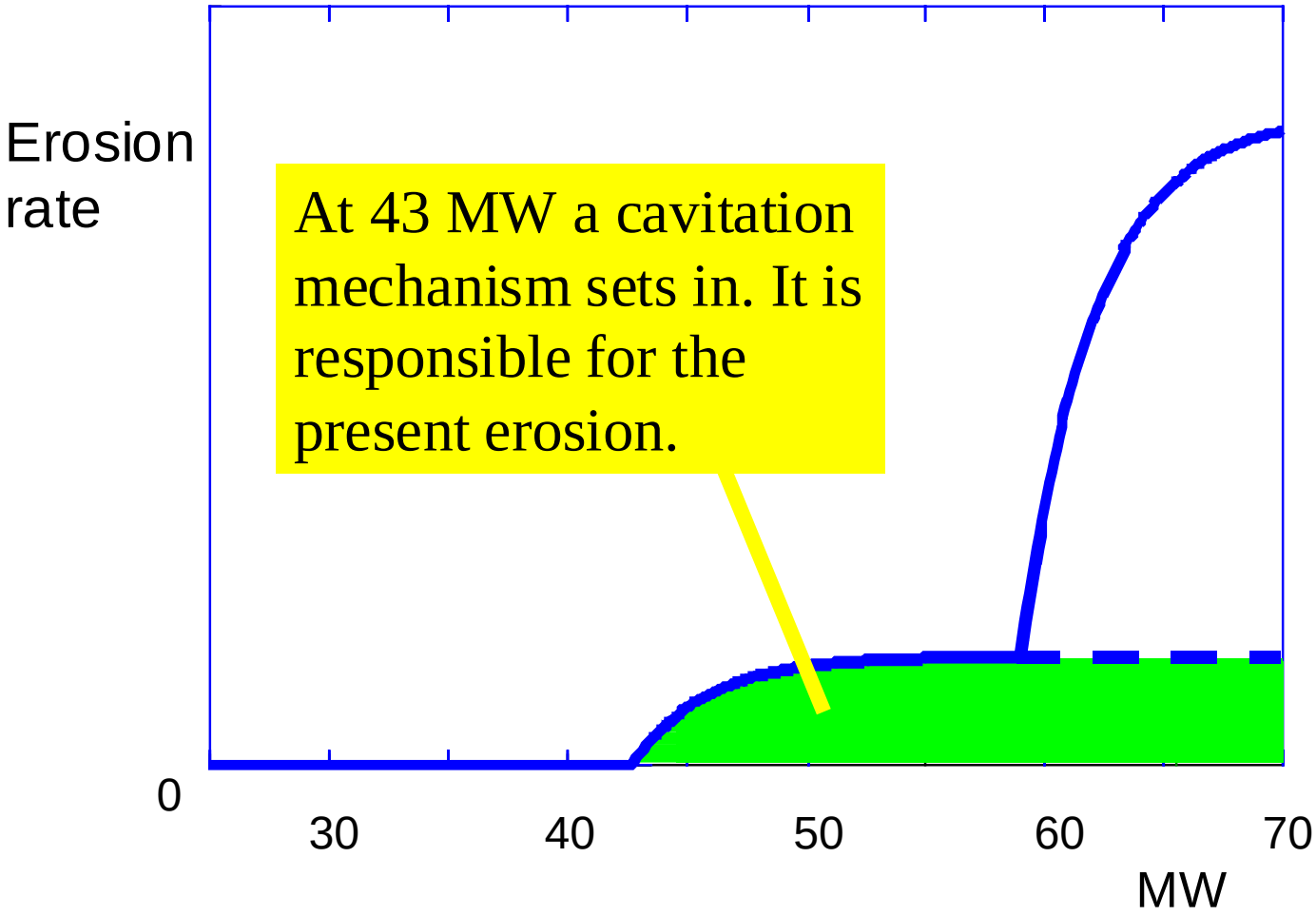
Identification of weak turbine parts - Kaplan

In the turbine under consideration, there is an abrupt increase of erosion rate at a higher loading degree.

