The Best, and the Rest

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Åre, 2013

What Differentiates Skiers?

- Ability to handle terrain
- Ability to handle rhythm changes
- Ability to manage balance, and imbalance
  - Particularly in the transition

“Riding” Sports

- Skiing, alpine and tele
- Snowboarding
- Surfing
- Skateboarding
- Etc.

What They Have in Common

- Balancing on a moving platform whose motion is always changing

Mechanically Speaking…

- They're all *inverted pendulums*

The Fundamental Skill of Skiing

- ***Balancing*** on a moving platform, while that movement changes

What is “Balance”?

How Do You Make Something Move?

- Speed up?
- Slow down?
- Change direction?


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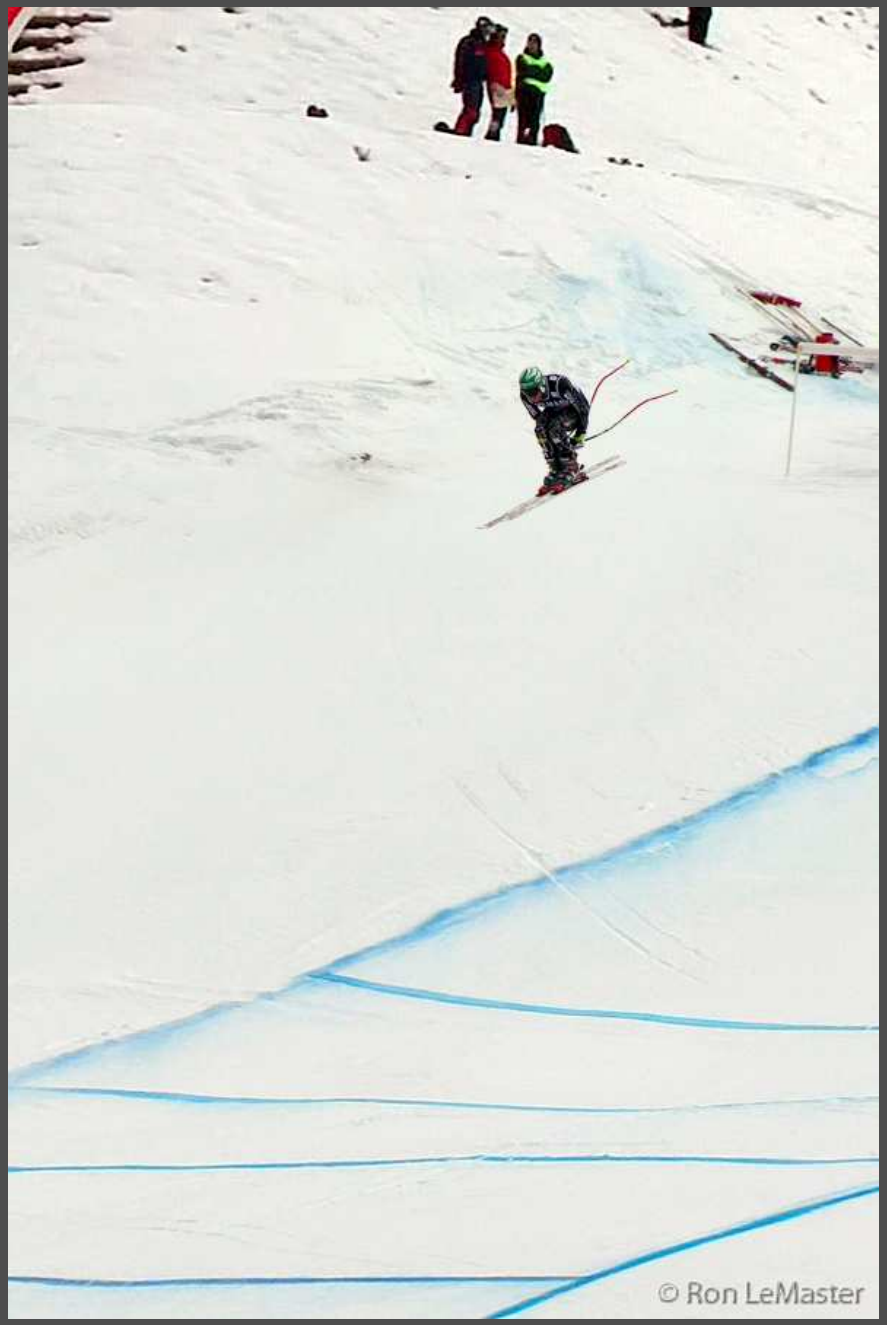
You Apply a ***Force*** to It

- A push or a pull
- What are the forces in skiing?



What makes You Slow Down?

