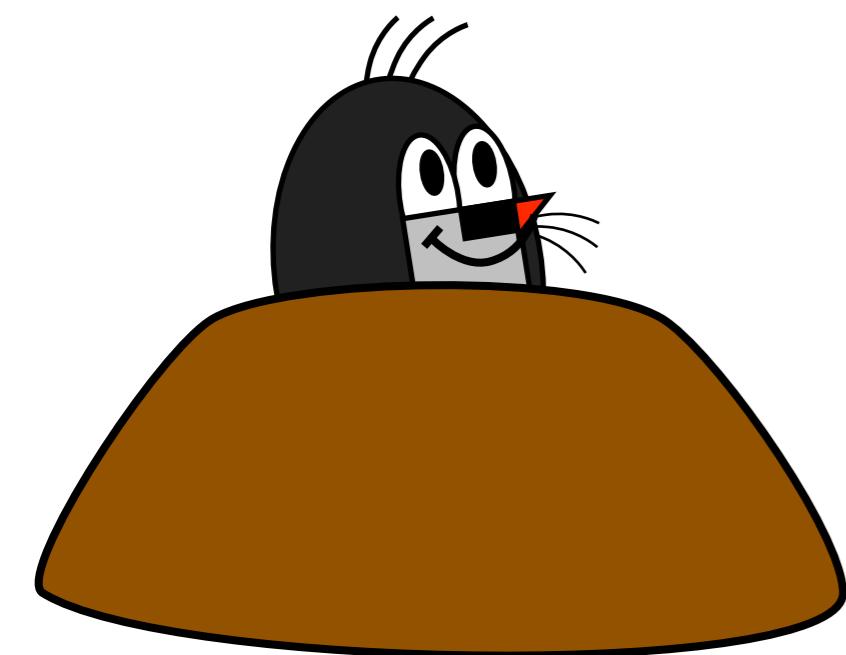


# Finding dynamical electroweak symmetry breaking above ground



DENNIS D. DIETRICH

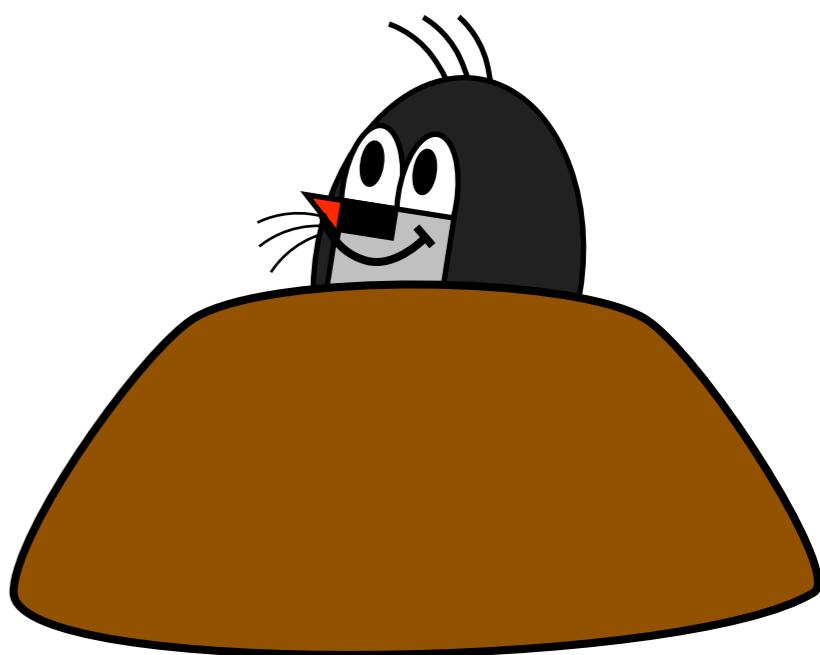
Goethe-Universität, Frankfurt am Main

arXiv:1206.????

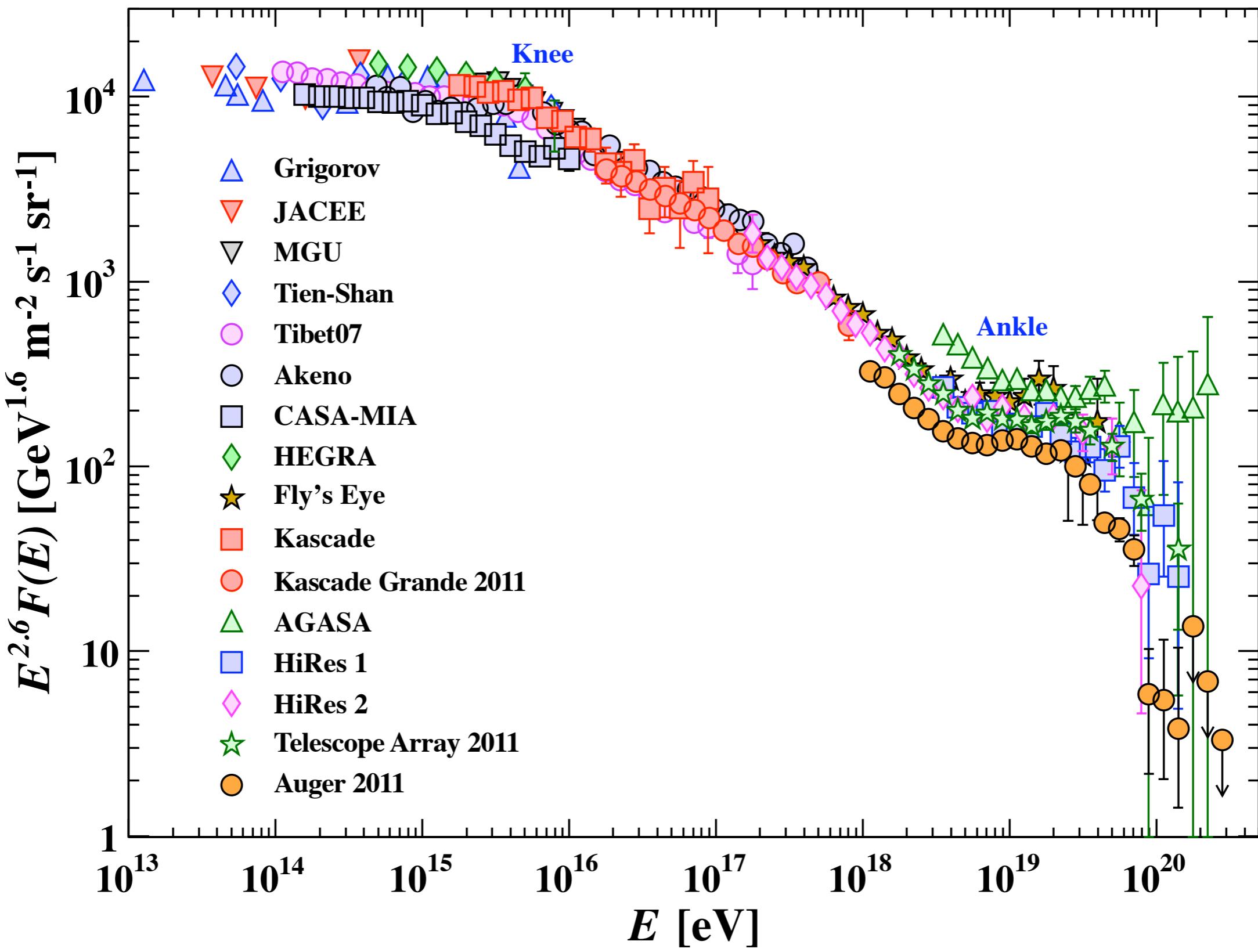
DDD

# Outline/Motivation

- DEWSB mechanism hard to catch
  - energy frontier
    - UHECR  $s > (100\text{TeV})^2$
    - air showers
  - explain structure in spectrum ?