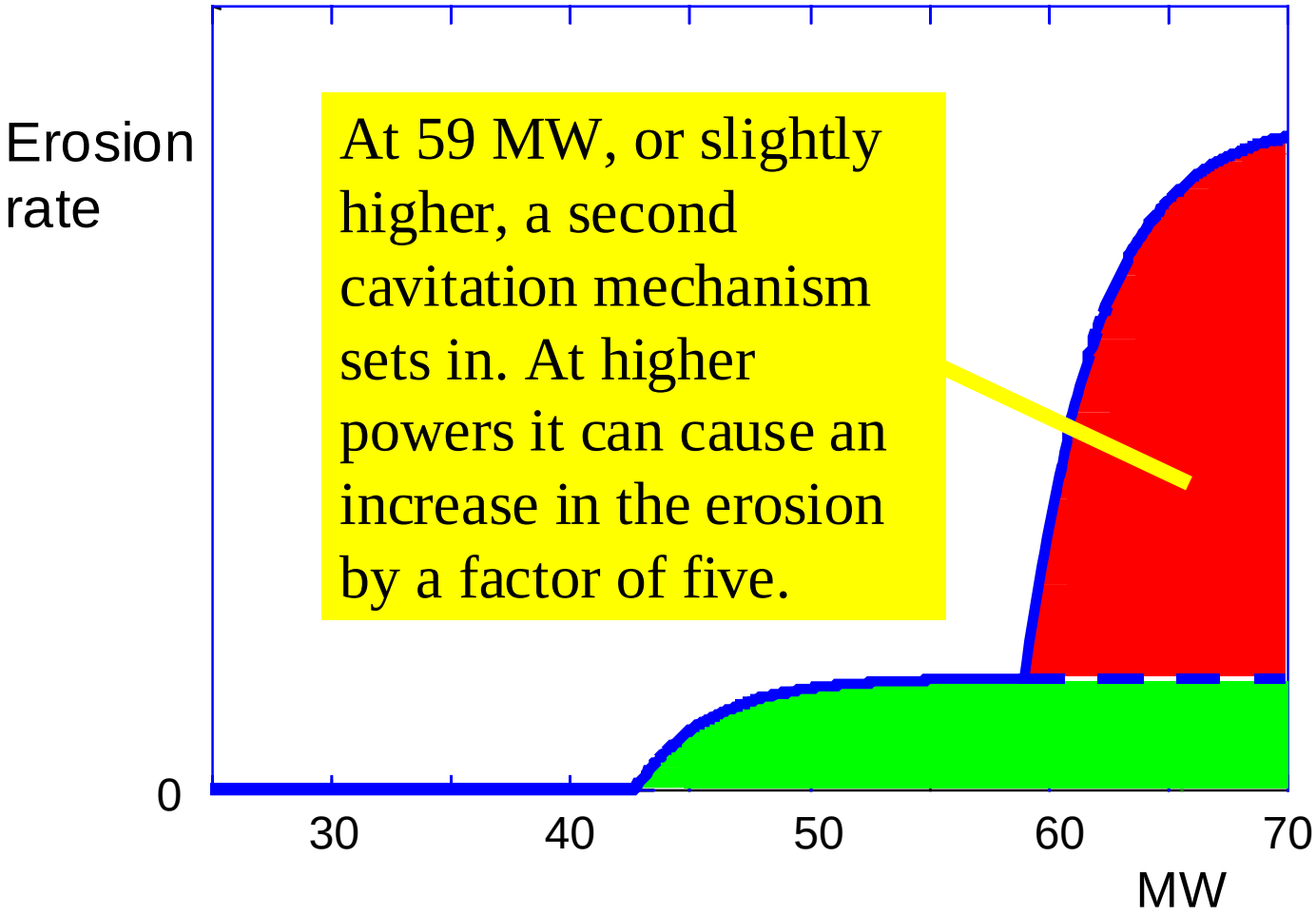
What is its cause?

Can the turbine be repaired so that this increase of erosion rate does not take place?

Identification



Identification



Identification

In the turbine under consideration ...

- 5 runner blades are rotating behind
- 24 guide vanes, 12 of which are lying behind
- 12 stay vanes.