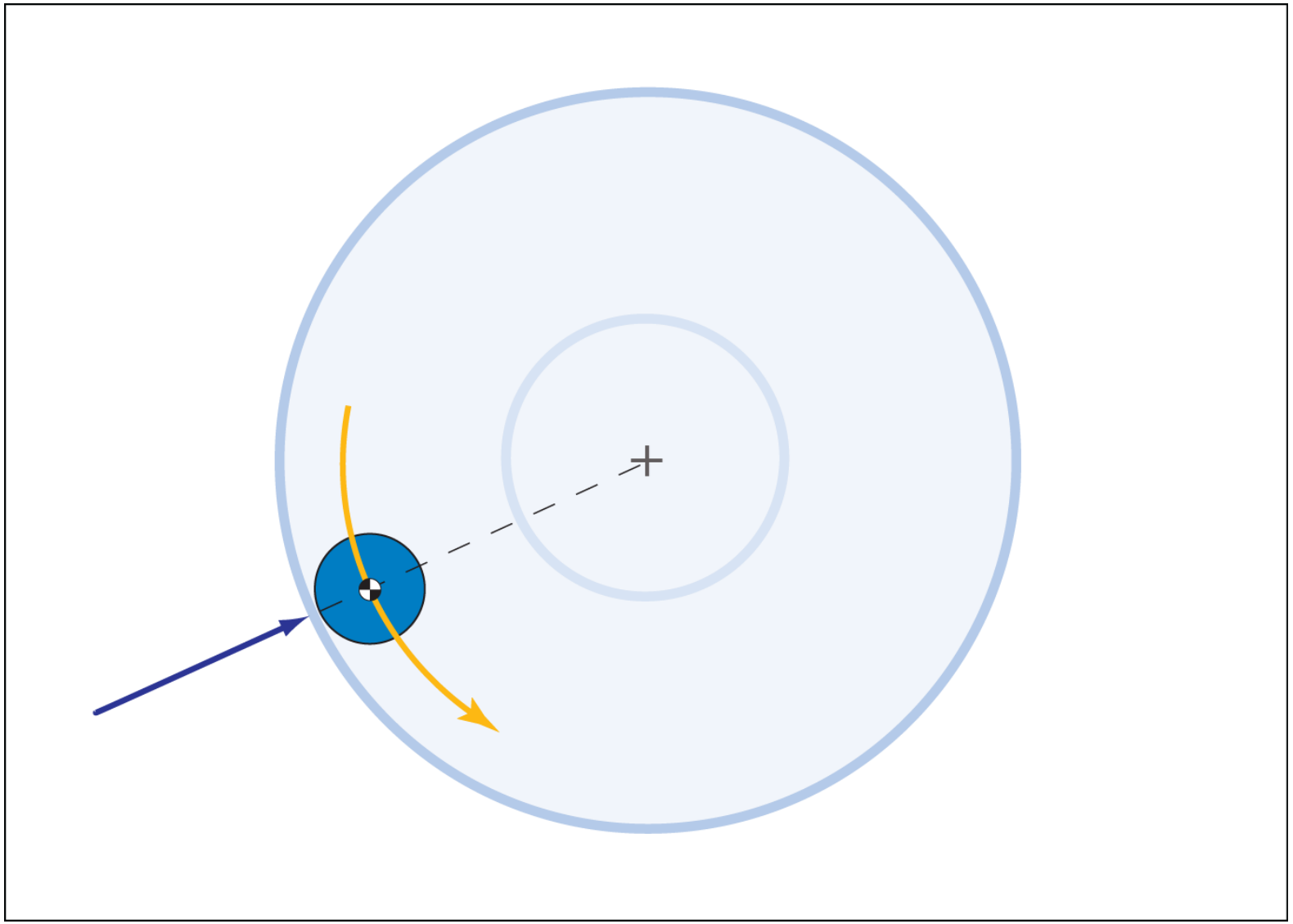
The Snow Pushes on You

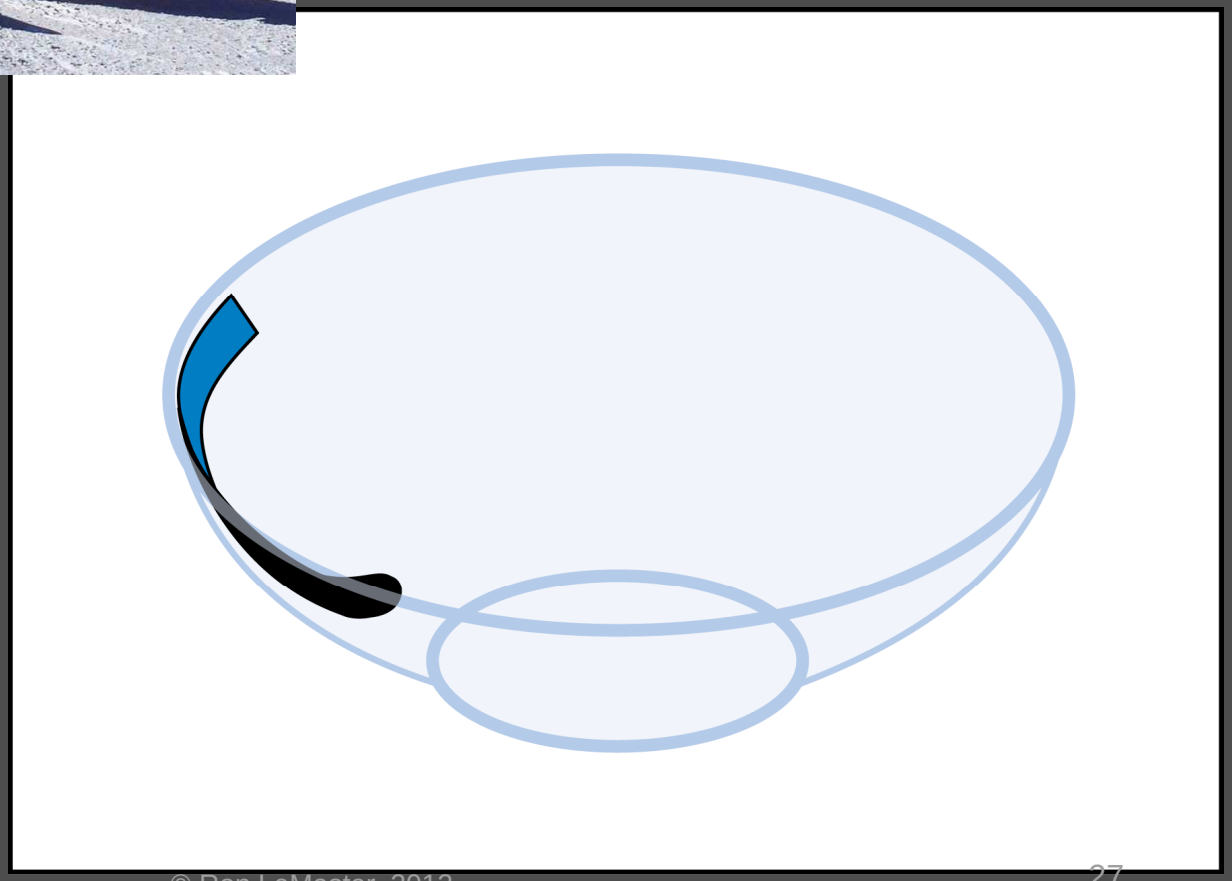
- It exerts a force on you through the bottoms of your skis

Force and Pressure

- Closely related
- Pressure is force spread over a surface
- If the size of the surface is constant
  - High force = high pressure
  - Low force = low pressure
- People have a better intuitive sense of pressure than of force