# Spectrum (all particles)

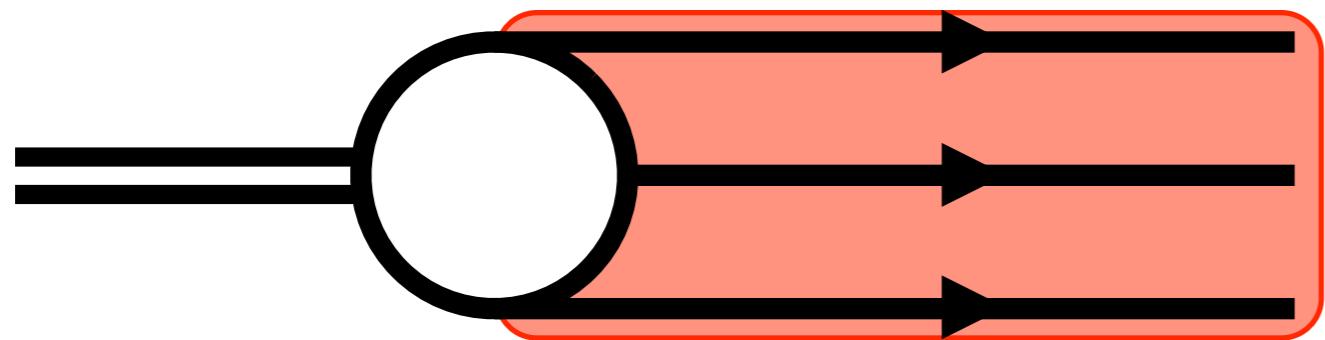


# Air showers

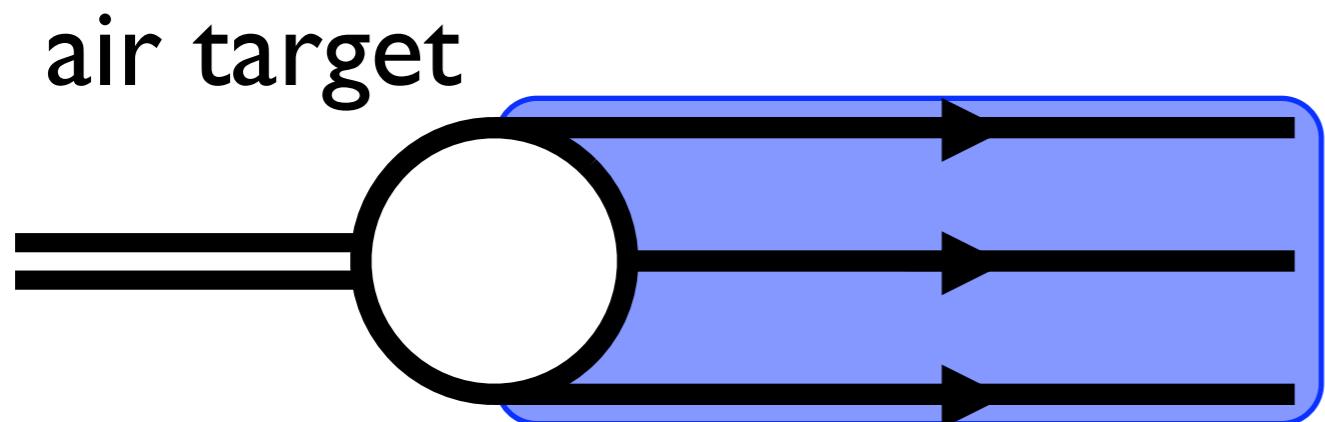


DDD

# QCD



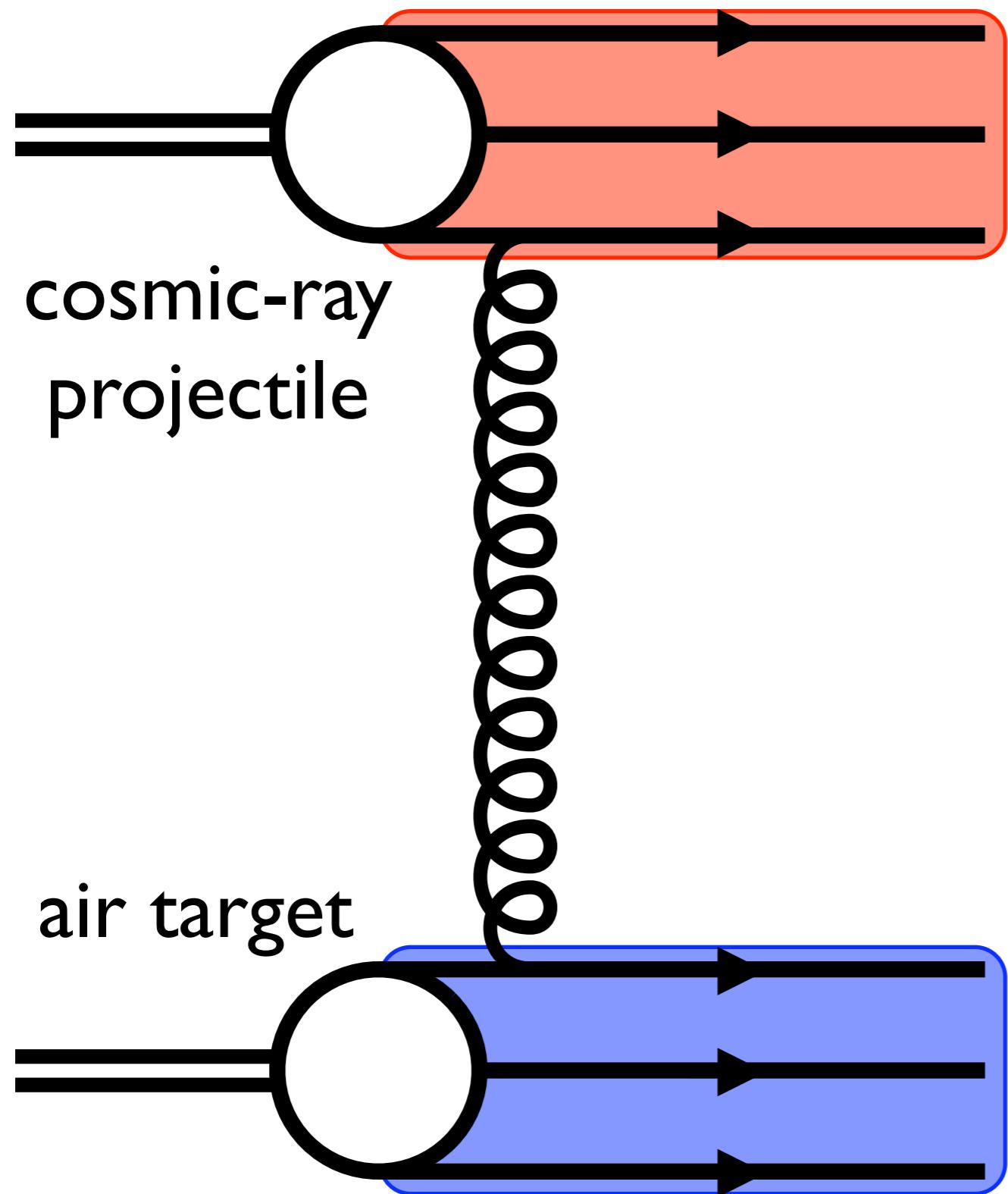
cosmic-ray  
projectile



