

Light-ion collisions to eke out the path-length dependence of energy-loss

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Model

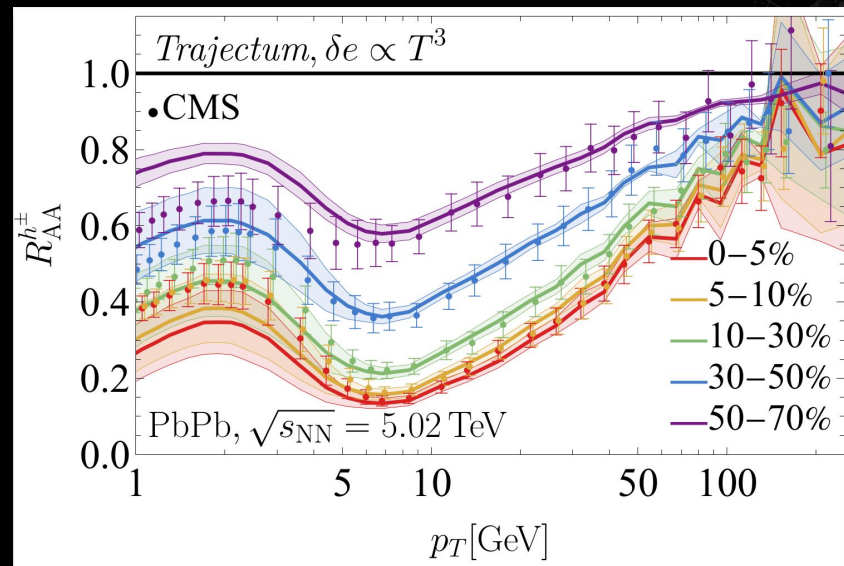
$$R_{AA} = \sigma_{pp}(p_T + \delta e(p_T)) / \sigma_{pp}(p_T)$$

$$\delta e(p_T) = \kappa(p_T) \int T^3 \mathbf{u} \cdot d\mathbf{L}$$

Along trajectories
through the plasma

Fit in some reference centrality
(not sensitive to choice)

Rest is a prediction



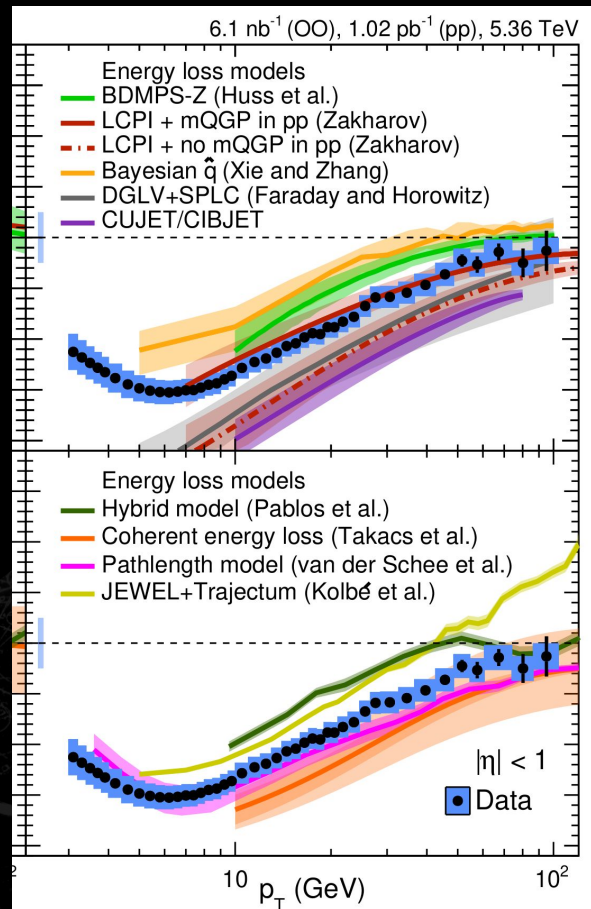
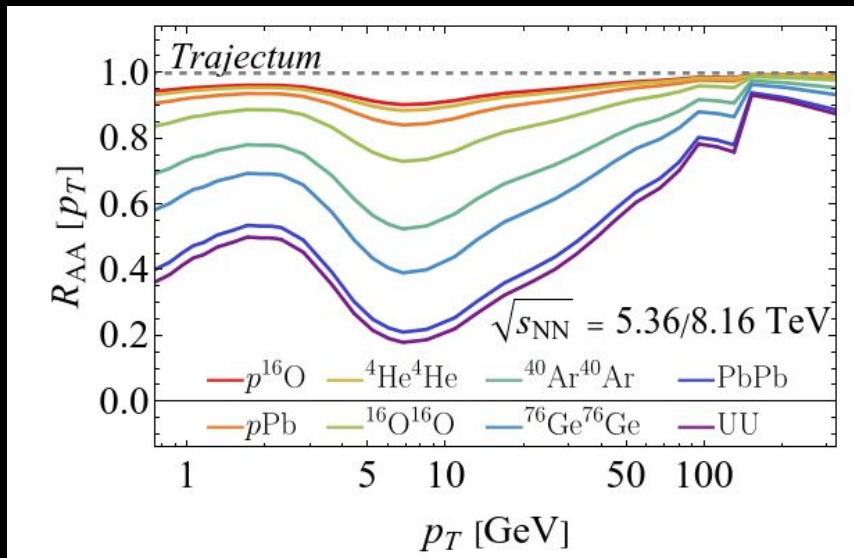
Bands:

