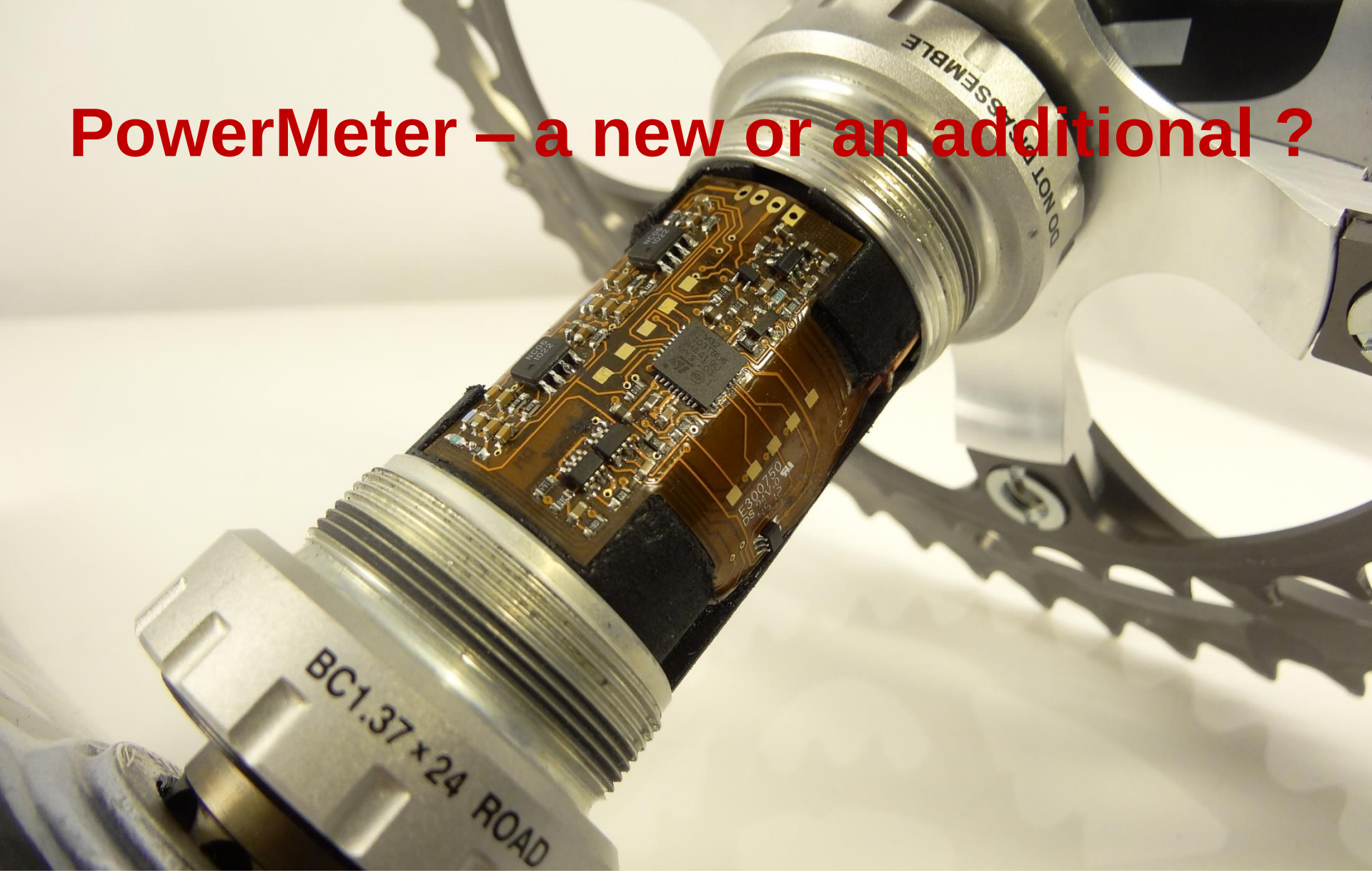
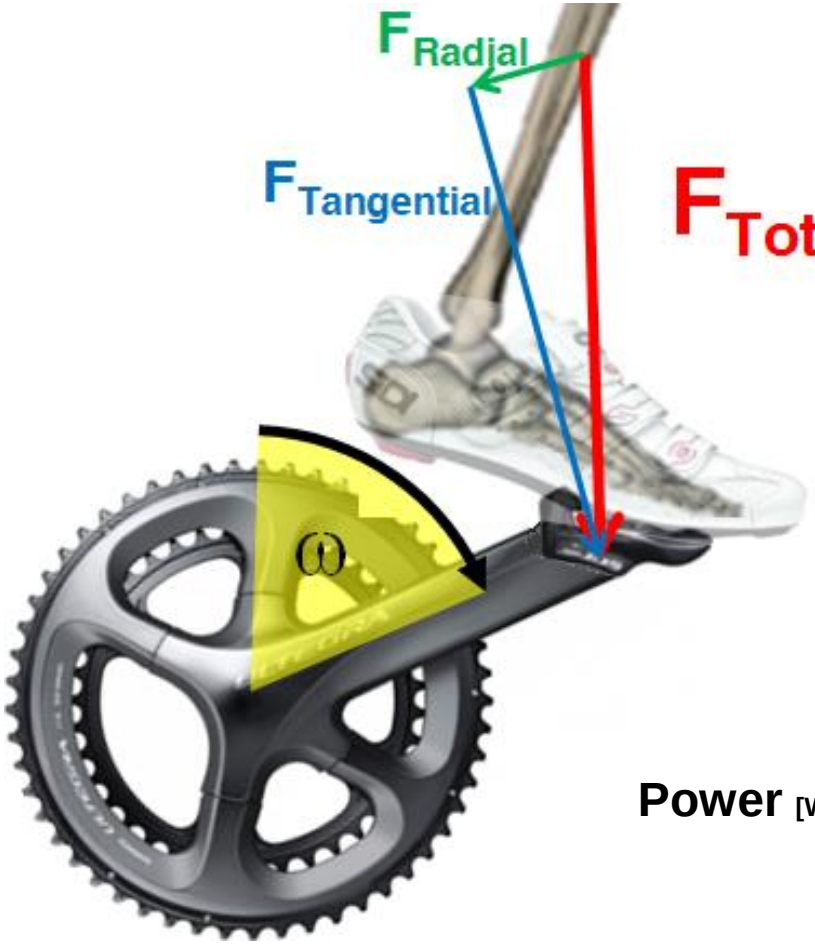
PowerMeter – a new or an additional ?



