Energetic approach of the gas-cluster transition in microgravity
Eric Opsomer, F. Ludewig and N. Vandewalle
GRASP, ULg Physics Departement B-4000 Liège

**SpaceGrains [1]**
- study of dilute systems in 0g
- observe phase transitions
- find condensation criteria

**MD Simulations**

- energy injection near pistons
- collision cascade (loss of energy)
- deviation of trajectories
- periodic patterns (stability)

**Energy propagation**
- mean kinematic energy (mJ)
  spatio for gas and cluster regime

- transition in a discrete media.

- Two phenomena in competition
  - energy injection and propagation
  - cooling due to inelastic collapse

**Transition curve**
- cluster condition leads to equation

\[
\frac{\delta}{R} > \frac{1}{3} \left( \frac{\xi}{\phi} \right) + \frac{\delta_0}{R} \quad \text{with} \quad \xi = -\frac{\ln \left( 1 + \frac{2}{\eta (1+\varepsilon)} \right)}{\ln \varepsilon} - 1
\]
- \( \delta_0 \) is the only fitting parameter
- \( R \) is the grain radius

- 2 sample Kolmogorov-Smirnov adequation test
- testing against uniform distribution of the grains in the constraint-free zone [3]

**Propagation time**

\[
\tau_P = \frac{\delta}{N^*} \sum_{i=0}^{N^*} \frac{1}{v_0 \varepsilon^i}
\]
- \( \delta \) mean exploration
- \( N^* \) encountered particles
- \( v_0 \) injection velocity

**Haff time [2]**
- characteristic relaxation time

\[
\tau_H = \frac{2}{v_0 (1 - \varepsilon^2) \eta \sigma}
\]
- \( \eta \) number density

**Cluster condition:** \( \tau_H < \tau_P \)

**Results**
- theoretic curve in good agreement with the statistical detection (KS test*) of the cluster

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