- Trajectum settings
- Choice of reference centrality

Light-ion predictions

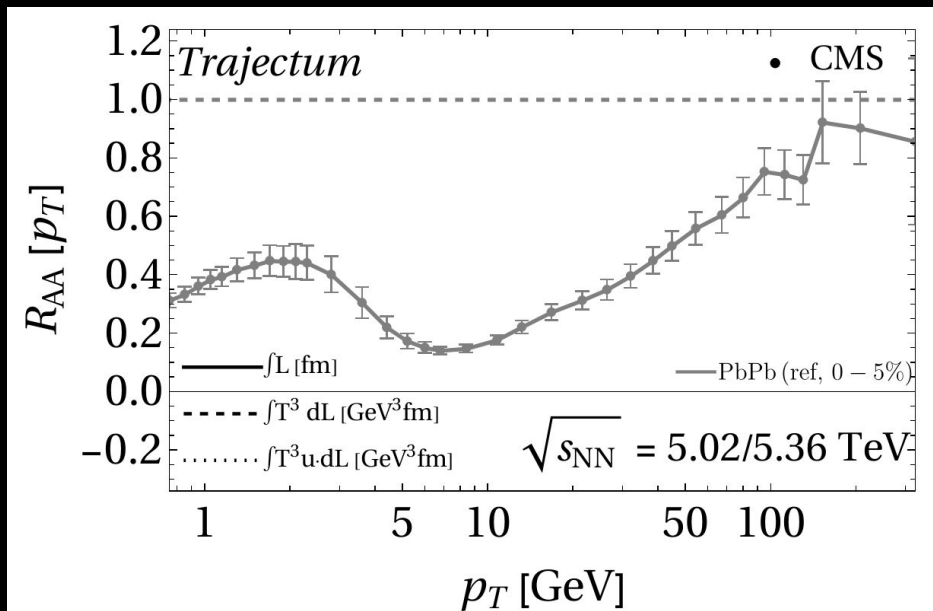


Light-ion predictions



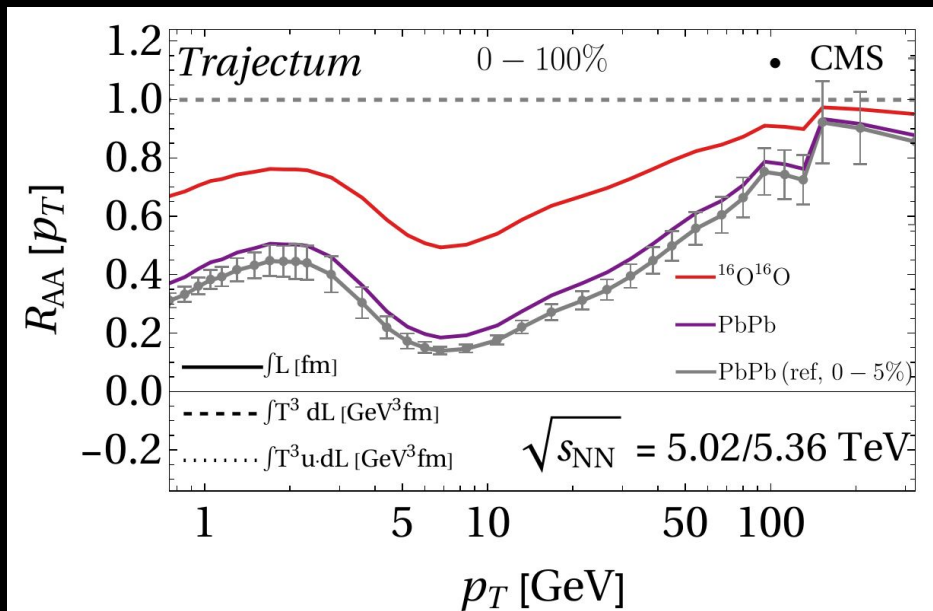
What is the nature of the path-length dependence?

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Start with a fit to
0-5% in PbPb

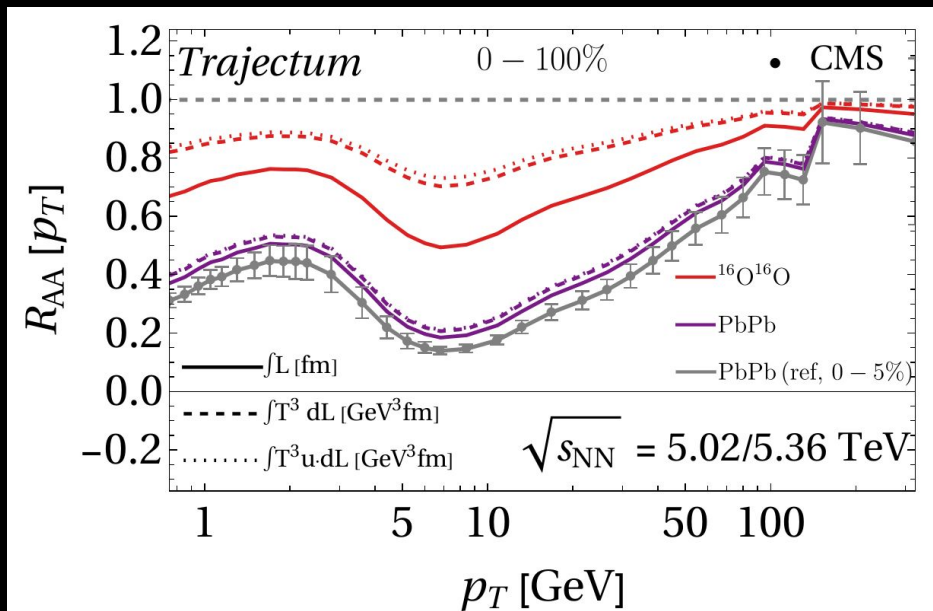
What is the nature of the path-length dependence?



Predict min.bias:

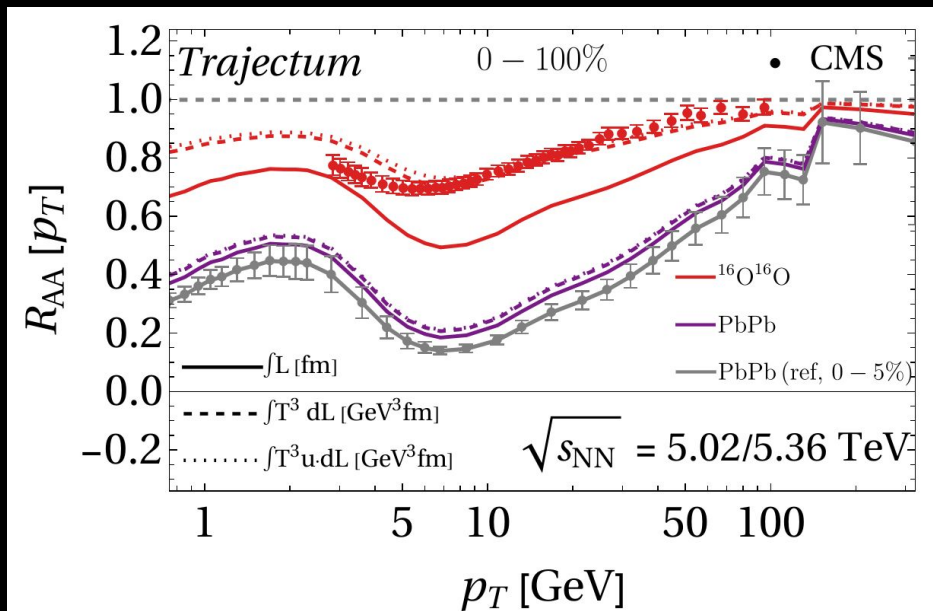
Energy-loss if only dependent on brick pathlength

What is the nature of the path-length dependence?