air target

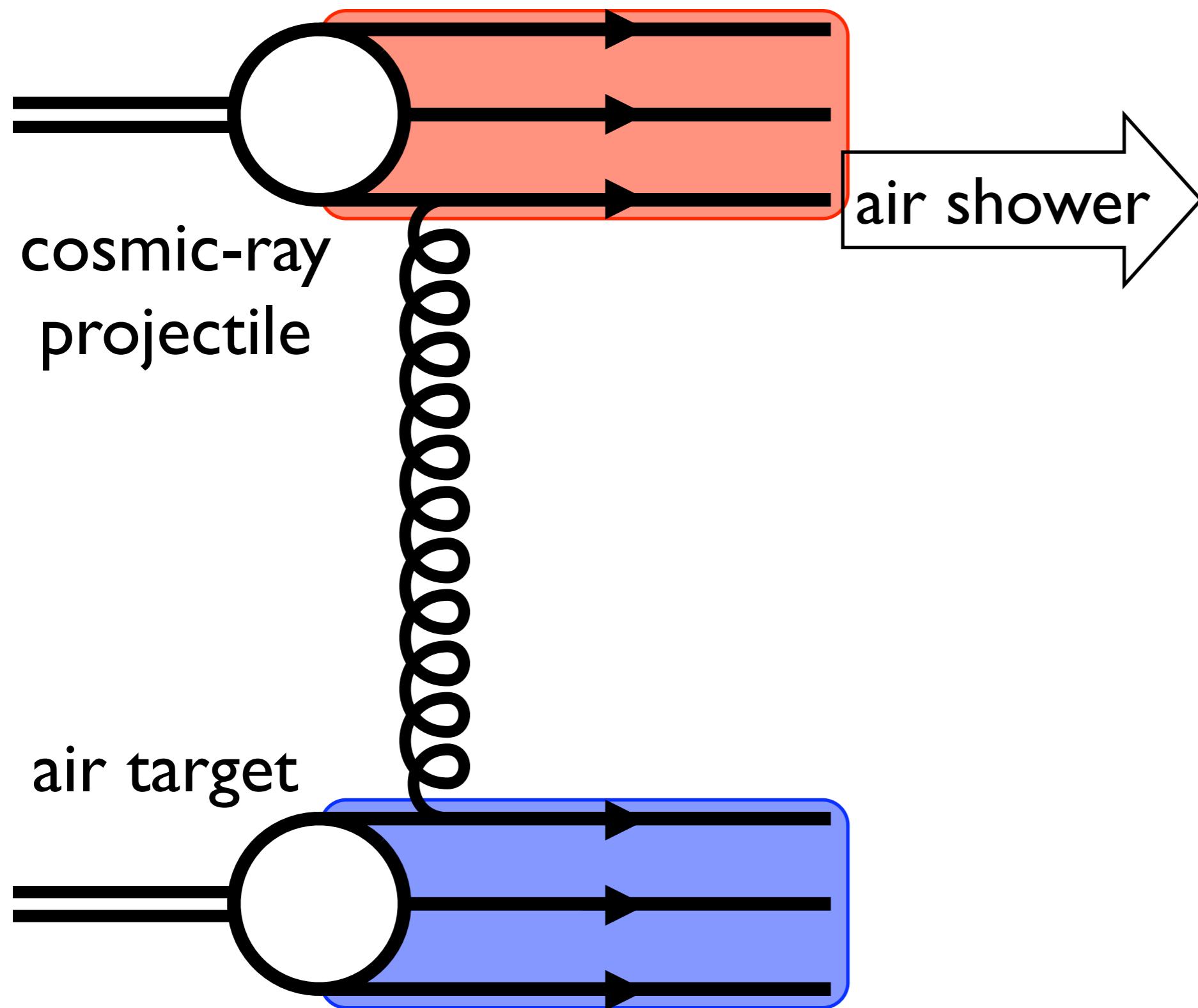
DDD

QCD



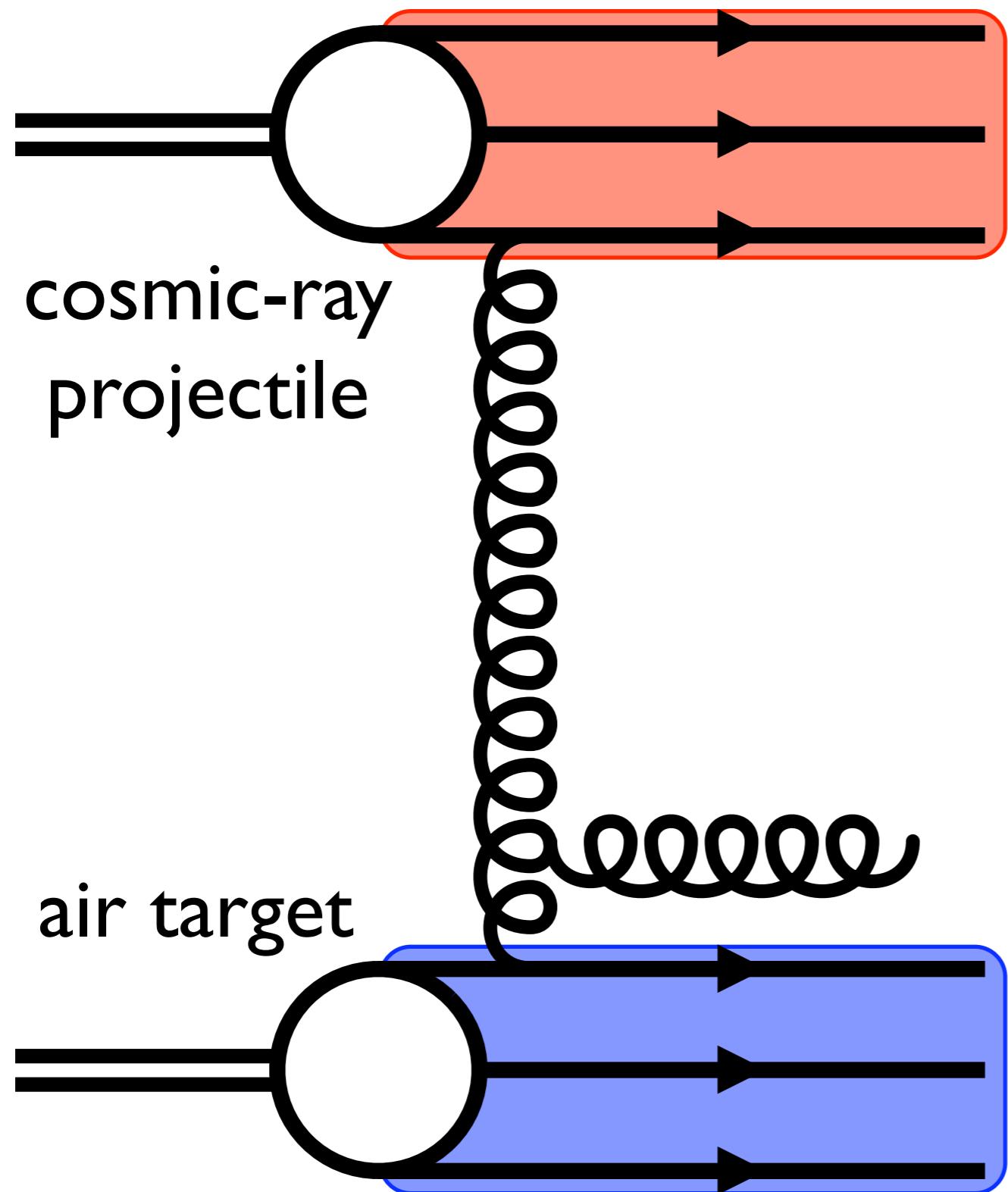
DDD

QCD



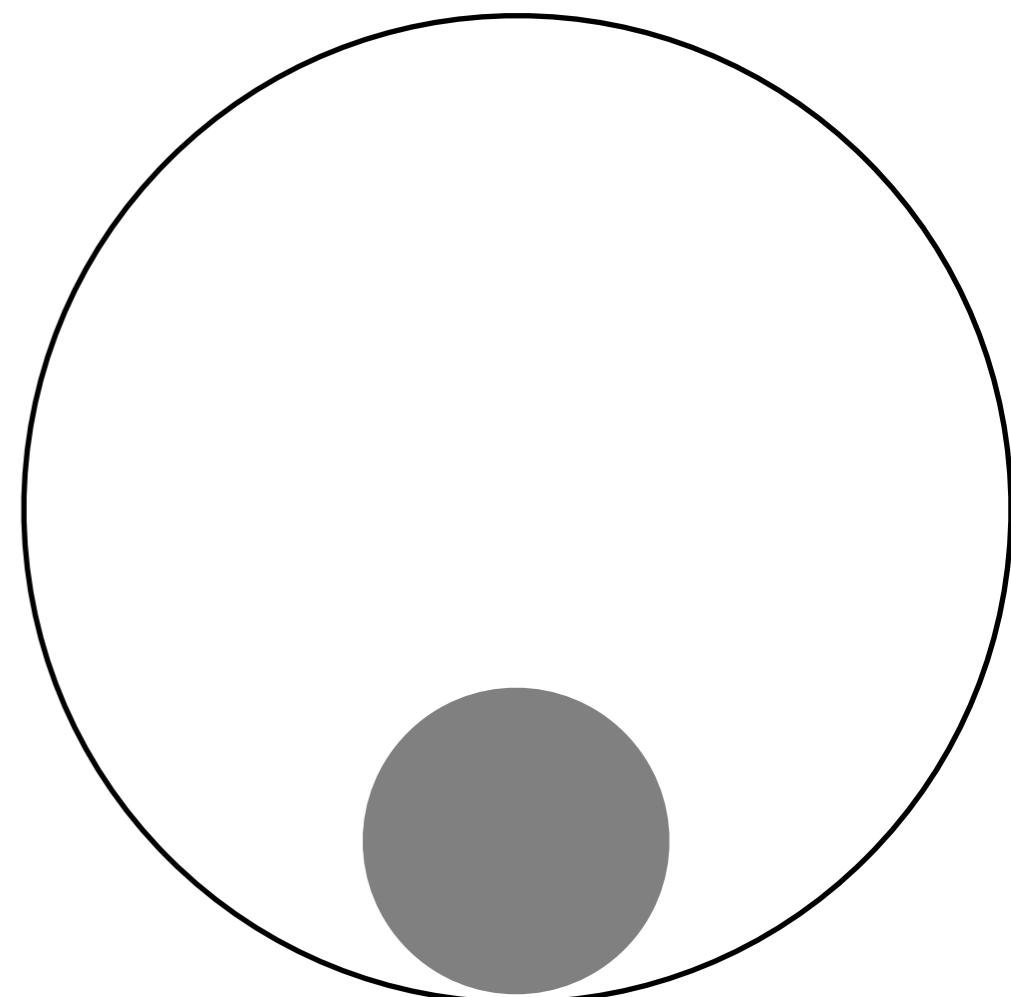
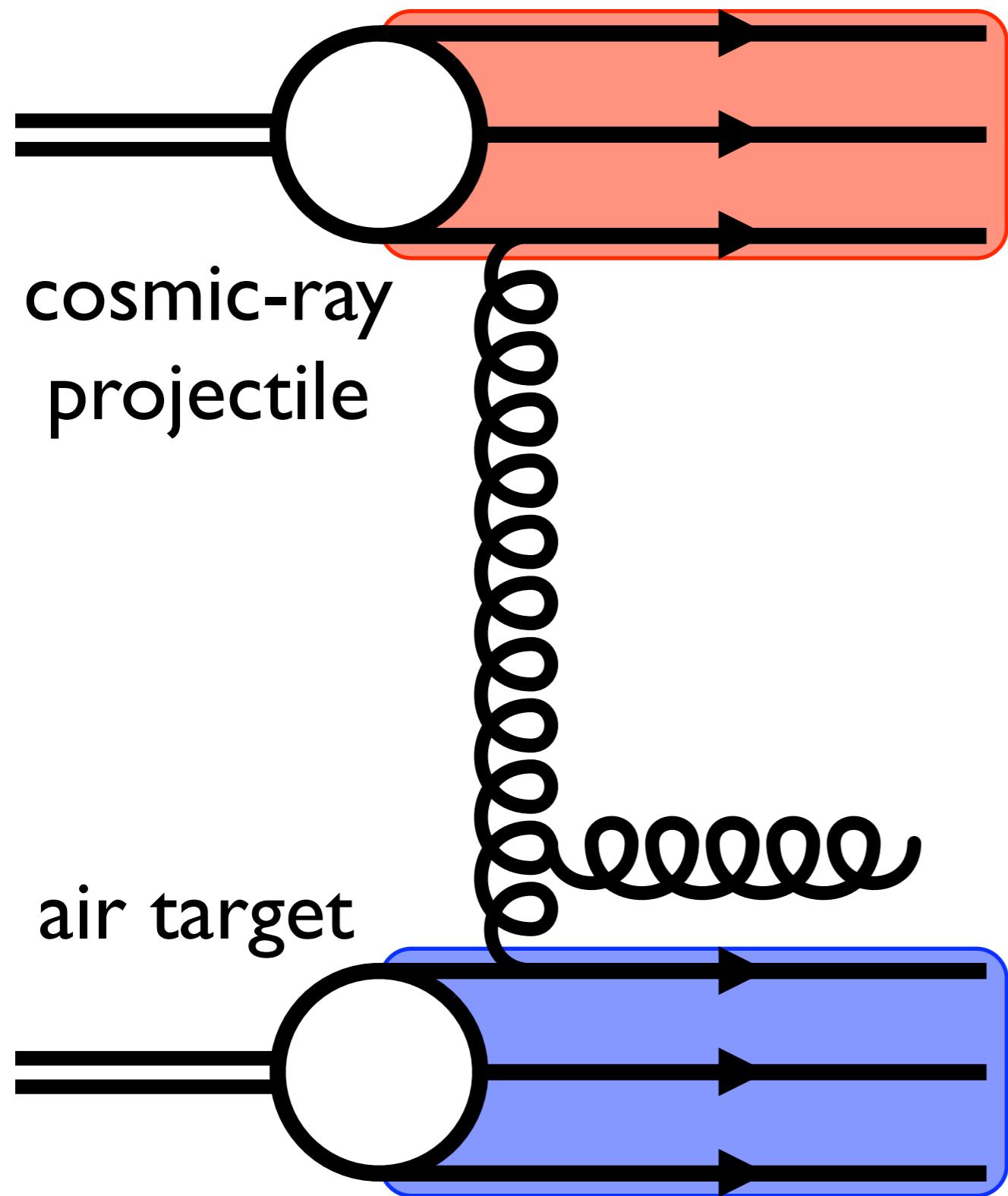
DDD

