P. Cobelli, A. Prazda,  
M. Chekroun, G. Lagubeau

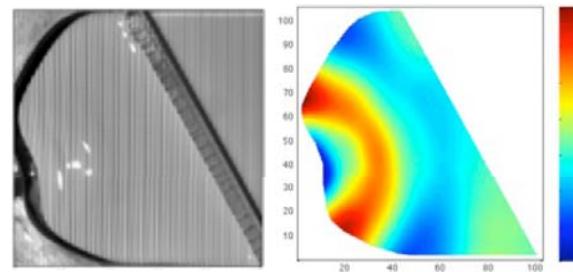


# Water wave experiments

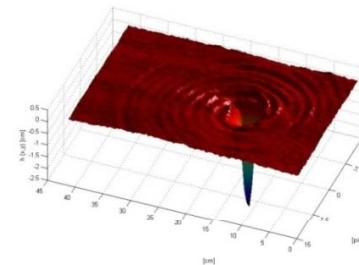
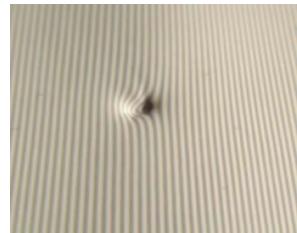
## Motivation



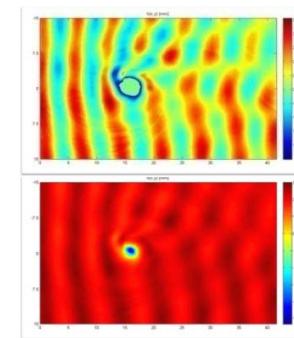
Time reversal water waves



Wave emission by a vortex

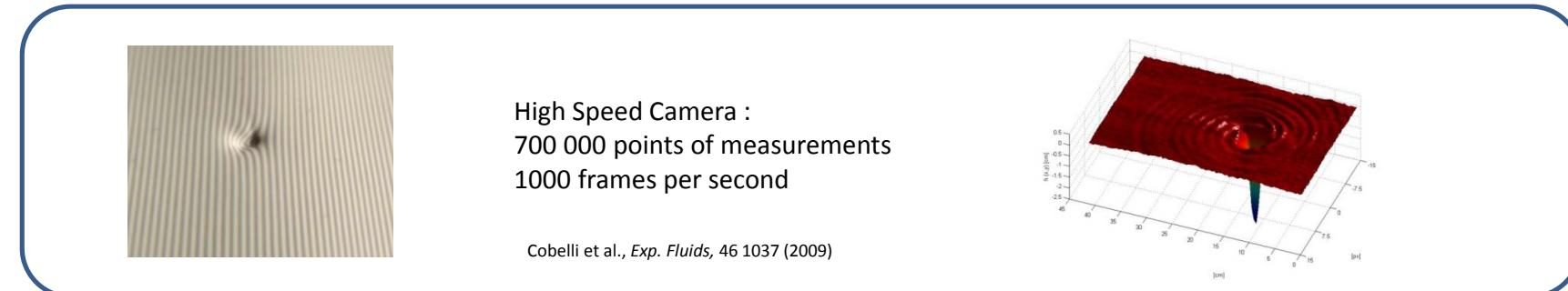
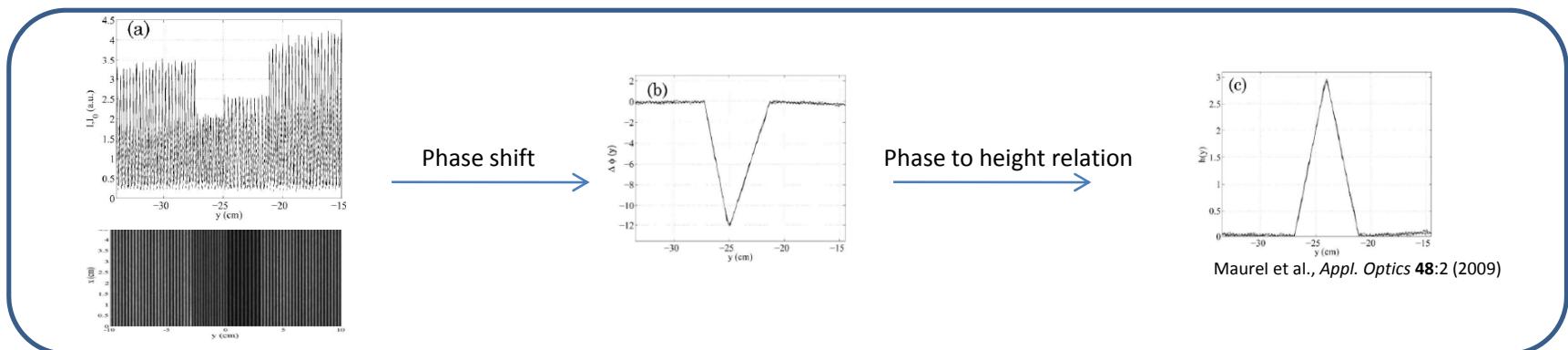
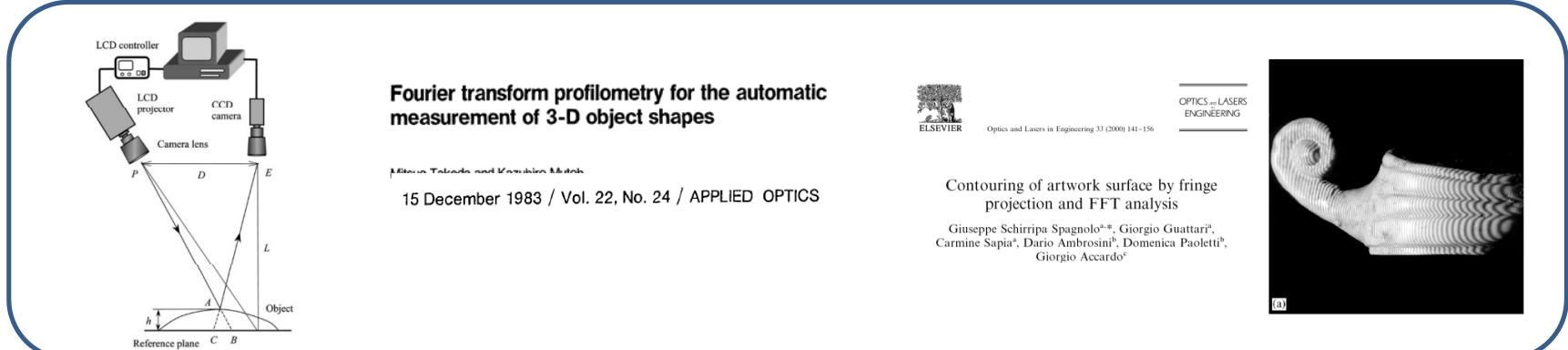


Interaction wave - vortex



# Water wave experiments

## How to get quantitative measurements ? (instantaneous, global): Fourier Transform Profilometry



## Current subjects

- Directional water wave emission by embedded sources  