Add temperature dependence

What is the nature of the path-length dependence?



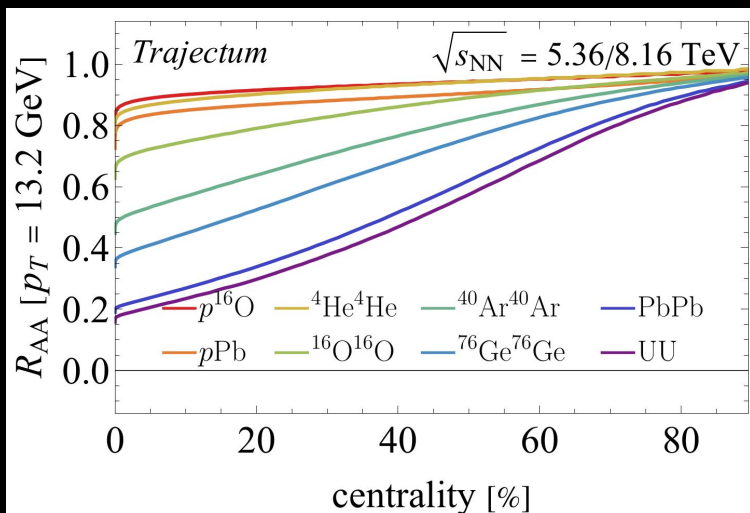
Show me some data



Let's dig into the system-size dependence

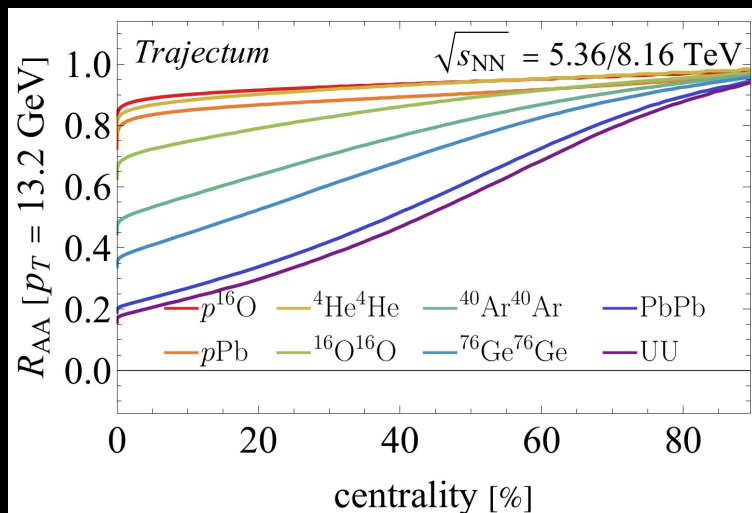
Does this get you to a system-size dependence?

Centrality obfuscates the size-dependence

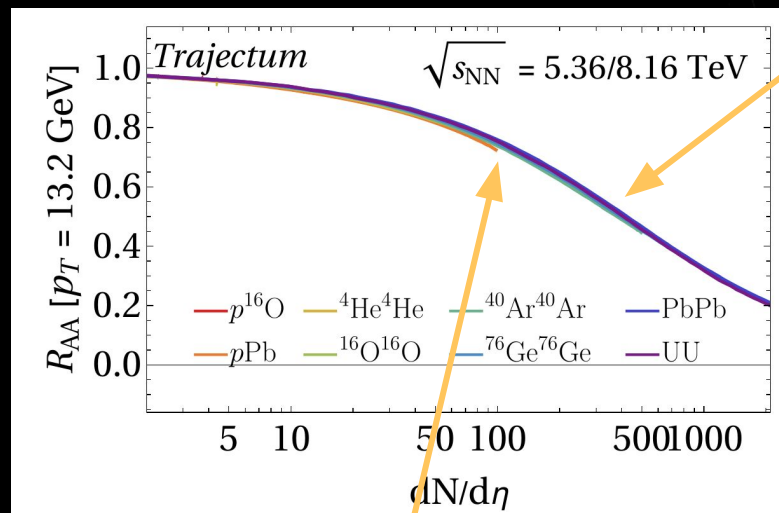


Does this get you to a system-size dependence?