QCD



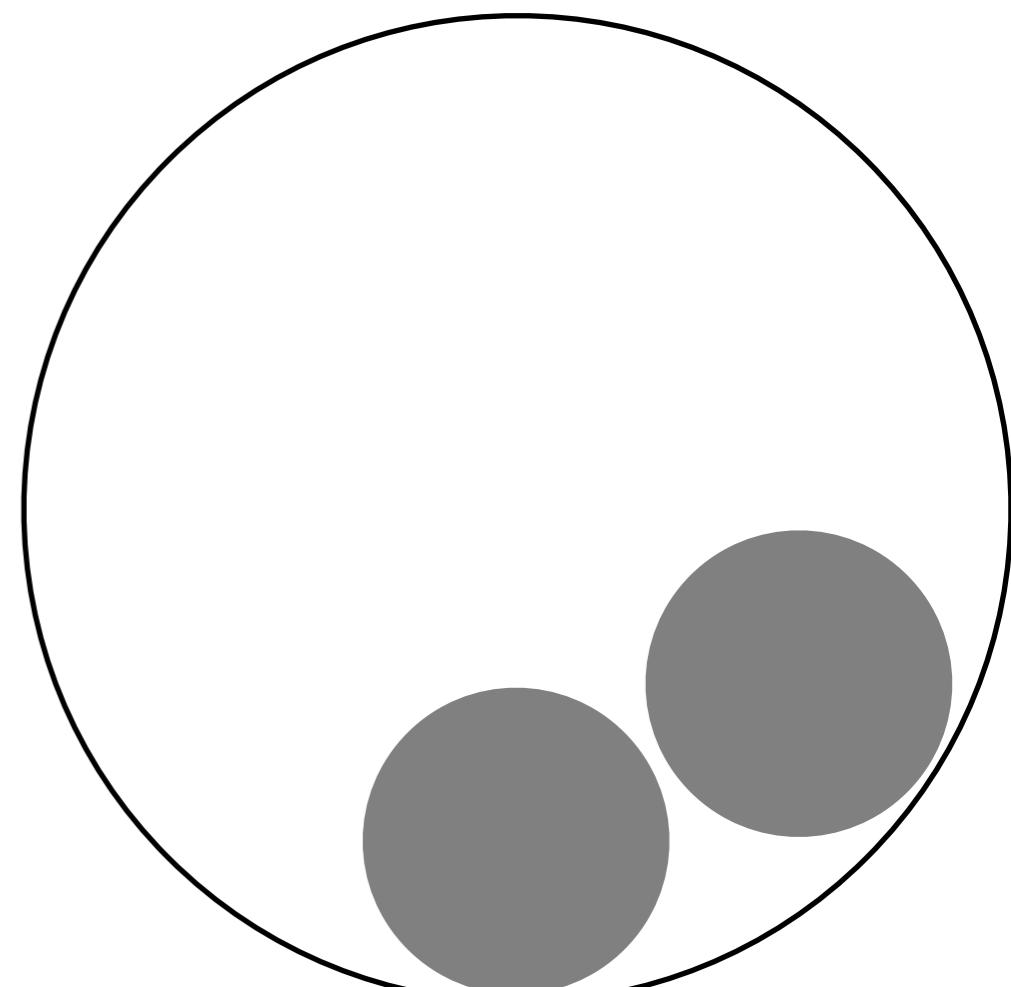
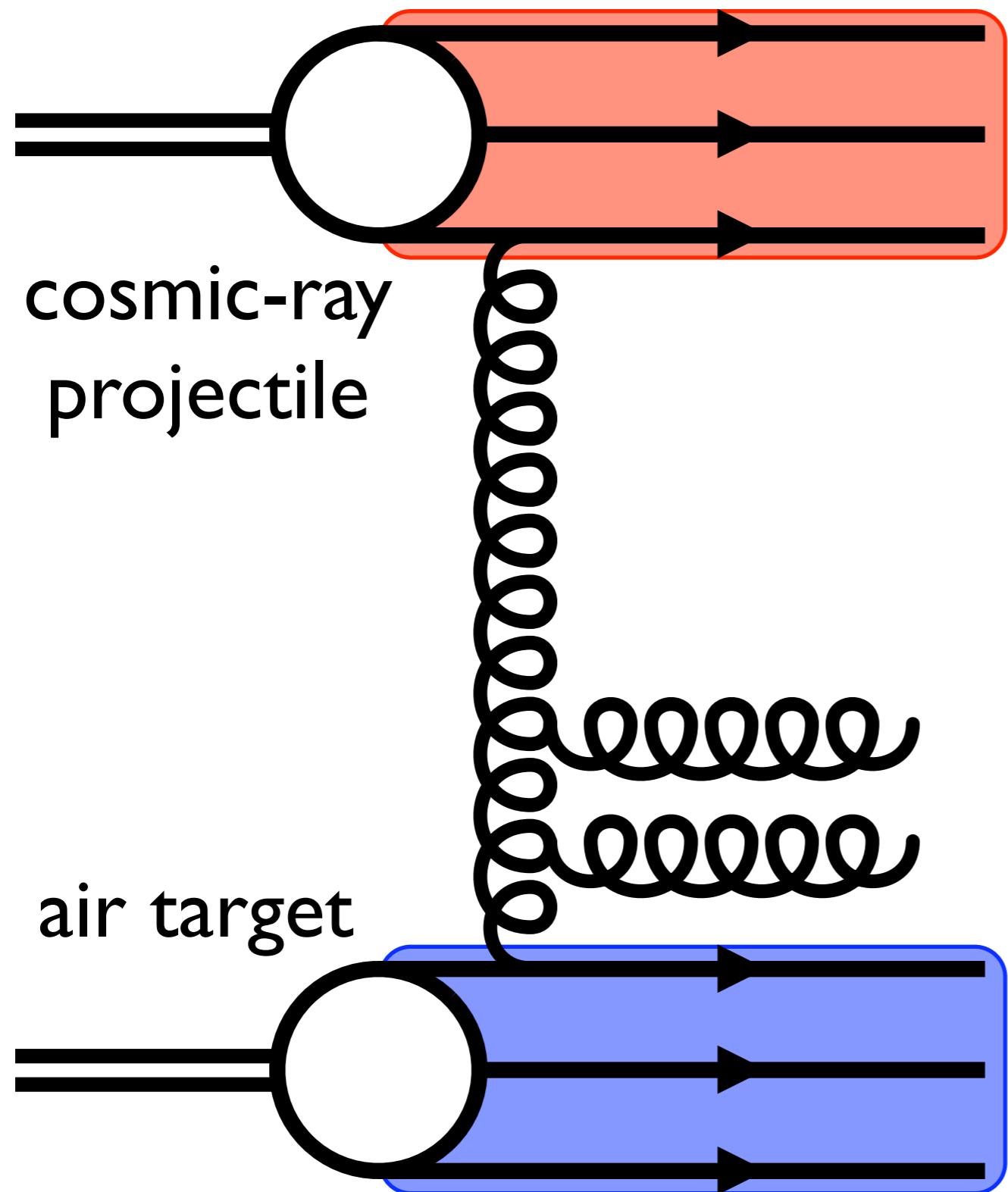
DDD

QCD



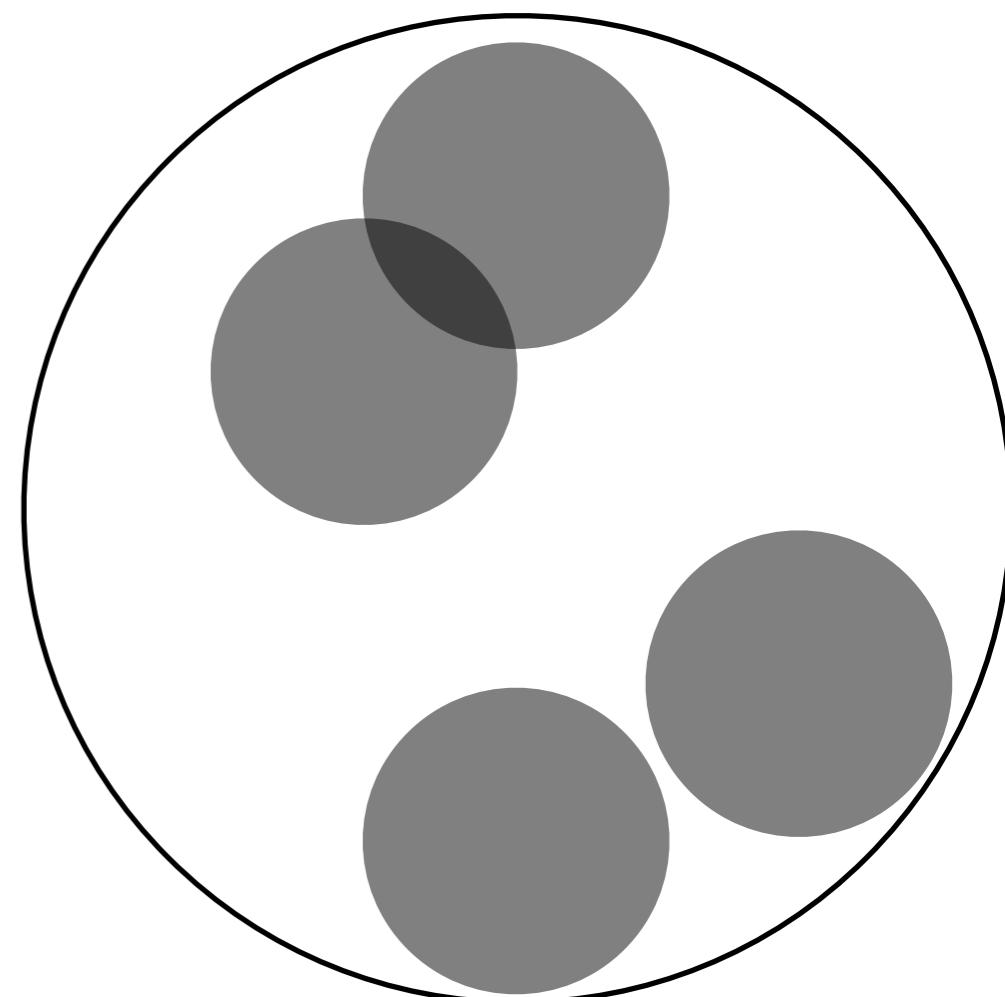
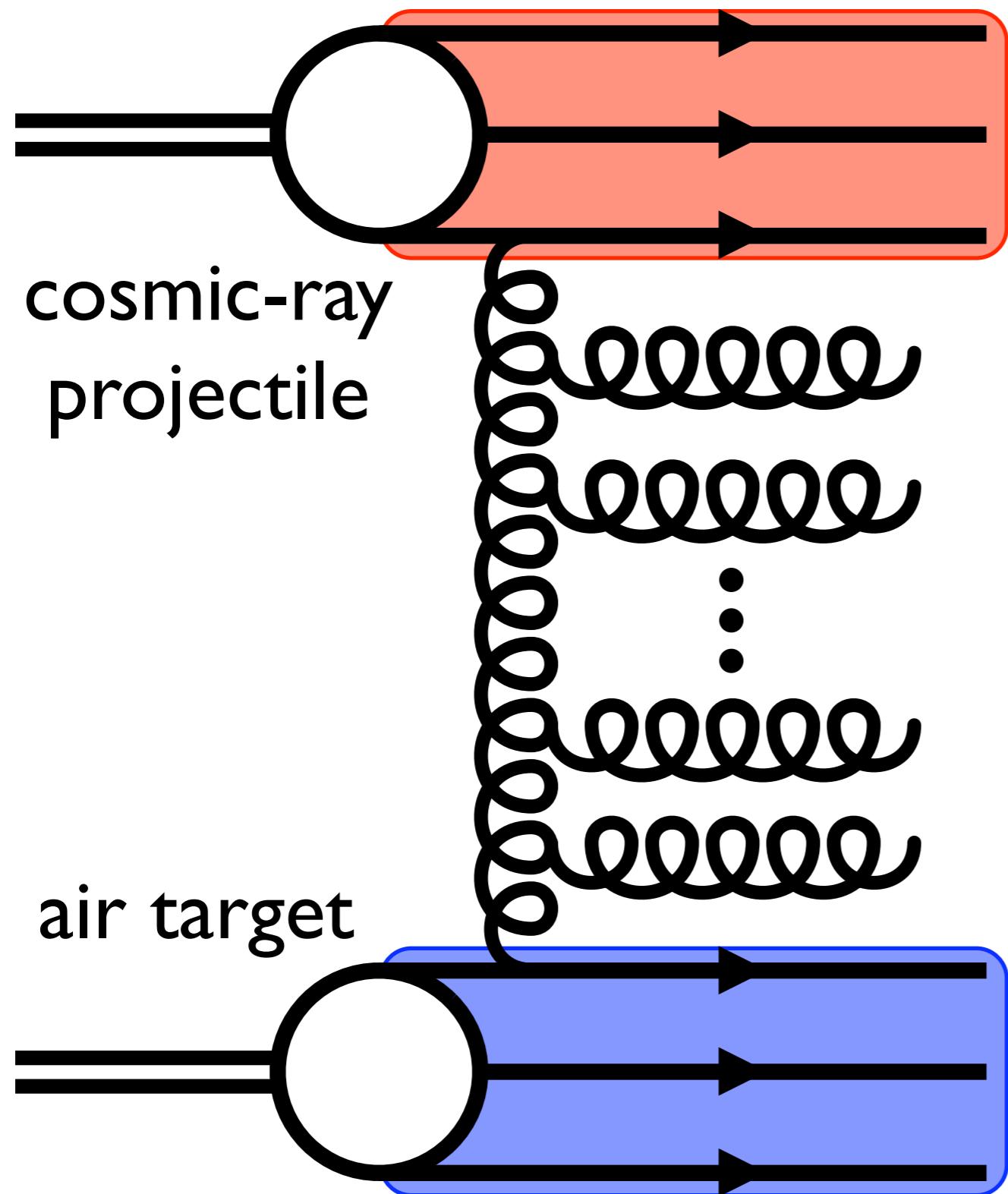
DDD

