Status of the Arm1 neutron analysis

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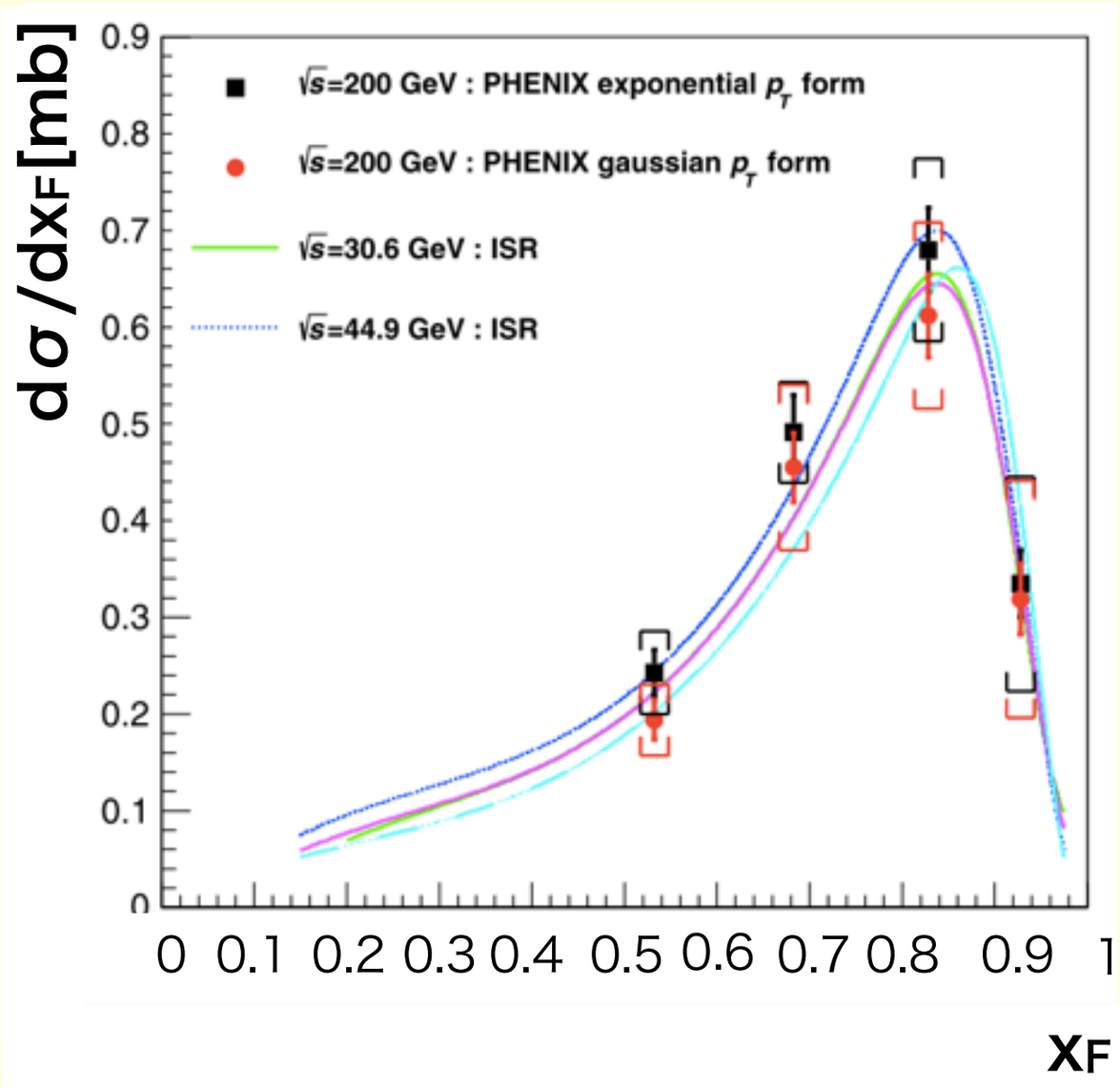
LHCf Collaboration Meeting, Nagoya, 6-Apr-2017

Energy dependence of neutron spectrum



- The PHENIX experiment and ISR showed that the neutron energy spectrum with proton-proton collisions scaled by beam energy in lower energy.
  → Neutron spectrum have no energy dependence with $\sqrt{s} < 200$ GeV collisions.