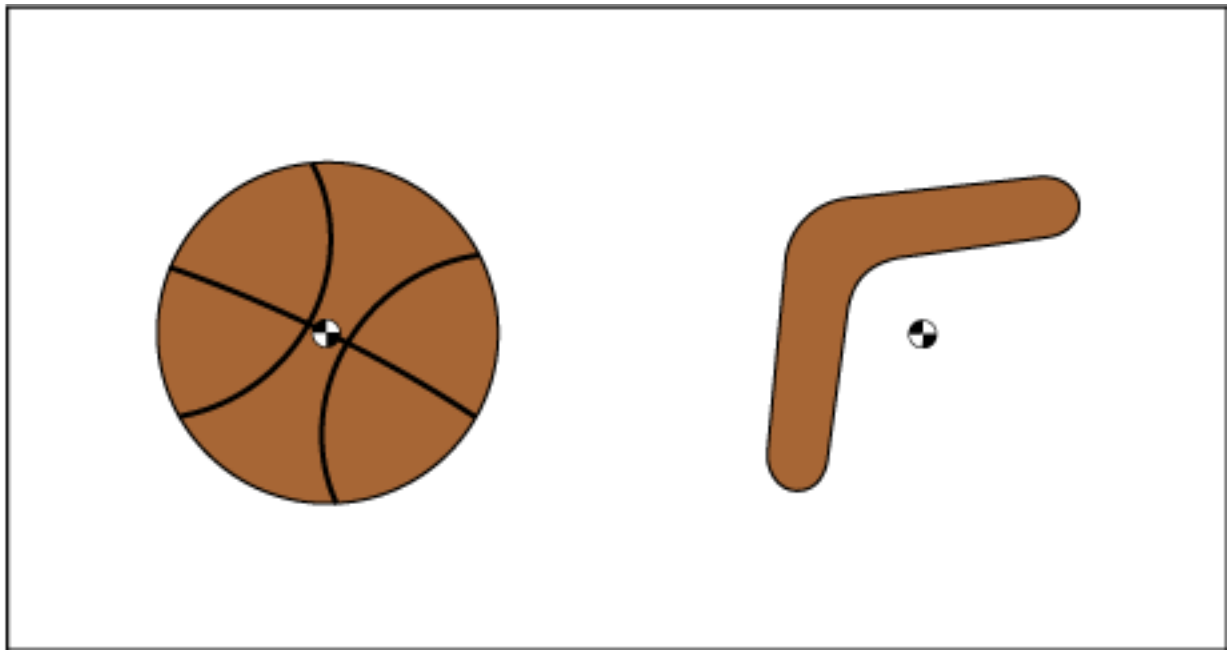
What Makes You Turn?