M. Chekroun
- Inverse measurement of underwater movement of the sea floor  
P. Cobelli
- Wave Turbulence served up on a plate  
P. Cobelli, Coll. N. Mordant, ENS - Paris
- Azimuthal instability of drop impact  
G. Labugeau,  
Coll. C. Josserand, Institut Jean le rond d'Alembert, Univ. Paris 6  
M. Fontelos, Dto Matemáticas, F. Ciencias, Univ. Autónoma de Madrid

# Directional water wave emission by embedded sources

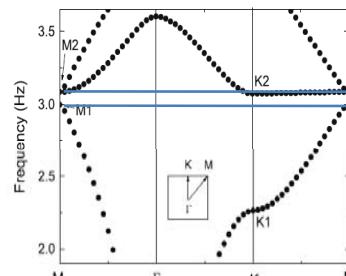
M. Chekroun



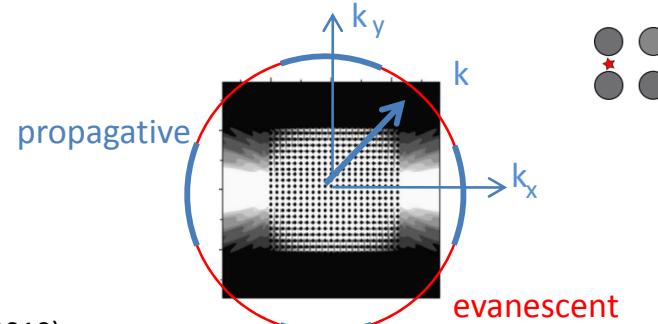
Water waves propagating through a square array of surface piercing cylinders