QCD



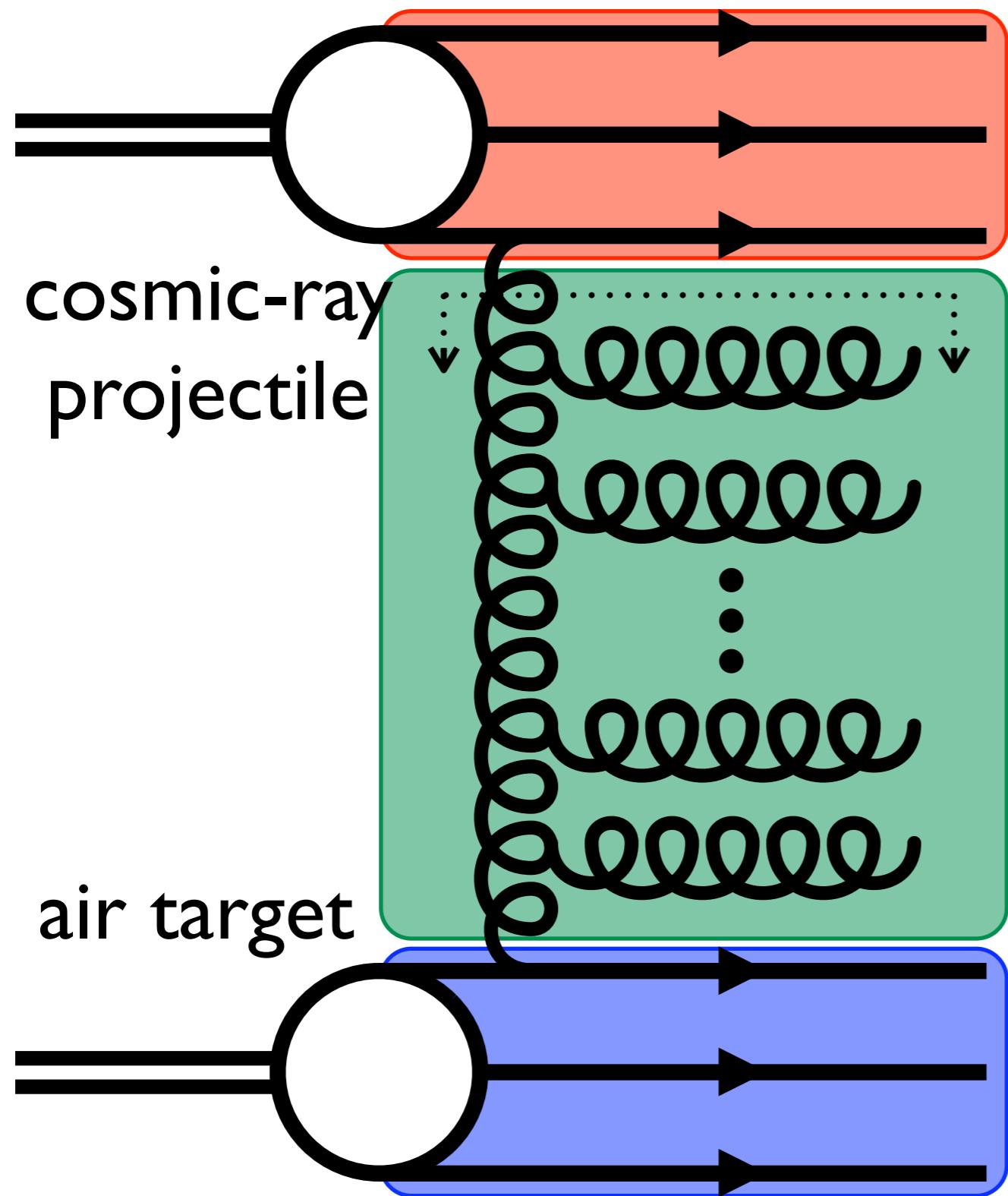
DDD

# QCD



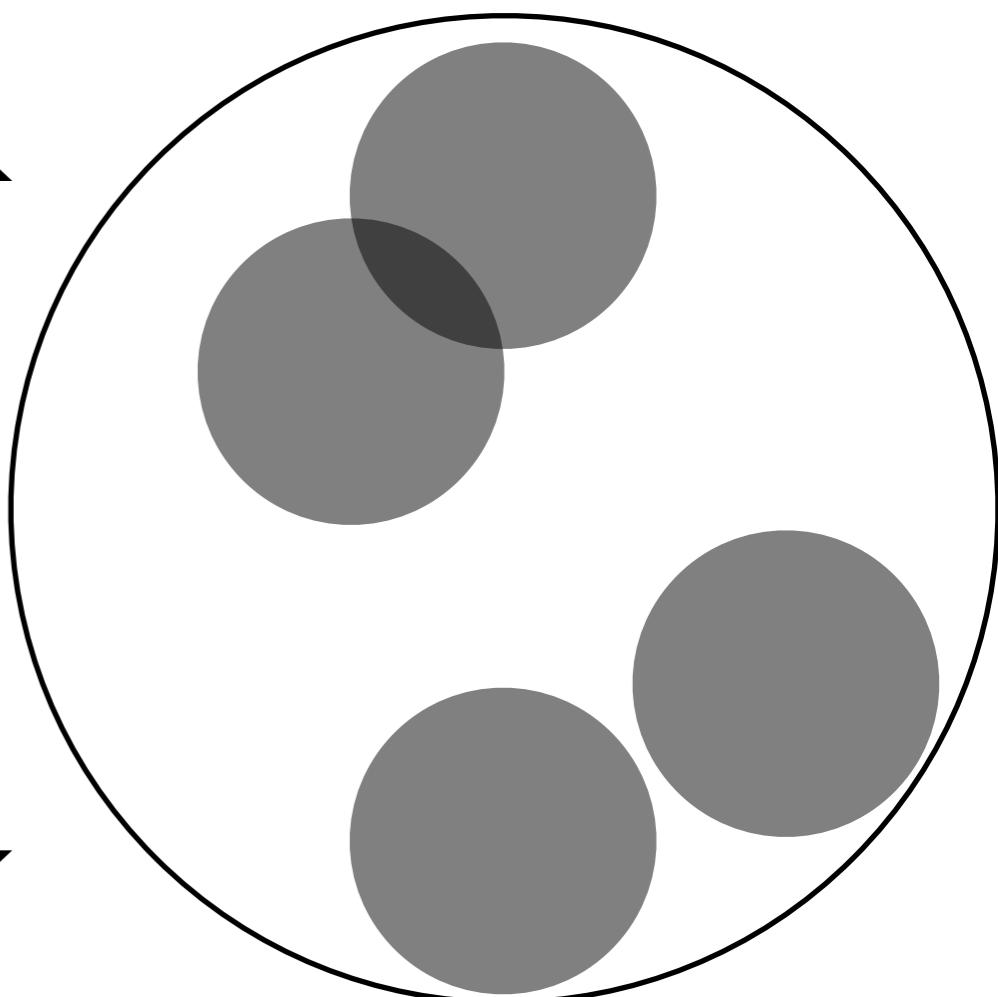
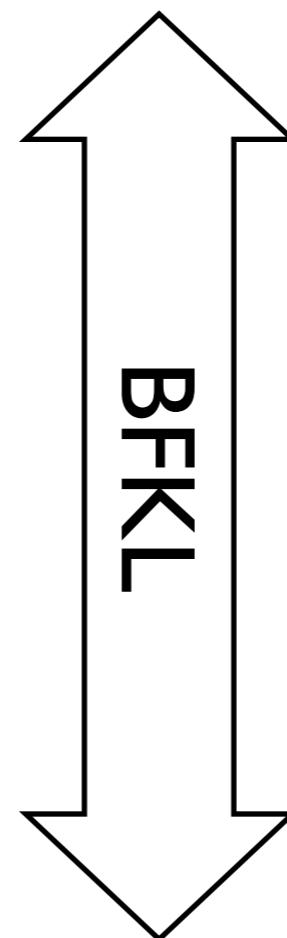
DDD

