Faculty of Physics

WARSAW UNIVERSITY OF TECHNOLOGY

Unfolding the effects of FSI and QS in two-particle angular correlations

PRC 104, 054909 (2021)

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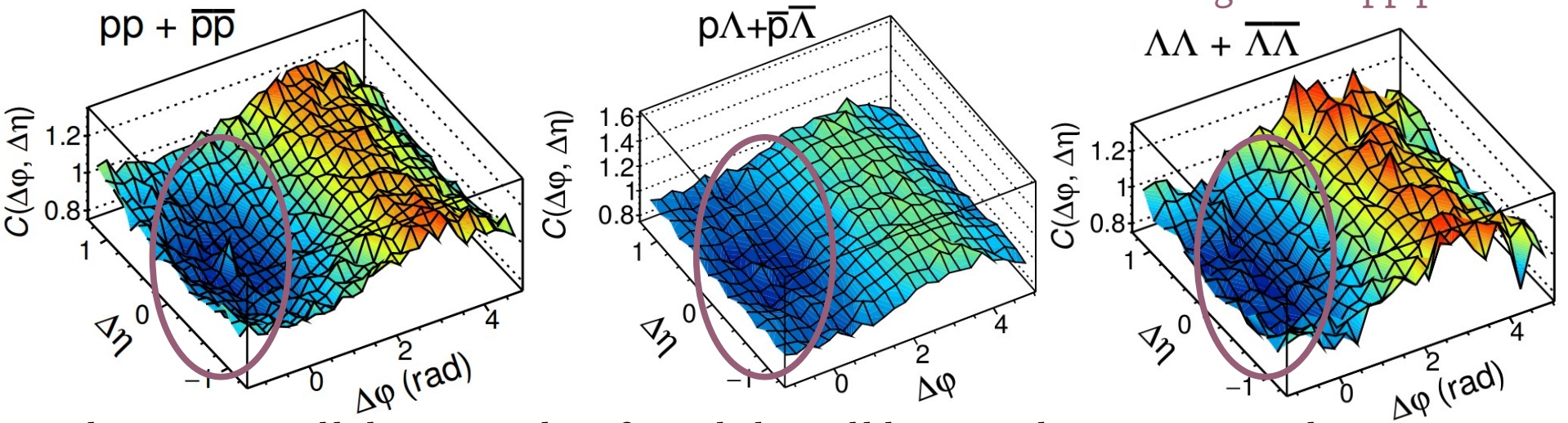
Δη Δφ of baryons