$$(\nabla_2^2 + k^2)\phi = 0,$$

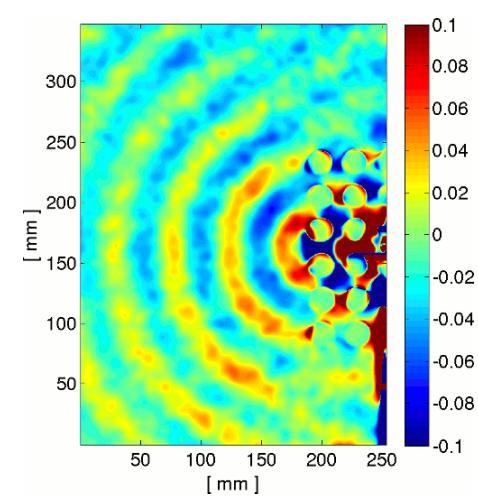
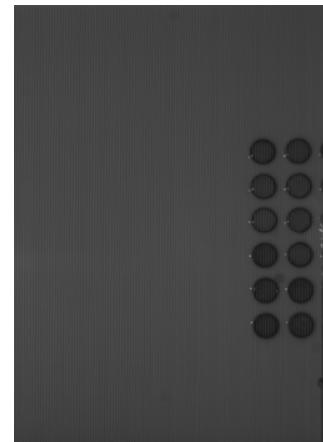
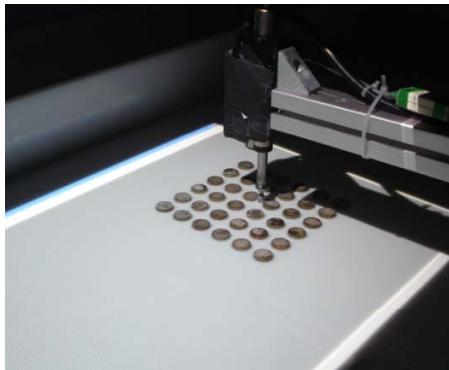
$$\partial\phi/\partial\vec{n} = 0,$$



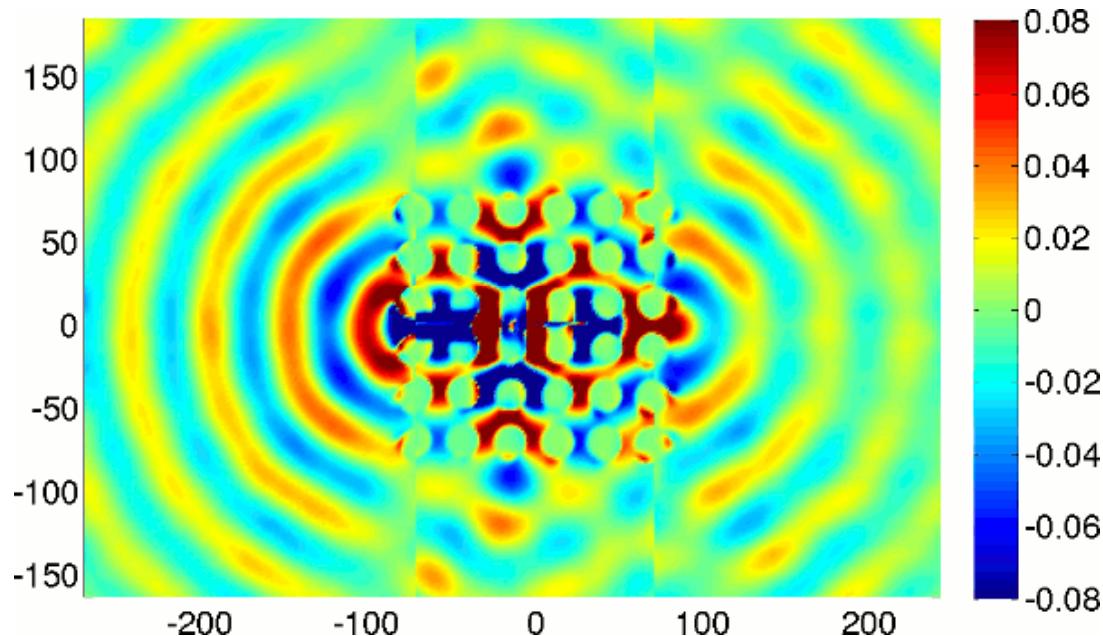
J. Mei et al., Wave motion 47, 131 (2010)



