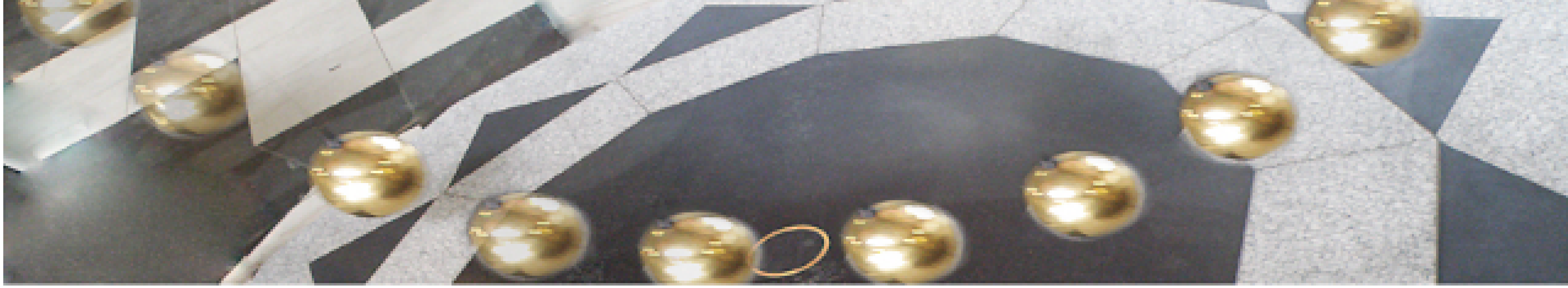

UiO : Fysisk institutt

Det matematisk-naturvitenskapelige fakultet

Lecture 4

Recap

- The essence of Lagrange-Hamilton formalism is

Find generalized coordinates → Find K & V in terms of these → Find e.o.m. from K & V → Solve e.o.m. with initial conditions

- The Lagrange equation dealing with part 3 is

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right) - \frac{\partial L}{\partial q_i} = 0, \qquad j = 1,2,\ldots,d$$

where the Lagrangian *L* is given by

$$L(q,\dot{q},t) = K(q,\dot{q},t) - V(q,t)$$

Plan for today

- Symmetries of systems (Sections 2.3-2.3.3)
  - Conserved quantities (constants of motion)
  - Cyclic coordinates
  - Generalized momentum
  - More general symmetries of the Lagrangian
  - A proof of conservation of angular momentum! (If we have time)

Summary

- Cyclic coordinates are generalized coordinates q_i that do not appear in the Lagrangian
- The corresponding **conjugate momentum** p_i is conserved

$$p_i \equiv \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right)$$

- If Q is the parameter of a transformation leaving the Lagrangian invariant the conserved quantity K is

$$K = \sum_i \frac{\partial L}{\partial \dot{q}_i} Q_i$$