# QCD



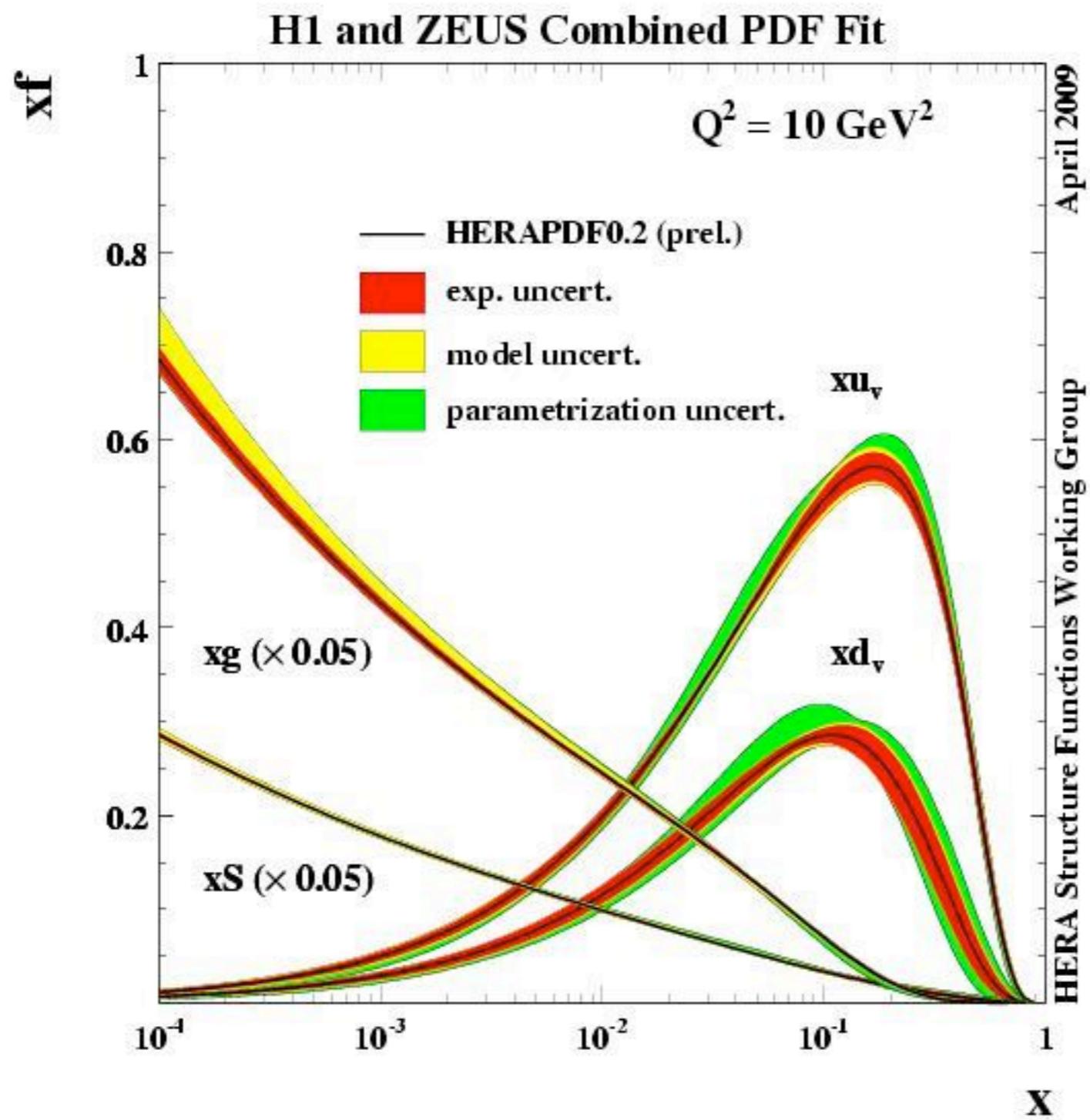
cosmic-ray  
projectile

air target

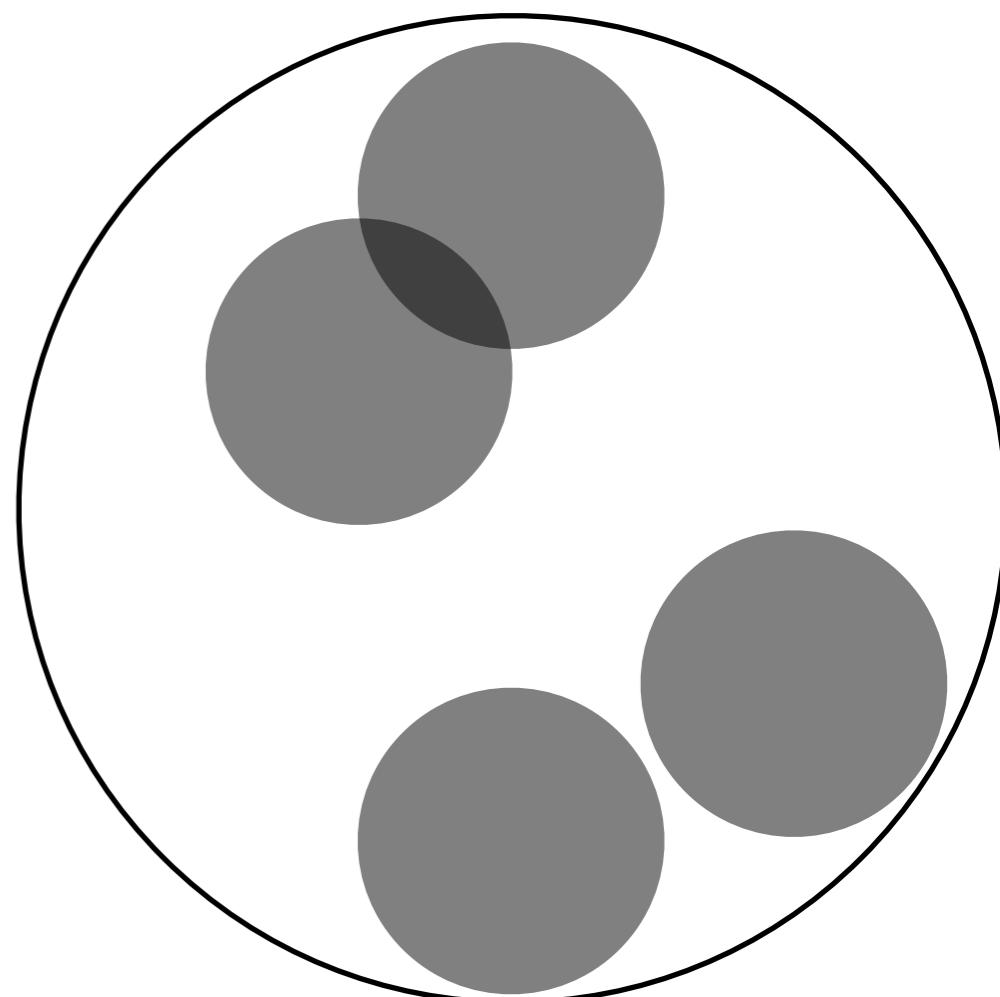
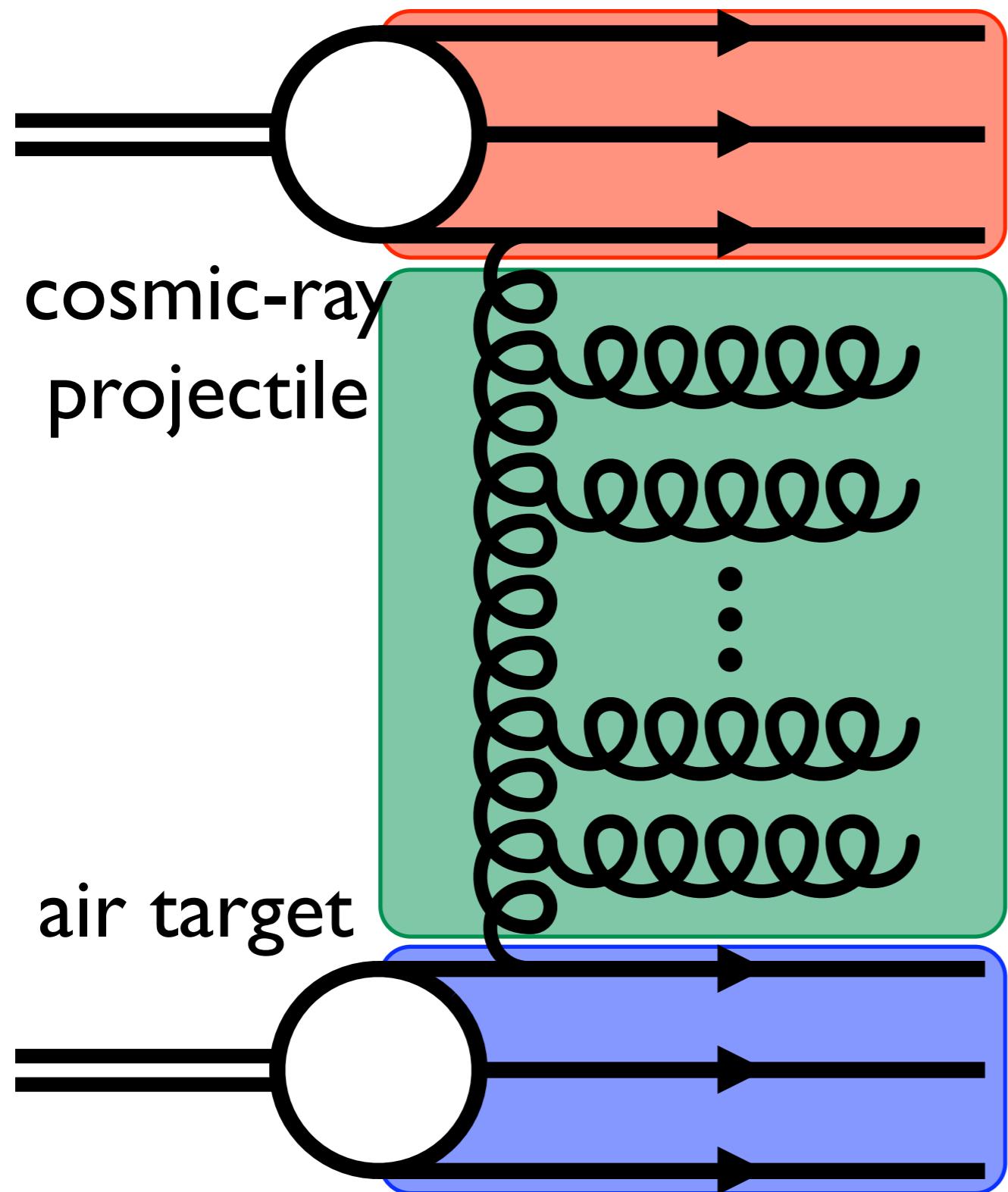


