Event Shape Sorting

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XII Quark Confinement and Hadron Spectrum

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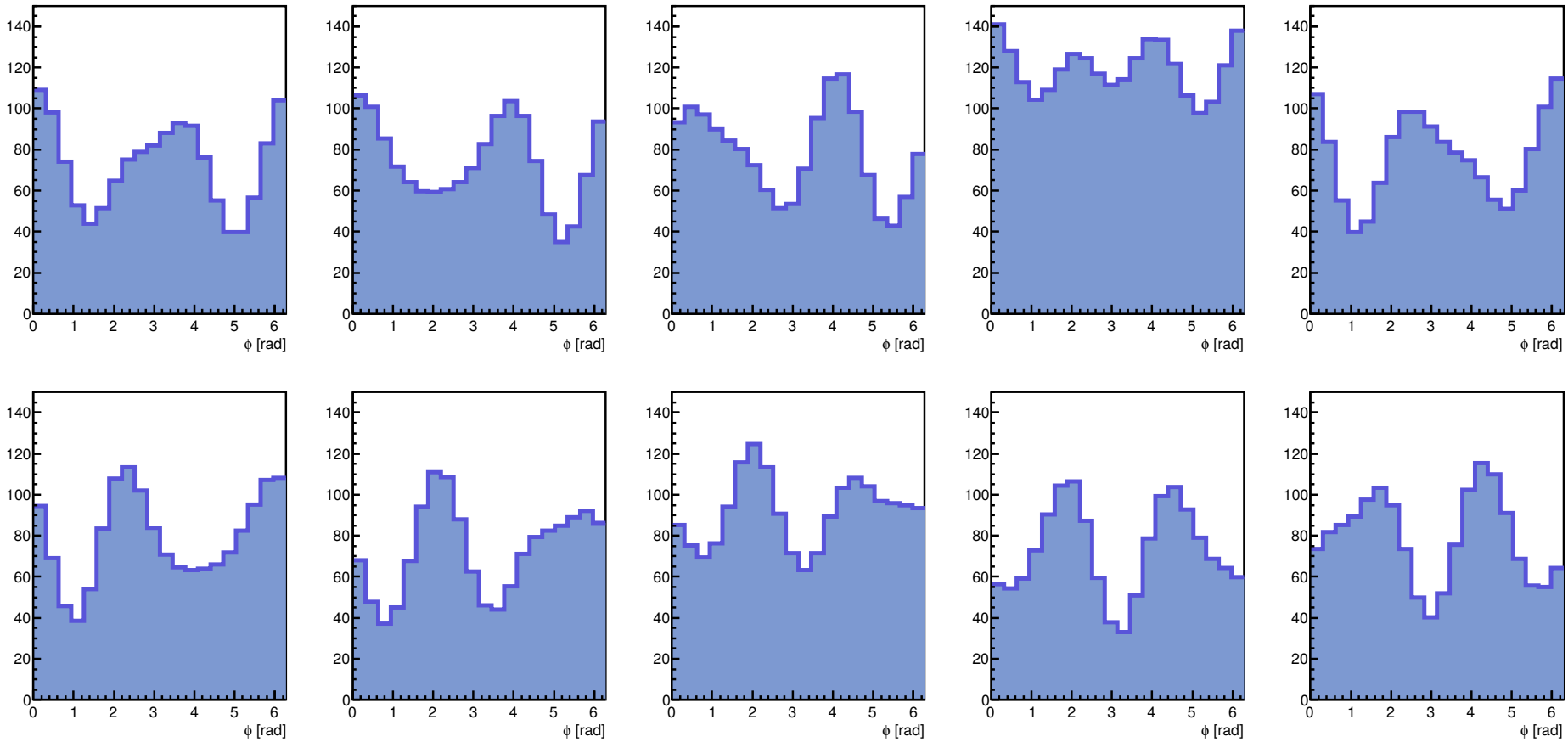
Event Shape Sorting is a method . . .

- good for organising events with multi-particle production, e.g. in ultra-relativistic heavy-ion collisions.
- that allows to select events which have similar distributions of hadron momenta.
  Paradigm: such events started from similar initial conditions and evolved in a similar way.
- that is self-organised and does not require the user to specify any sorting variable.