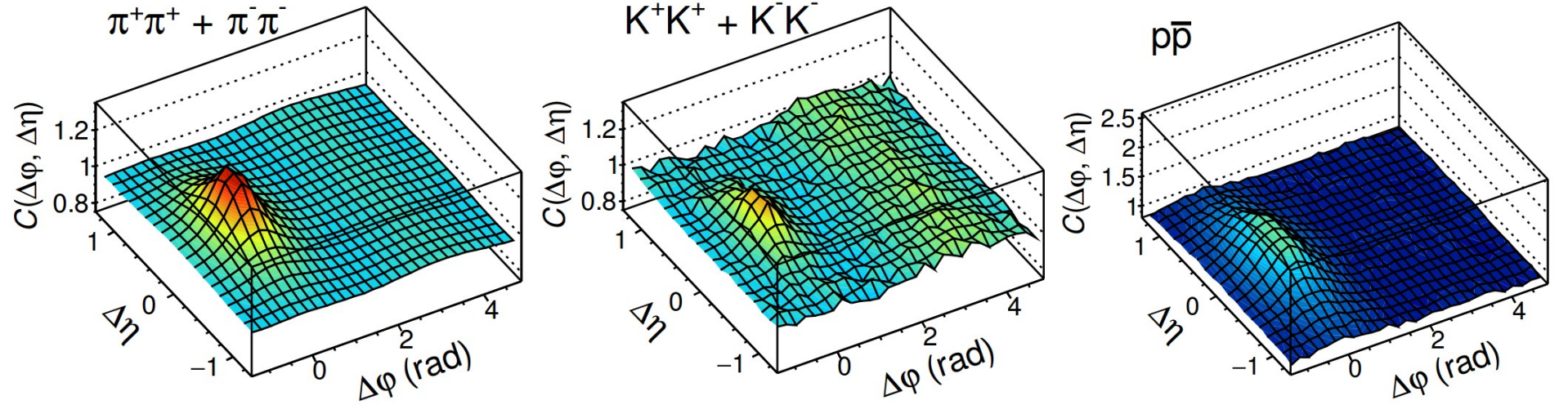
ALICE, Eur.Phys.J. C77 (2017) 8, 569

pp @ $\sqrt{s}$ = 7 TeV

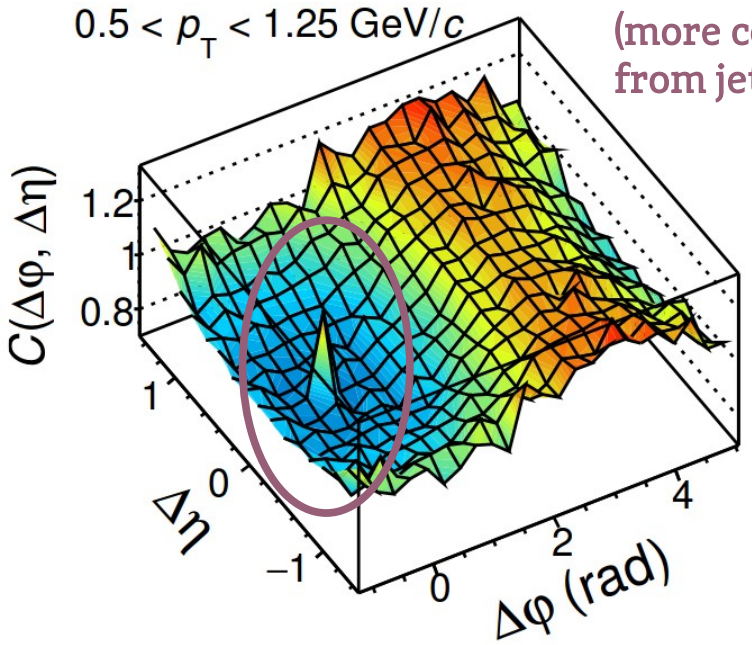
"strange" small peak at (0,0)
strongest for pp pairs



- The ALICE Collaboration has found that all baryon-baryon pairs show a **depression (anticorrelation)** instead of a typical near-side peak
- Baryon-antibaryon pairs or meson pairs produce "expected" correlation shape

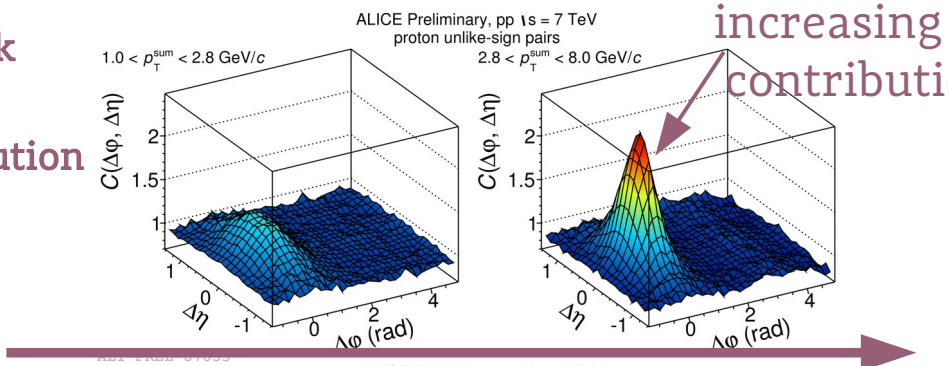


What is the origin of the "small peak" in pp correlations?



