In any collision between two bodies, the colliding objects must obey the laws of conservation of energy and conservation of momentum. With the help of these two conserved quantities, it is possible to describe how the bodies will behave after the collision. In the case of a flat plane, the velocity and momentum need to be expressed as vectors. A particularly simple description can be obtained by switching to a system which focuses on the mutual centre of gravity of the two bodies. In this experiment, two discs of specific mass are allowed to collide on an air cushion table and the velocities are then recorded with the aid of a spark generator.

In addition, when the collisions are elastic, the overall kinetic energy in the system is also conserved:
\[
\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 v_1'{}^2 + \frac{1}{2} m_2 v_2'{}^2.
\]

If body 2 is at rest before the collision, it is possible to select a coordinate system in which the motion of body 1 is along the x-axis \(v_2 = 0\). This does not in any way affect the generality of the description. First let us consider a collision in line with the centres of gravity of both objects, where \(d = 0\), see Fig. 1. The bodies will then move along the x-axis and the velocities after the collision are given by:
\[
\begin{align*}
  v_1' &= \frac{m_1 - m_2}{m_1 + m_2} v_1 \\
  v_2' &= \frac{2m_2}{m_1 + m_2} v_1.
\end{align*}
\]

For identical masses, \(m_1 = m_2\), the following conditions are true:
\[
\begin{align*}
  v_1' &= 0 \\
  v_2' &= v_1.
\end{align*}
\]

If collisions are off-centre but the masses are the same, the bodies will separate from one another at an angle of 90°, i.e.,
\[
\theta_1 = \theta_2 = 90°
\]

Additionally, if \(v_{2y} = 0\) and \(m_1 = m_2\), then equation (1) provides the following result:
\[
\begin{align*}
  v_{1y}' &= -v_{1y}.
\end{align*}
\]

The position vector for the centre of gravity is as follows:
\[
\vec{r}_c = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2}.
\]

Since the total momentum is conserved, the velocity of the centre of gravity is constant and is given by the following equation:
\[
\vec{v}_c = \frac{m_1 \vec{v}_1 + m_2 \vec{v}_2}{m_1 + m_2}.
\]

The total momentum corresponds to the momentum of a single mass \(m = m_1 + m_2\), which moves at the same velocity as the centre of gravity. It often makes sense to transform the frame of reference to a system centred on the combined centre of gravity of the two bodies. Then, before the collision, the two bodies will converge towards one another in such a way that the overall momentum is zero. After an elastic collision, they then separate in such a way that the total momentum continues to be zero. After a completely inelastic collision, they stick together and rotate about their mutual centre of gravity. The kinetic energy of the system is also conserved in this case. In this experiment, two discs of known mass are allowed to collide on a cushion of air. The motion they undergo is recorded with the help of a spark generator.

**EVALUATION**
Calculation of the kinetic energy indicates that some energy is lost. This is due to the sound made upon collision, the slight deformation of the bodies when they collide, any intrinsic rotation of the discs which has not been taken into account and movement of the hoses feeding the cushion of air.

The magnitude of the velocities can be calculated using the following relationship:
\[
v = \Delta f/j,
\]
where \(\Delta\) Distance between two points, \(f\) Frequency of spark generator.