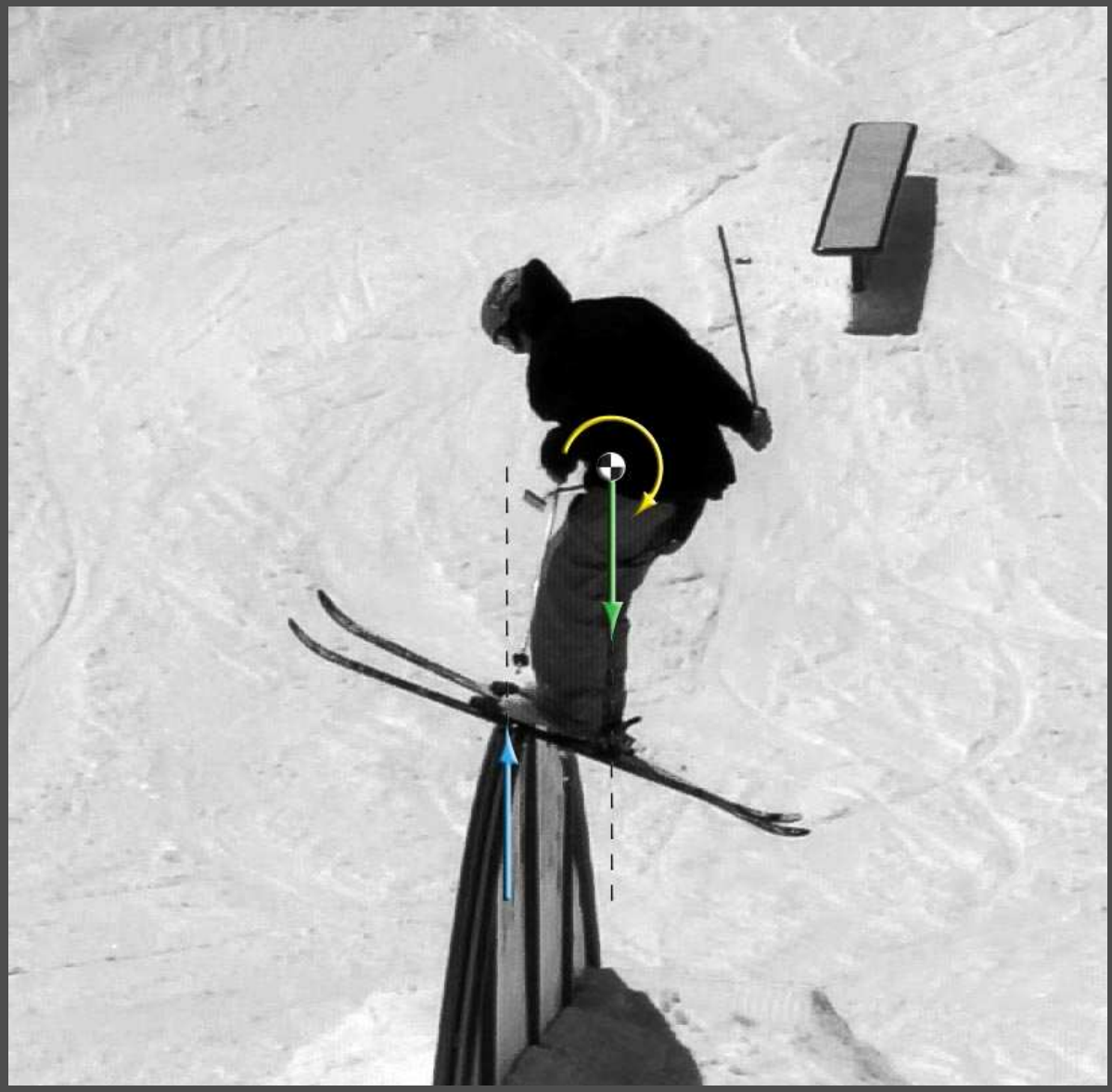


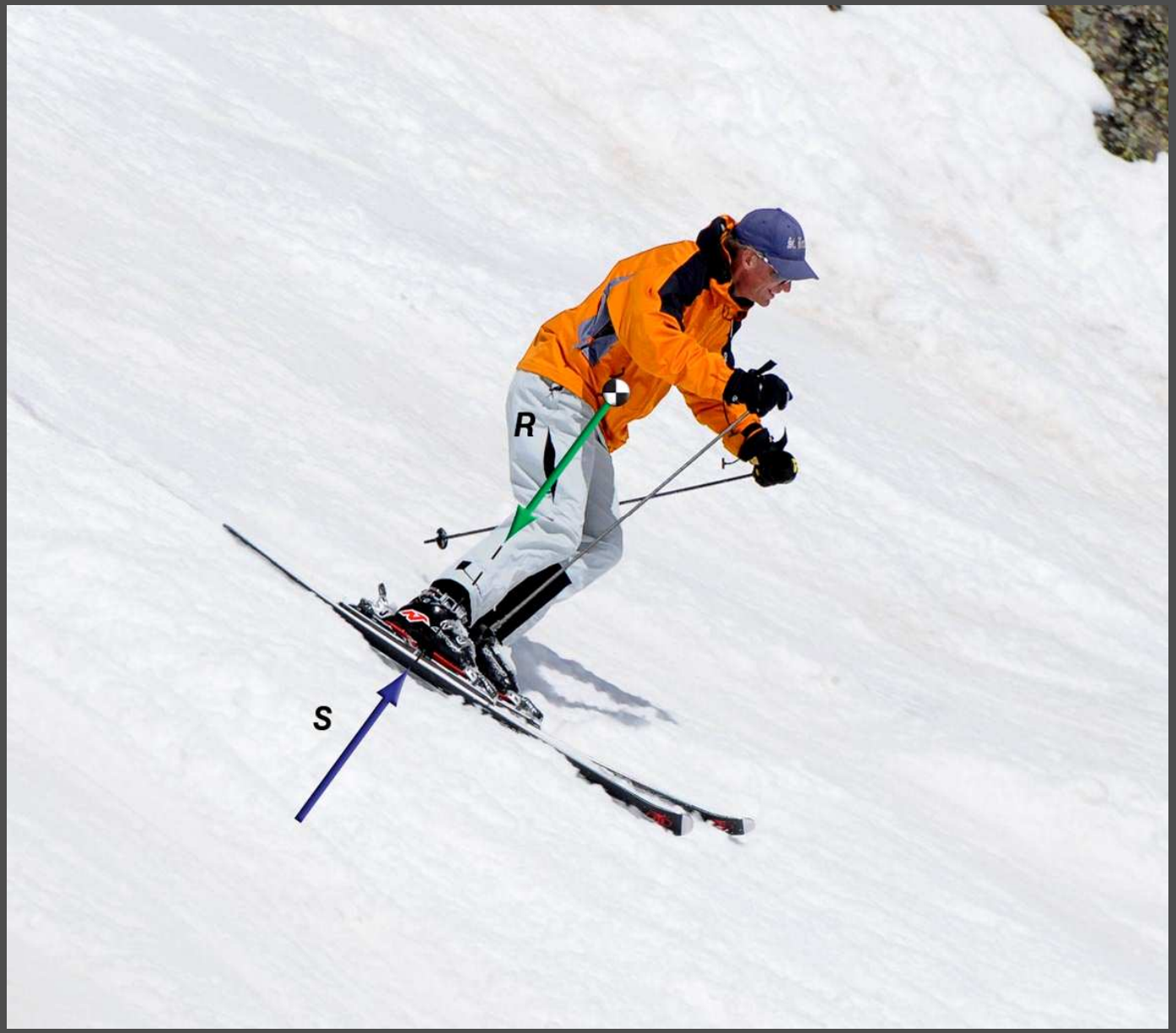
What is “Balance”?

Center of Mass



- The same as center of gravity





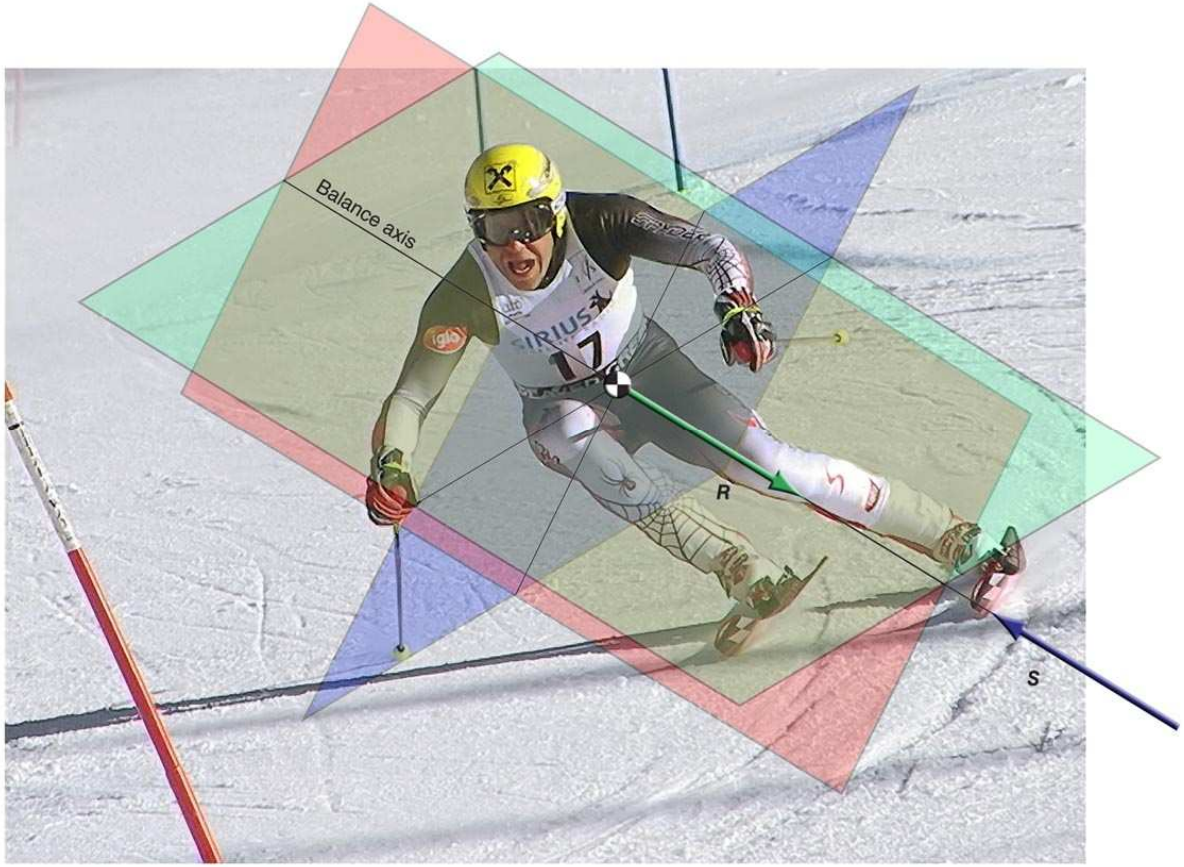
What is Balance?

- “You don’t fall over”

What is Balance?