Centrality obfuscates the size-dependence



Multiplicity reveals universal behaviour

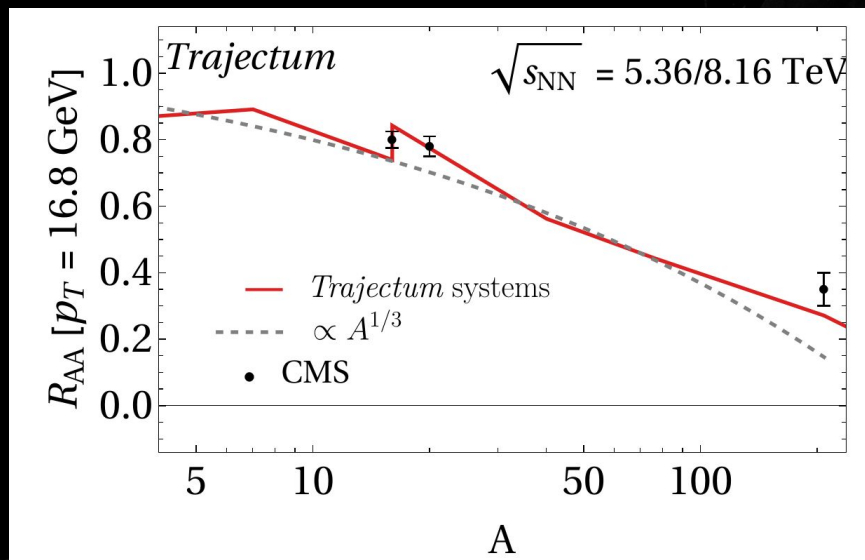
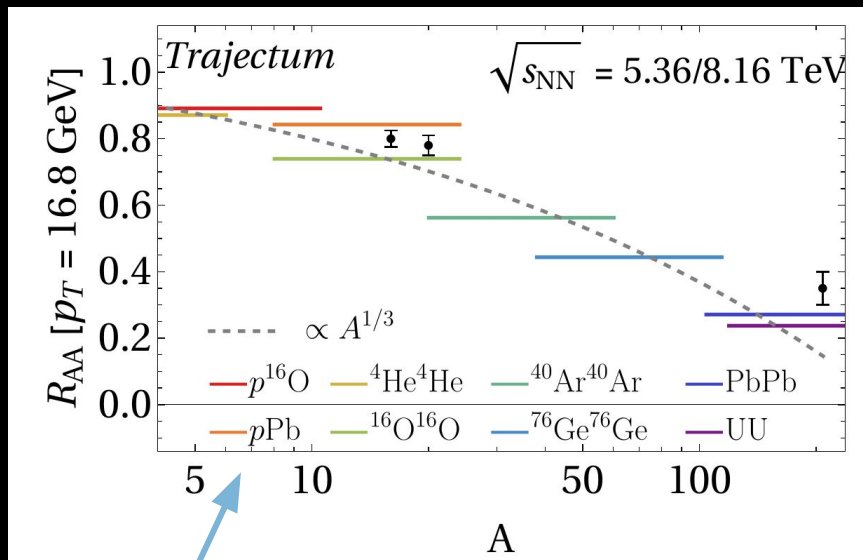


Smooth transition across systems

Universality broken in high-mult. tails:
Same L, higher T

Energy-loss as a function of system-size*

* size of the colliding system

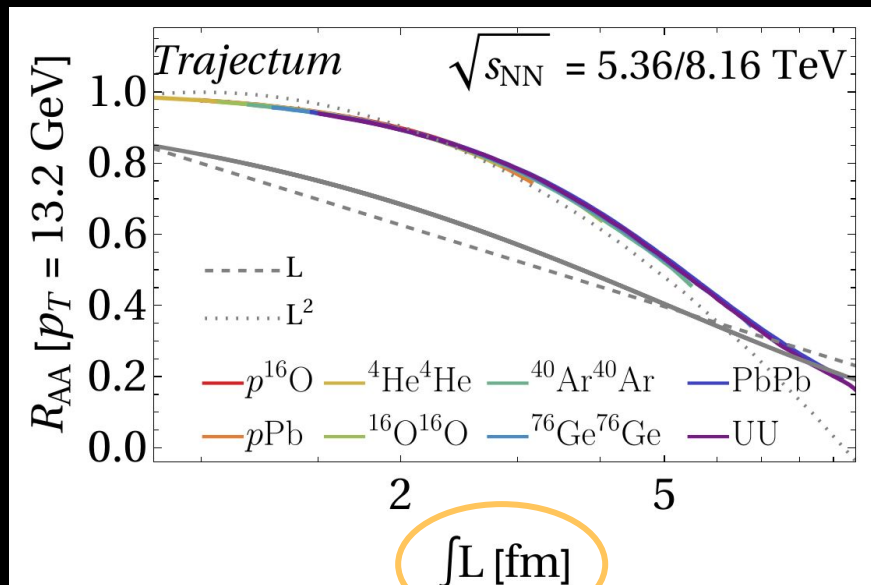


“Effective” A:

- pO: 7
- pPb: 16

Same physics, different aesthetics

One last thing about the brick

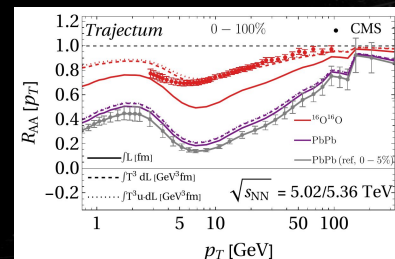
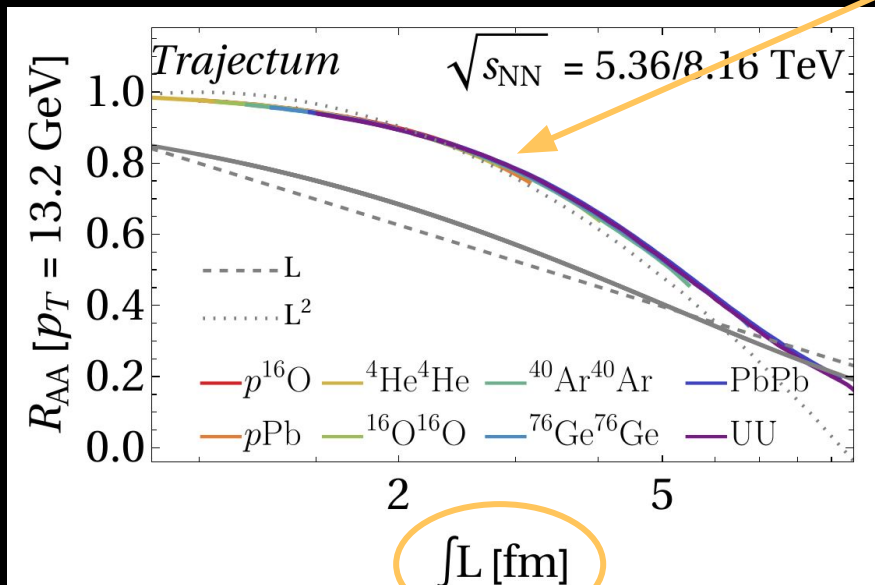