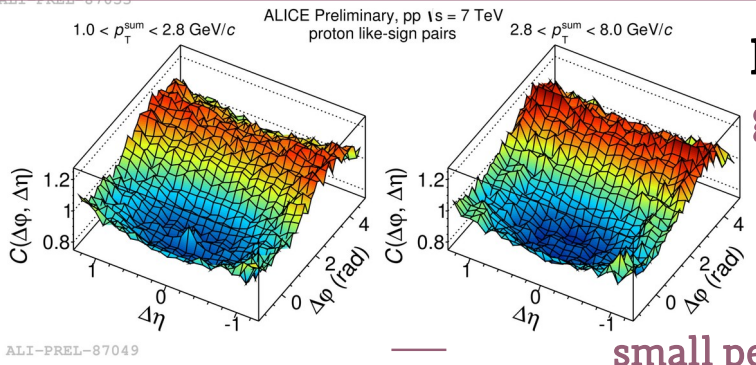
Near-side peak grows with p_T (more contribution from jets)

$\overline{pp}$



increasing jet contribution

p_T growth



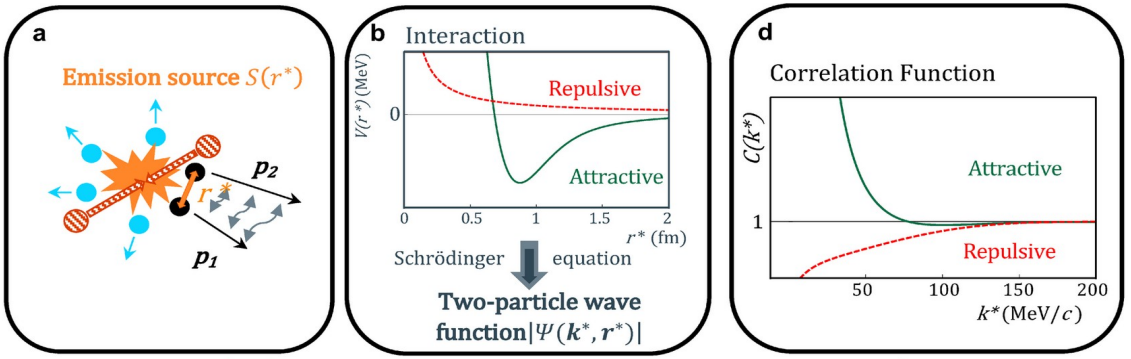
$pp+\overline{pp}$

small peak disappears for high p_T

- The peak seems to behave **strangely** → decreases with increasing p_T
- Is it an unnoticed and not removed **detector effect** OR is there some **physics behind it**?
  - the ALICE paper **claims** it is a **manifestation of the strong baryon-baryon final-state interaction** (strong FSI) → **how to prove it?**

Strong interaction studies with femtoscopy

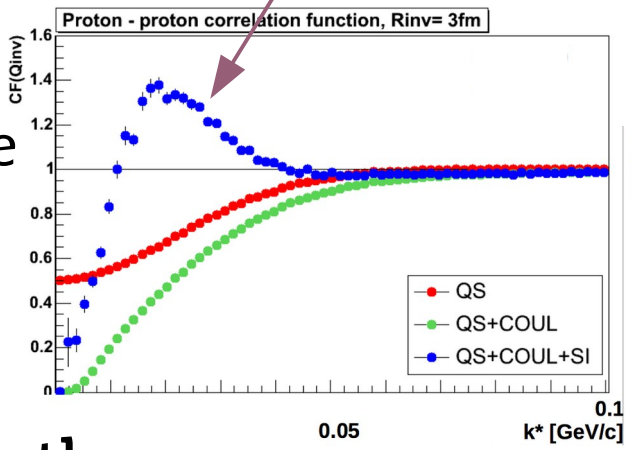
ALICE, Nature 588, 232-238 (2020)



ALI-PUB-483391

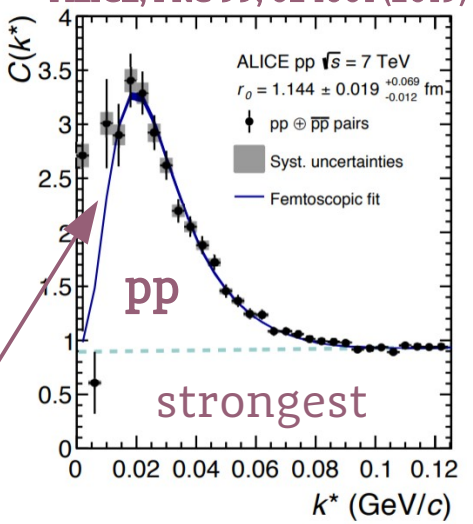
- Femtoscopy has recently become a powerful tool used to study two-particle interactions
- **Can we use femtoscopic measurements to test the "small peak" hypothesis in the angular correlations?**