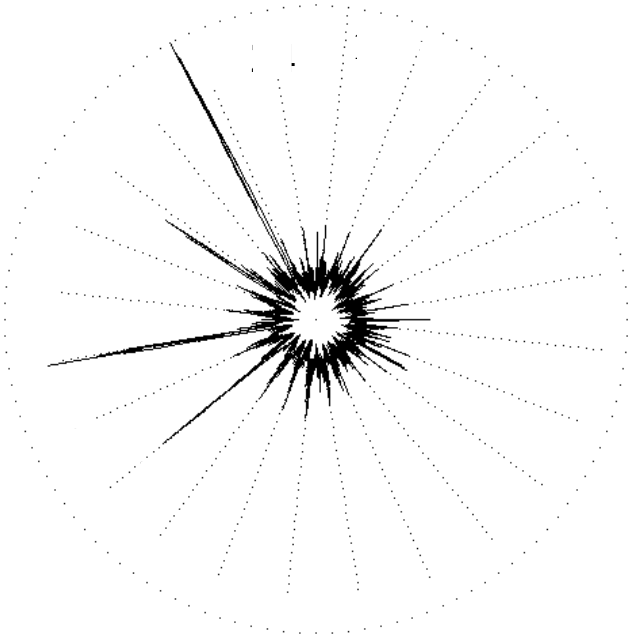
Which of these 41 turbine parts or the 120 combinations of their interactions are responsible for the strong erosion at a high loading ?

Identification

The 5 runner blades interact with the 24 guide vanes to make 120 different pairs, which, when cavitating, produce noise in 120 special angular positions.

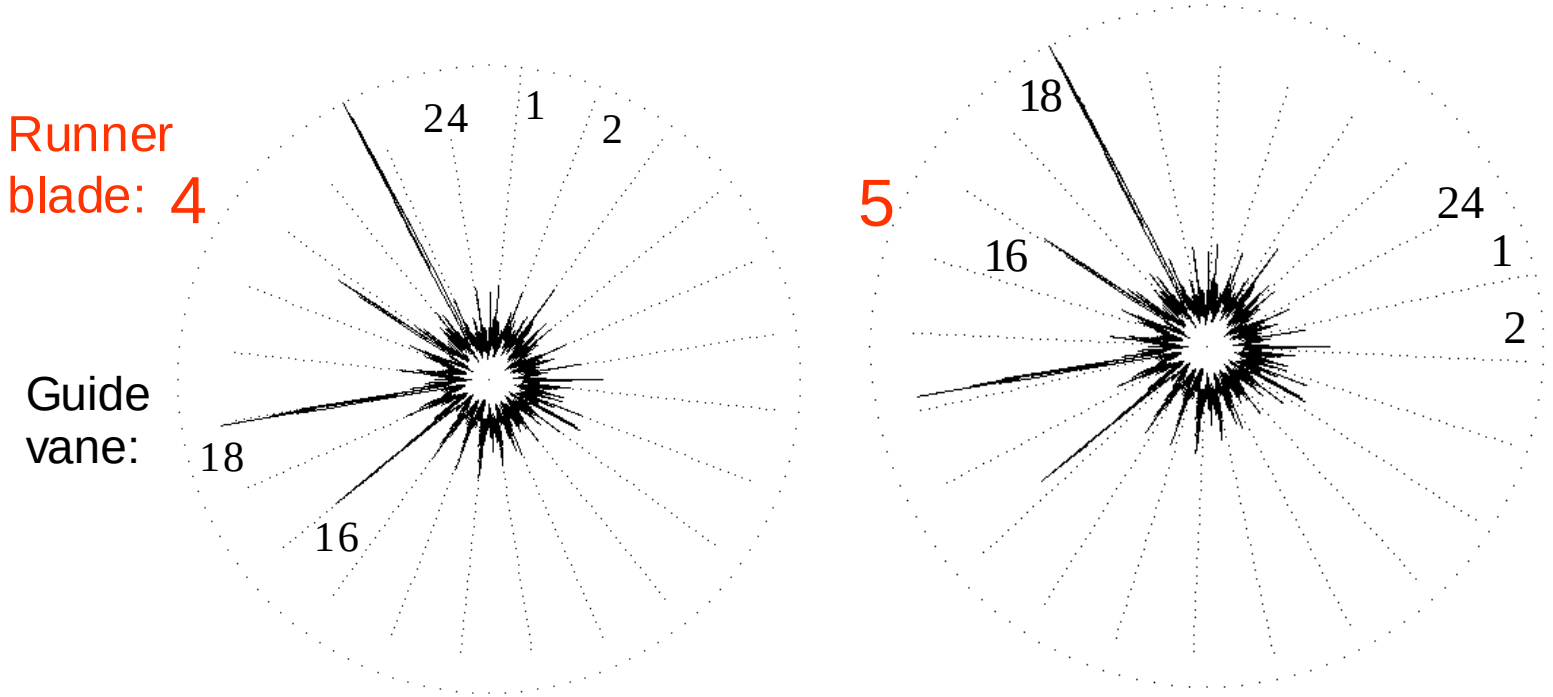
The result of the vibro-acoustical analysis presented in the next figure shows which of the 120 pairs cavitate and to which extent.