All PowerMeter measure Torque and Crank Revolutions



$$\text{Power}_{[W]} = \frac{\text{Force}_{[N]} \times \text{Distance}_{[m]}}{\text{Time}_{[sec]}}$$

$$\text{Power}_{[W]} = \text{Torque}_{[Nm]} \times \text{Angular Velocity}_{[sec^{-1}]}$$

All PowerMeter suppliers use Strain Gauges

SRM

CycleOps powertap
TESTED. TRUSTED. TRUE.

SRAM
QUARQ

power2max

Pioneer

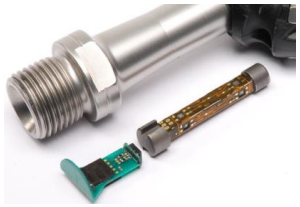
POLAR
LISTEN TO YOUR BODY

GARMIN

ROTOR
BIKE · COMPONENTS

STAGES
CYCLING
STAGESPOWER

iCranks



Bottom Bracket PowerMeter uses inverse magnetostriction

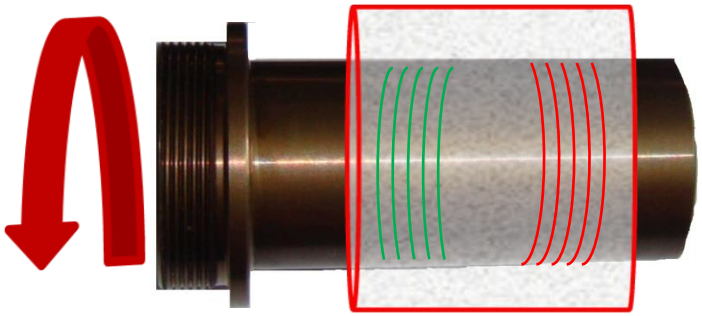
Principle of Measurement

I. Left Torque (Leg)

During pedaling by force applied torsion to the shaft generats proportional shifts in the magnetic fields.

Counterrotating magnetic fields protect against external magnetic effects by differential measuring.

