

lighter ions: rare probes

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THE PROS AND CONS OF LIGHT[ER] IONS.....

PROS

- [significantly] higher nucleon-nucleon luminosity
 - higher statistics for precision
 - access to rare[r] processes
- lower background
 - reduction of systematics?

CONS

- smaller quenching
 - precision for effect size trade-off
 - when is smaller too small?

THE SIZE OF QUENCHING :: ROUGH ESTIMATE

- assume 15% average jet p_T -loss for [0-10%] central PbPb
 - conservative estimate from boson-jet data
- assume [consistent with CuCu jet R_{AA} @RHIC] scaling with

$$\left(\frac{A_{light}}{A_{Pb}} \right)^{1/3}$$

- needs to be supported by MC studies
 - need hydro simulations...
- XeXe data described by quenching models

PbPb	15%
XeXe	13%
KrKr	10%
ArAr	8.7%
OO	7.3%

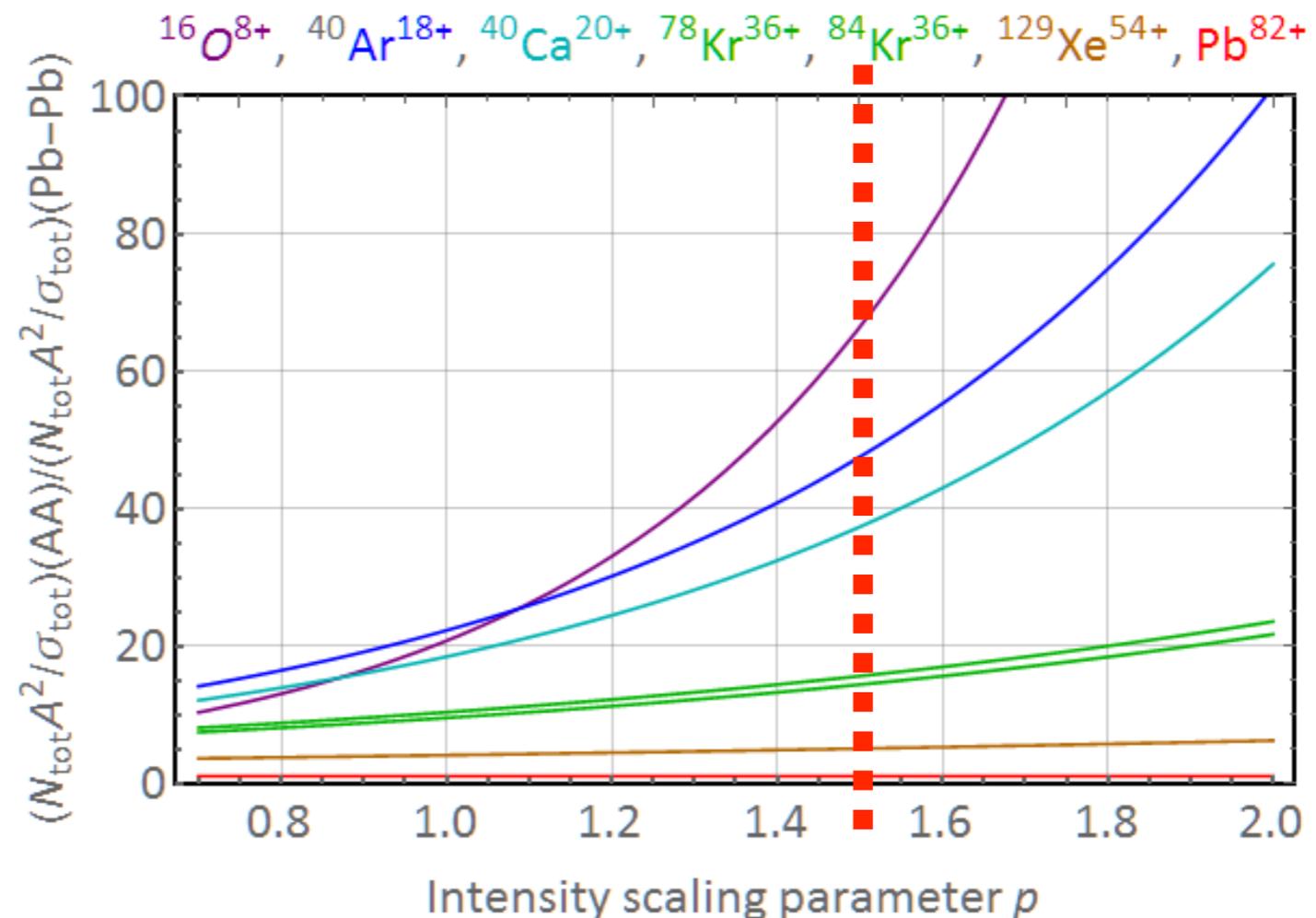
HIGHER NUCLEON-NUCLEON LUMINOSITY

Gains in ULTIMATE integrated nucleon-nucleon luminosity PER FILL wrt Pb-Pb

This would be on the assumption that a fill would be kept forever until one beam was exhausted (and other loss mechanisms are neglected). Real gain/fill will be less.

