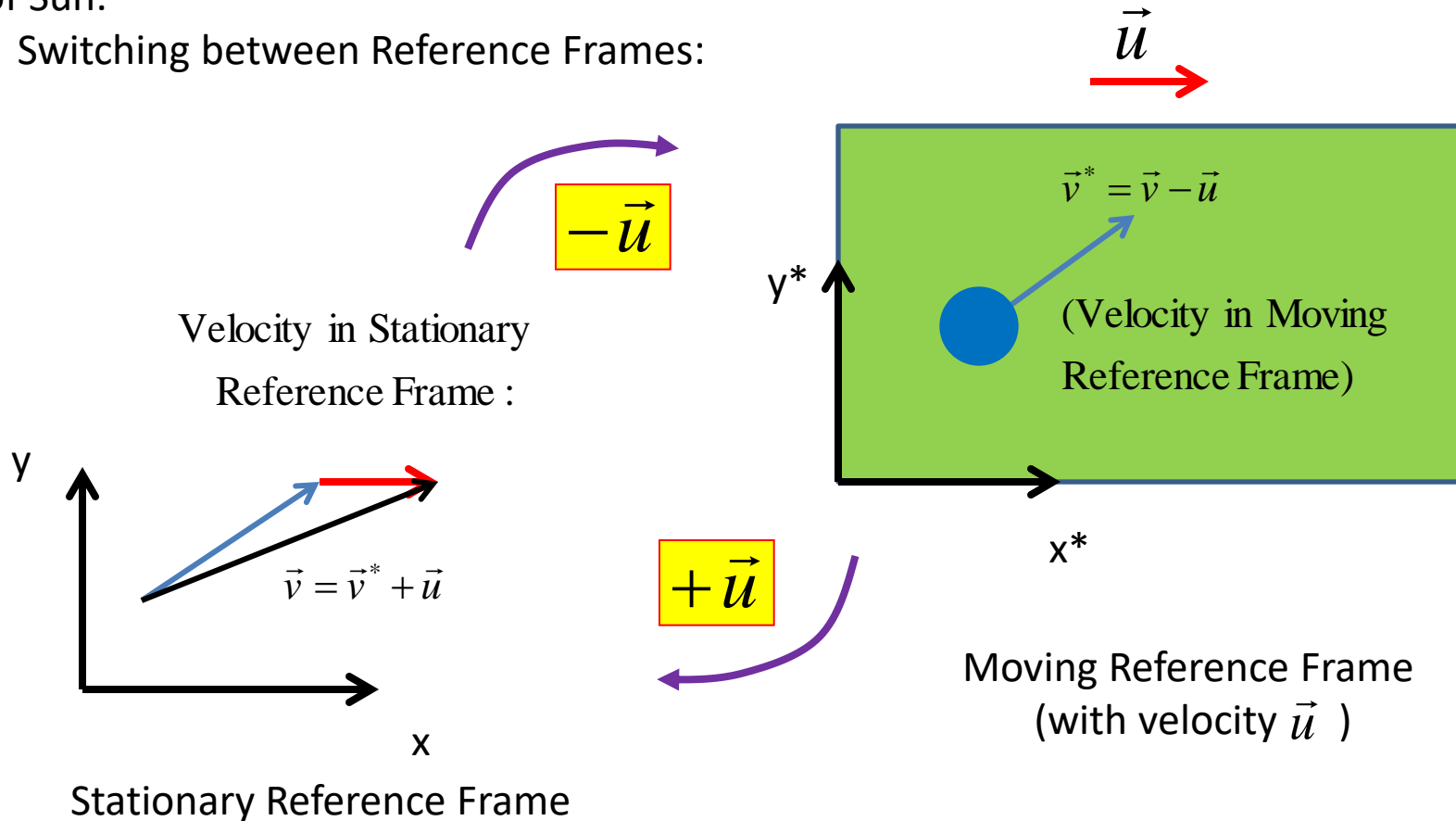# Reference Frame

• In order to describe a motion , we need to specify the **Reference Frame**, i.e. Coordinate System at each moment of time.

• **Examples:** Reference Frame of a moving train, of water in river, of a person on a bench, of Sun.

• Switching between Reference Frames:

$$\vec{u}$$

$$-\vec{u}$$

Velocity in Stationary

Reference Frame :

$$\vec{v}^* = \vec{v} - \vec{u}$$

y*

(Velocity in Moving

Reference Frame)

y

$$\vec{v} = \vec{v}^* + \vec{u}$$

x*

$$+\vec{u}$$

Moving Reference Frame
(with velocity $\vec{u}$)

x

Stationary Reference Frame

Homework

Problem 1

River flows with speed $v_r=2m/s$. A fisherman uses his boat to get to a village situated at distance $d=2$ km down the river, and returns back to his home. During the whole trip, the speed of the boat is **V=3m/s** *with respect to the water*. Find the total time of the two-way trip. Does river flow make it longer or shorter?

v_r
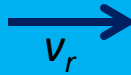
Problem 2

Fisherman crosses a wide river on a boat. The velocity of the boat with respect to the water has magnitude V and is directed exactly perpendicular to the flow. What is the speed of the boat *with respect to the land*, if the speed of the river is v_r.

v_r