$$x_F = \frac{\text{particle energy}}{\text{beam energy}}$$

A. Adare. et al. (2013)

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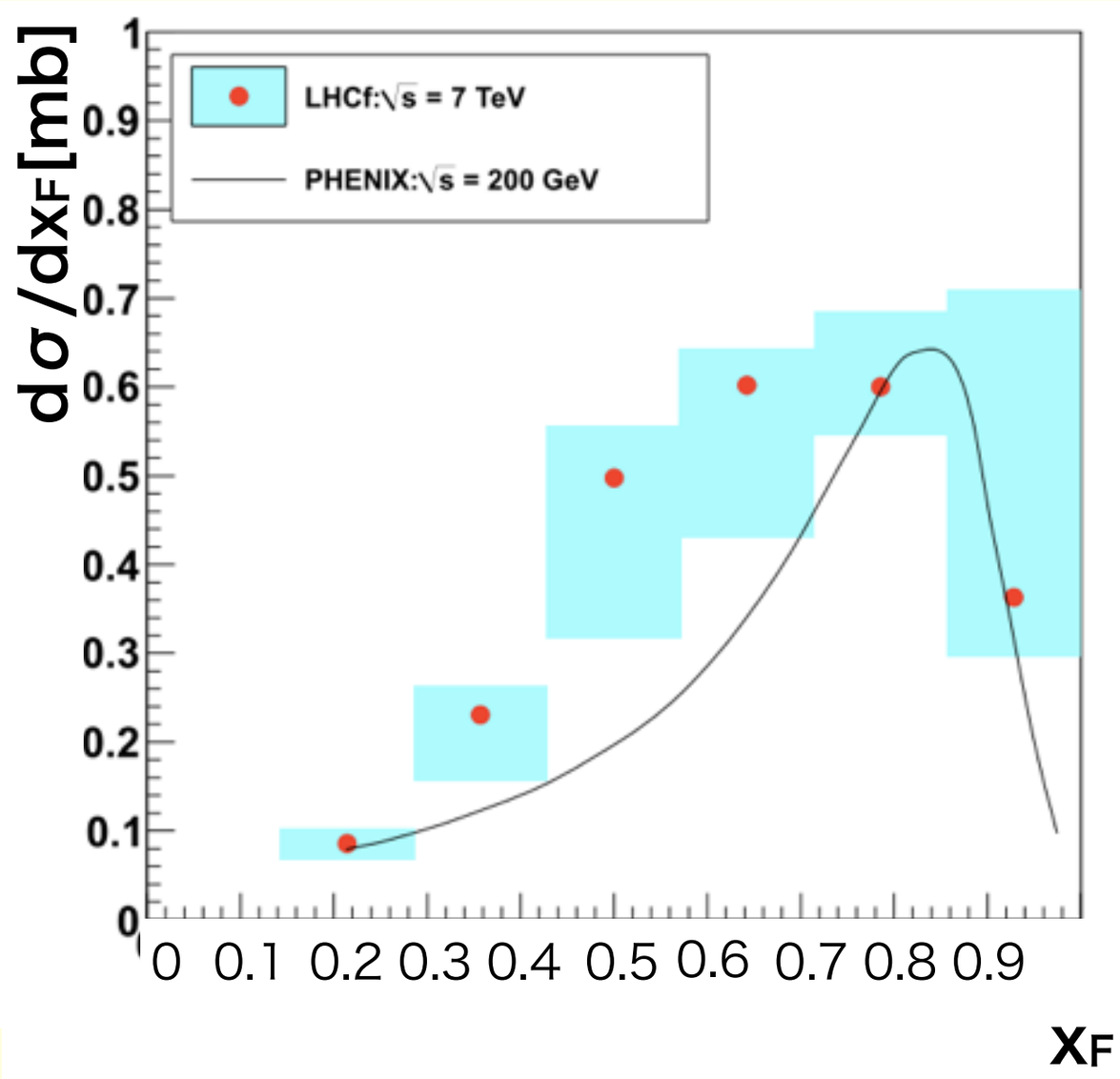

K. Kawade (2014)

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  → Is there collision energy dependence in neutron spectra??