In reality, one also gains from longer luminosity lifetime and less time spent refilling the machine.

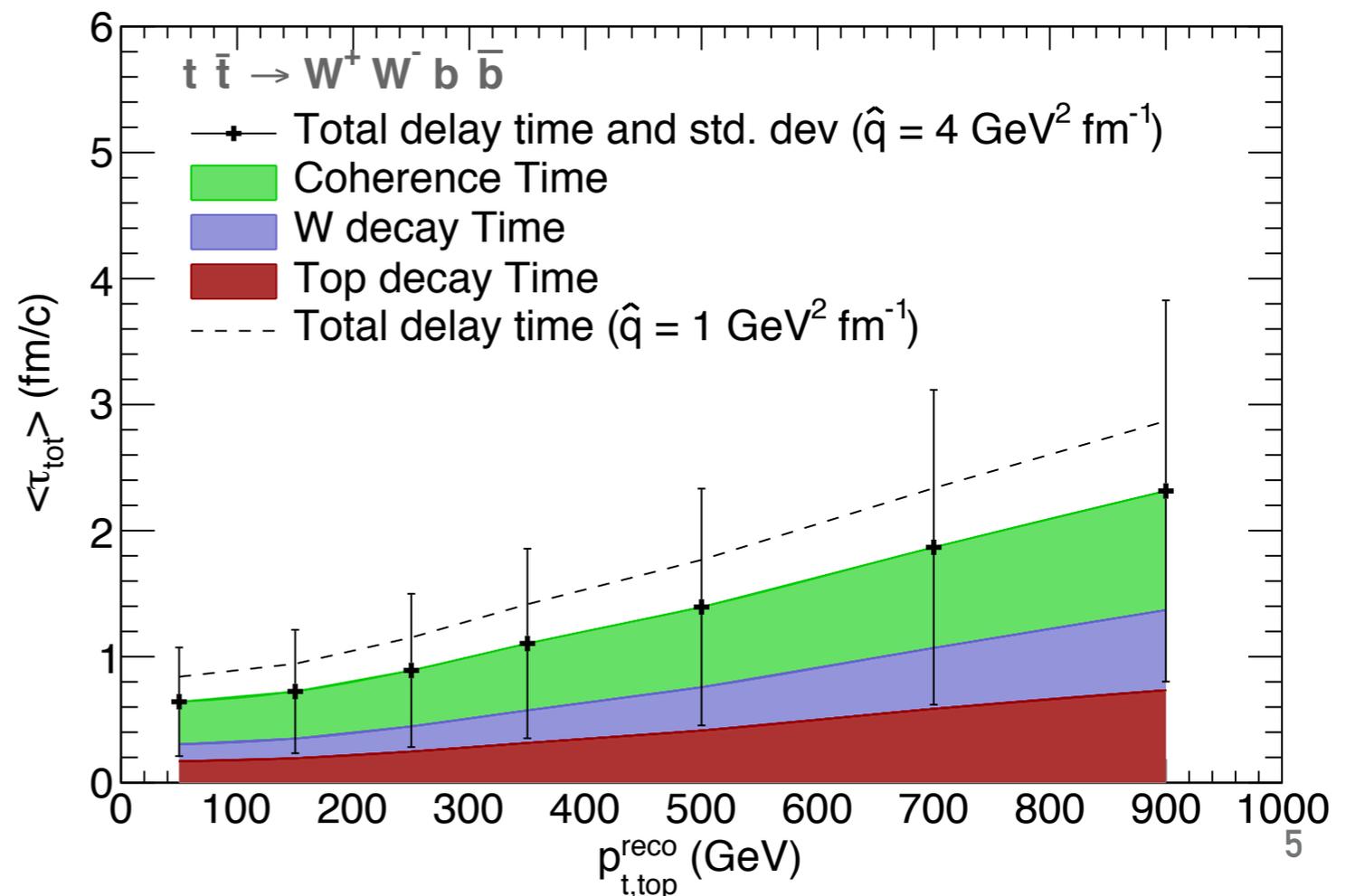
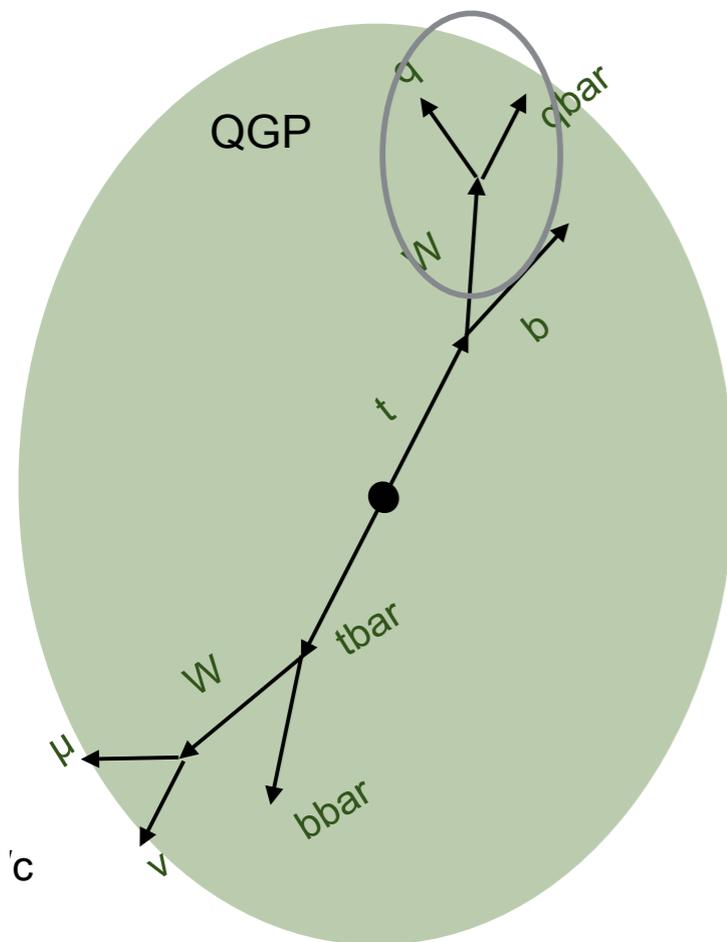
We will try to quantify this better in future.