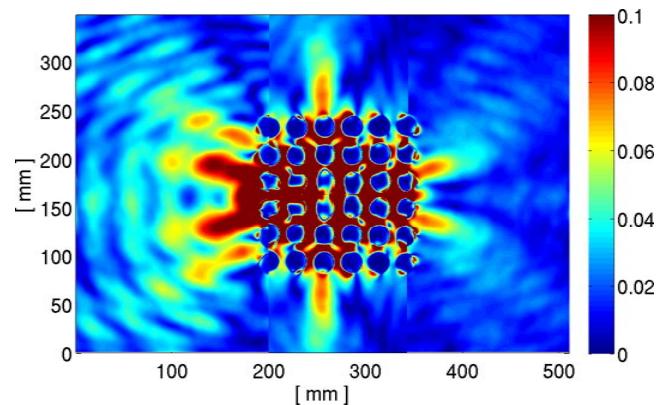
## Experiments



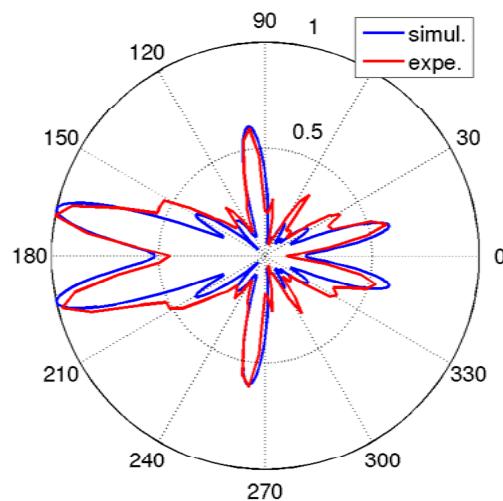
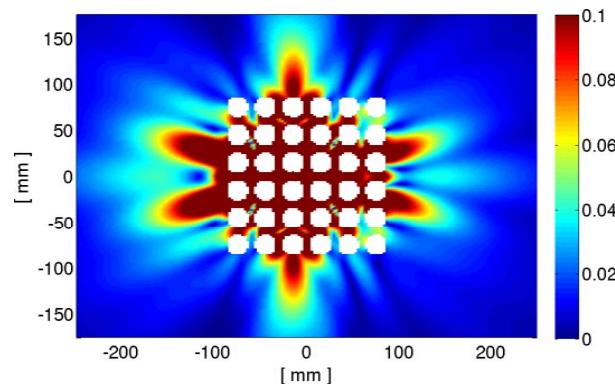
Experimental measurements (6 x 6 square array)  
(at the working frequency)



Experimental measurements  
(amplitude)