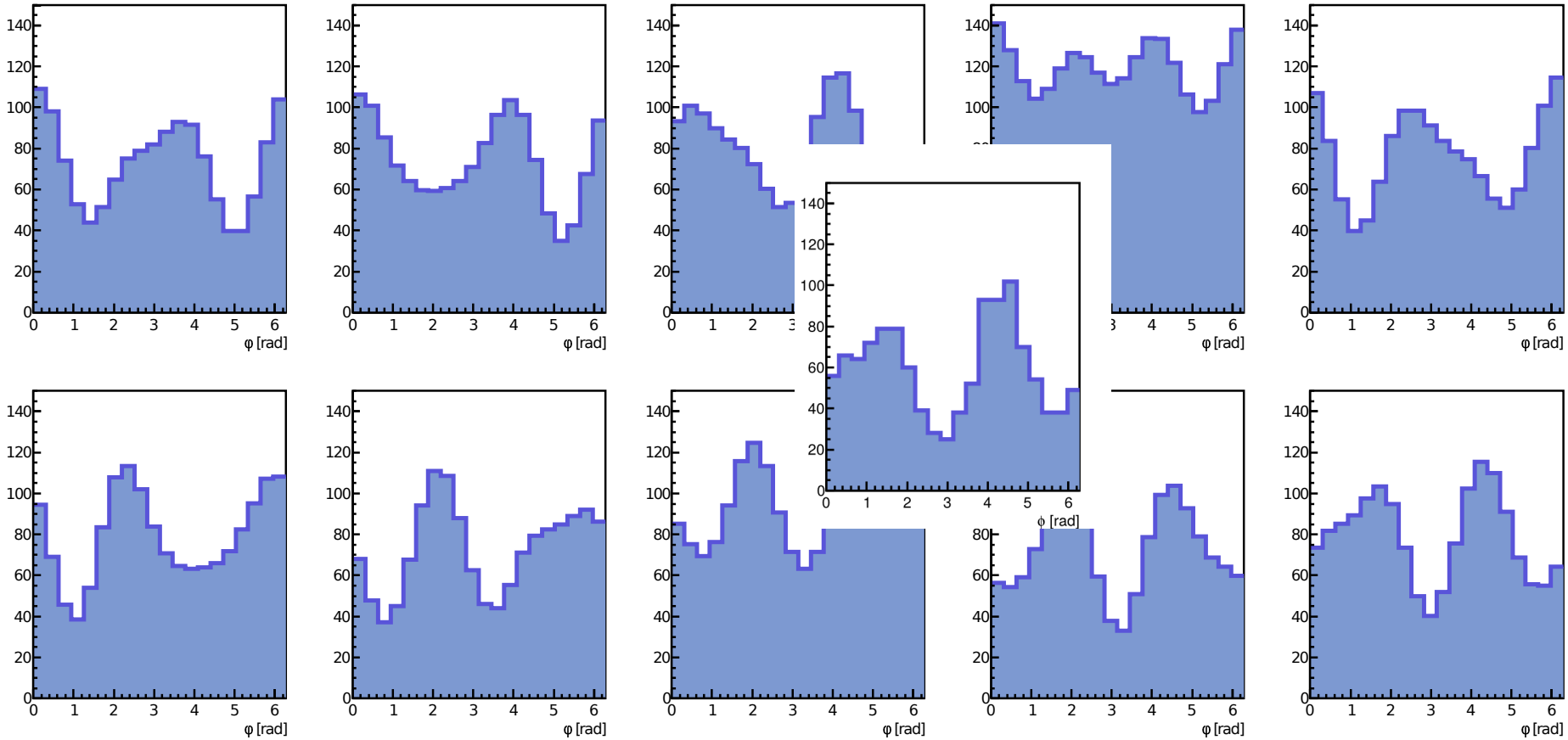
How does it work

2000 AMPT events, Pb+Pb at $\sqrt{s_{NN}} = 2.76$ TeV, centr. 0–20%, sorted



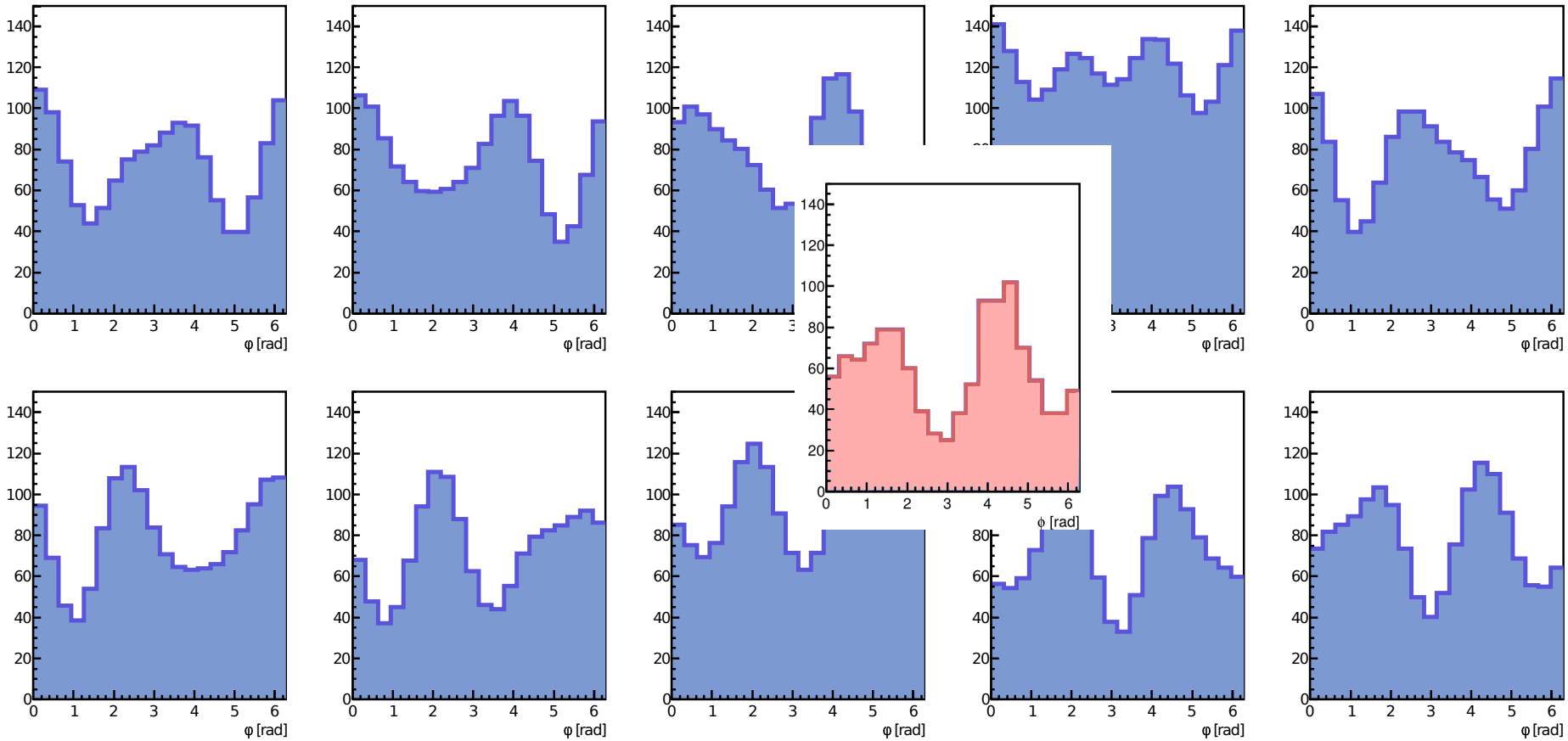
How does it work

To which event bin is this event similar?



