

# Billiard

**Problem:**

Before a pool-billiard game starts, 15 balls form an equilateral triangle on the table. Under what conditions will the impact of the white ball (16<sup>th</sup> ball) produce the largest disorder of the balls?

- definitions
- solution by a simulation
- different forms of disorder
- conclusions

## definitions

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- disorder at the end
- chose of a standard table
  - \* size: 1,2m times 2,4m
  - \* diameter of the balls 5,2cm
  - \*  $\rho_{\text{balls}} = 3 \frac{\text{kg}}{\text{l}}$

## simulation

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### - simulation concerns:

- \* 16 equal balls
- \* energy lost in ball-ball and ball-wall interactions
- \* roll friction
- \* nearly elastic hits
- \* different starting hits:
  - 5 different positions for the white ball
  - speeds varies between  $1\frac{m}{s}$  and  $5\frac{m}{s}$
  - angle varies between  $-50^\circ$  and  $50^\circ$

### - simplifications:

- \* no pocket
- \* no spin
- \* no rolling energy

## different disorder definitions

- useful definitions:
  - \* boxcount
  - \* stretched boxcount
  - \* linear distances
  - \* square distances
- indirect definitions:
  - \* difference between two similar hits
  - \* time

## conclusions

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- difference between simulation and reality
- general conclusions are:
  - \* high energy
  - \* play from behind
  - \* play under a angle  $\approx 45^\circ$
- other possibilities:
  - \* “jumping balls”  
(table takes most of the impulse)
  - \* extreme spin  
(not very important in ball-ball interaction)