The brick pathlength

One last thing about the brick

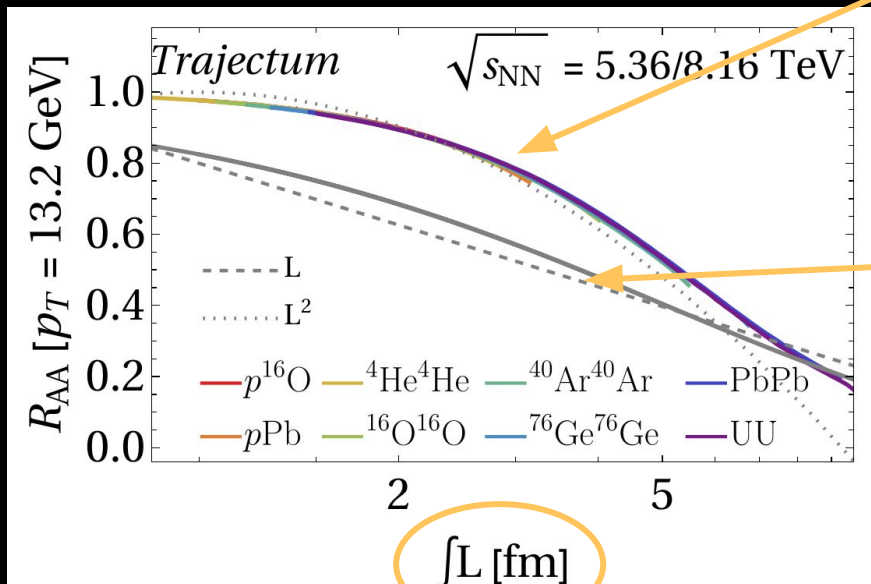
$$R_{AA}^{\int T^3 u \cdot dL}$$

(fits data)



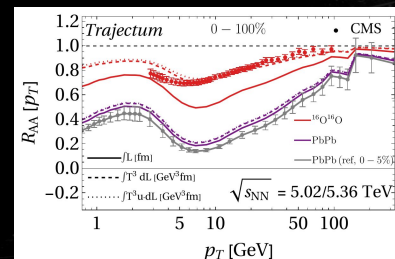
The brick pathlength

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$$R_{AA}^{\int T^3 u \cdot dL}$$

(fits data)



$$R_{AA}^{\int dL}$$

(disfavoured by data)

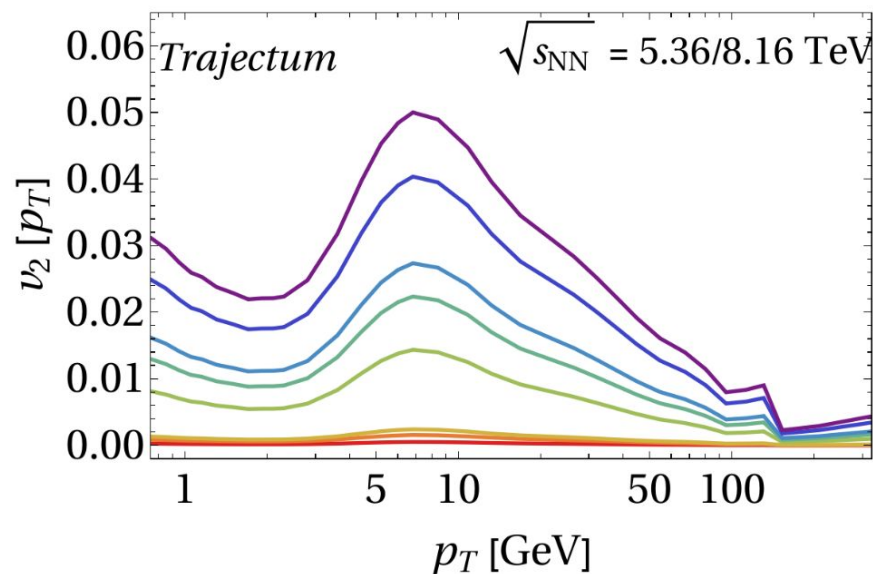
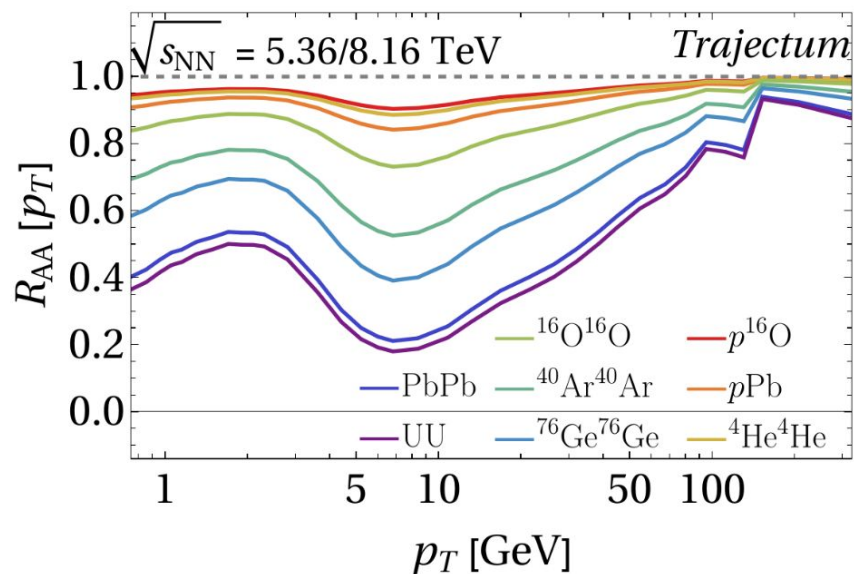
Energy-loss coincidentally scales like L^2 because of the temperature dependence