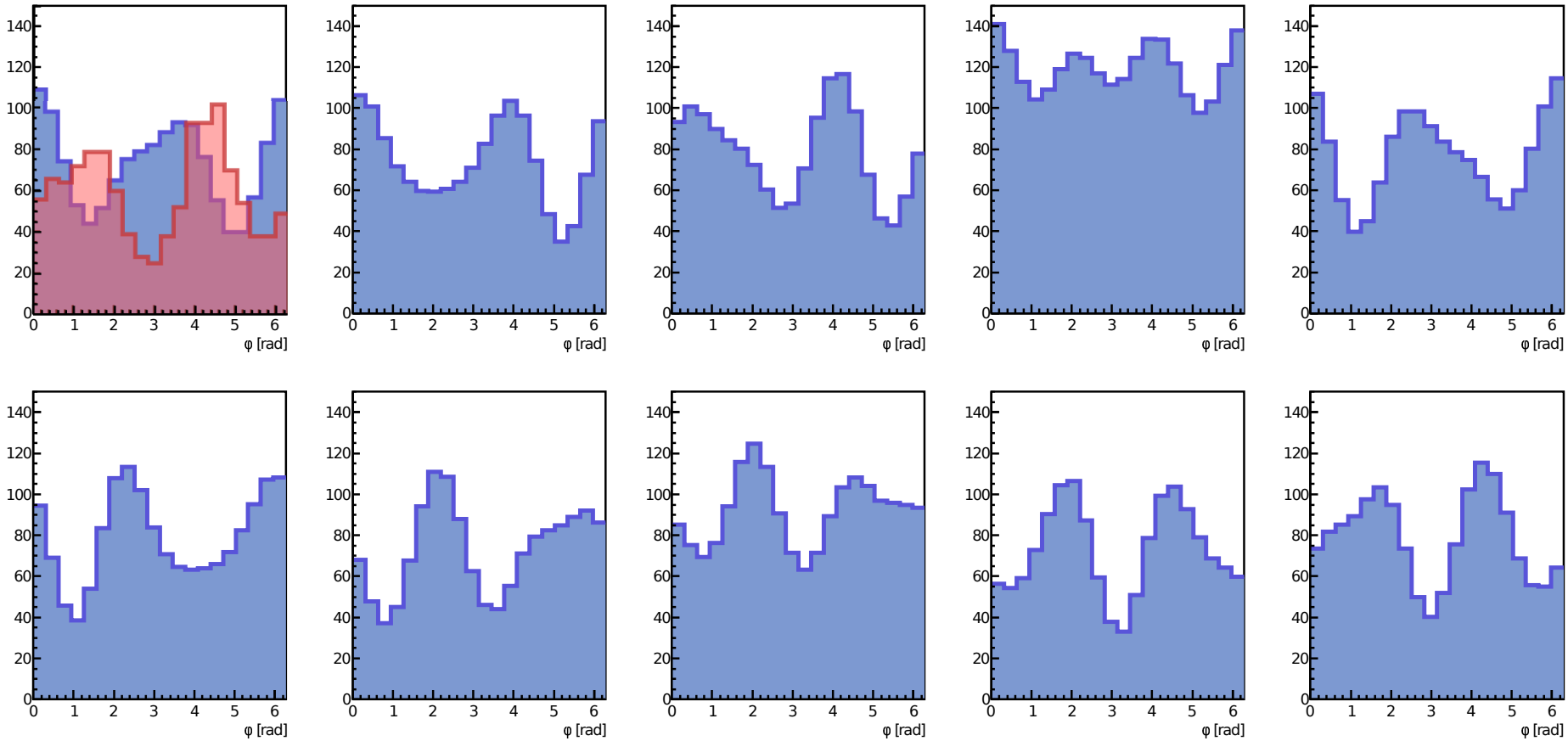
How does it work

Calculate Bayesian probability that the event belong to each event bin



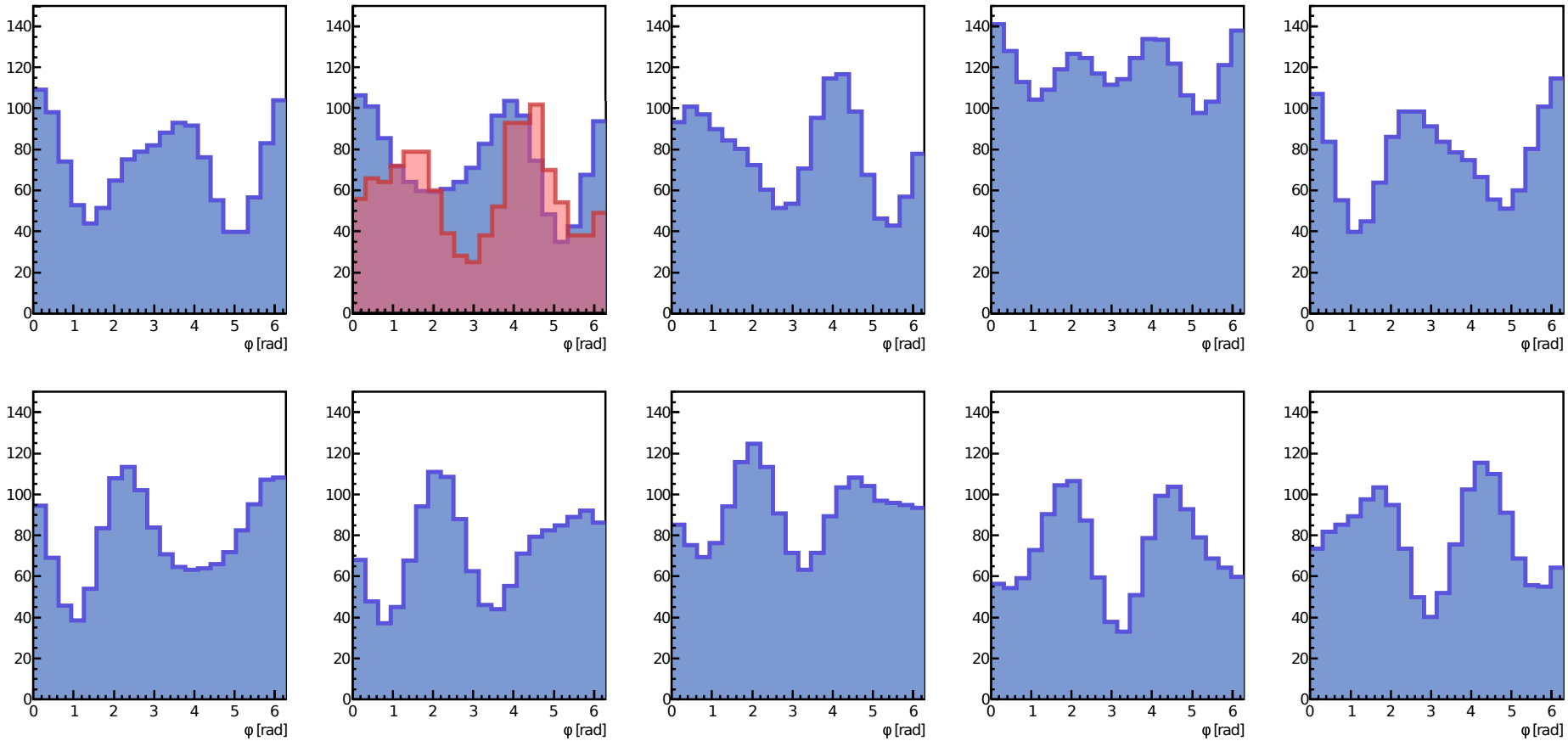
How does it work

Calculate Bayesian probability that the event belong to event bin 1



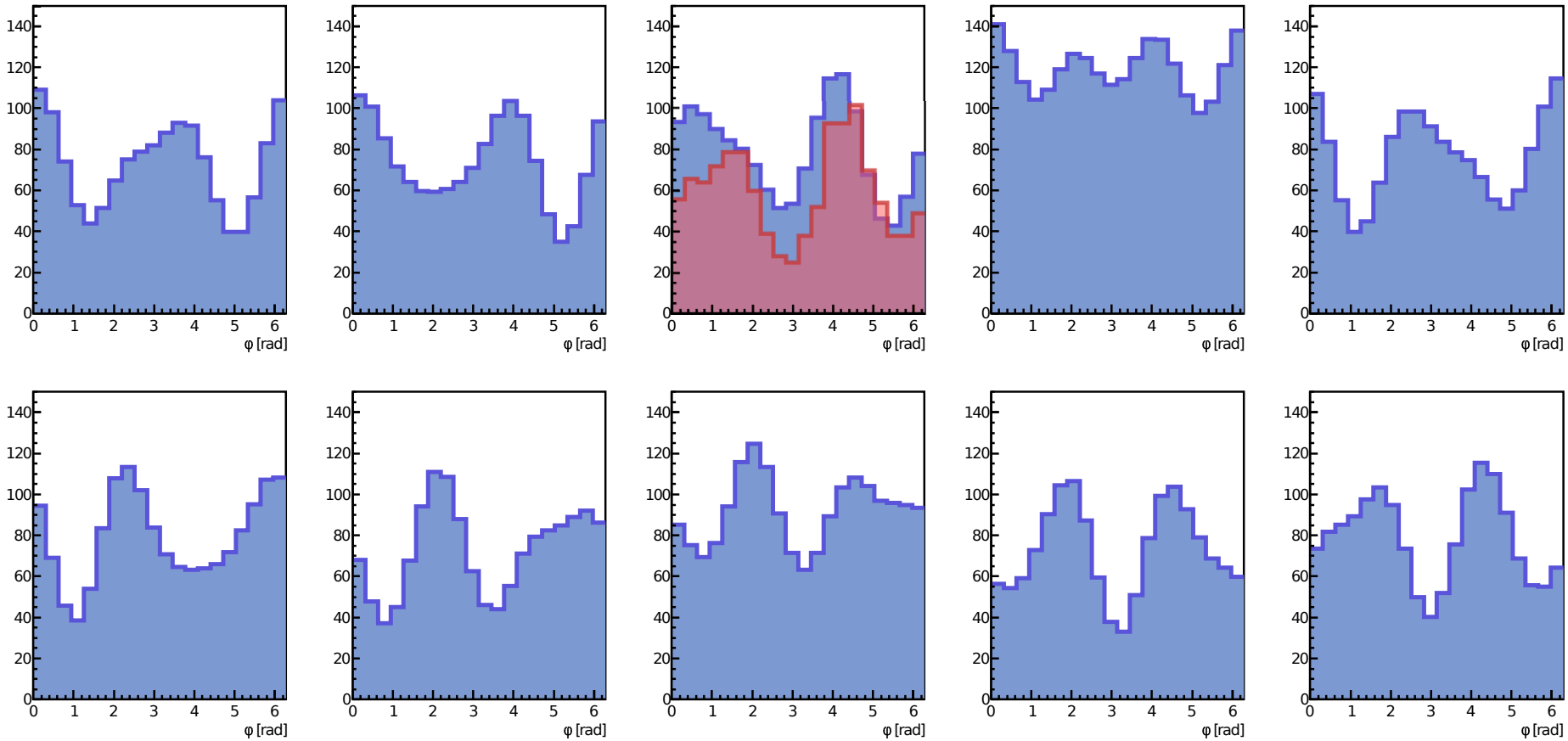
How does it work

Calculate Bayesian probability that the event belong to event bin 2



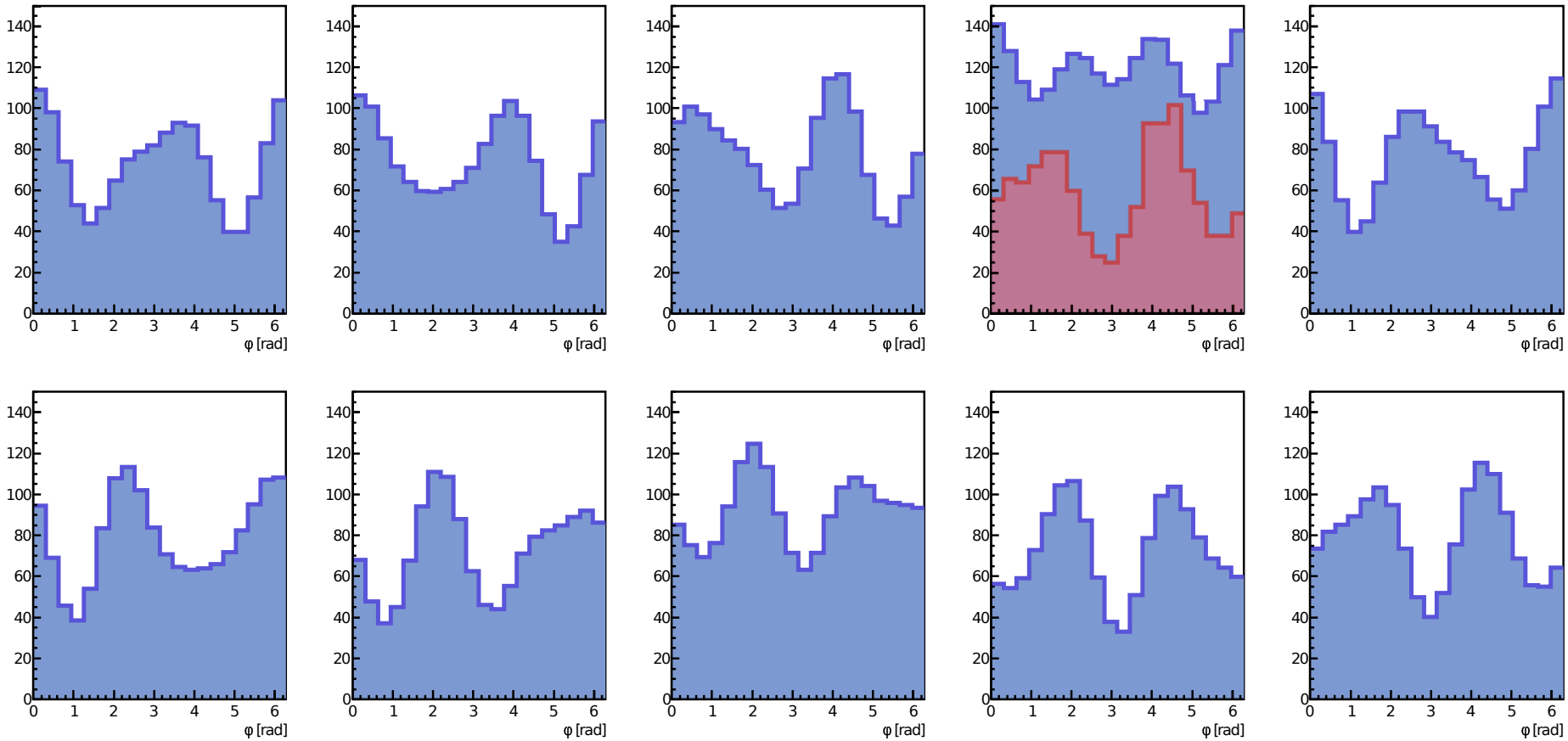
How does it work

