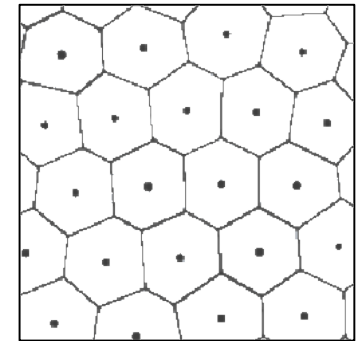


# Angular momentum flux in the description of “multi-cellular” media

34èmes Journées de Physique Statistique 31/01/14  
Antoine Fruleux (ESPCI/P7), Ken Sekimoto (P7/ESPCI)

## Multi-cellular media

The medium is divided into cells.



## Macroscopic description

- The conservation laws from micro to macro.
- A description adapted for multi-cellular media.

## Problem

$\overleftrightarrow{\mathcal{G}}$ : microscopic momentum flux — contains too much information.  
 $\overleftrightarrow{G}$ , macroscopic momentum flux.



\* relative position + momentum transfer between neighboring cells

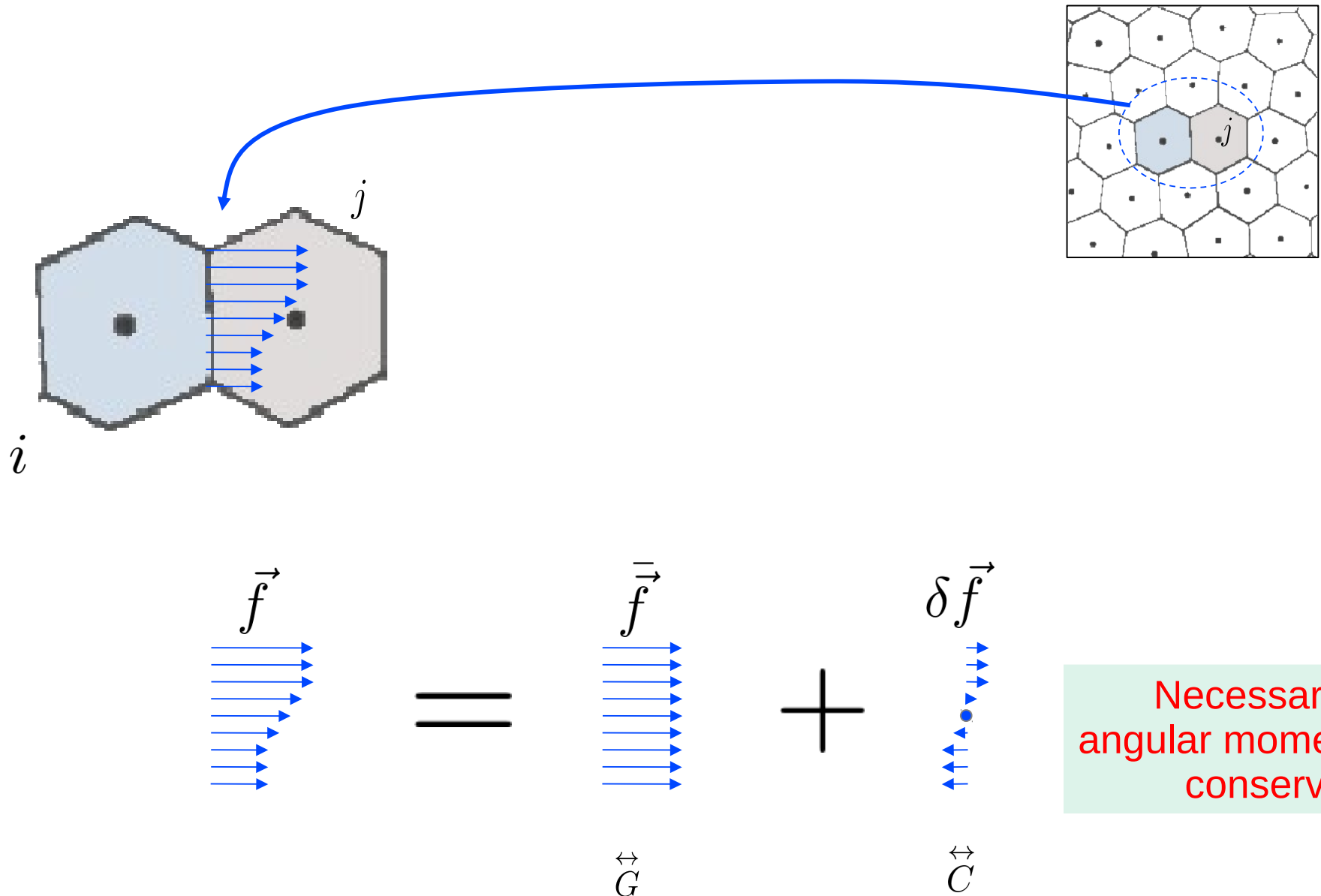
$\overleftrightarrow{G} \neq \overleftrightarrow{G}^T$  → insufficient for angular momentum conservation

→ need of another physical quantity reflecting finite size of cells

# Angular momentum flux

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# Angular momentum flux

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$\overleftrightarrow{C}$  : angular momentum flux.

## Conservations

$$\nabla \cdot \overleftrightarrow{G} = \vec{0}$$

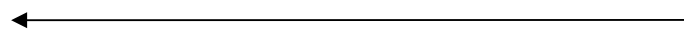
$$\nabla \cdot \overleftrightarrow{C} = \varepsilon : \overleftrightarrow{G}$$

$\varepsilon$ , is the Levi-Civita tensor.

Conservation equations of E. Cosserat's theory of deformable bodies.

[Cosserat, E (1909). Théorie des Corps deformables. Hermann.]

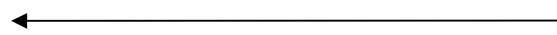
Cosserat's theory



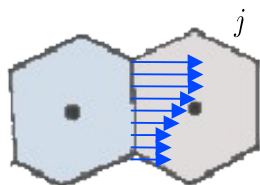
Order parameters.

Variational Method

Our description



Momentum Conservation.



Momentum / Angular Momentum  
Transfer distribution redundancies

$$\{i, j, \vec{f}\} \Leftrightarrow \{j, i, -\vec{f}\}$$

# Angular momentum flux

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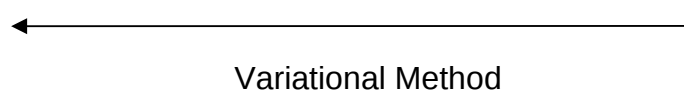
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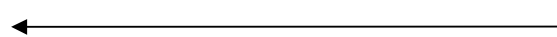
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Cosserat's theory

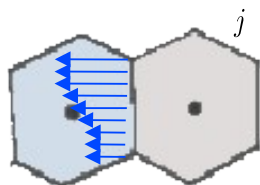


Order parameters.

Our description



Momentum Conservation.



Momentum / Angular Momentum  
Transfer distribution redundancies

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Starting point for multi-cellular media.  $\longrightarrow$  work under way.