PROBING TIME-DEPENDENCE OF QGP PROPERTIES

Apolinário, Milhano, Salam, Salgado PRL 120 (2018) 232301

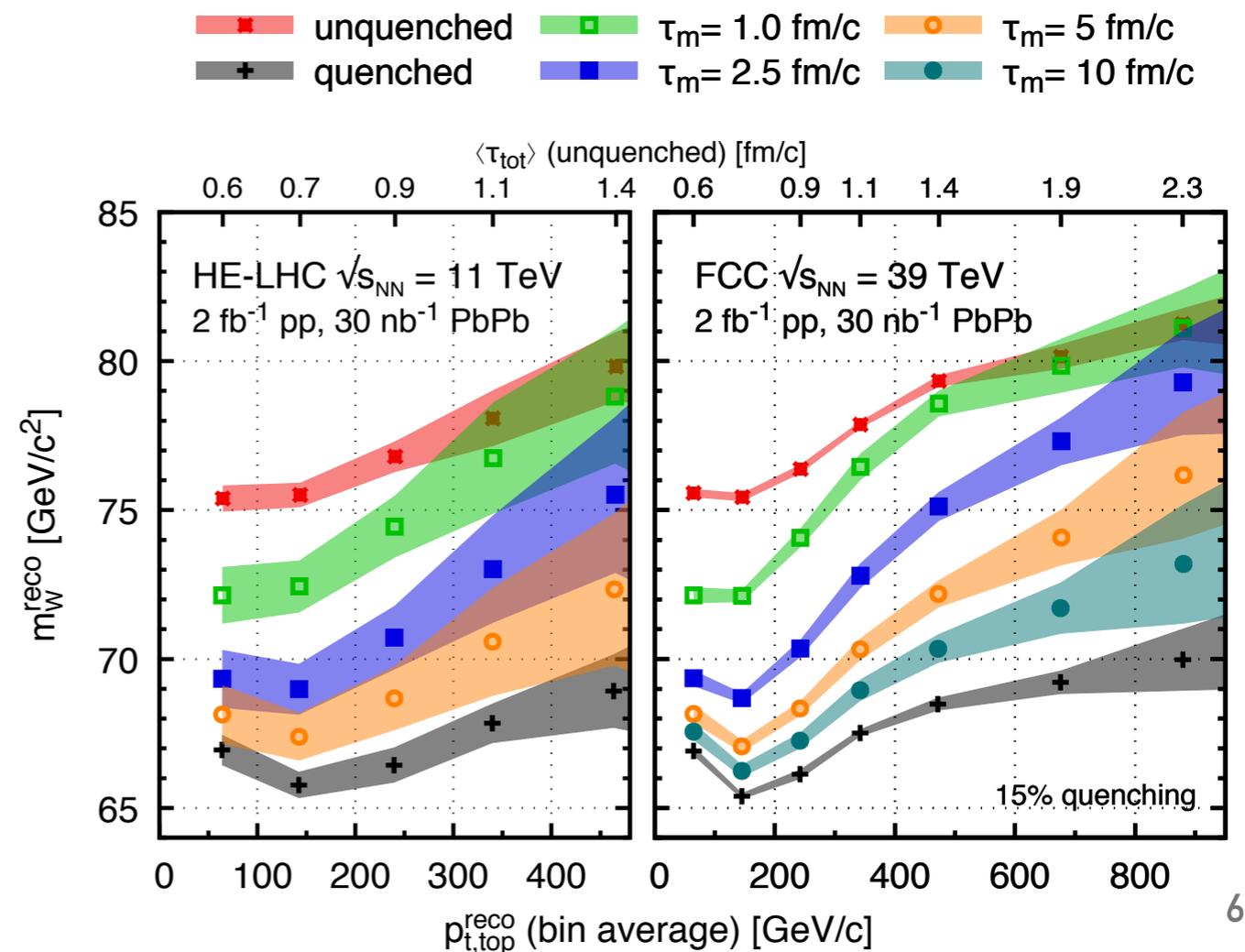
- (top decay + W decay + qqbar coherence) delays interaction with QGP :: sensitivity to QGP time evolution
- delay time accessible from reconstructed event kinematics [top p_T]