II. Total Torque (right + left Leg)

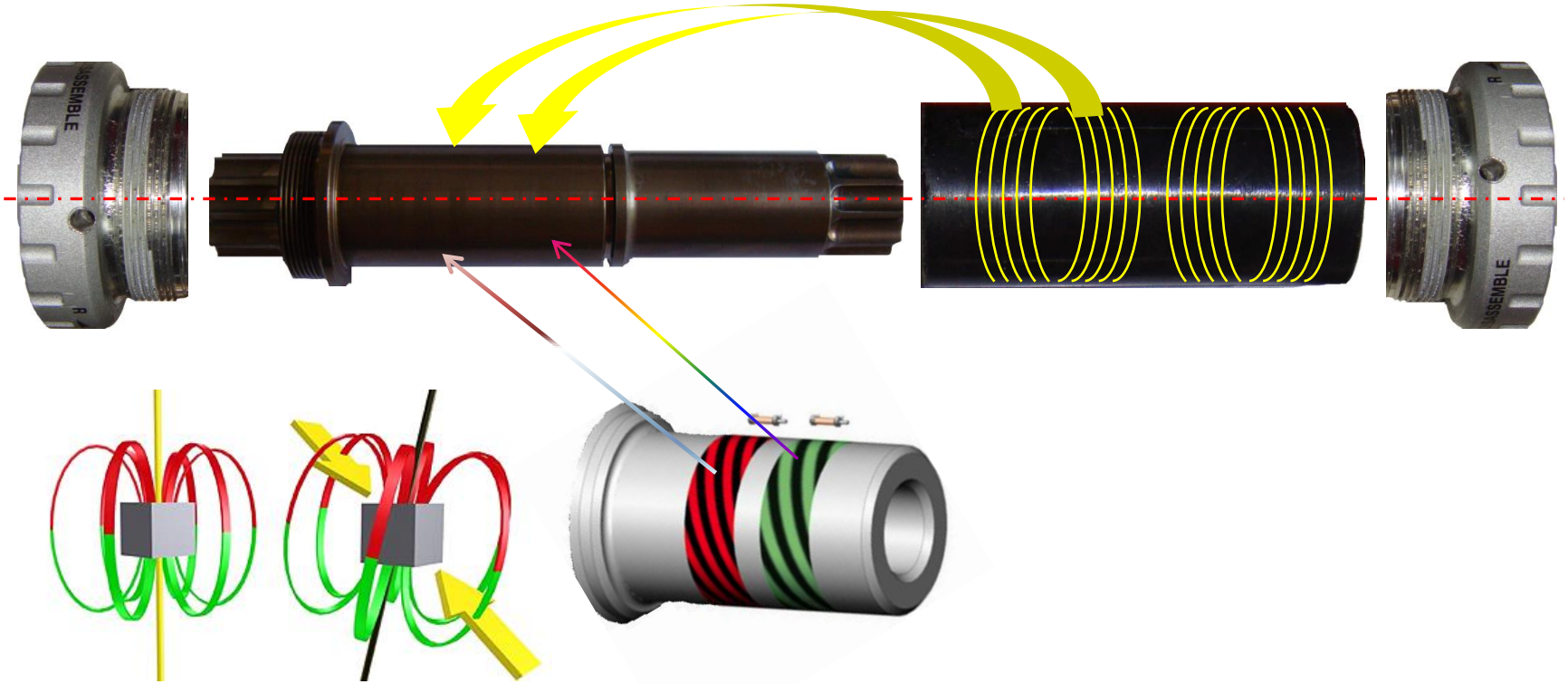


III. Right Torque (Leg) = II. – I.

Bottom Bracket PowerMeter uses inverse Magnetostriction

Two (2) high resolution split pair coils (Secondary sensor)
detect the shifts in the magnetic encoded fields (Primary sensor)

Each coil of the pair detects only one of the bucked magnetic fields.



The *Virelli* effect says: Stress on a ferromagnetic body change its magnetic field.

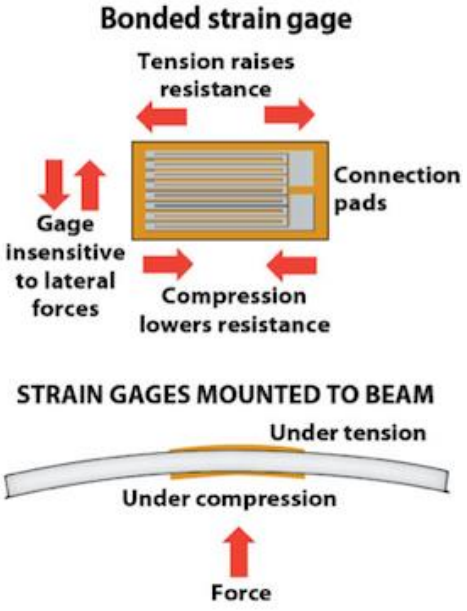
Magnetostriction advantages over Strain Gauges

The magneto-elastic effect

Due to the influence of the force the magnetic permeability μ is changed (inverse magnetostriction)

So the transferred magnetic flux from the primary coil to the secondary coil changes.

The advantages of this principle are high robustness against overloads and high sensitivity.



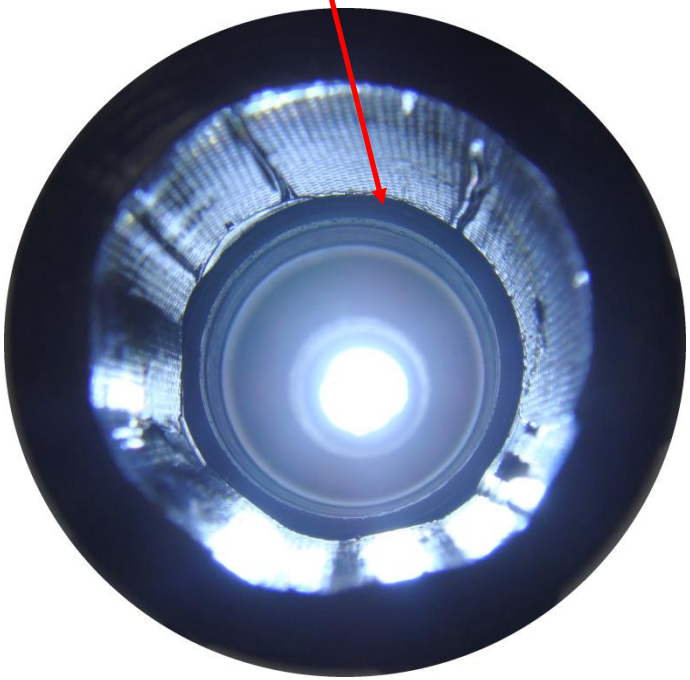
The handicap of *Strain Gauges* is the demand of temperature compensation and the effect of retardation.