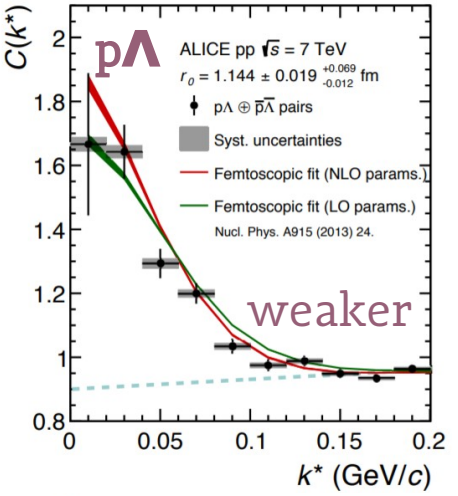
strong FSI

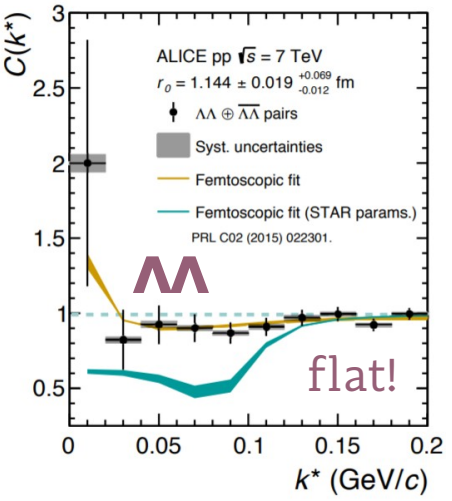


H. Zbroszczyk, Ph.D. thesis

ALICE, PRC 99, 024001 (2019)





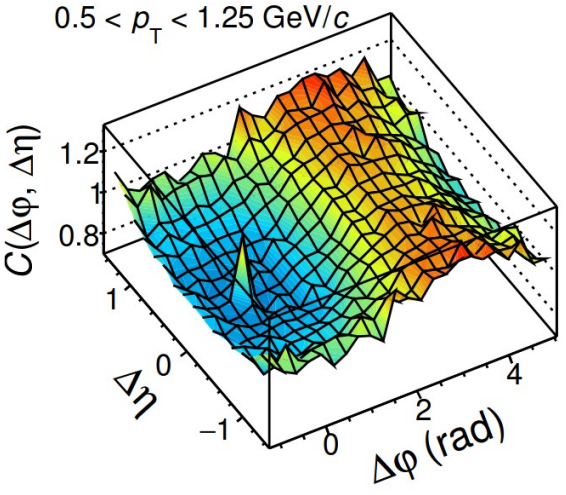


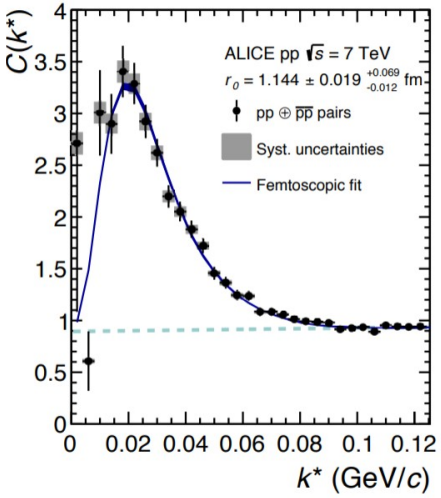
Unfolding FSI and QS effects

In our new paper we propose a **simple algorithm** to **unfold** the angular correlation from measured femtoscopic one