Calculate Bayesian probability that the event belong to event bin 3



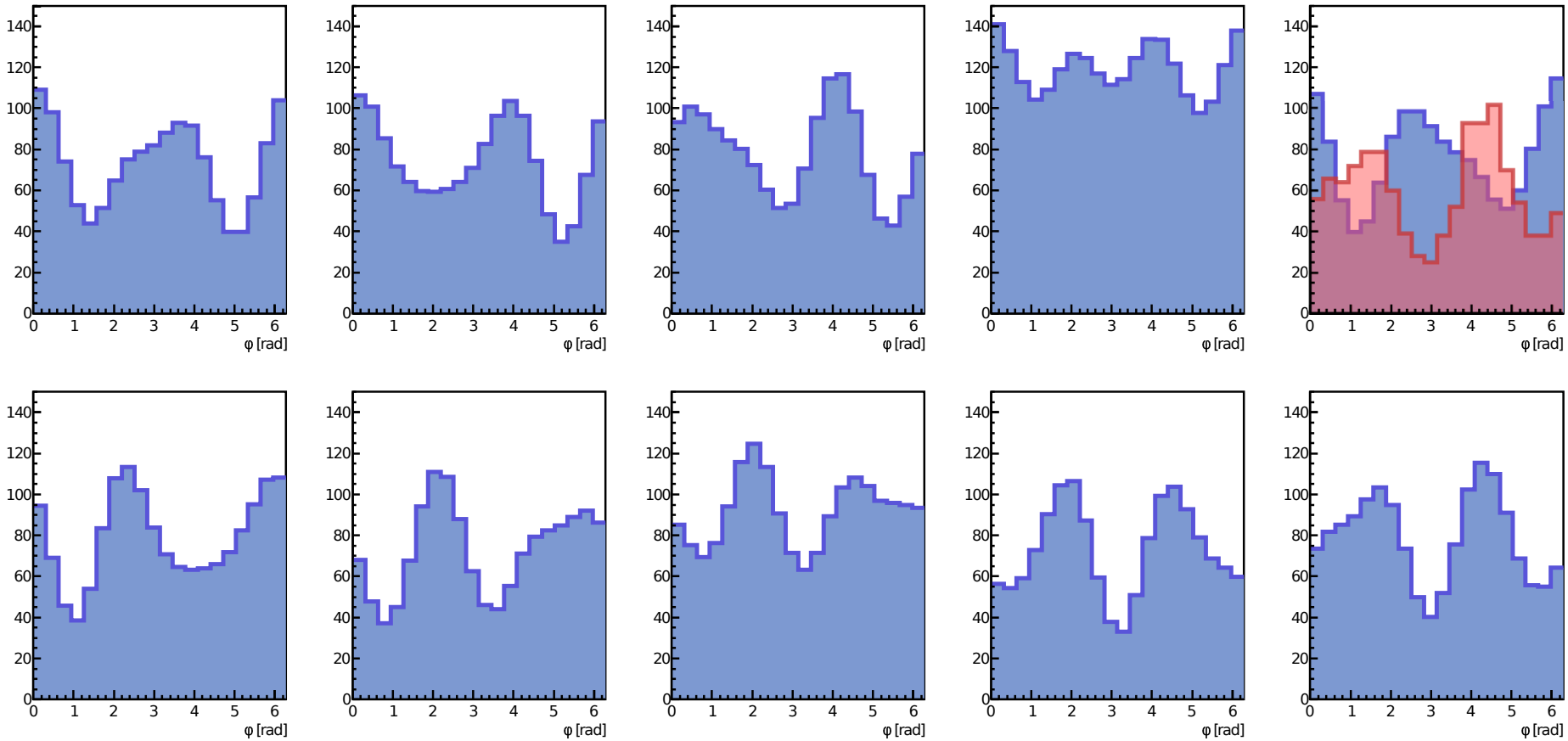
How does it work

Calculate Bayesian probability that the event belong to event bin 4



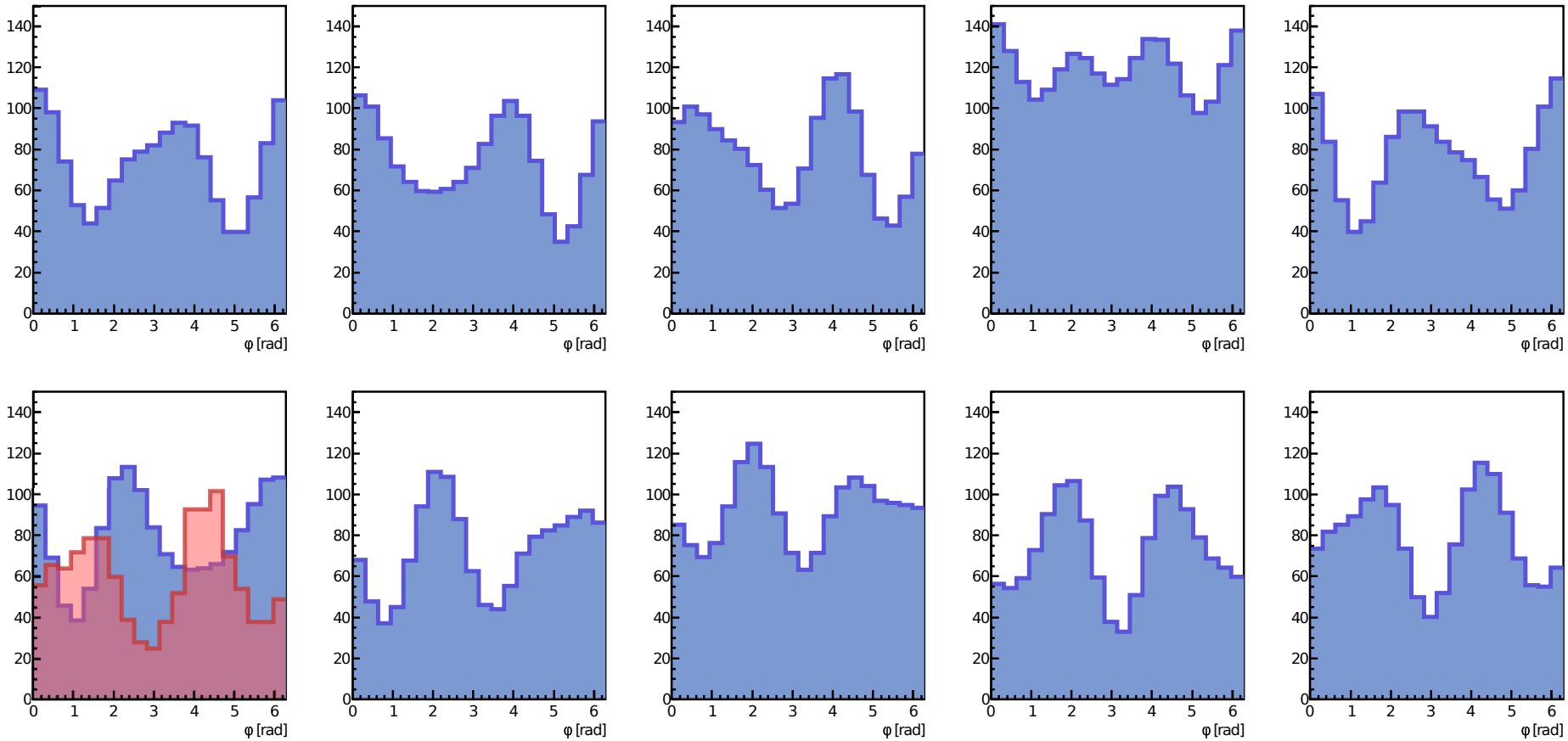
How does it work

Calculate Bayesian probability that the event belong to event bin 5



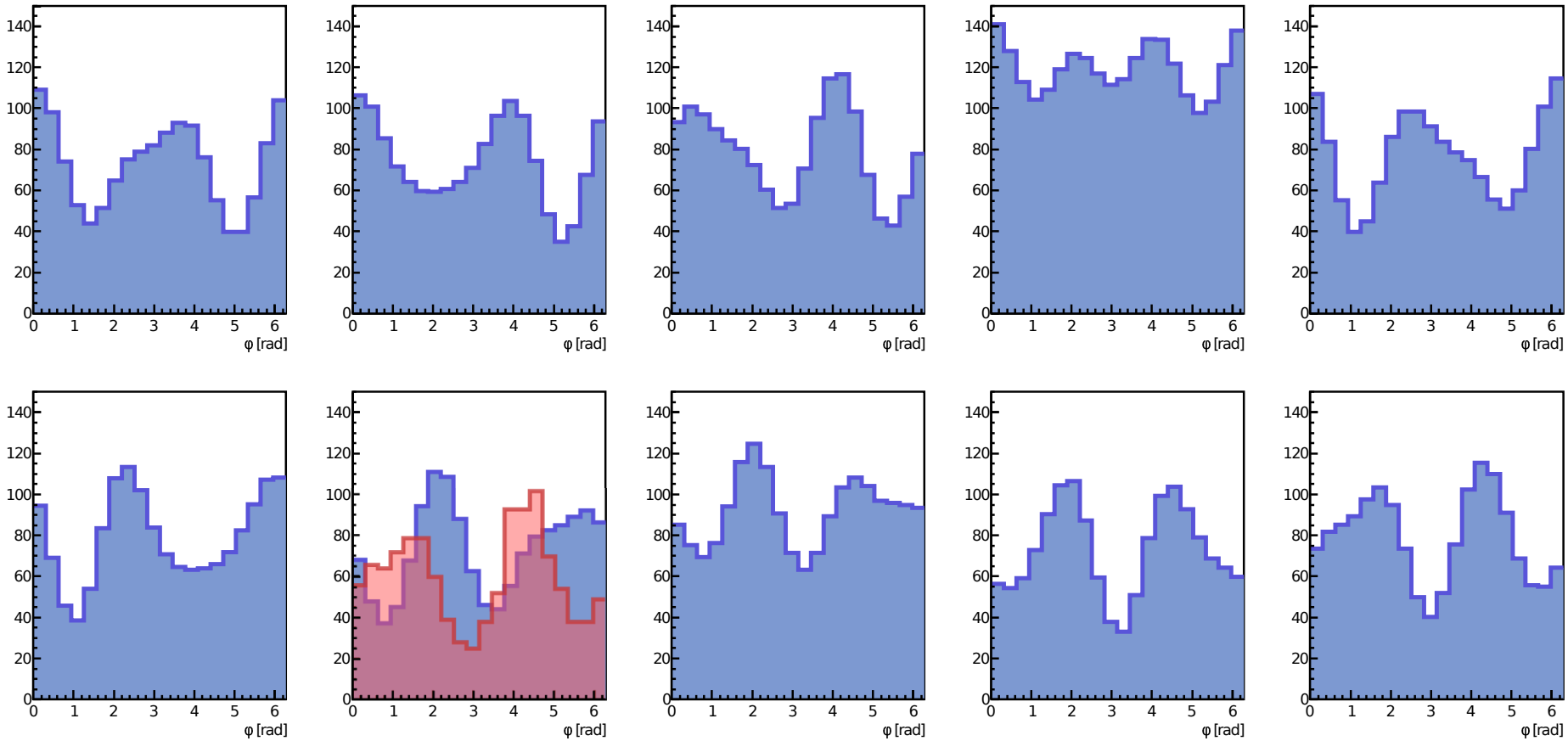
How does it work

Calculate Bayesian probability that the event belong to event bin 6



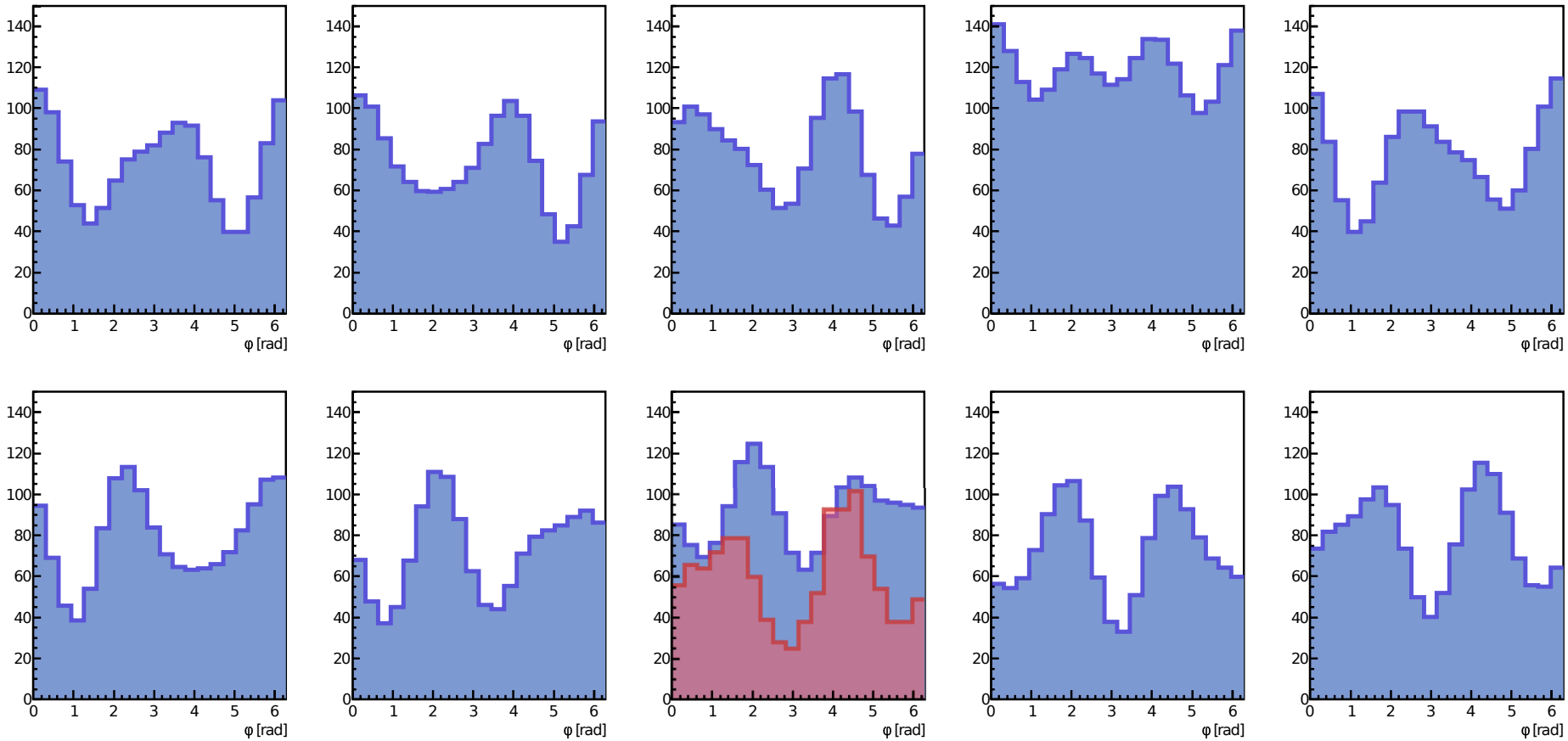