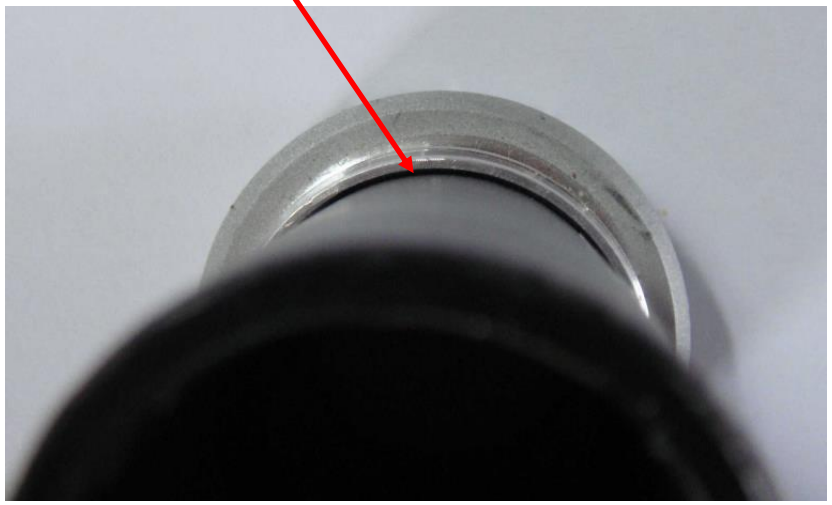
Magnetostriction advantages over Strain Gauges

	Magnetostriction	Strain Gauge
Robustness	++	+
Sensitivity	++	+
Cost of production	++	-
Temperature	++	-
Retardation	++	-
Occurrence Bike Market	-	++
Long-life-cycle	++	+
Extrem low system complexity	++	-
Ideal for series and mass production	++	-

Design Constraints

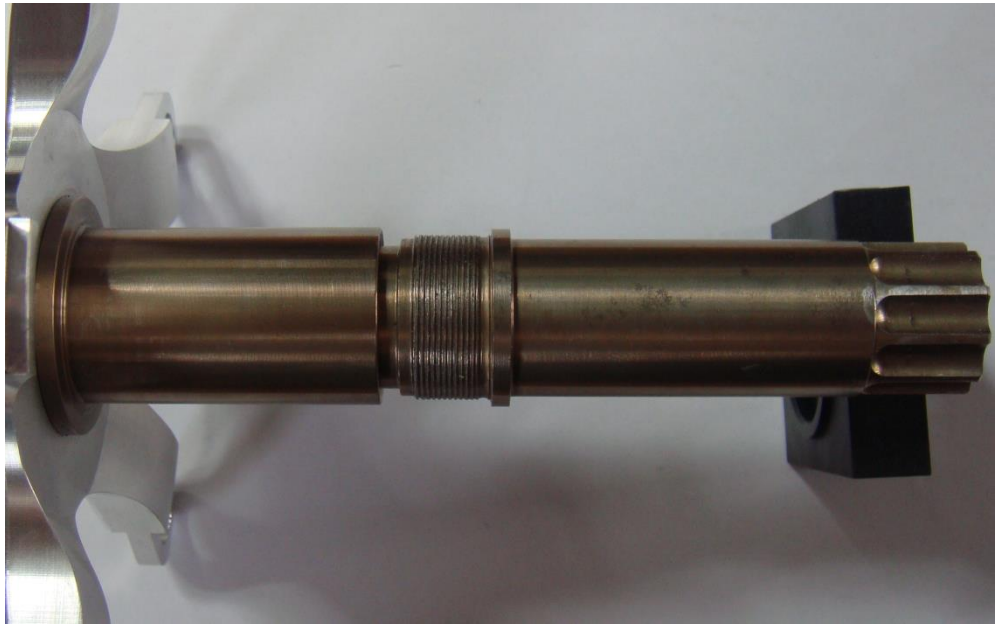
Equal air gap around the shaft needs basis fit into the bearing cup