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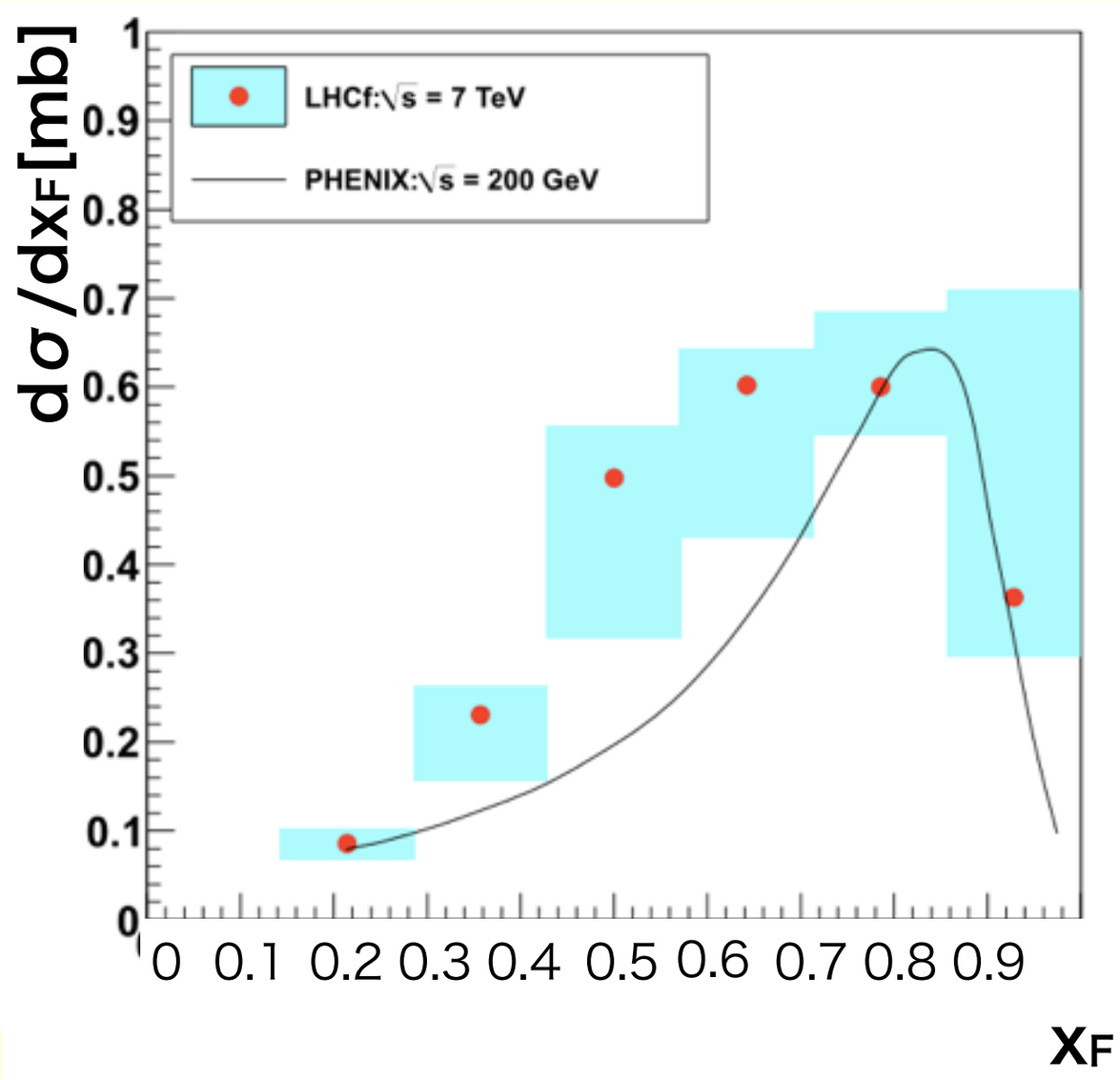

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- BUT the LHCf spectra with $\sqrt{s}$=7TeV proton-proton collision was not scaled.
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LHCf can check the neutron spectra with highest collision energy.

Neutron spectra analysis

・Data : 12-Jun-2015 — 13-Jun-2015

・The number of events : 2.1×10^6

Event selection criteria

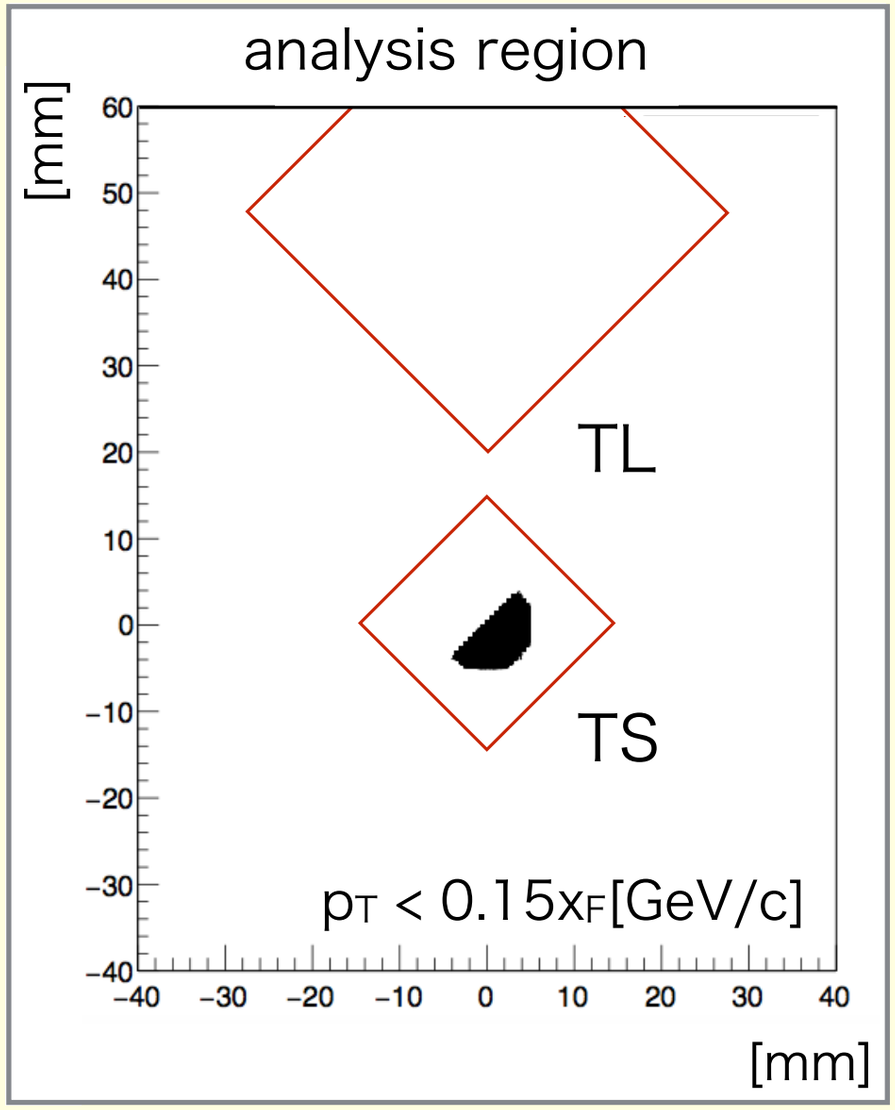
- Software trigger
- p_T selection:

  (Compare with Arm2)

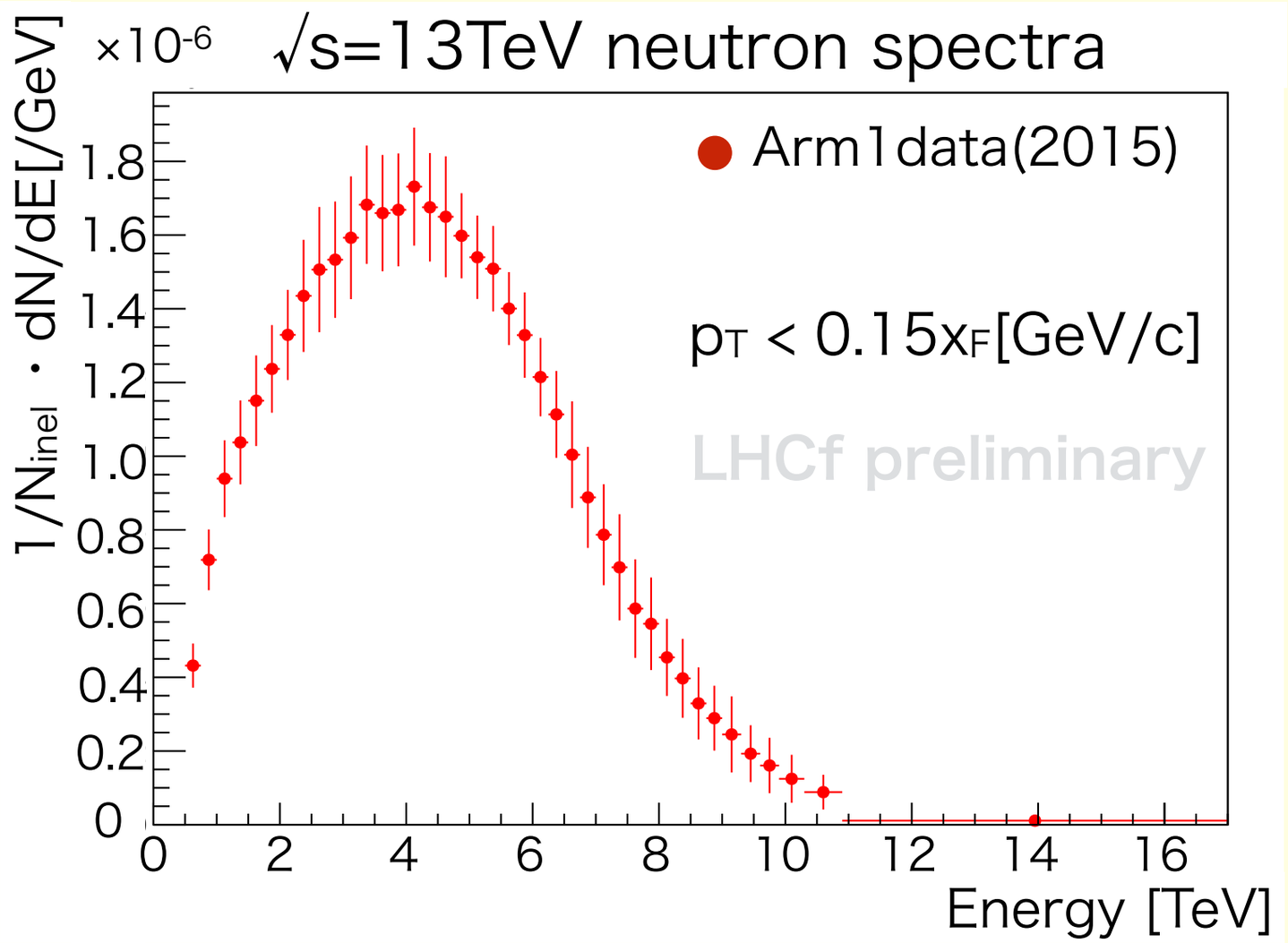
  $p_T < 0.15x_F$[GeV/c]