How does it work

Calculate Bayesian probability that the event belong to event bin 7



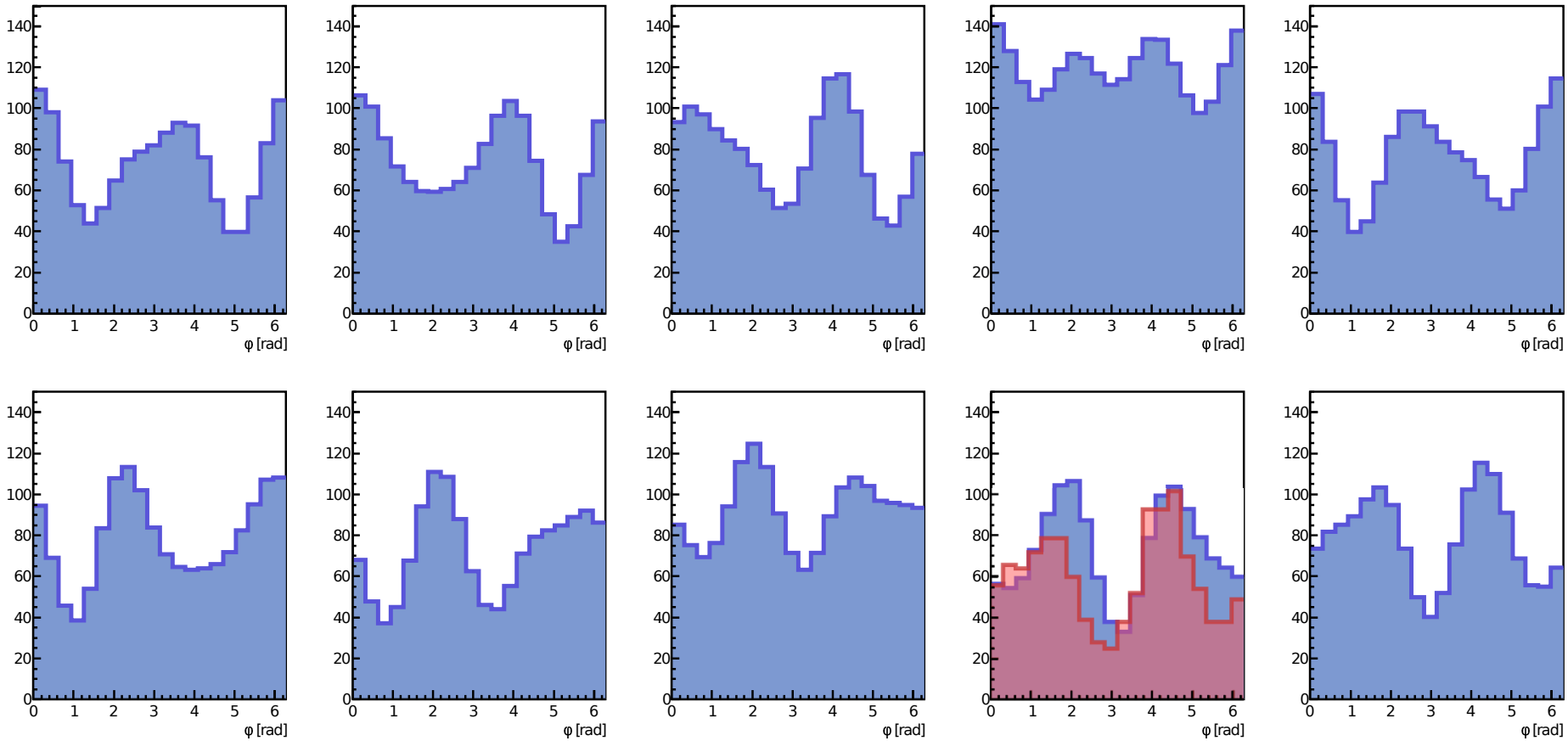
How does it work

Calculate Bayesian probability that the event belong to event bin 8



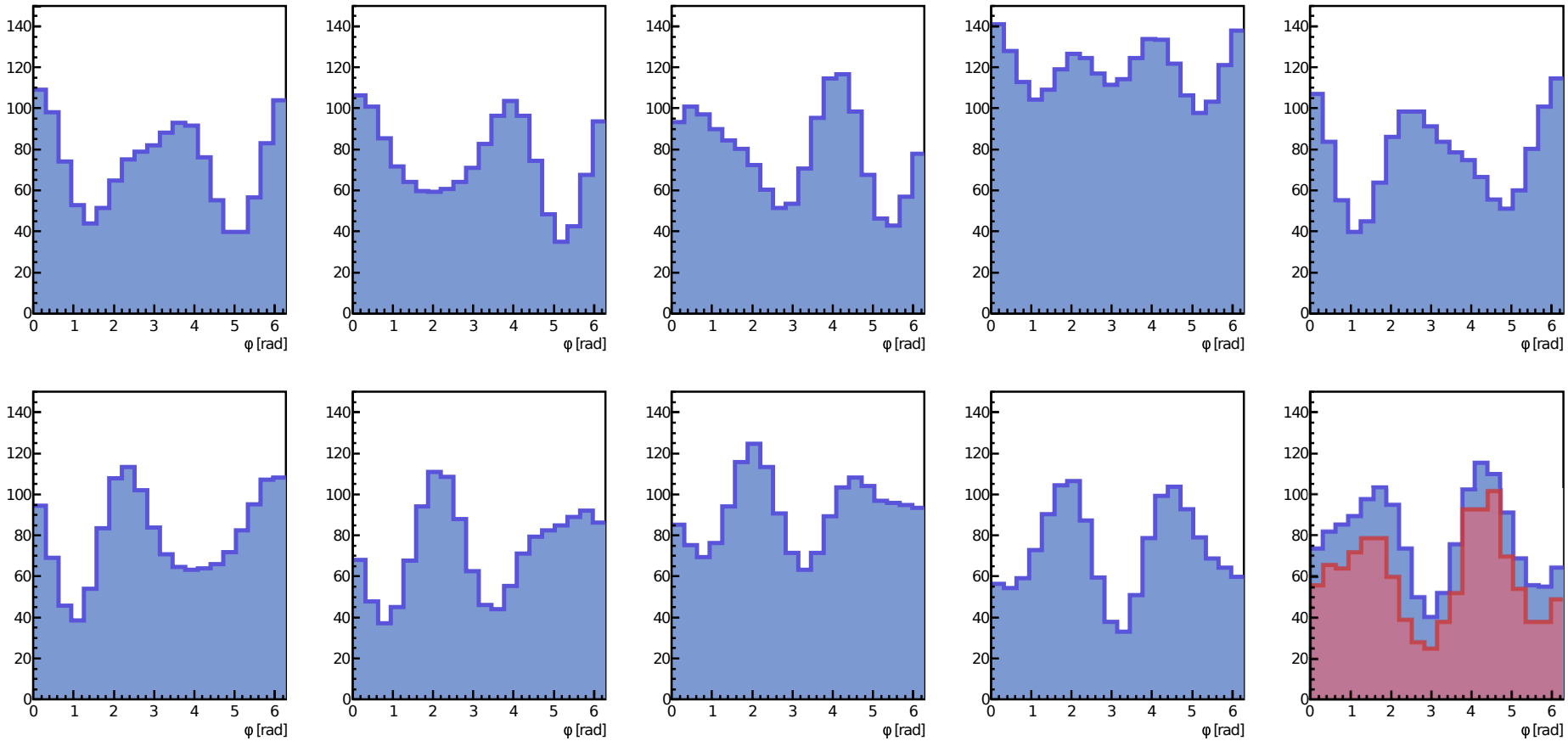
How does it work

Calculate Bayesian probability that the event belong to event bin 9



How does it work

Calculate Bayesian probability that the event belong to event bin 10



After sorting . . .