DDD

# HERA

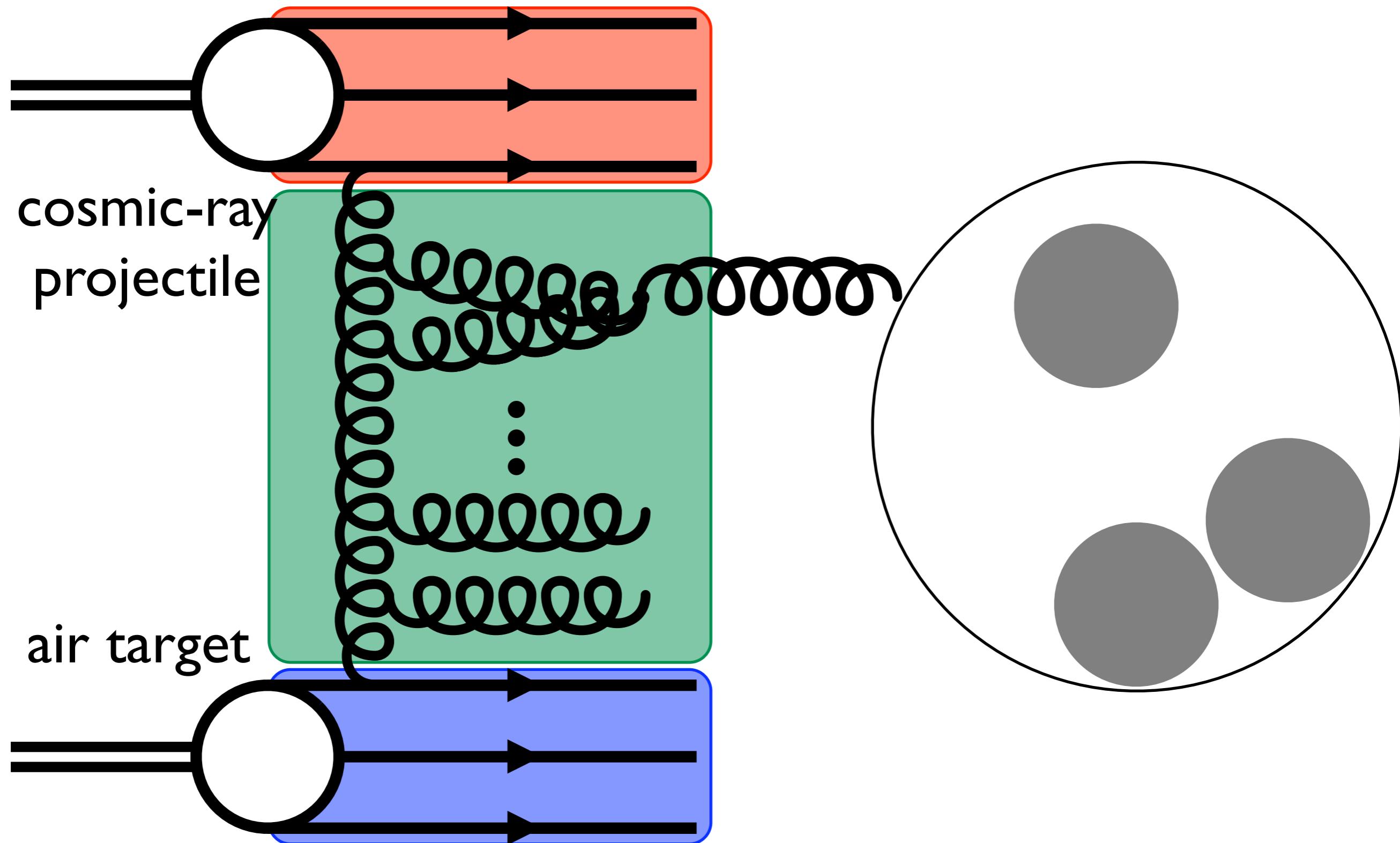


# QCD



DDD

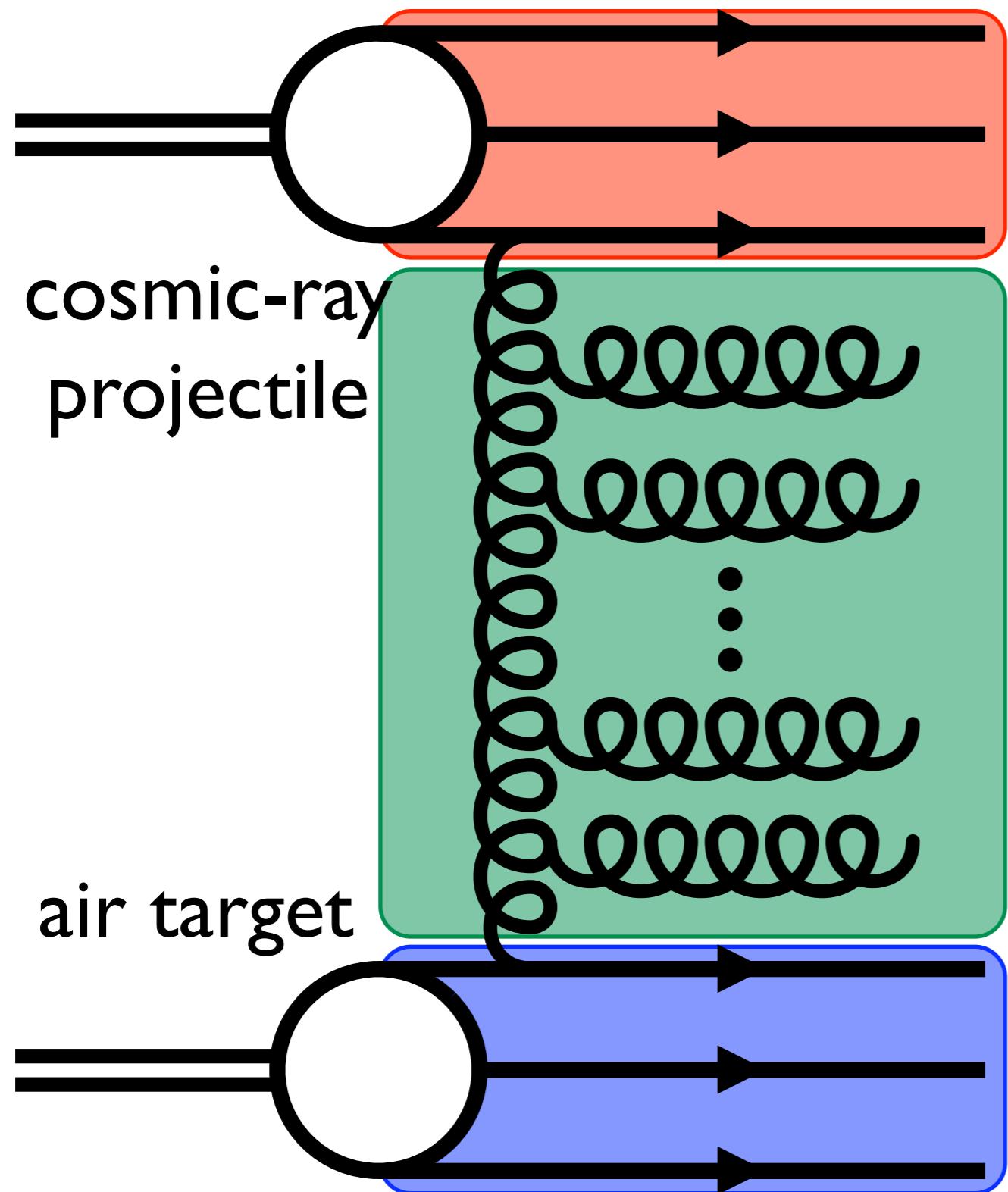
# QCD



see, e.g., Drescher, Dumitru & Strikman, PRL 94 (2005) 231801

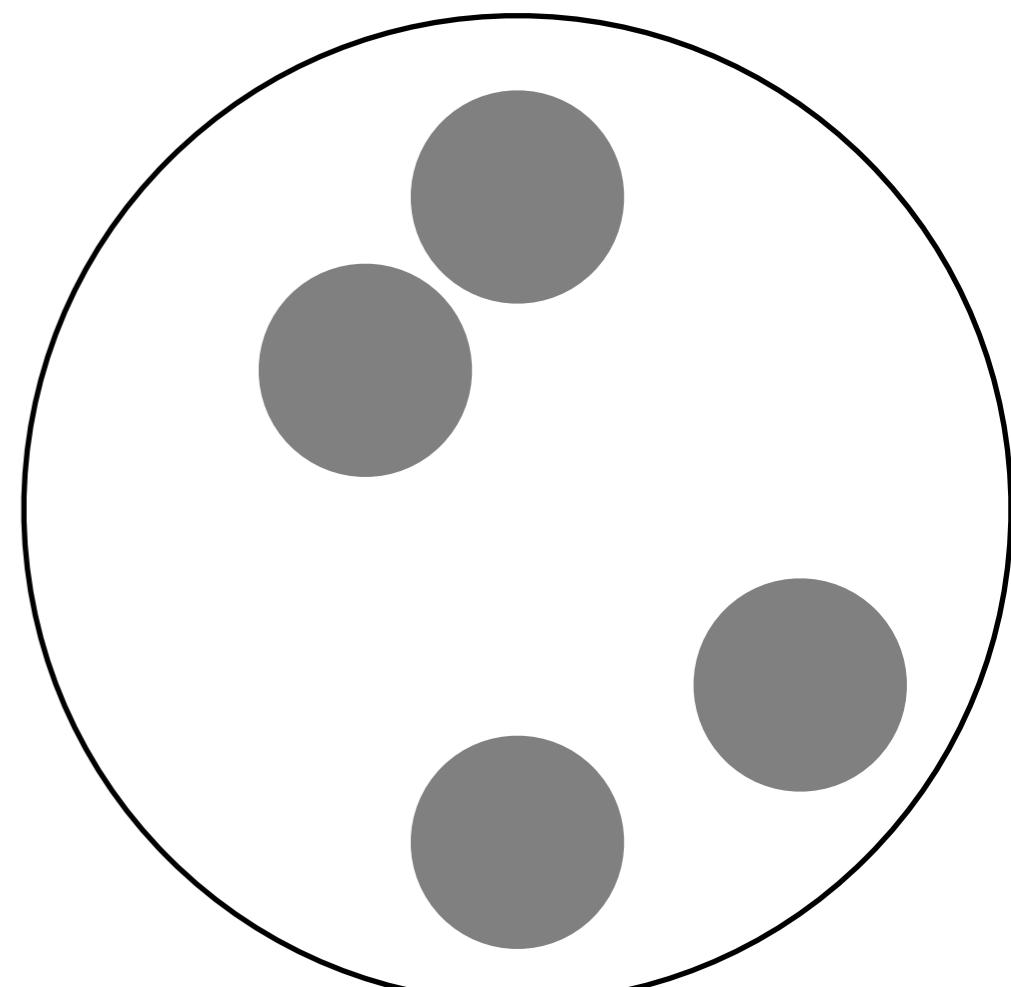
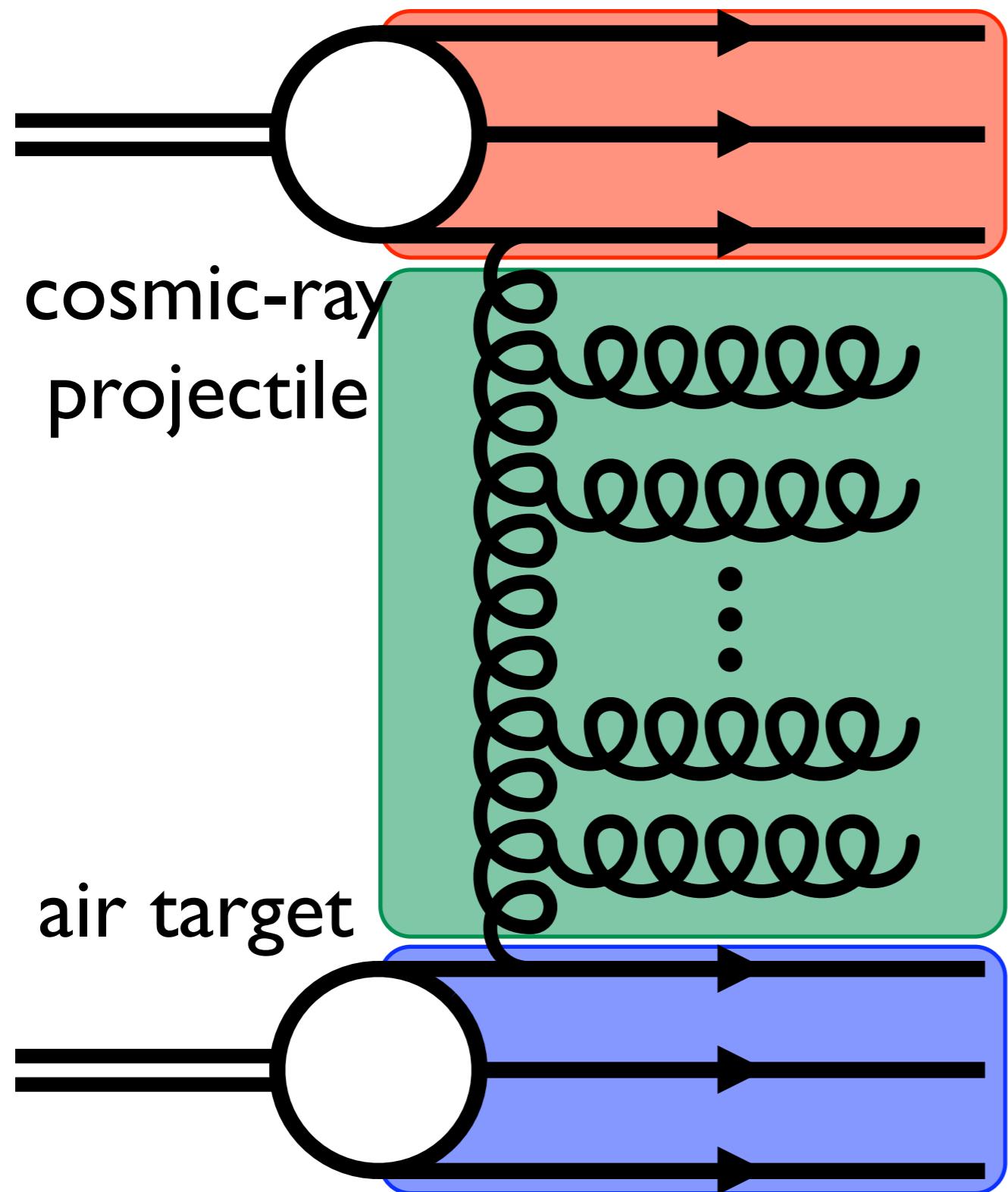
DDD