- we test the method with PYTHIA 8 simulations coupled to Lednicky and Lyuboshitz formalizm
- we show **how** the effects of **strong FSI and QS** manifest in angular correlations

unfolding



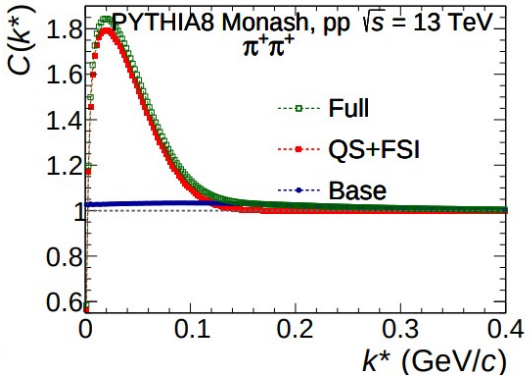


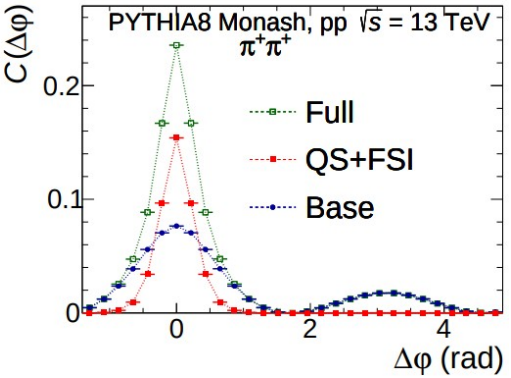
1. $C_{\text{base}} = S/M$, where M is the mixed-event distribution, contains only the event-wide correlations, without the QS and FSI effects added by the afterburner;

S – same event distribution
w – weight from Lednicky model

2. $C_{\text{full}} = S_{\text{w}}/M$ contains the full information, that is the event-wide correlations with additional effects of QS and FSI added by the afterburner;

3. $C_{\text{QS+FSI}} = M_{\text{w}}/M$ contains only the effects related to QS and FSI and is an equivalent to numerical integration of Eq. (2).





Ł.G. & M.J., PRC 104, 054909 (2021)

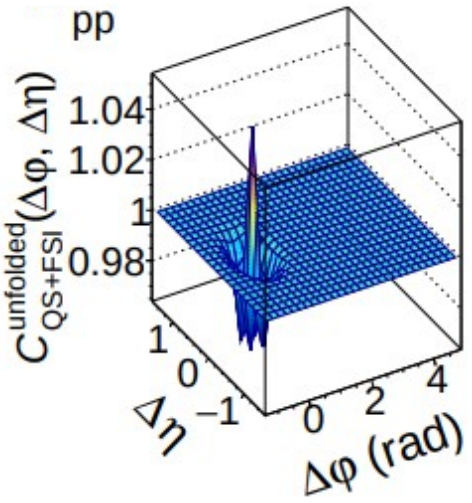
Unfolding procedure

Ł.G. & M.J., PRC 104, 054909 (2021)

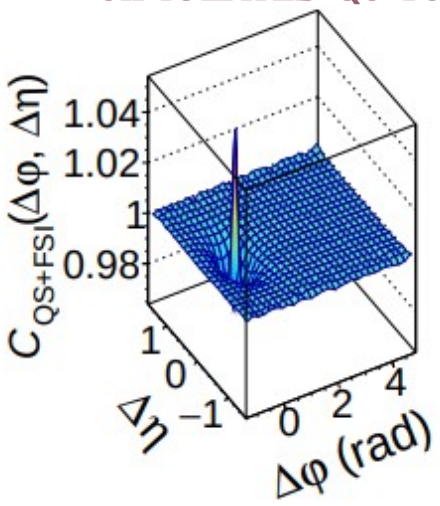
- **Direct transformation** from C(k*) to C(ΔηΔφ) **not possible**
- We propose a **simple Monte Carlo procedure**
  - we obtain the angular correlation function by **sampling** the measured (or theoretical) femtoscopic correlation
  - femto CF has **increased sensitivity** to **short-range effects** (i.e. strong FSI), and **reduced sensitivity** to **event-wide effects**
    → the global energy-momentum conservation shape is not preserved in unfolded angular CF
    → the strong FSI is well-preserved and clearly seen as a sharp, narrow peak at (0,0), which proves the ALICE hypothesis
    → weaker femto CF for pΛ and ΛΛ pairs (weaker contribution from strong FSI) → less prominent "small peaks" in angular CF