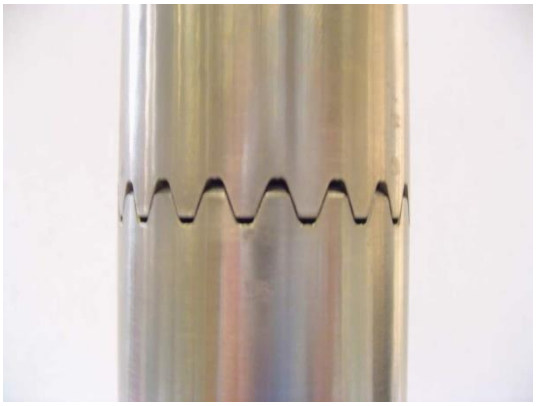




Design Constraints

For simple and rigid fixture we propose a *Hirth* coupling

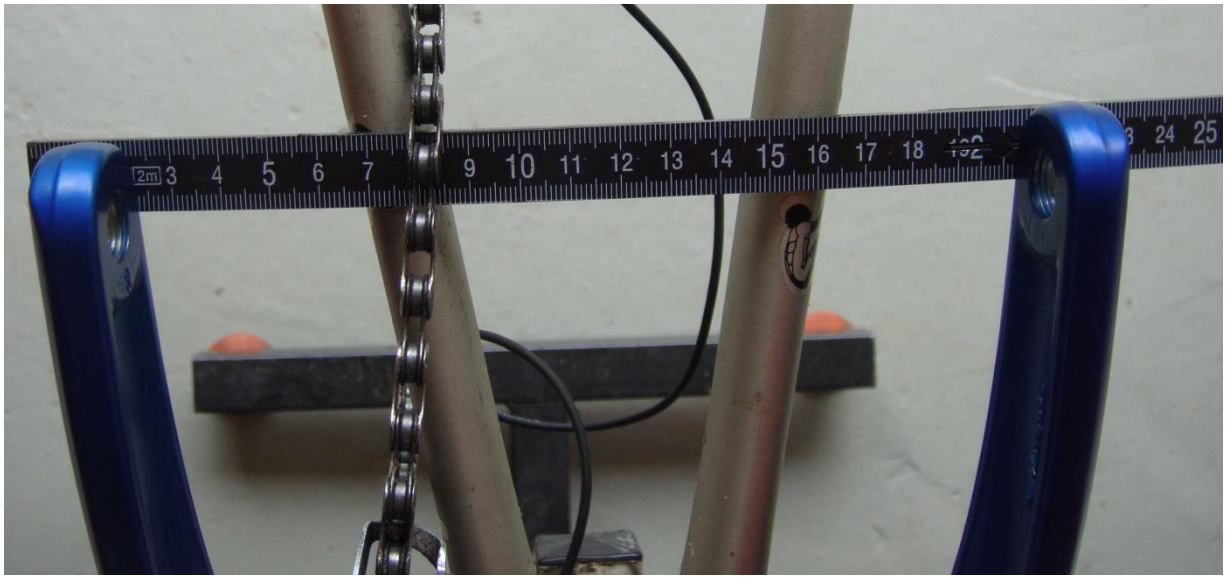




Design Constraints

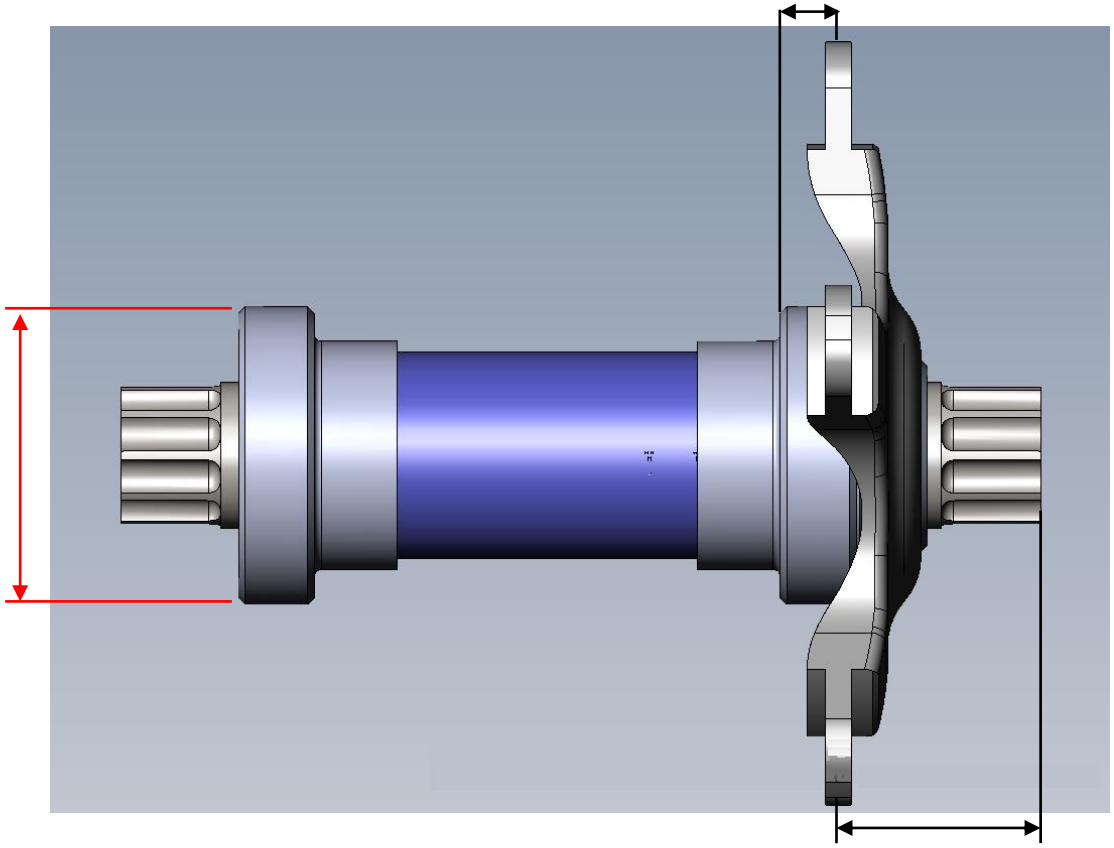
Usual Q-factors [mm]