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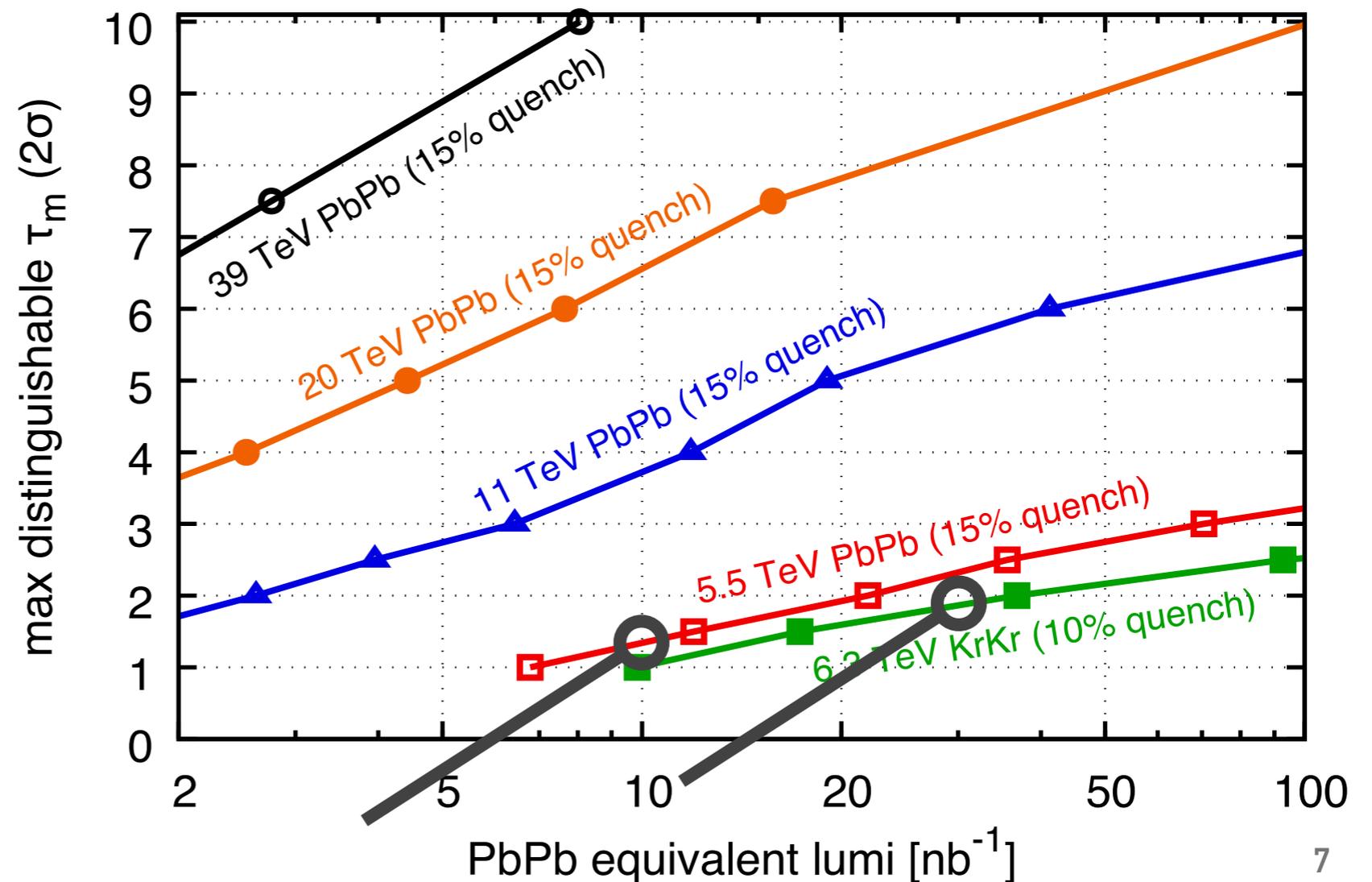
- modification of reconstructed W mass as measure of quenching
- longer delay leads to less modification
- determine largest medium size that can be distinguished from full quenching [no delay] at $2\sigma+1\%$ [syst]