Similar events end up close to each other.

Different events are far away from each other.

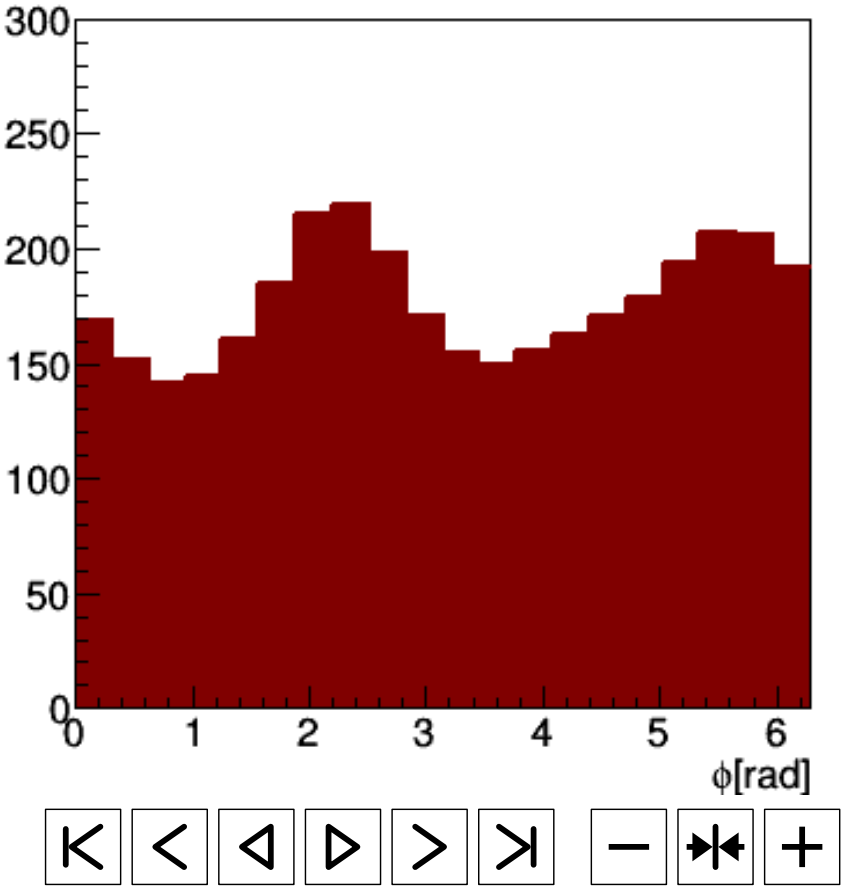
The method always converges to the same sorting.

What is it good for?

- More selective comparison of data to theory.
- Construction of mixed-events background for correlation functions.
- Allows single-event femtoscopy?
- . . . ideas welcome!

Published in
R. Kopečná, B. Tomášik: Eur. Phys. J. A **52** (2016) 115.

Sorted events: Gradual change of event shape



- 2000 events, AMPT centrality 0–20%, $\sqrt{s_{NN}} = 2.76$ TeV
- each frame averaged over 50 events and shifted by 10 events wrt previous frame
- change of colour = change of event bin

Backup: Event Shape Sorting: the algorithm

We will sort events according to their histograms in azimuthal angle.

1. (Rotate the events appropriately)
2. Sort your events as you wish
3. Divide sorted events into quantiles (we'll do deciles)
4. Determine average histograms in each quantiles
5. For each event i calculate Bayesian probability $P(i|\mu)$ that it belongs to quantile μ
6. For each event calculate average $\bar{\mu} = \sum_\mu \mu P(i|\mu)$
7. Sort events according to their values of $\bar{\mu}$
8. If order of events changed, return to 3. Otherwise sorting converged.

S. Lehmann, A.D. Jackson, B. Lautrup, arXiv:physics/0512238
S. Lehmann, A. D. Jackson and B. E. Lautrup, Scientometrics **76** (2008) 369 [physics/0701311 [physics.soc-ph]]