Identification



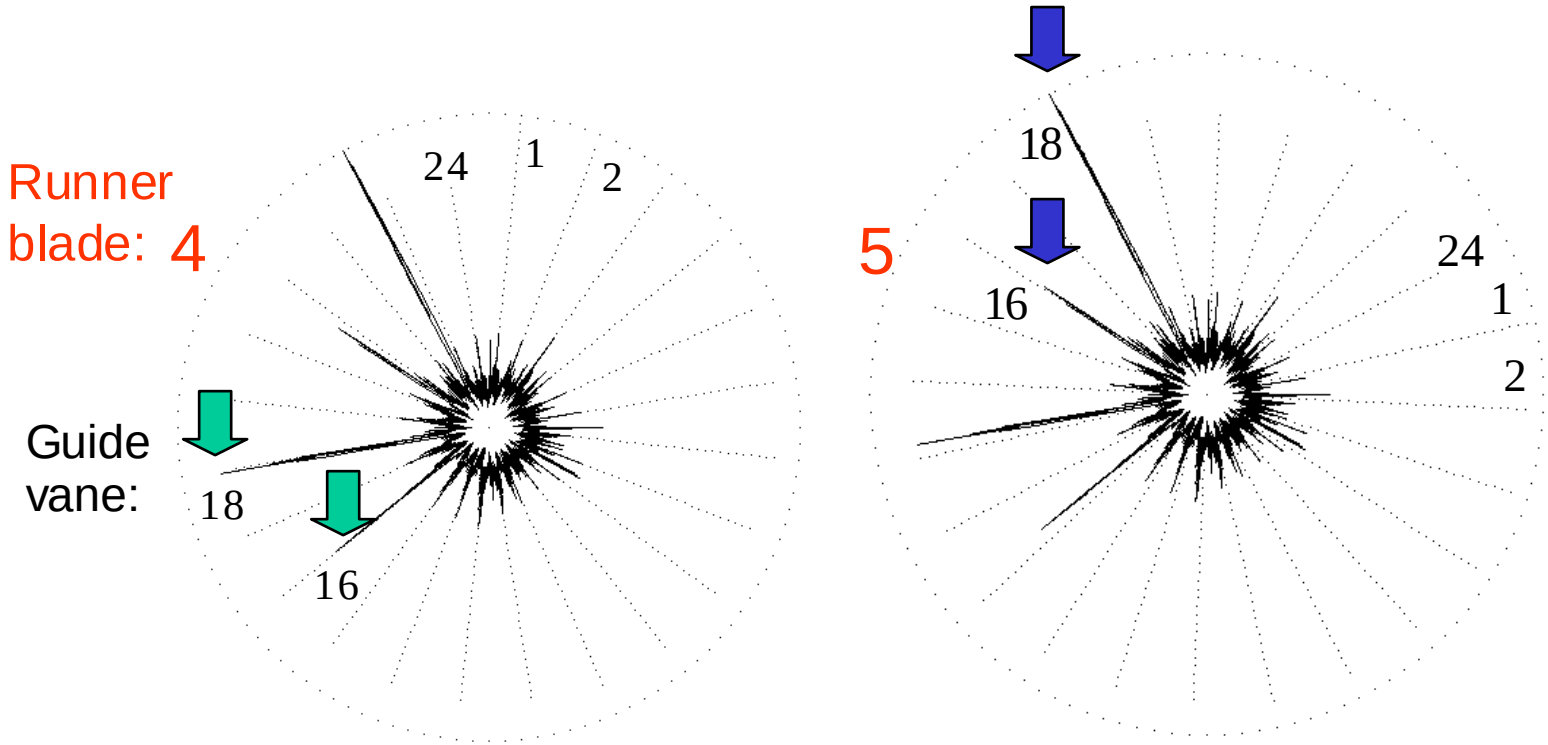
The polar diagram shows the dependence of cavitation intensity on the instantaneous runner’s position, recorded at high loading, where the strong mechanism is acting.