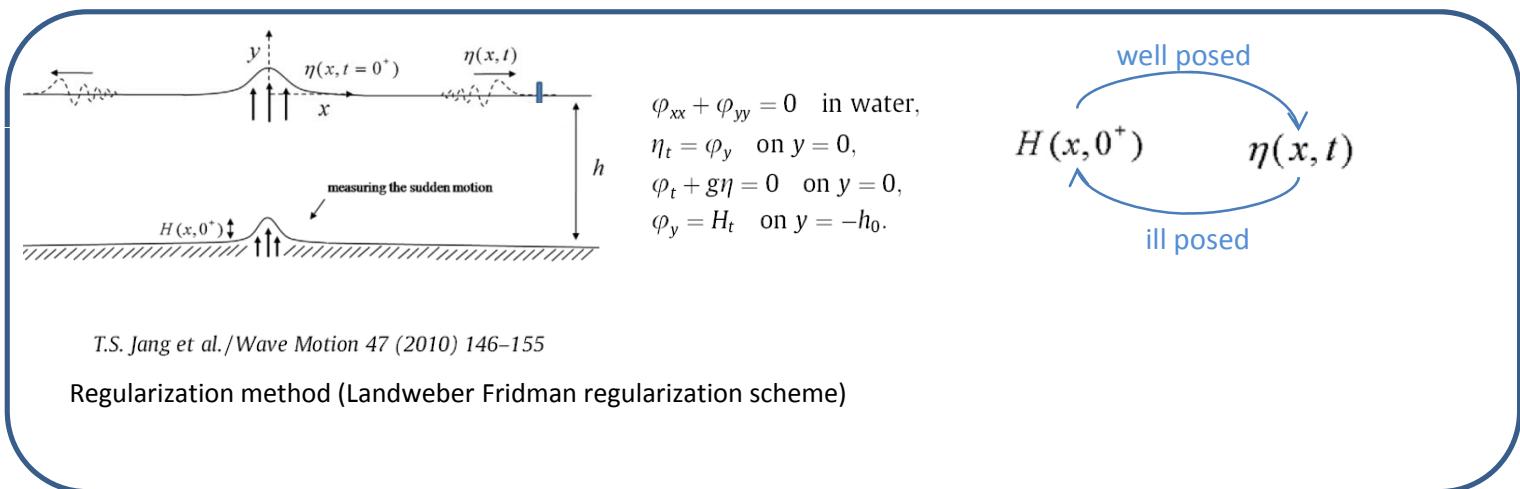


Numerics (with artificial attenuation)



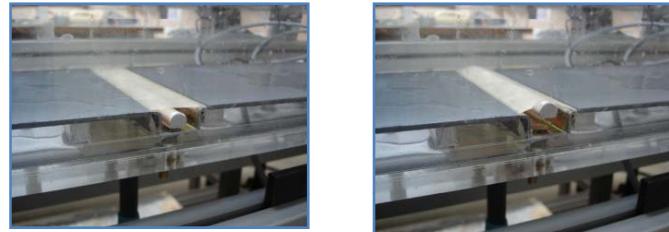
# Inverse measurement of underwater movement of the sea floor