- The result of gravity and centrifugal force passes through your base of support
- The force of the snow pushing on you passes through your center of mass
- Otherwise, you ***topple (välta)***

The Balance Axis



Fore-Aft Balance

Fundamental Skill of Skiing

- Balancing **the ski**, while its movement changes
- Arranging your body and skis so that the ***balance axis*** goes through your base of support

Fundamental Skill of Skiing

- Being tuned in to the force from the snow acting on you: it's size and its ***direction***
- Anticipating how that force will change, especially it's ***direction***

Balancing in a Turn

- You experience the combination of
  - Gravity
  - Centrifugal force
- Requires ***inclincation***

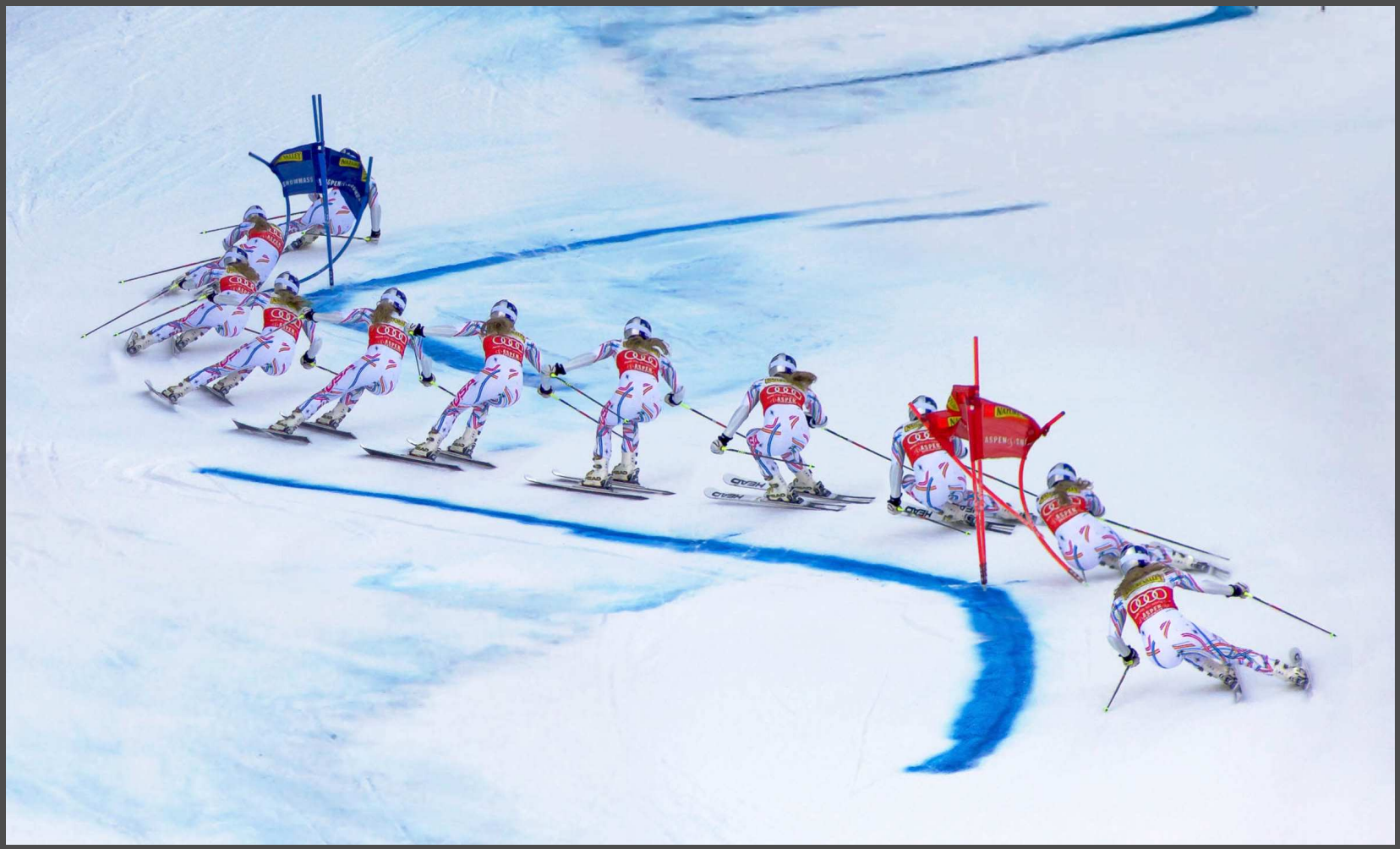
Balancing in a Turn

- You must be ***inclined*** into the turn
  - Center of mass has to be closer to the center of the turn than your outside foot
  - The sum of gravity and centrifugal force must pass through your base of support

Learning to Walk

Linking Turns

- The skier's CM and point of support must switch sides with each other



The Key Skill in Advanced Skiing

- Linking turns through deliberate toppling
- “Falling into the turn”

Controlled Toppling

- Developing judgment is crucial
- Beginning parallel skiers pivot quickly at turn initiation to shorten the period of imbalance
- Expert skiers enjoy it

The Estimation Problem

- Critical with regard to varying terrain and rhythm

The Estimation Problem

- Before you begin the transition, you must estimate
  - Where exactly it will end
  - How much lateral (centrifugal) force you will experience
  - How fast to topple

- As speeds and lateral forces increase, things get harder because you're moving between positions of greater inclination
- As hill gets steeper it gets harder because it's a longer time before you get some force