Identification



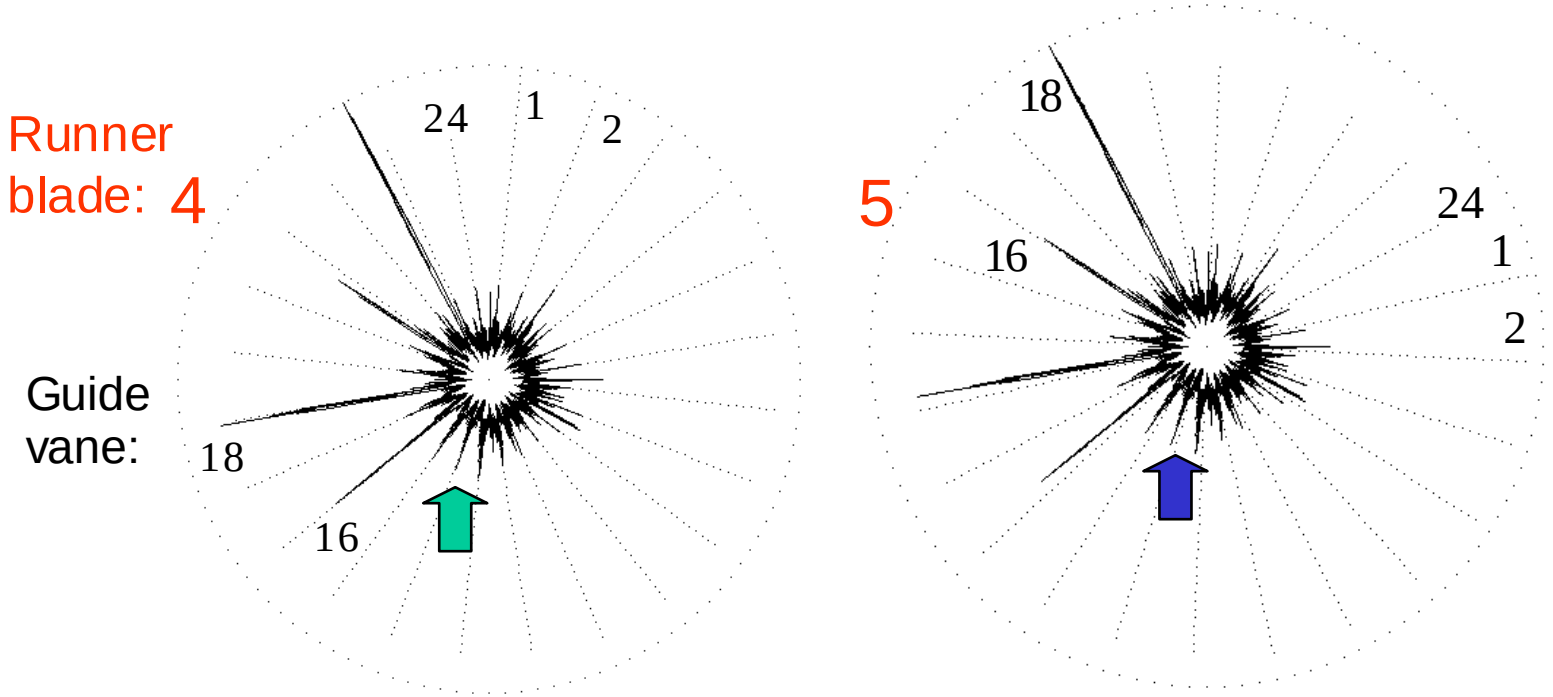
The two diagrams show the positions in which the denoted runner blades interfere with the denoted guide vanes.