P. Cobelli



## Experimental set up

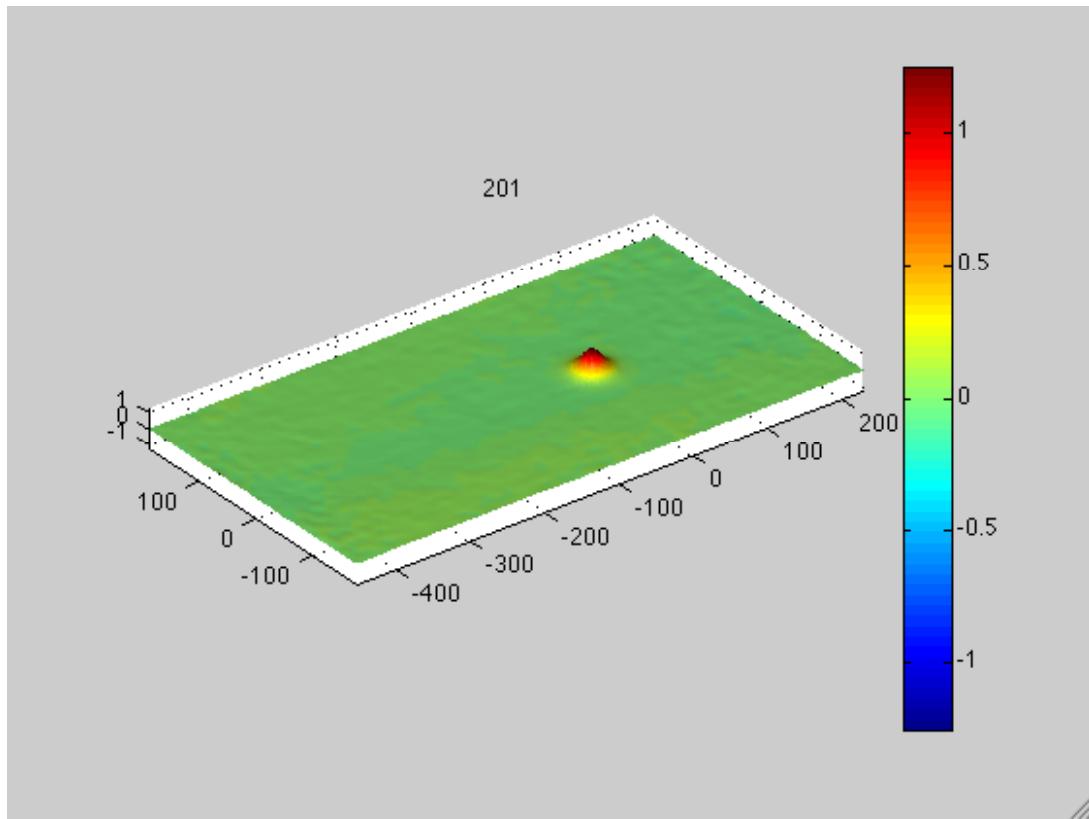
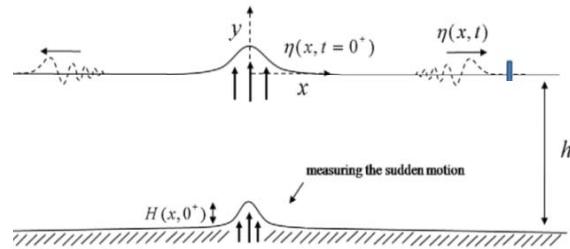
- 2D problem



- axisymmetric

## Experimental measurements

### Axisymmetric configuration

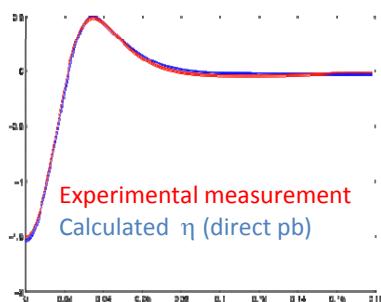


## Result of the inversion

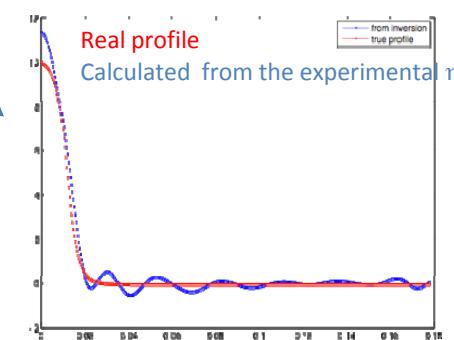
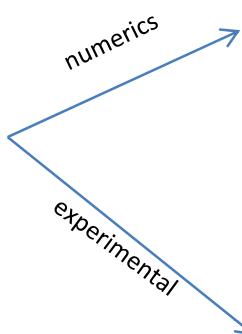
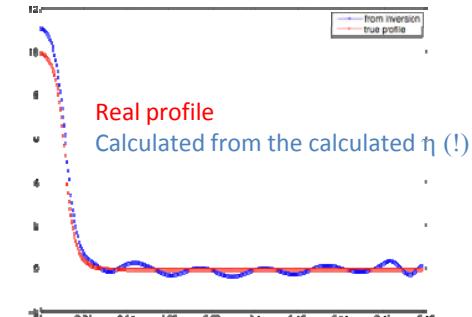
$$\eta(x, t) \longrightarrow H(x, 0^+)$$