  (Compare with $\sqrt{s}$=7TeV)

  $p_T < 0.11x_F$[GeV/c]
- Particle identification



Folded neutron spectra in Arm1



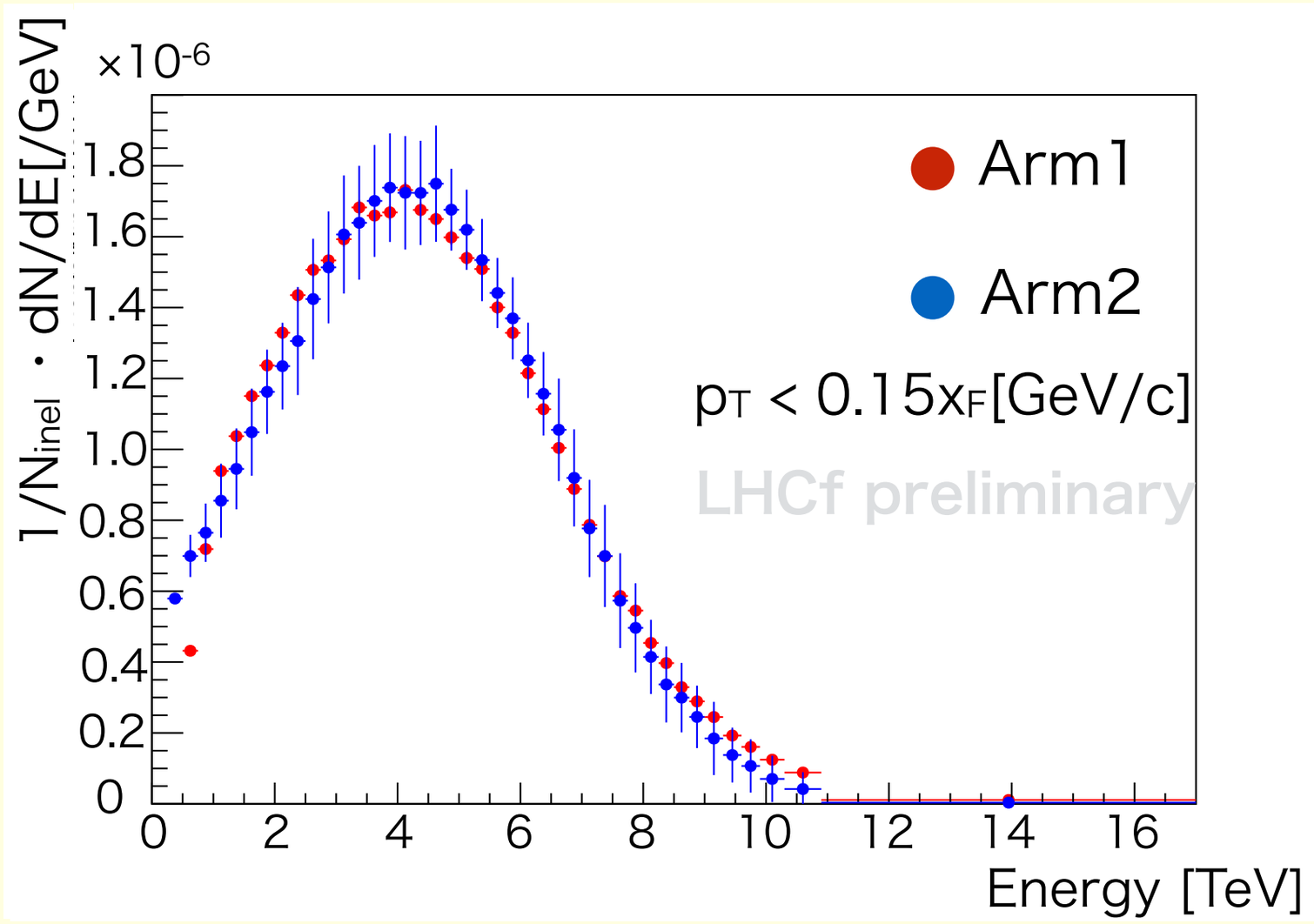
*error: Arm2 systematic + statistic

・Comparison with Arm2
($p_T < 0.15x_F$[GeV/c])

・Comparison with
√s=7TeV(Arm1)
($p_T < 0.11x_F$[GeV/c])