Identification



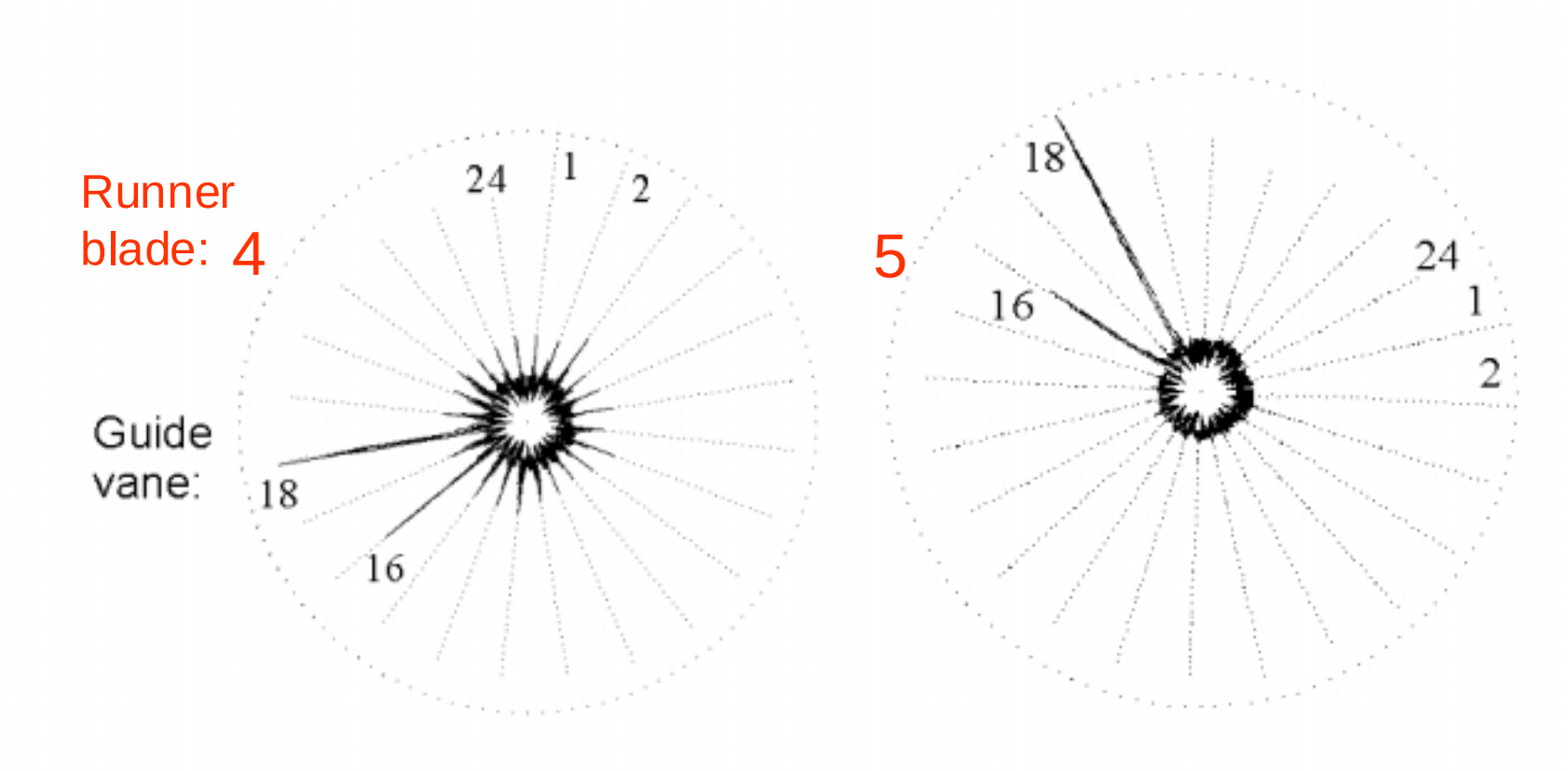
The peaks indicated by ⇩ correspond to runner blade 4 and guide vanes 16 and 18, and the peaks indicated by ⇩ correspond to runner blade 5 and the same guide vanes, 16 and 18.

Identification



Almost all small peaks coincide with the runner blade 4 diagram, and none with the one of blade 5. There are small peaks at all the guide-vane directions related to blade 4.

Identification



All this shows that the entire pattern can be divided into two additive patterns, which are pure results of cavitation close to runner blade 4 and 5.

Identification

Conclusion:

Since the two components, related to runner blades 4 and 5, exhaust the total pattern, these are the only blades that cavitate strongly. Both blades do so only behind two guide vanes, 16 and 18; blade 4 also cavitates weakly behind all other guide vanes.