Sea bottom motion  $H(x, 0^+)$  known (measured)

free surface displacement  $\eta(x, t)$

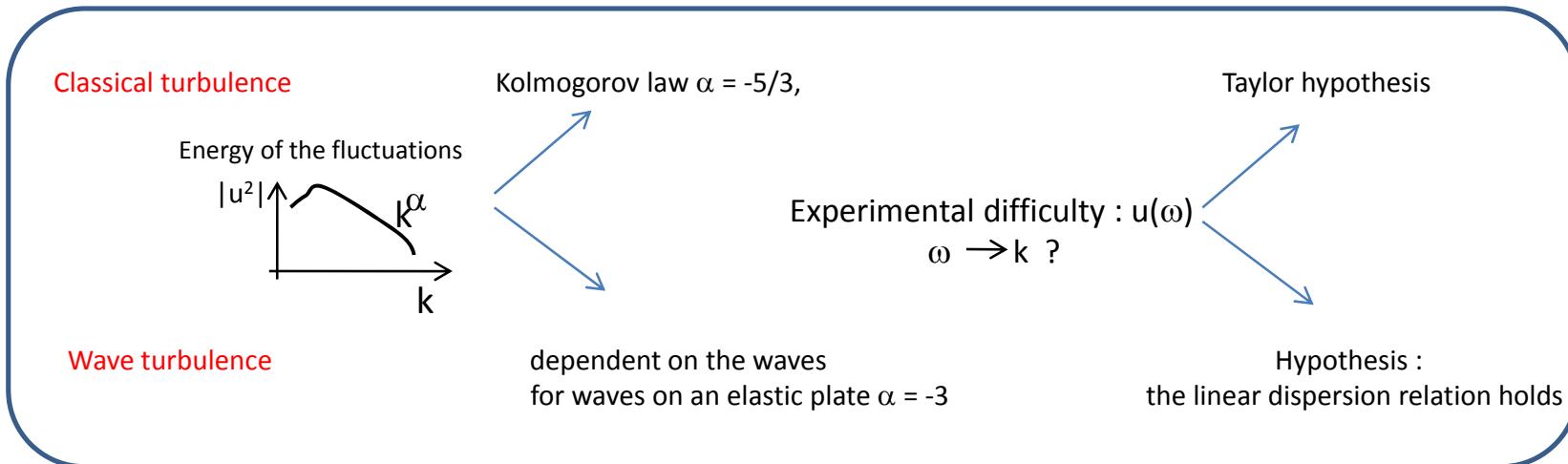


Reconstructed bottom sea motion  $H(x, 0^+)$

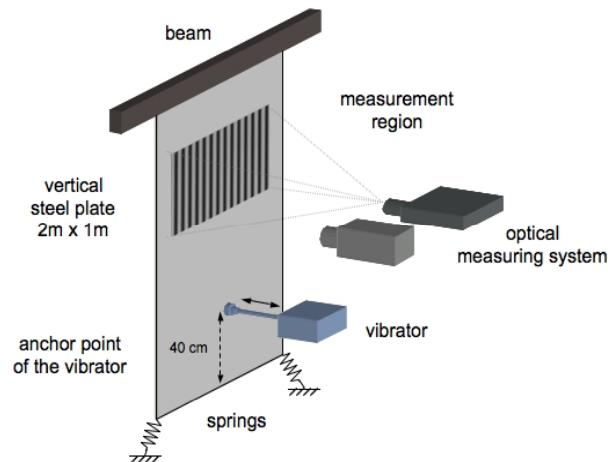


# Wave Turbulence served up on a plate

P. Cobelli, Coll. N. Mordant, ENS - Paris

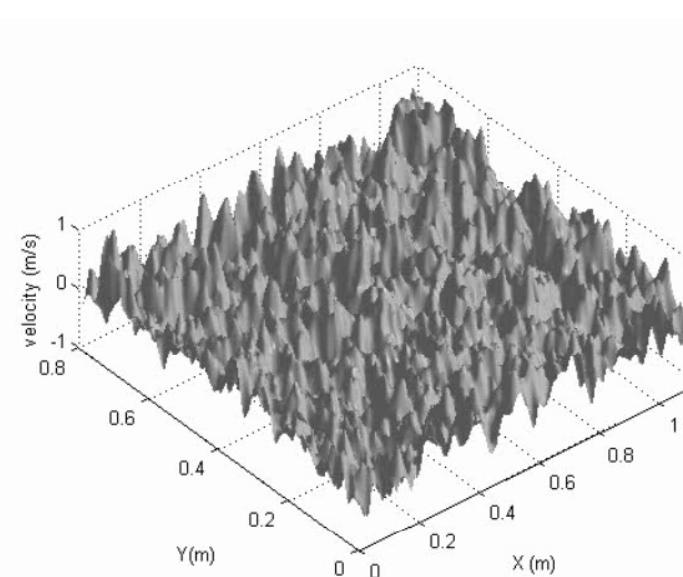
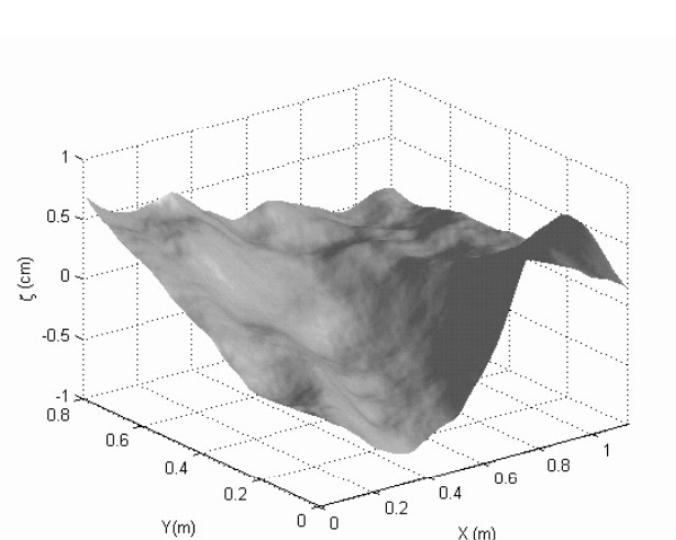


Experimental set up (N. Mordant ENS)

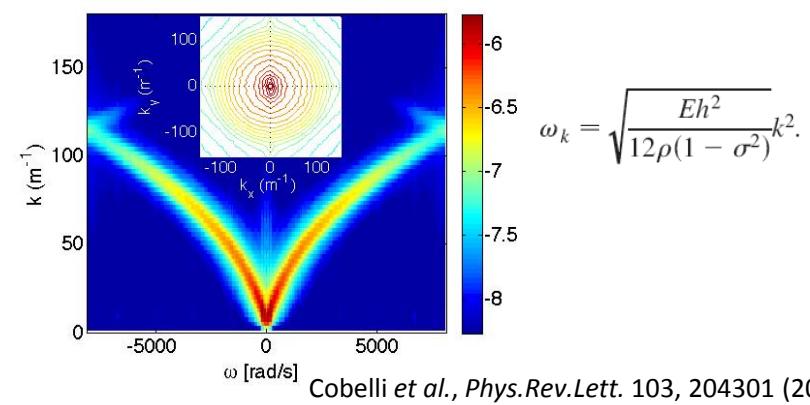
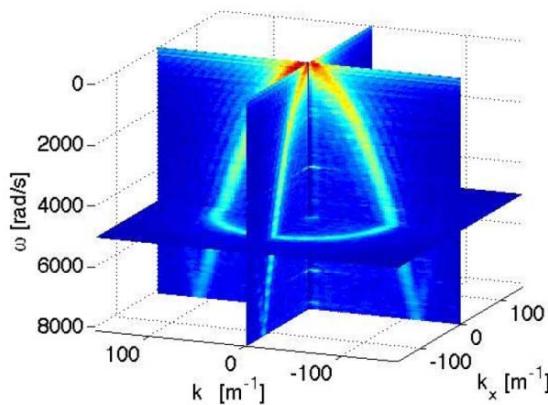


## Fluctuation velocity $u(x,t)$

Experimental measurements



First experimental evidence of the dispersion relation in wave turbulence  $|u^2|(k,\omega)$



Cobelli et al., Phys.Rev.Lett. 103, 204301 (2009)

# Azimuthal instability of drop impact

G. Lagubeau,

Coll. C. Josserand, Institut Jean le rond d'Alembert, Univ. Paris 6

M. Fontelos, Dto Matemáticas, F. Ciencias, Univ. Autónoma de Madrid