The brick pathlength

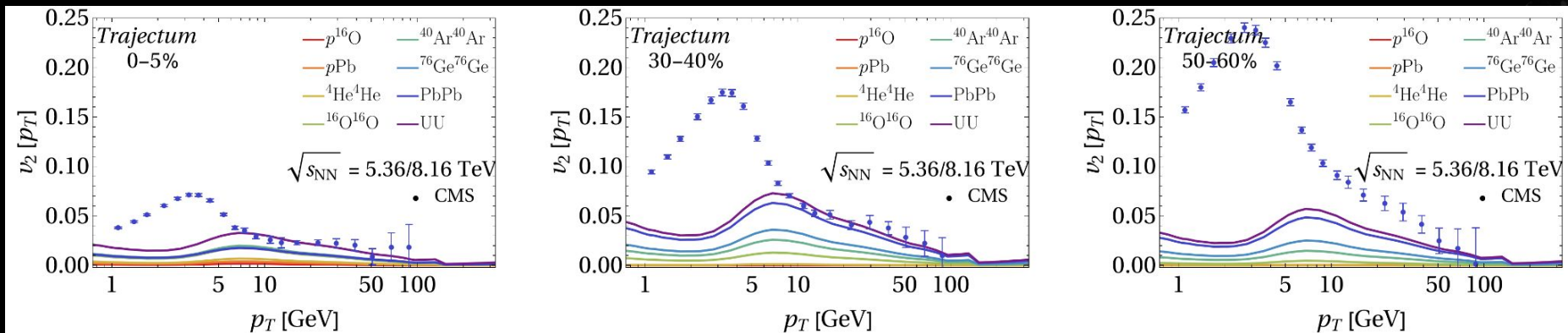
High- p_T v_2

Canonical lore: high- p_T v_2 is path-length-dependent energy-loss

(Min. bias)

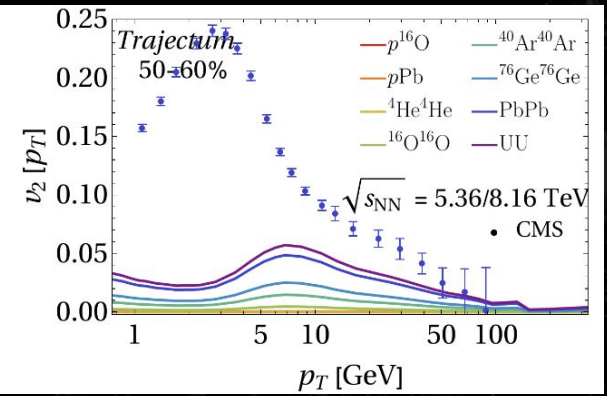
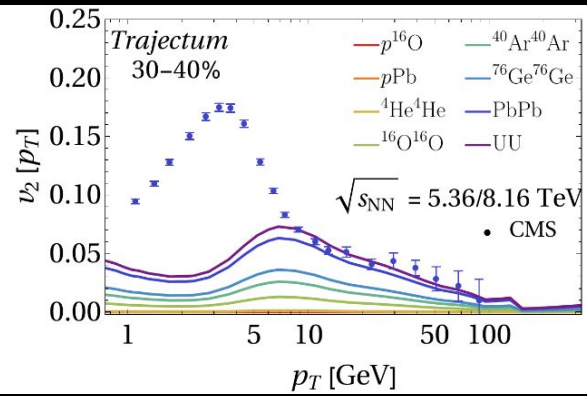
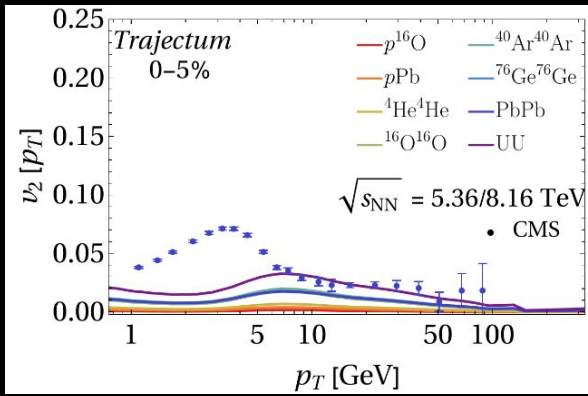


Extract v_2 from a fit to in-plane and out-of-plane R_{AA}



pPb data not shown b/c:

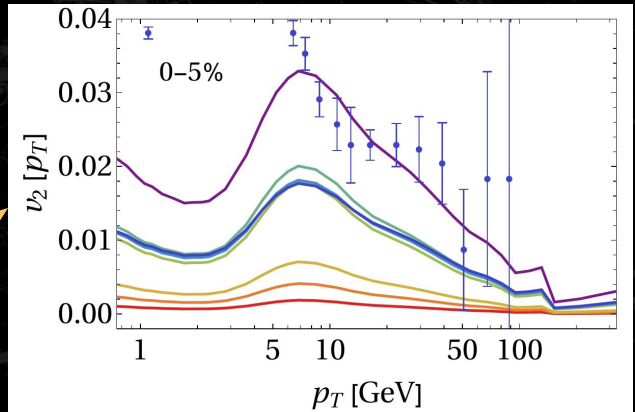
- We really compute $v_2\{2\}$ - hard to measure
- $v_2\{4\}$ exists, but very different quantity



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Zoom in on 0-5%:
pPb less than 0.002



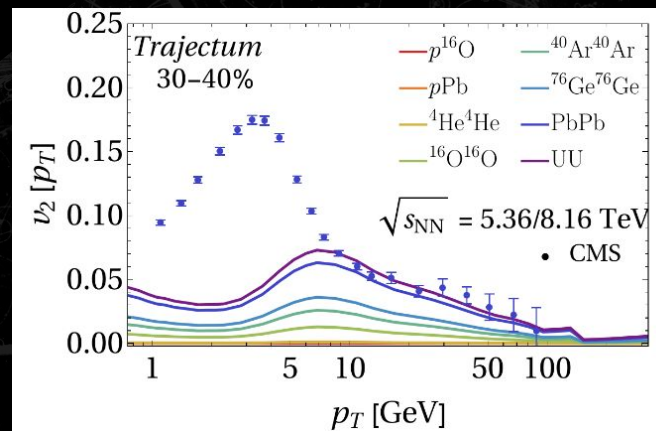
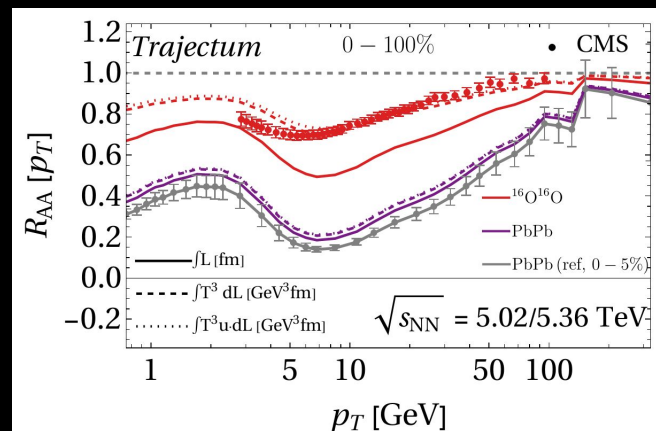
Summary & Conclusions