pp

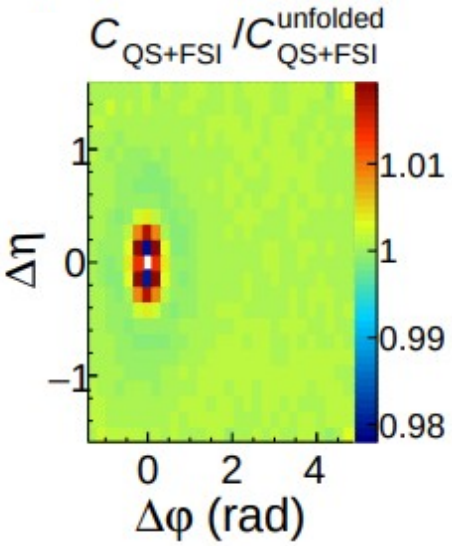
UNFOLDED FROM FEMTO CF QS+FSI

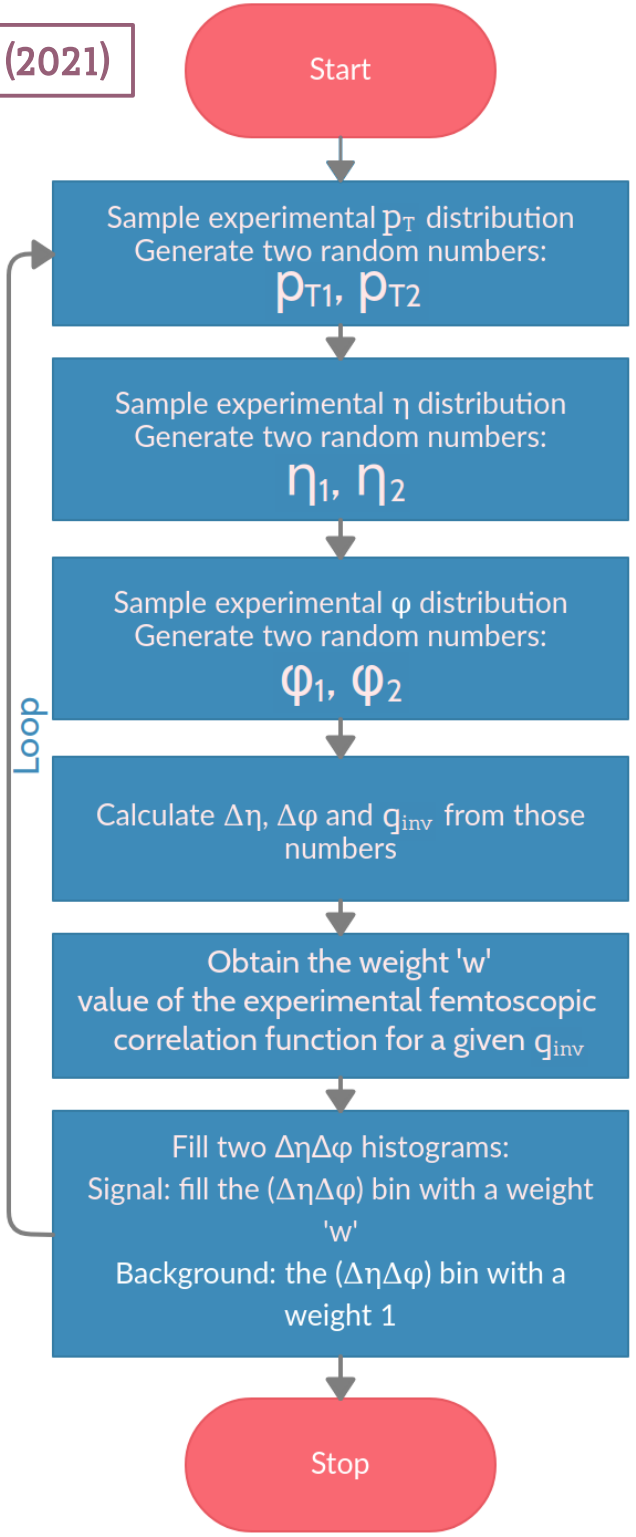


PYTHIA WITH LEDNICKY SIMULATED QS+FSI



RATIO





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