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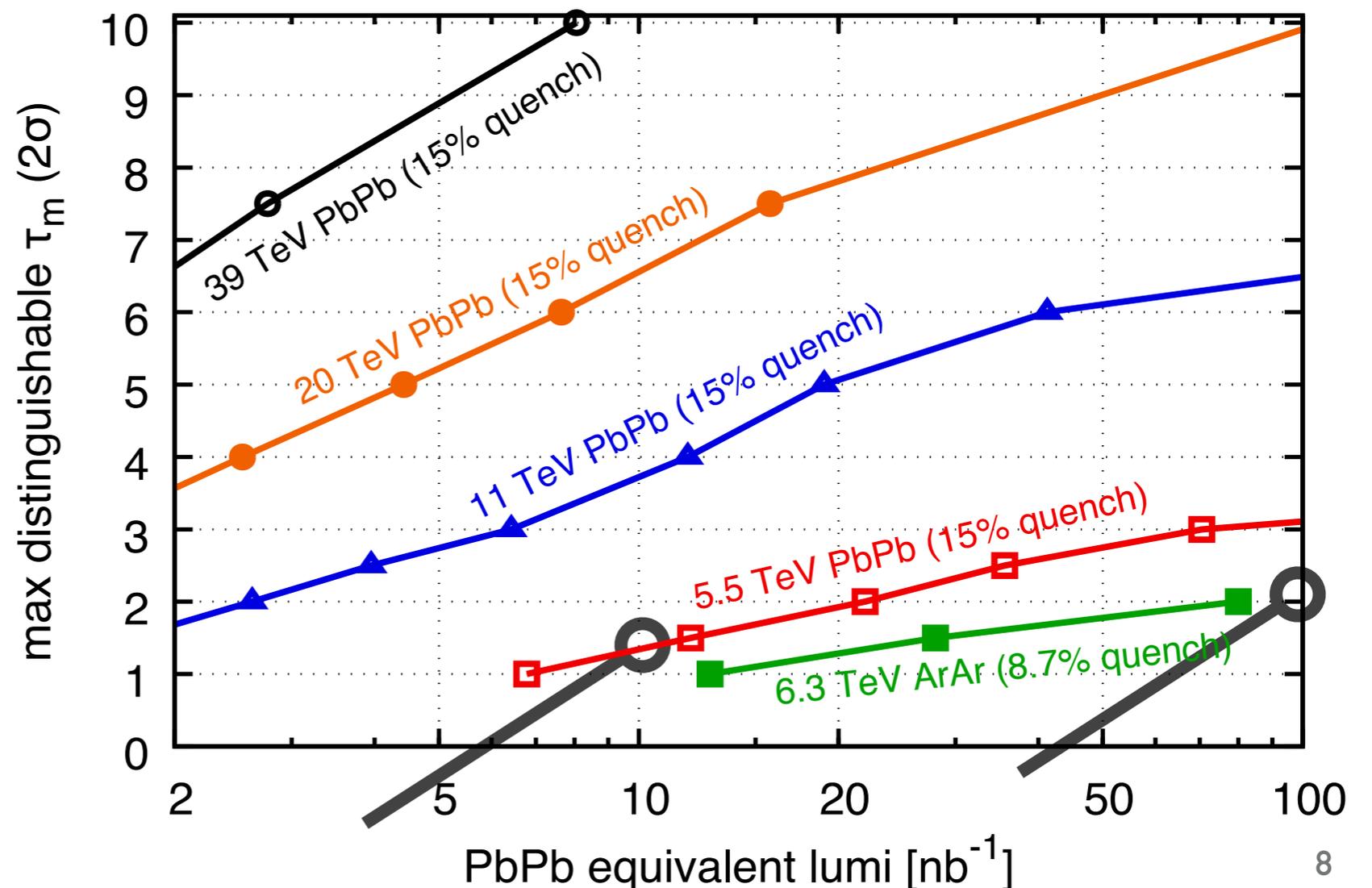
- lighter ions [Kr] bring significant gains wrt to Pb at the LHC
- full PbPb programme [10 nb^{-1}] :: 1.4 fm/c
- 1 month KrKr [30 nb^{-1}] :: 1.8 fm/c