Energy loss is **temperature-dependent**
(not just path-length)

If you *must*:

The L-dependence is **L^2** because of T

Path-length (and temperature) dependent
energy-loss is not the whole story for high- p_T v^2



Summary & Conclusions

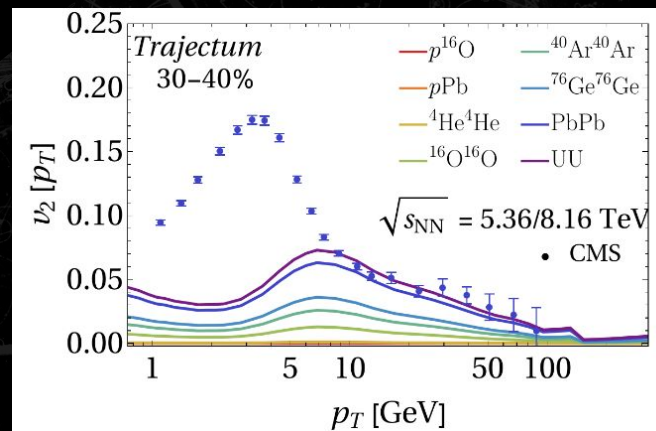
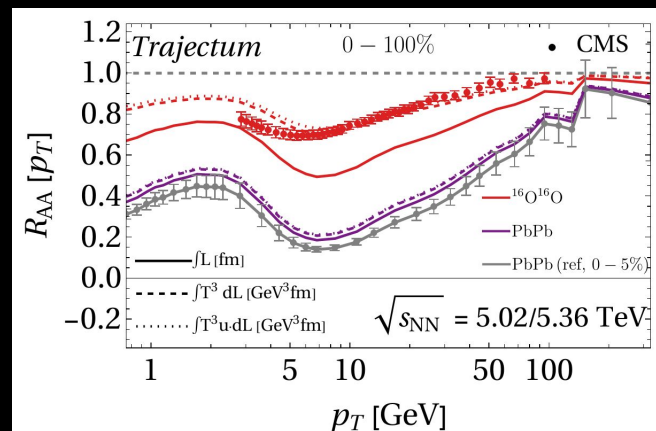
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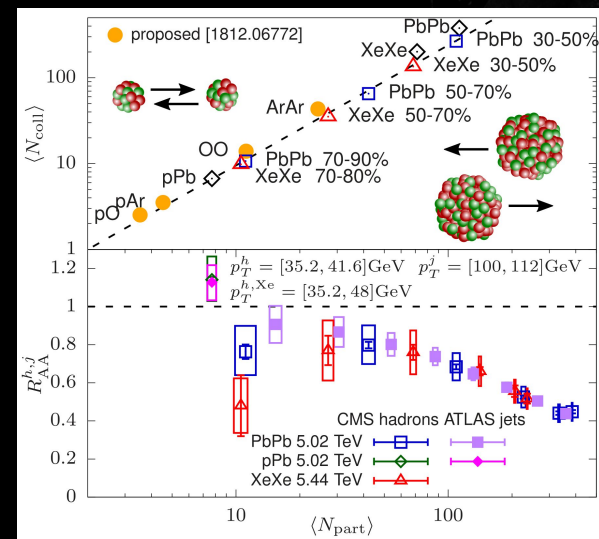
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Thank you!



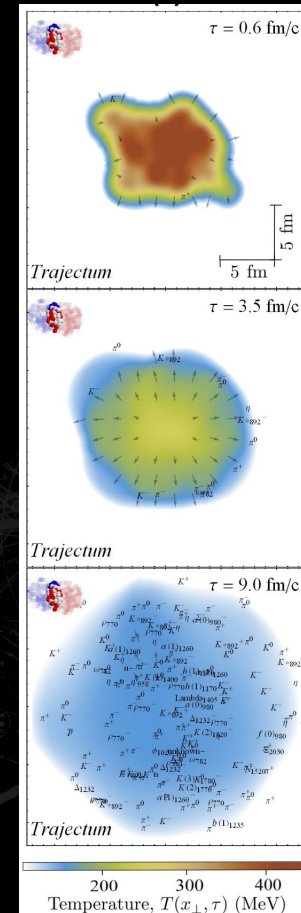
Backups

Oxygen-Oxygen - a controlled small system

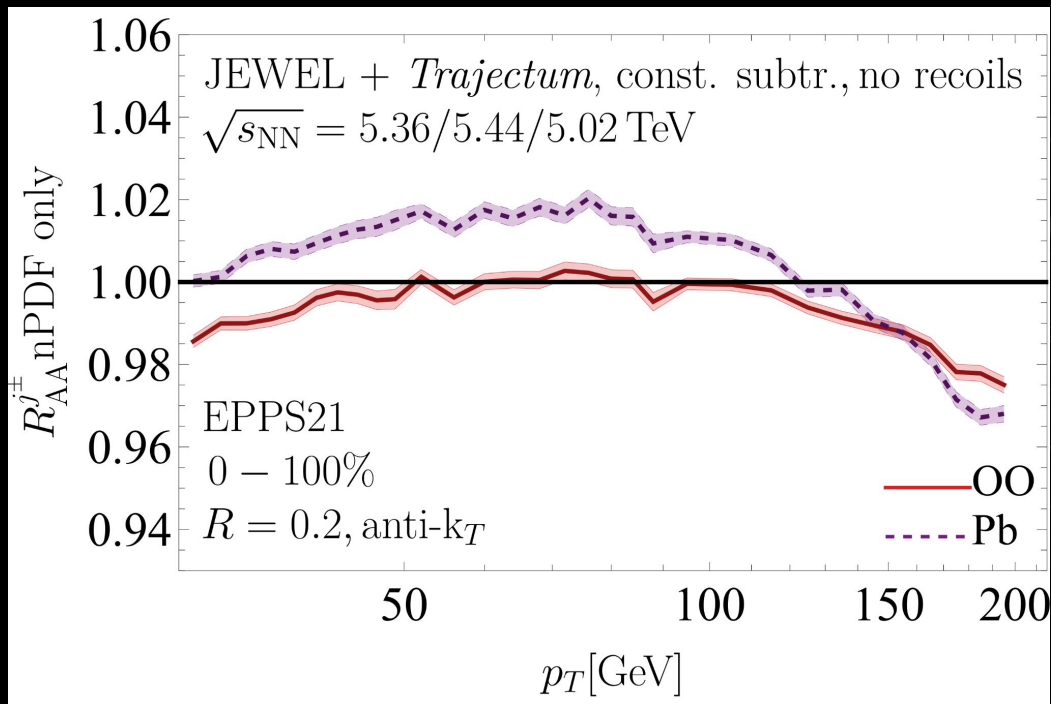
PbPb: $t = 00.358$ fm/cOO: $t = 00.352$ fm/c