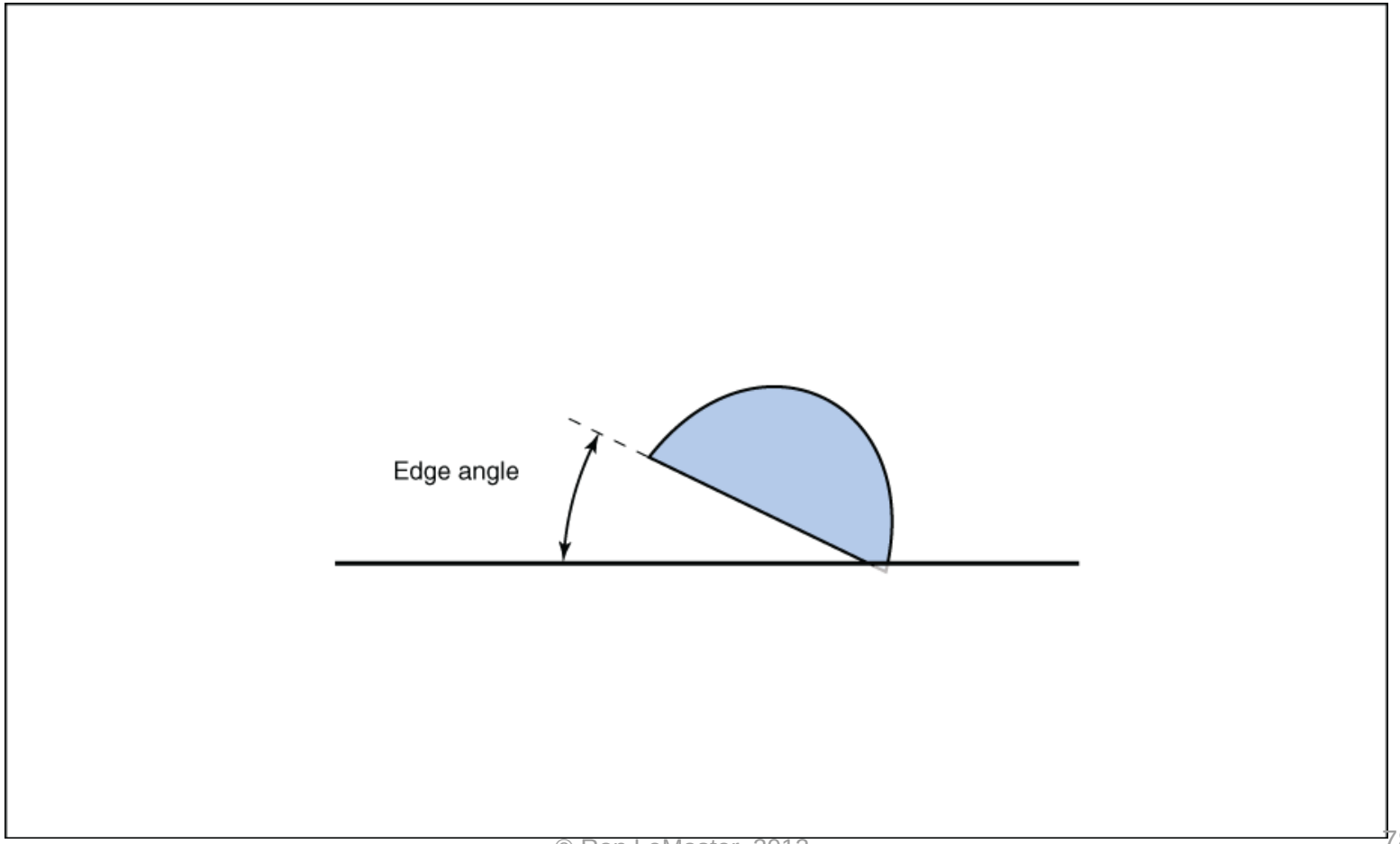
Techniques for Toppling

Make the Feet Slow Down

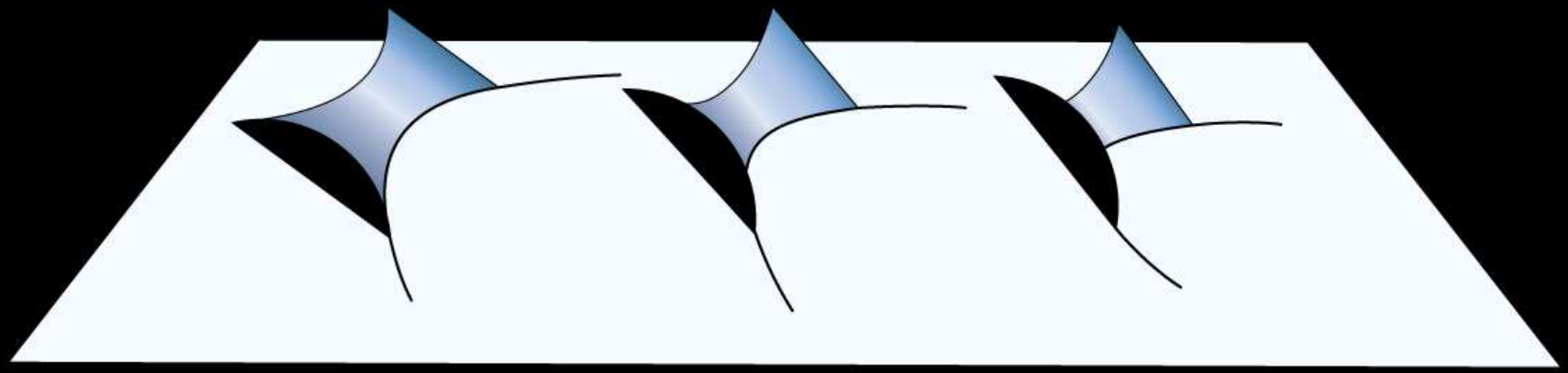
Remove Support of the Downhill Foot

Make the Feet Turn More Sharply

Edge Angle



Edge Angle and Turning Radius



Make the Upper Body Go Straighter