Comparison with the Arm2 spectra

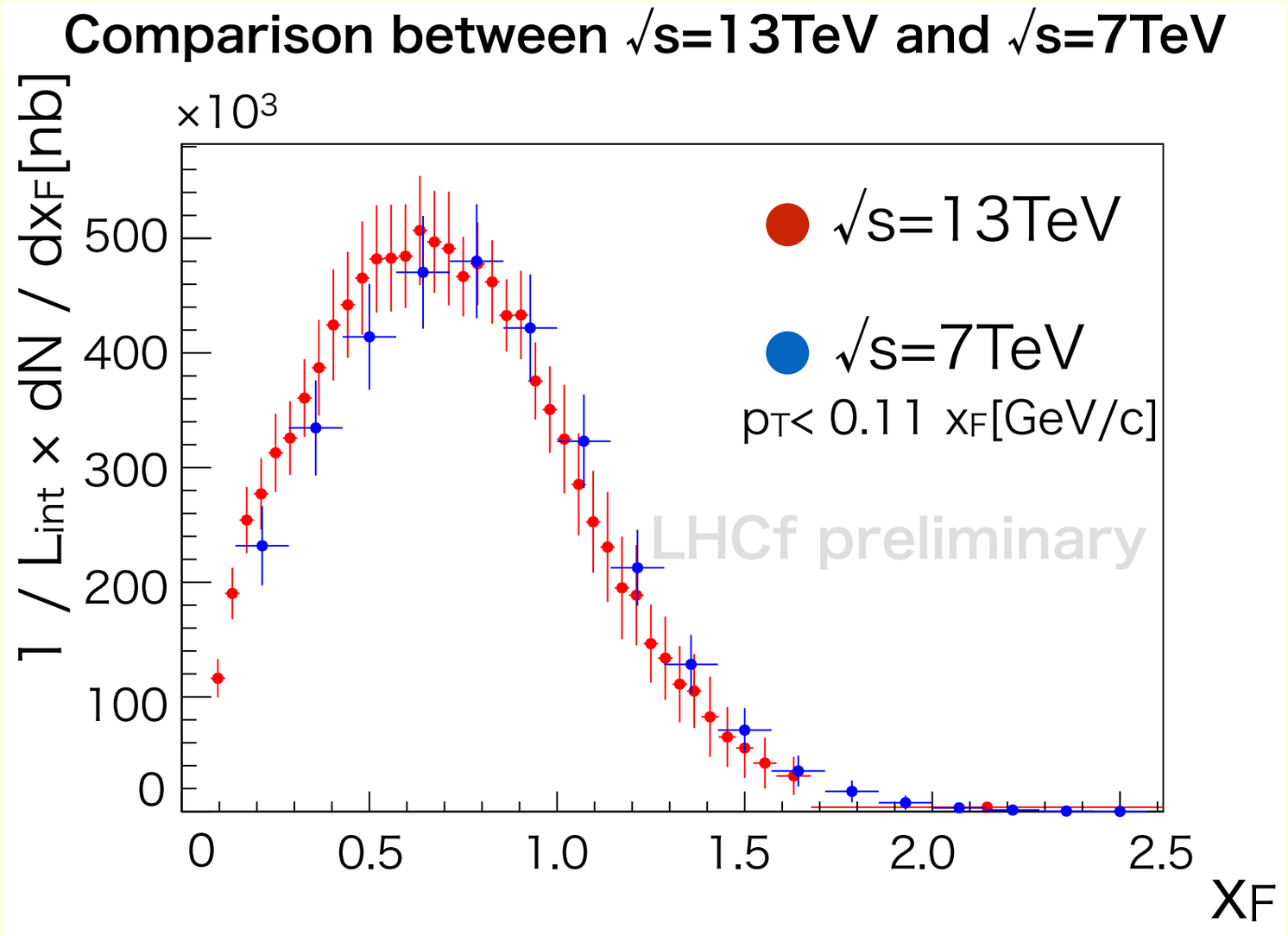
Obtained folded spectra was compared with Arm2 folded spectra.



・Arm1 spectra was consistent with Arm2 spectra in systematic error.

Comparison with √s=7TeV neutron spectra

Obtained √s=13TeV spectra was compared with √s=7TeV spectra.