Trajectum

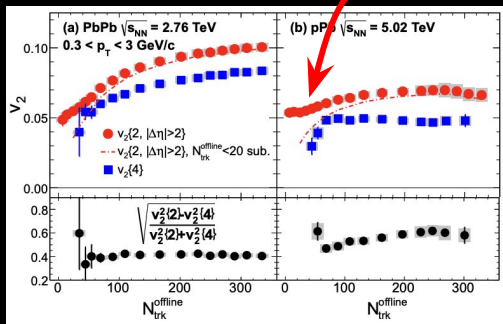
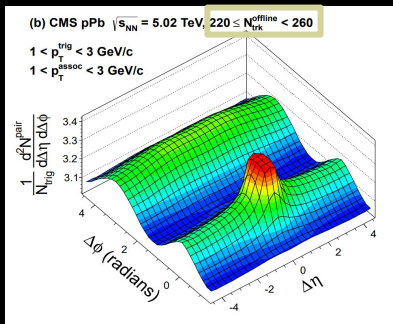
- Utrecht / CERN / MIT
- Contains:
 - Initial stage (Trento)
 - pre-equilibrium
 - Hydrodynamics
 - Freeze-out
 - Hadron phase
- Fast
- Bayesianized parameter lists



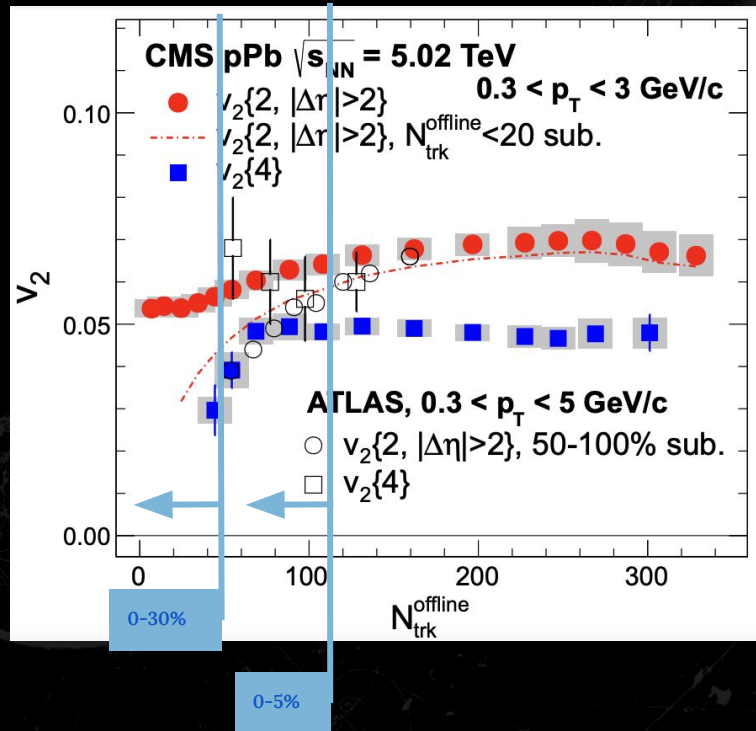
No-quenching scenario



R_{AA} , v_2 , and Centrality



Subtract low multi-data (match ATLAS)



$N_{trk}^{offline}$ bin	PbPb data			pPb data		
	\langle Centrality \rangle \pm RMS (%)	$\langle N_{trk}^{offline} \rangle$	$\langle N_{trk}^{corrected} \rangle$	Fraction	$\langle N_{trk}^{offline} \rangle$	$\langle N_{trk}^{corrected} \rangle$
[0, ∞)				1.00	40	50 \pm 2
[0, 20)	92 \pm 4	10	13 \pm 1	0.31	10	12 \pm 1
[20, 30)	86 \pm 4	24	30 \pm 1	0.14	25	30 \pm 1
[30, 40)	83 \pm 4	34		0.12	35	42 \pm 2
[40, 50)	80 \pm 4	44	0-50%	0.10	45	54 \pm 2
[50, 60)	78 \pm 3	54		0.09	54	66 \pm 3
[60, 80)	75 \pm 3	69	87 \pm 4	0.12	69	84 \pm 4
[80, 100)	72 \pm 3	89		0.07	89	108 \pm 5
[100, 120)	70 \pm 3	109	0-10%	0.03	109	132 \pm 6
[120, 150)	67 \pm 3	134		0.02	132	159 \pm 7
[150, 185)	64 \pm 3	167	210 \pm 9	4×10^{-3}	162	195 \pm 9
[185, 220)	62 \pm 2	202	253 \pm 11	5×10^{-4}	196	236 \pm 10
[220, 260)	59 \pm 2	239	299 \pm 13	6×10^{-5}	232	280 \pm 12
[260, 300)	57 \pm 2	279	350 \pm 15	3×10^{-6}	271	328 \pm 14
[300, 350)	55 \pm 2	324	405 \pm 18	1×10^{-7}	311	374 \pm 16

0-0.00631% bin