Racing Bike	MTB	Shaft length [mm]
145	157	104
148	160	107
151	163	110
154	166	113
158	170	117
162	174	121



Design Constraints

The distance between Spider and Crank must be reduced !

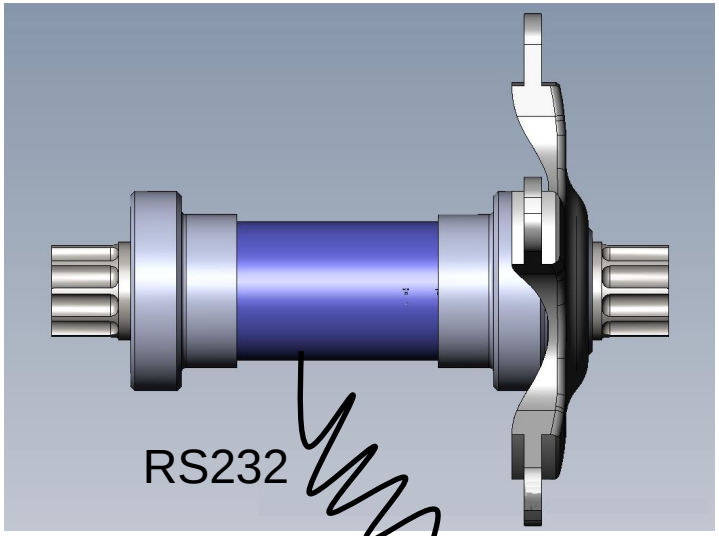


Bearing cup should fit to every bottom bracket shell !

Design Constraints

Power data transmited to any display devices like bike computer, cell phone, watch, fitness equipment or several personal display devices

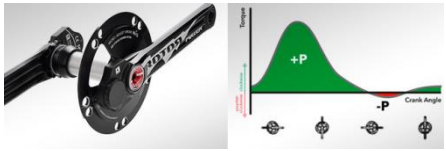
GARMIN
iPhone/ANT+ Adapter



Pricing

Supplier	SRM	SRAM QUARQ	GARMIN
			
PowerMeter	€ 1.952 - € 3.451	$1.200 - $1.795	€ 1.399
Bottom Bracket	€ 50 - € 156	$ 30 - $ 220	no
PowerDisplay	€ 655 - € 893	no	€ 299 - € 499
Accessories	€ 12 - € 108	$ 5 - $ 60	€ 20 - € 170
Software	free	free	free
Systems	€ 2.606 – € 4.106	no	no

Pricing

Supplier	powertap TESTED. TRUSTED. TRUE.	ROTOR POWER	Power2Max
			
PowerMeter	€ 1.090 - € 1.290	€ 1.695 - $ 2.400	€ 840 - € 1.690
Bottom Bracket	no	$ 60 - $ 150	€ 19 - € 159
PowerDisplay	$ 100 - $ 300	no	€ 199
Accessories	€ 12 - € 300	$ 90 - $ 280	€ 2 - € 139
Software, Apps	free	free	no
Systems	€ 2.606 – € 4.106	no	no

Pricing

Supplier	Pioneer	STAGES CYCLING STAGESPOWER	iCranks
			
PowerMeter	$ 1.550 - $ 1.850	€ 699 - € 999	€ 1.554 - $ 3.200
Bottom Bracket	no	no	€ 19 - € 159
PowerDisplay	$ 299 - $ 749	no	no
Accessories	$ 1.299	no	$ 199
Software, Apps	free	no	free
Systems	no	no	no