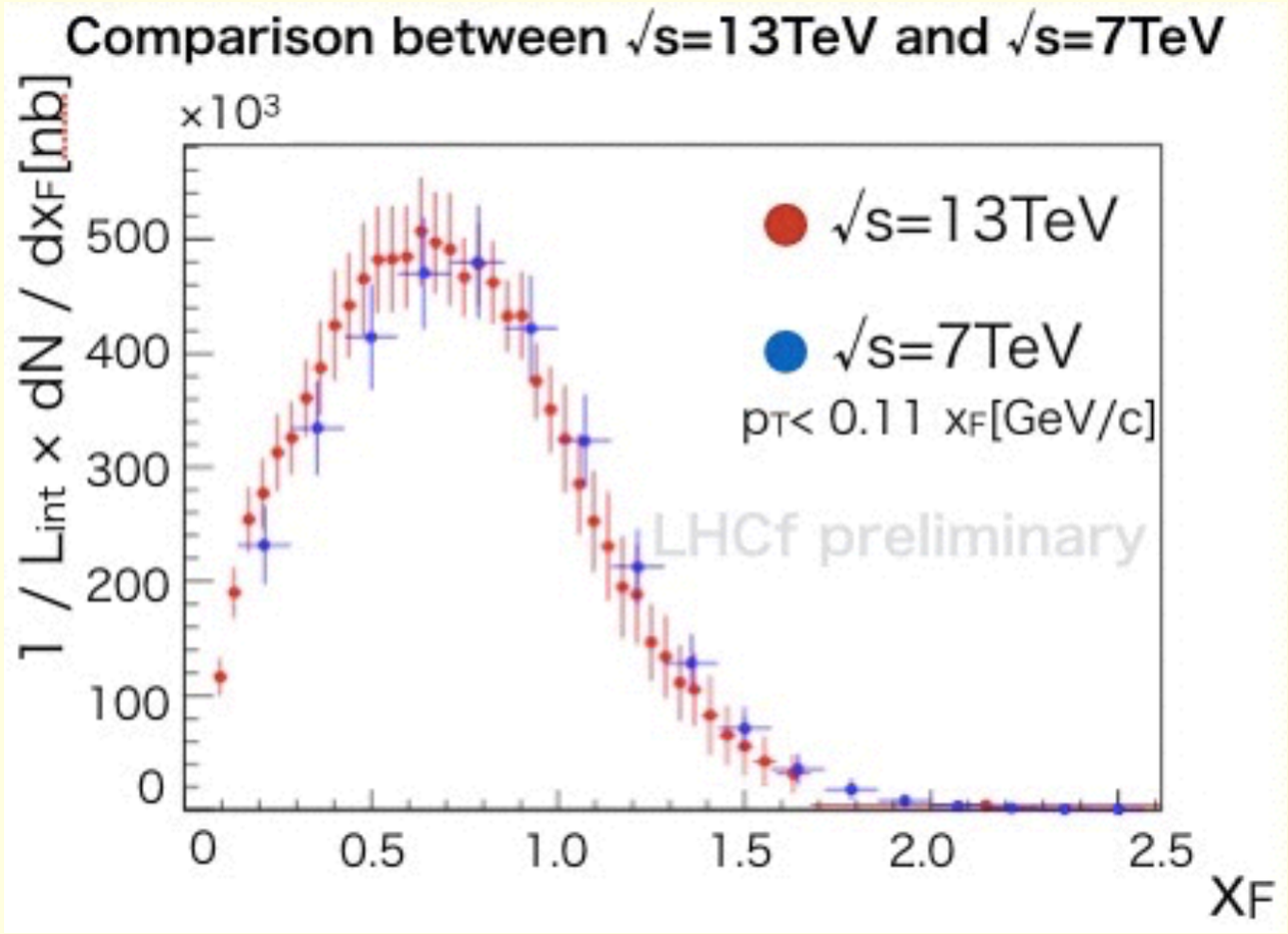


- √s=13TeV spectra looks like shift to lower x_F.
- √s=13TeV spectra is consistent with √s=7TeV spectra in systematic error.