PROBING TIME-DEPENDENCE OF QGP PROPERTIES

Apolinário, Milhano, Salam, Salgado :: new result

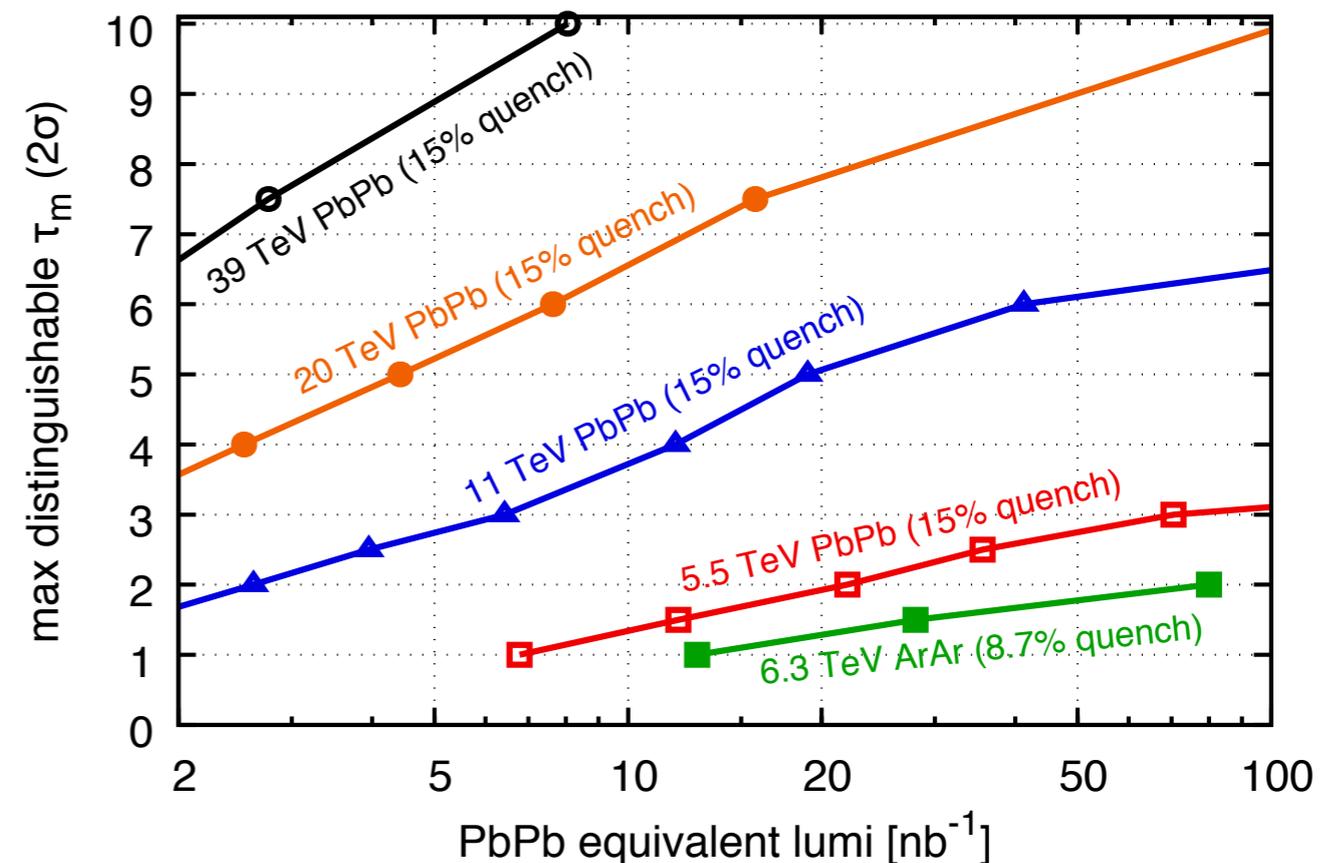
- lighter ions bring significant gains wrt to Pb at the LHC, however
 - mild gain from going lighter and lighter
 - inability to distinguish from full quenching increasingly dominated by 1% [syst]



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how over-conservative are our assumptions?