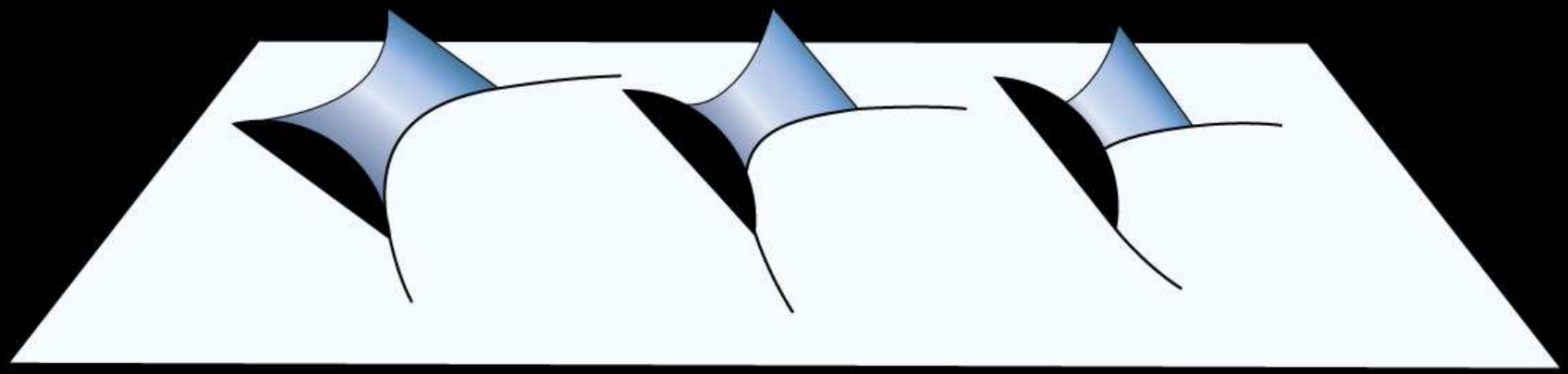
Pole Plant

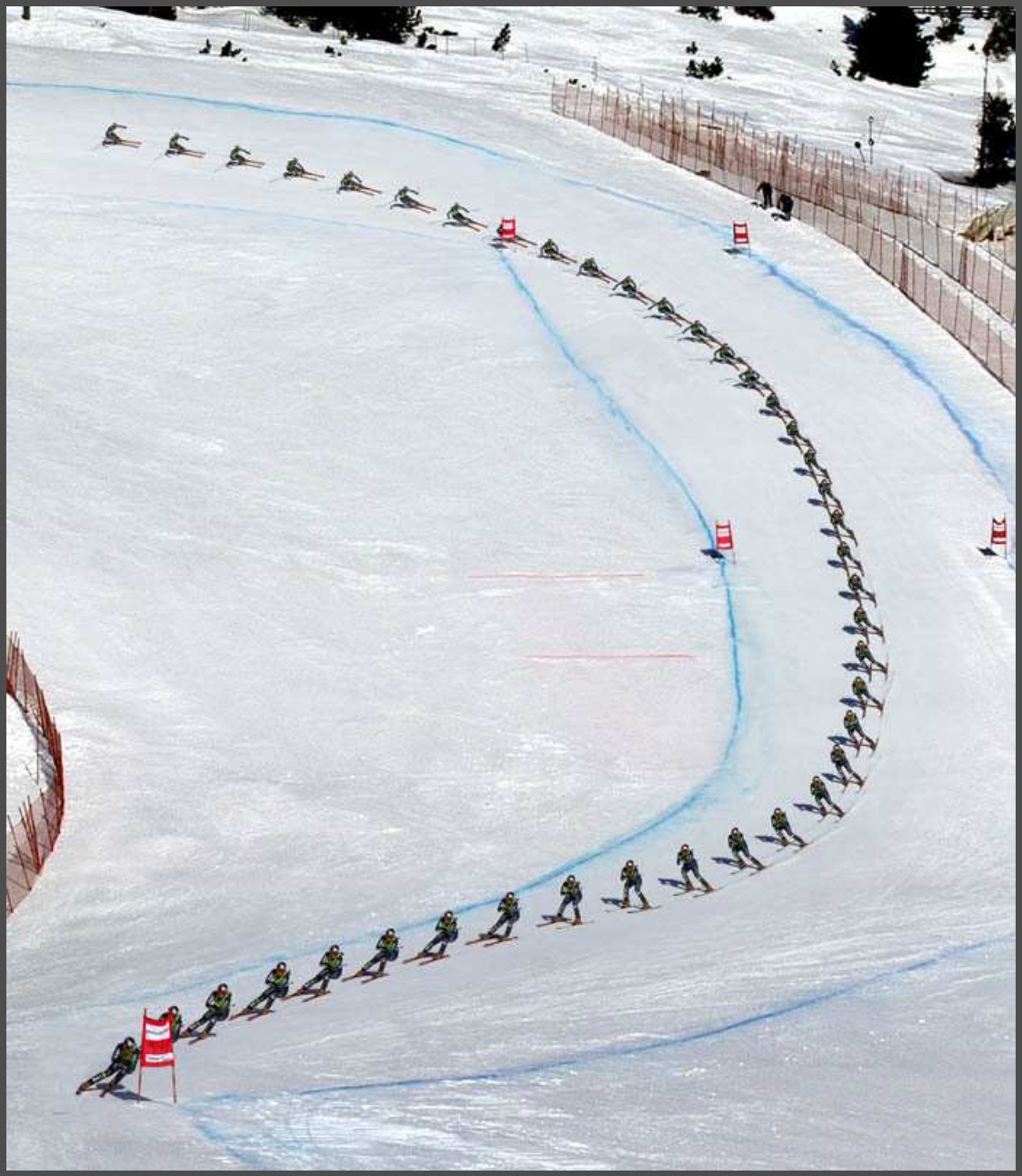
Using the Inside Ski

- Best skiers use it to ***assist*** carving on the outside ski
  - Primarily in first half of turn
  - Not carving on the inside ski