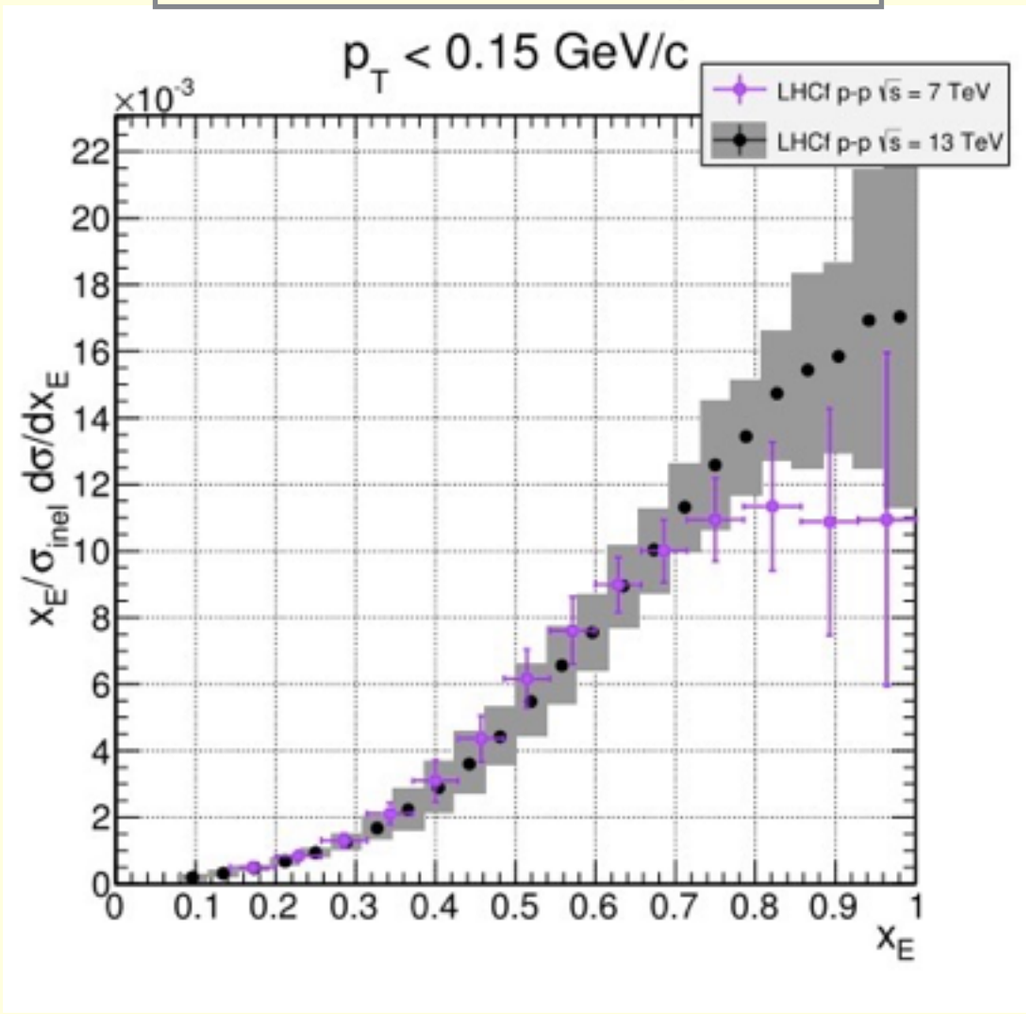
$$x_F = \frac{\text{particle energy}}{\text{beam energy}}$$

Comparison with Arm2 result

Arm1 folded spectra



Arm2 unfolded spectra



The Arm1 spectra looks shift to low x_F,
the other hand, Arm2 spectra looks shift to high x_F.

Status of the analysis
Calibration of the detector

Estimation of ADC/GeV conversion factors using proton beam for last layers	Not yet
Estimation of energy conversion coefficients and position dependent correction factor.	In progress
Estimation of the energy uncertainty from calibration	Not yet

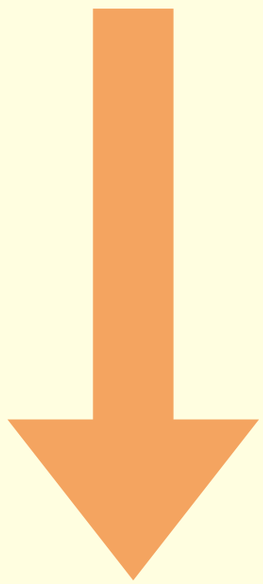
Analysis status

Raw energy spectra

Background correction not yet

PID correction almost done

Reconstructed energy spectra



Multihit correction not yet

Fake event correction not yet

Iterative Bayesian Unfolding not yet

Unfolded energy spectra

MC status

		ARM1		ARM2	
		QGSJET	DPMJET	QGSJET	DPMJET
SPS configuration	calibration of old detecter		<p250GeV> 500k(TS) 1000k(TL) <p300GeV> 410k(TS) 511k(TL) <p350GeV> 500k(TS) 1000k(TL)	<p300GeV> 800k(TS) 1600k(TL) <p350GeV> 1600k(TS) 3200k(TL)	<p300GeV> 800k(TS) 1600k(TL) <p350GeV> 1600k(TS) 3200k(TL)
LHC configuration	for sumdE to E conversion factor		<n100,200,300,500,800GeV> 10k <n1,1.31.5,2,3,4,5,6.5TeV> 10k	(only DPMJET)	<n100,200,300,500GeV> 125k <n1,2,3,4,5,6TeV> 50k
	for shower leakage function		<n1TeV> 4000k(TS) 5000k(TL)		<n1TeV> 1512k(TS) 2400k(TL)

shortage of statistics

Summary

- Neutron energy spectra with $\sqrt{s} < 200$ GeV p-p collisions are scaled by beam energies.
- But LHCf $\sqrt{s} = 7$ TeV neutron spectra suggested the possibility of energy dependence with high energy p-p collisions.

- Analyzed LHCf $\sqrt{s}$=13 TeV data and obtained raw neutron energy spectra.

- There is many things for final neutron result…
  →We will concentrate for neutron works.