

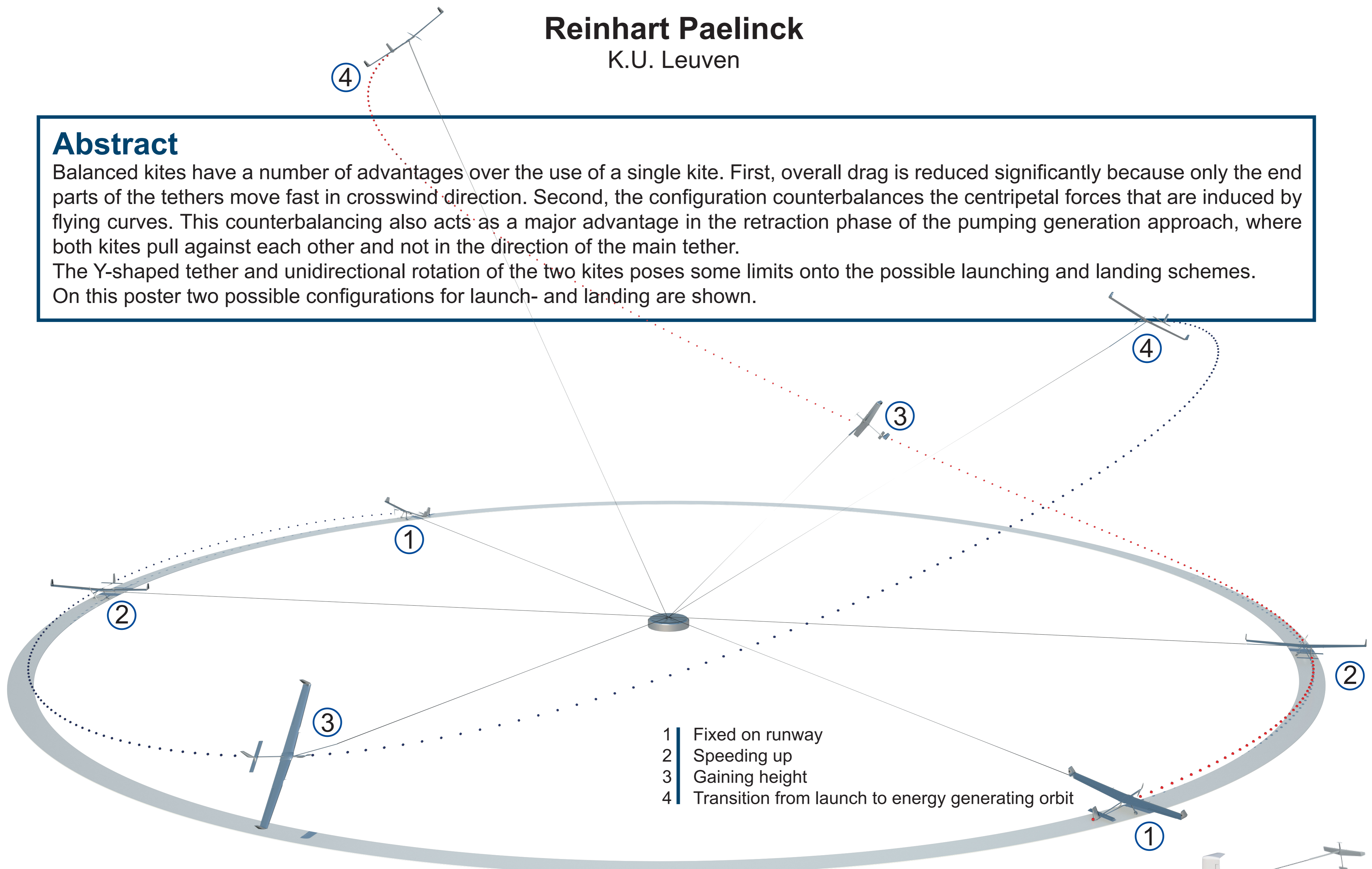
# Take-off and landing of balanced kites

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## Abstract

Balanced kites have a number of advantages over the use of a single kite. First, overall drag is reduced significantly because only the end parts of the tethers move fast in crosswind direction. Second, the configuration counterbalances the centripetal forces that are induced by flying curves. This counterbalancing also acts as a major advantage in the retraction phase of the pumping generation approach, where both kites pull against each other and not in the direction of the main tether.

The Y-shaped tether and unidirectional rotation of the two kites poses some limits onto the possible launching and landing schemes. On this poster two possible configurations for launch- and landing are shown.



## Circular runway

**Idea:** As the length of the upper part of the Y-shaped tether is approximately 8 times the wingspan of the kite, we could consider only reeling in the main tether up to the splitting point.

**Benefits:** Very simple design: The kites are fitted with landing gear and a propellor to thrust them off a circular runway. The splitting point of the tether has a swivel against twisting of the tether. Only a single winch is needed.

**Drawbacks:** Only suitable on large flat areas on land as the kites have to land on landing gear.



## Rotation base

**Idea:** Use 1 winch for the main cable on the ground, and a passive capstan system in the air for the upper cables.

**Benefits:** Kites are fully attached to the base when landed. Only has a small footprint on the ground, making it suitable for offshore applications.

**Drawbacks:** Relatively heavy components in the air, high rotational forces in the beginning of the start-up phase.