- ***You must first learn to stand and carve on the outside ski!***

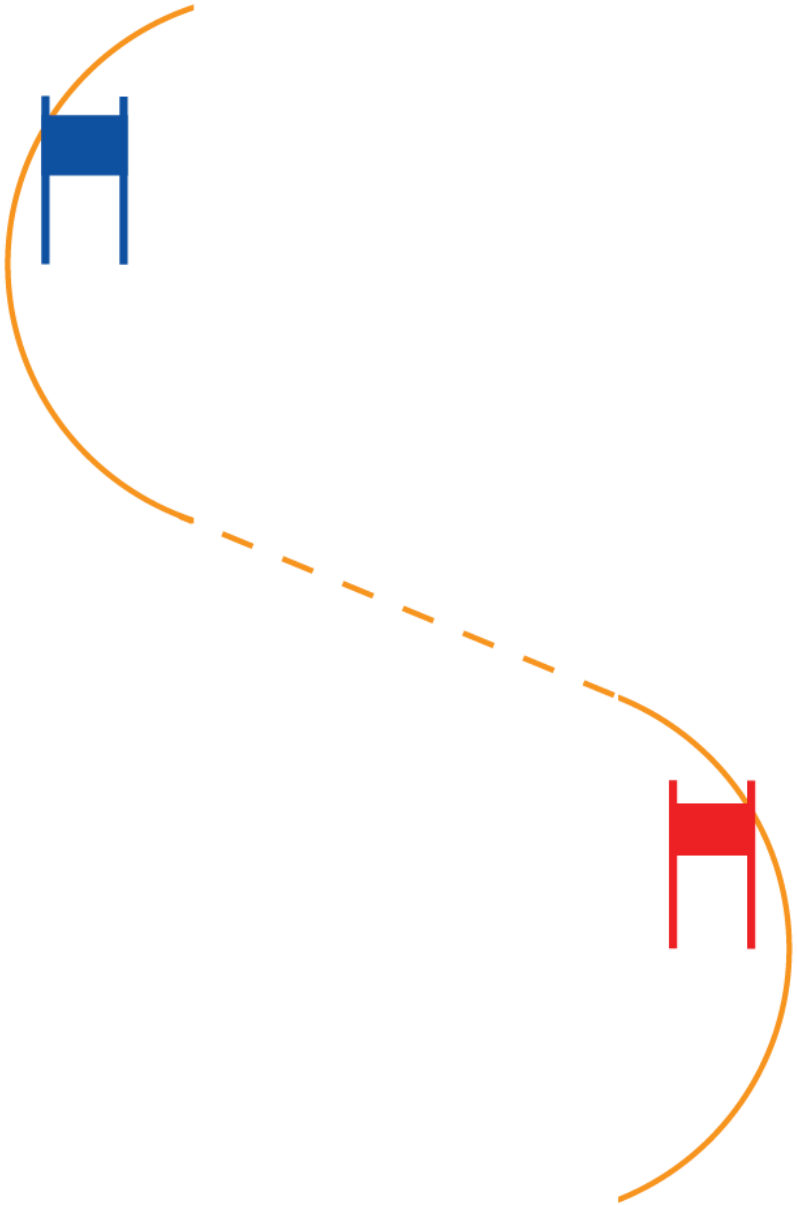
Edge Angle and Turning Radius

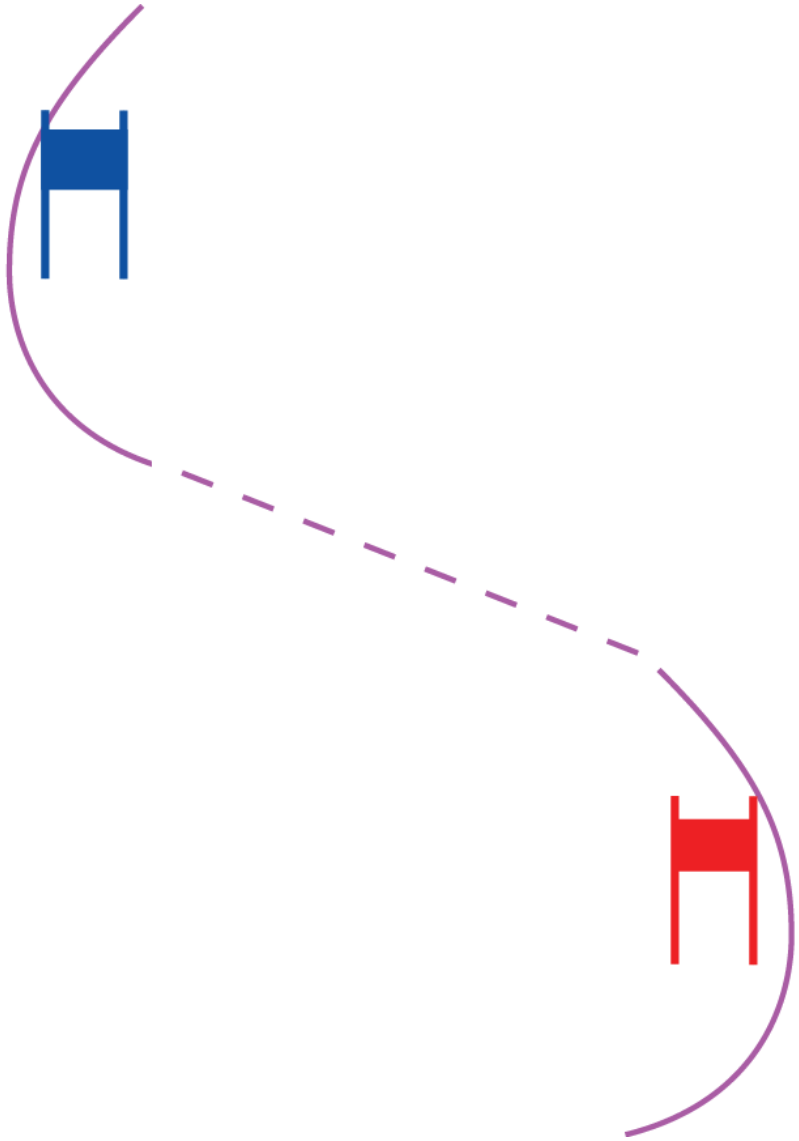




Slope and Carving Radius

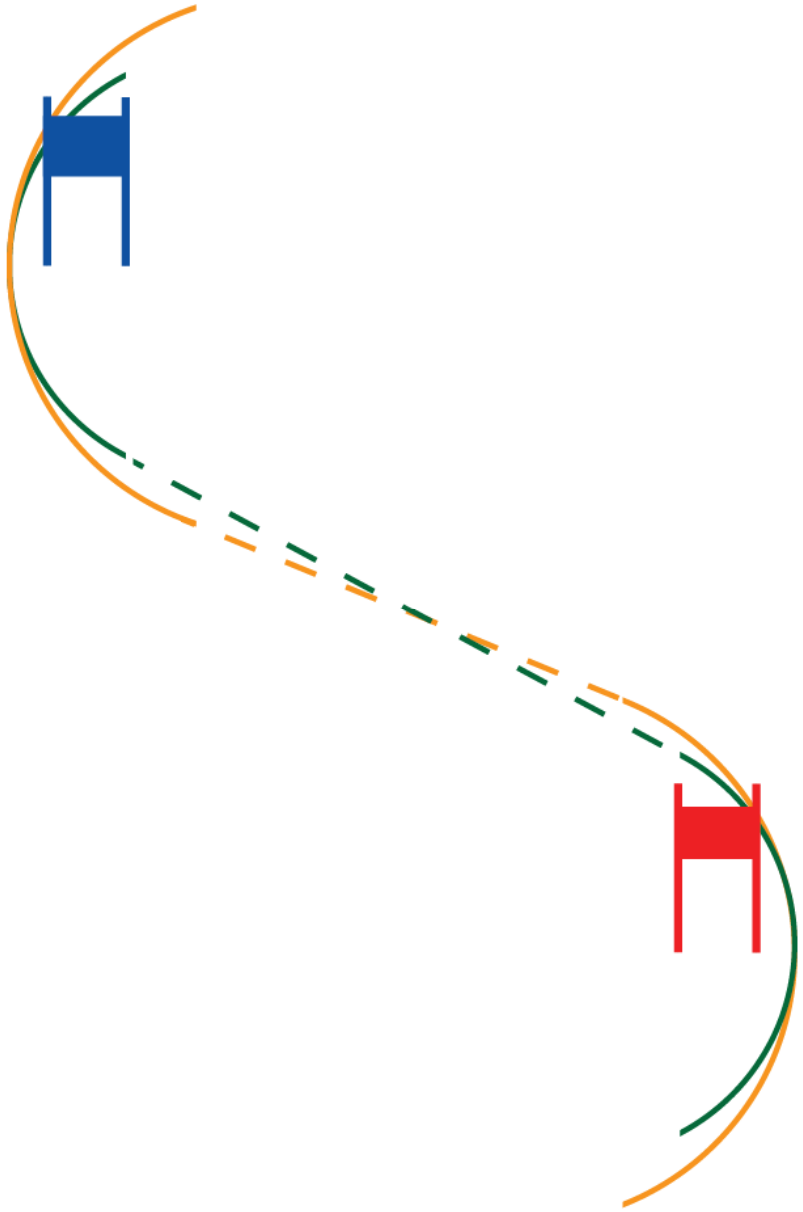
- The slope of the hill affects the ski's edge angle
- This causes the ski's carving radius to change through the turn





“7 degrees more…”

- About 8 deg. difference in edge angle of outside ski
- Outside ski edge angle 65°vs 57°(~8°)
- Carving radius 15m vs 19m (35m sidecut radius on infinitely hard snow)



Summary

- Skiing involves balancing on a moving platform whose movement is changing
- Learning to ski is learning to deal with more complicated changes
- *The key is being sensitive to the force from the snow (pressure), and anticipating how it will change*

- High-level skiing involves
  - Knowing when and how to go out of balance in a controlled way
  - Estimating the parameters of the transition well
  - Picking the best technique for the situation

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