POWER

POTENZA

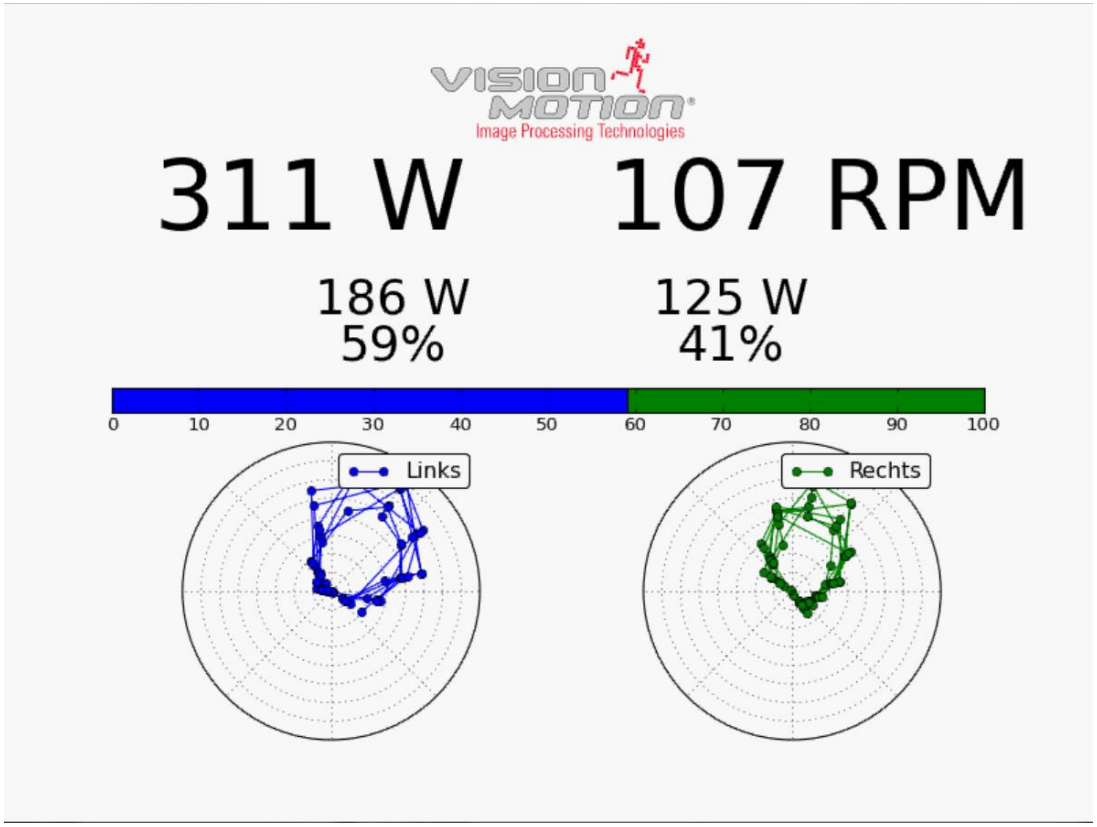
versus

Torque

momento di una forza

POWER versus Torque

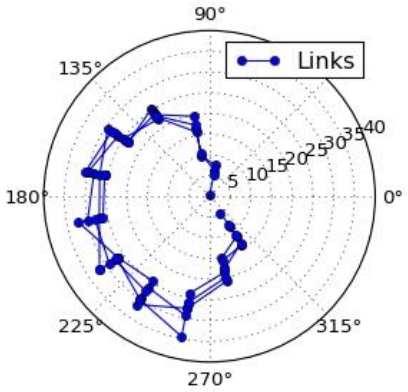
Torque is displayed every 22.5° - splitted in left and right leg

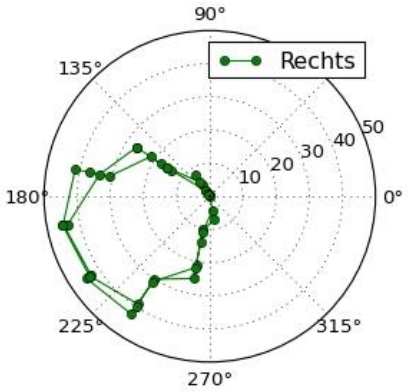


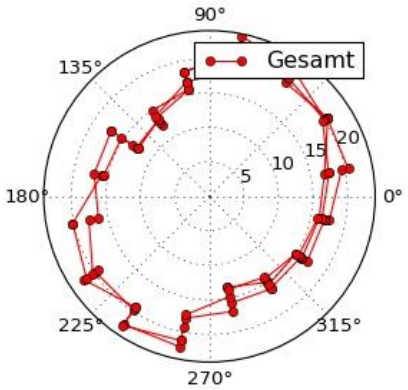
Shows percentage distribution, overall power and pedal frequency