[lower syst in lower background? :: higher eloss in reference PbPb?] 9

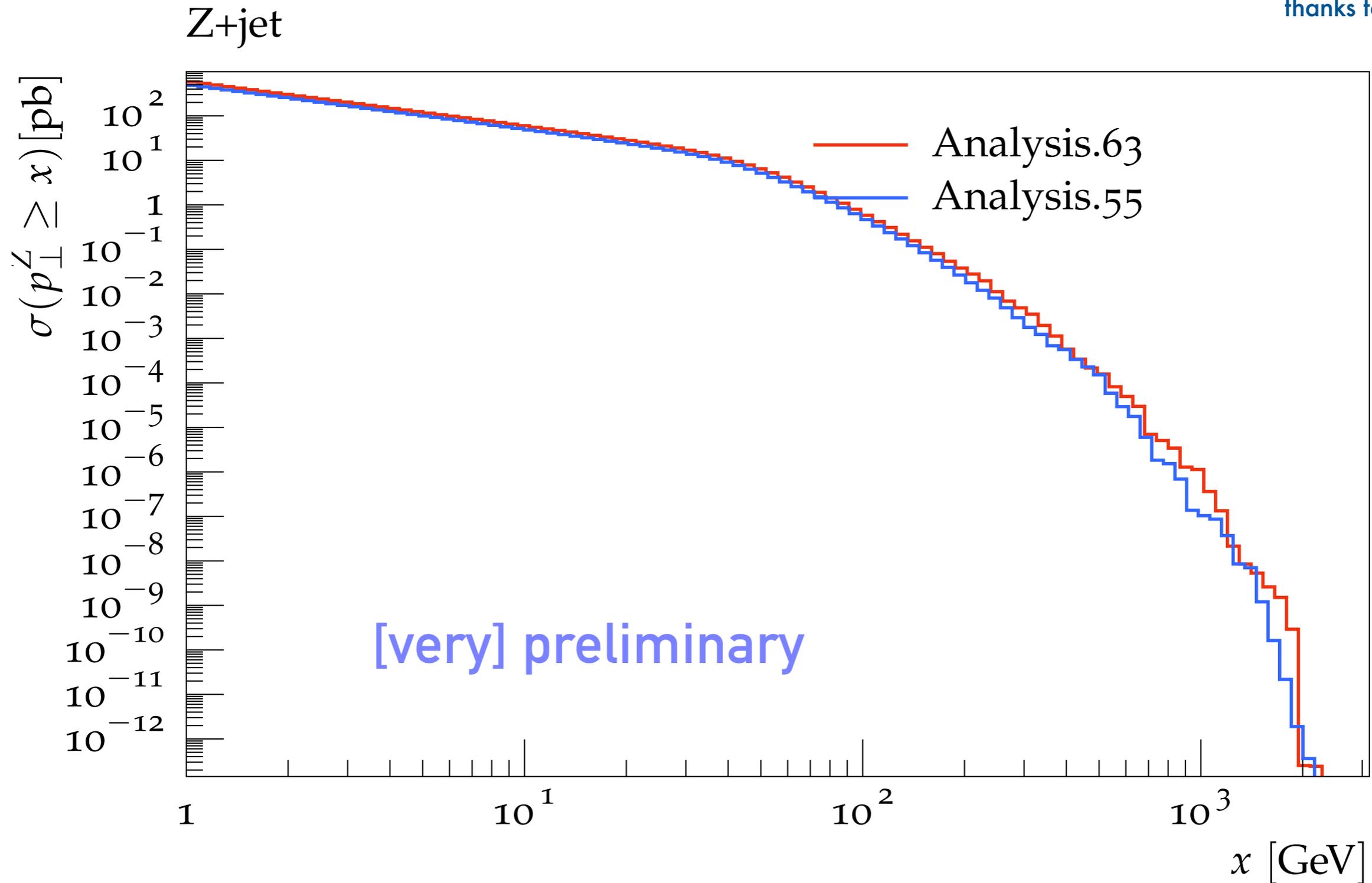
PRECISION JET MODIFICATION :: Z-JET

thanks to K. Zapp

- Z-jet as cleanest process to study jet modifications
 - p_T^Z provides absolute p_T reference for jet[s]
 - need p_T^Z substantially larger than $p_T^{\text{jet, min}}$ for mapping entire e_{loss} distribution, and to study jet modifications as function of e_{loss}