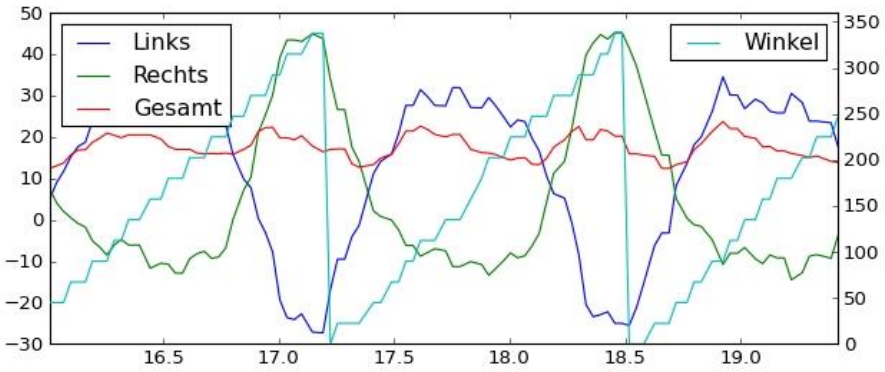
POWER versus Torque

Torque is displayed every 22.5° - splitted in left, right and both legs

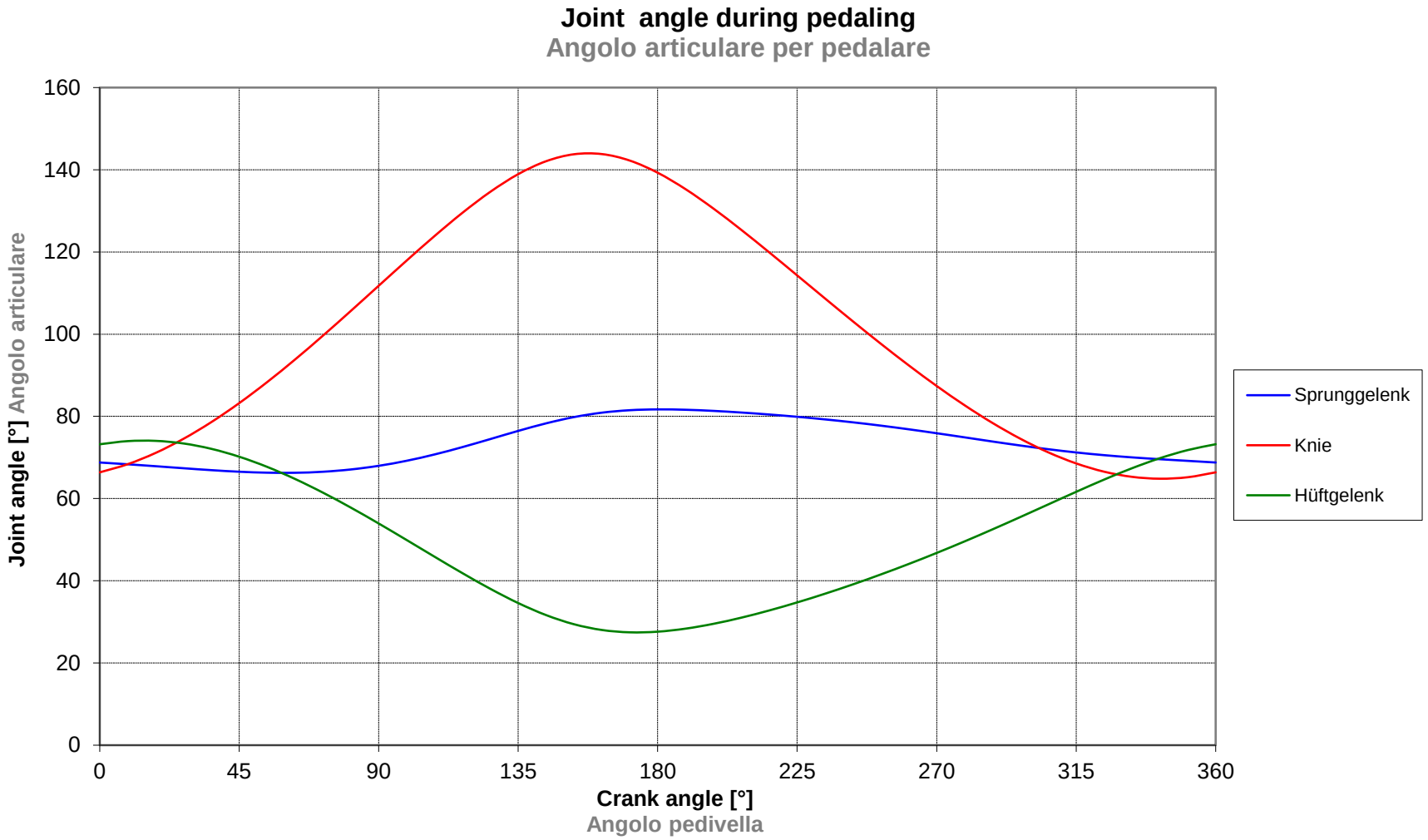








Time profile of torque development and compared to pedal angle



Ankle joint /Tibio tarsale

Knee joint /Ginocchio

Hip joint/ Anca


Thank you for your attention !