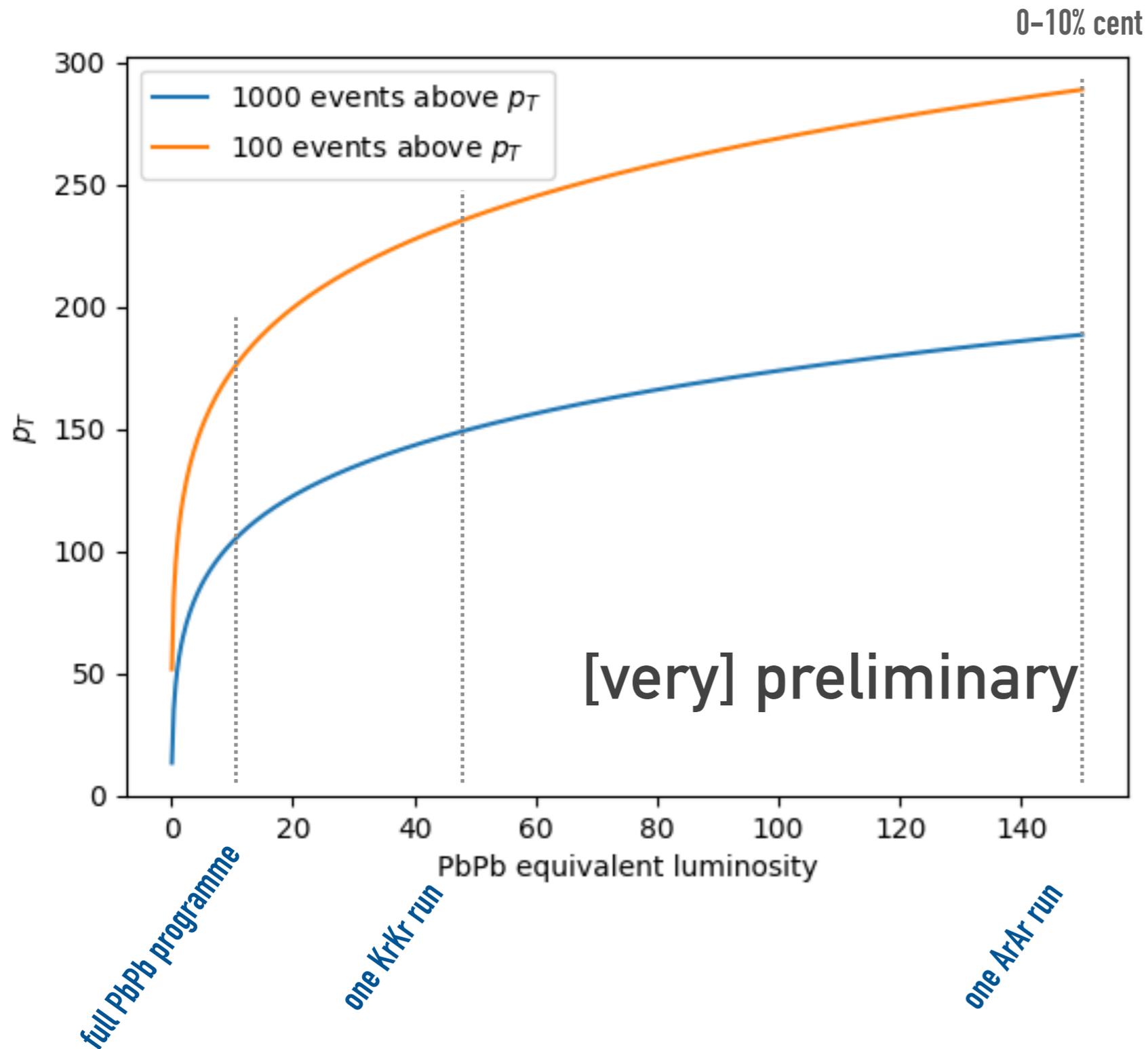
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SHERPA [NLO] :: $\sqrt{s}=6.3$ [5.5] TeV :: "CMS Z-jet cuts"r background?

PRECISION JET MODIFICATION :: Z-JET



NEXT STEPS?

- light[er] ions give access to new QGP probing channels [eg, tops for time evolution, Higgs, ...] and extended reach for precision jet modification studies
- for YR:: consider also other cases ? improve estimates on already studied ones?
- assessment beyond feasibility studies and rough estimates requires full simulation [hydro+jet quenching+detector effects]
- reduction of systematics from reduced background remains unstudied :: essential to decide when smallness of quenching offsets luminosity gains
- pilot run very useful to check accuracy of MC predictions [overlap in N_{part} with different geometry] and experimental improvements from reduced background