# QCD



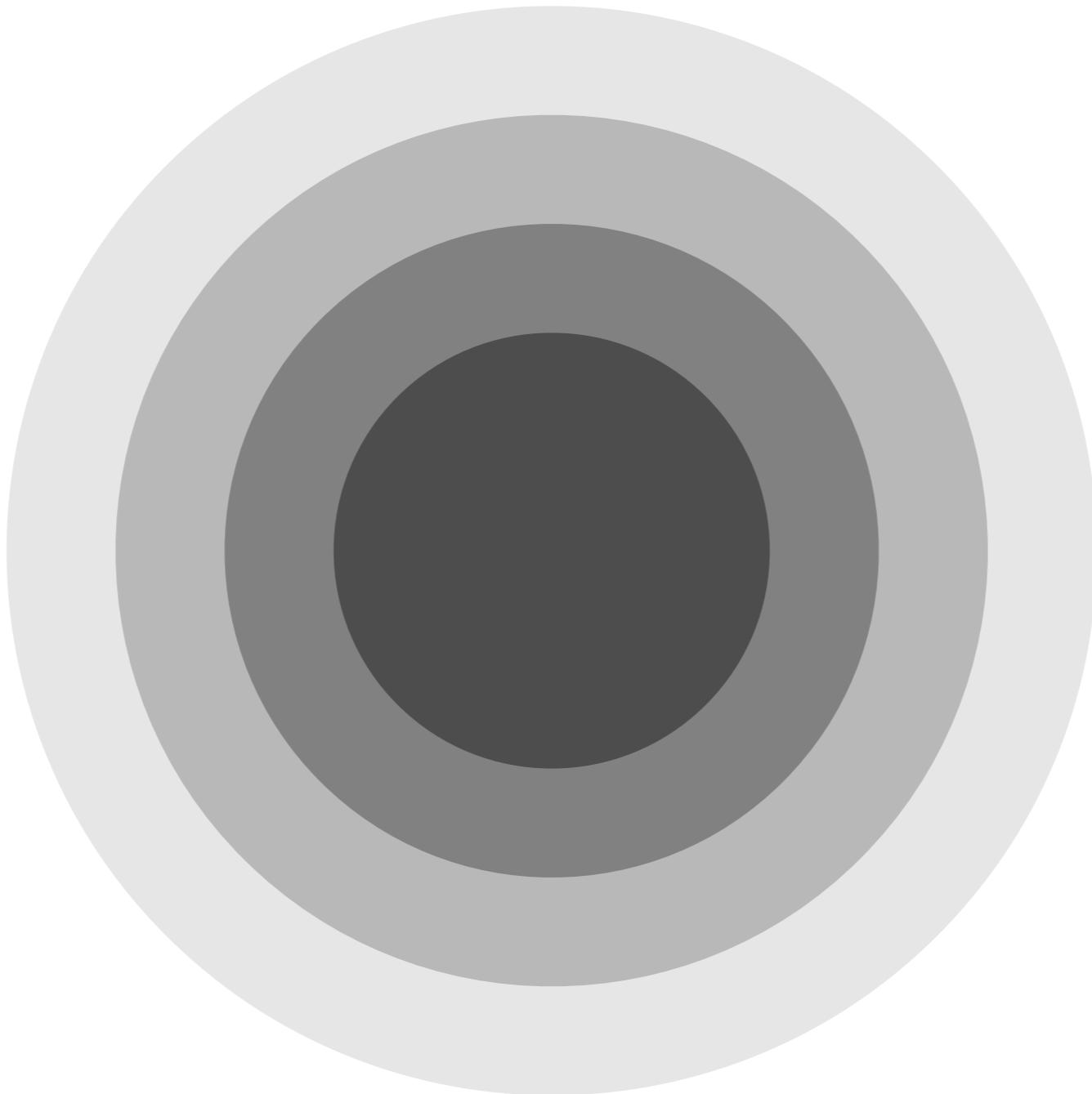
DDD

# QCD

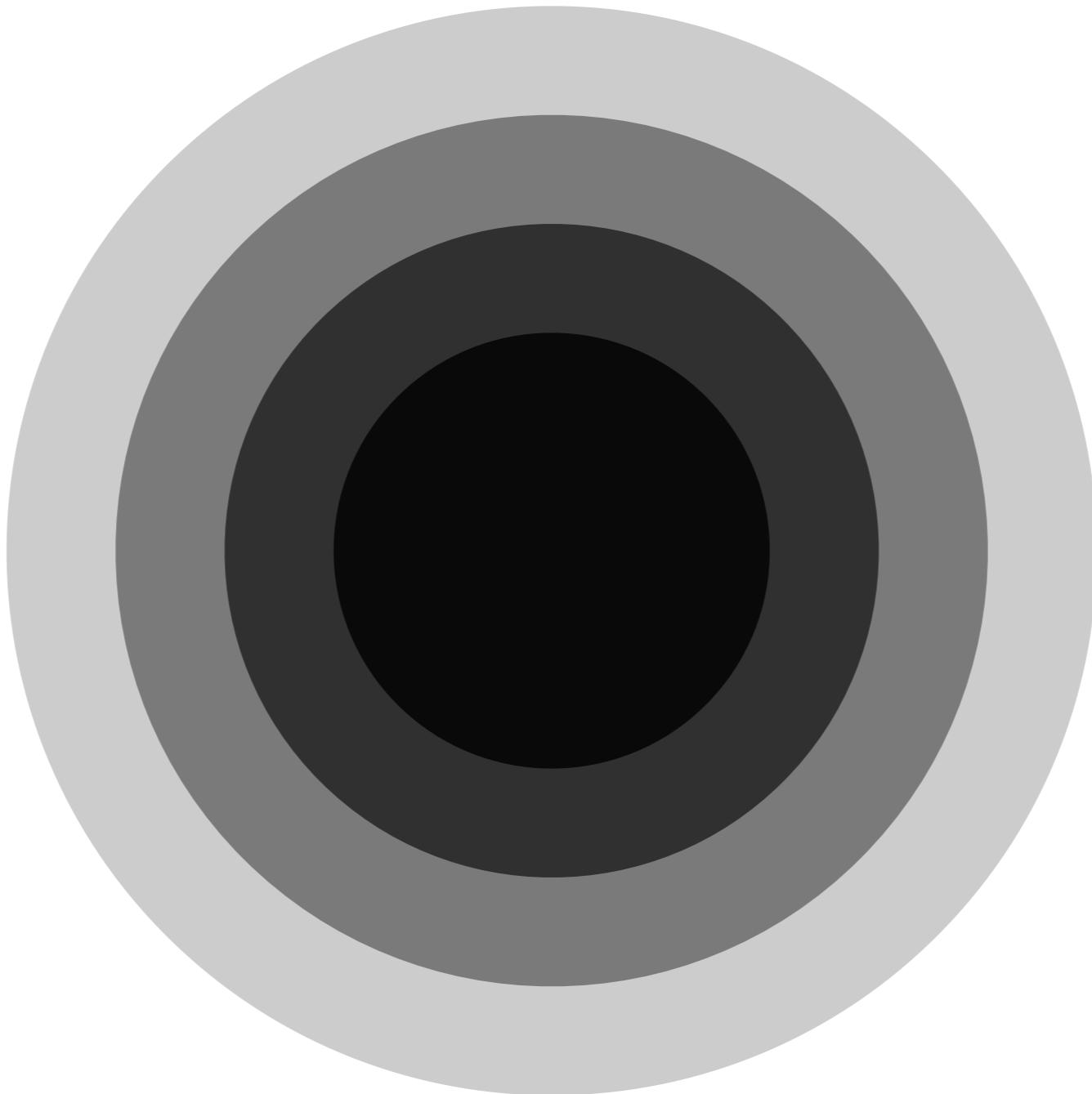


DDD

# Black disc limit

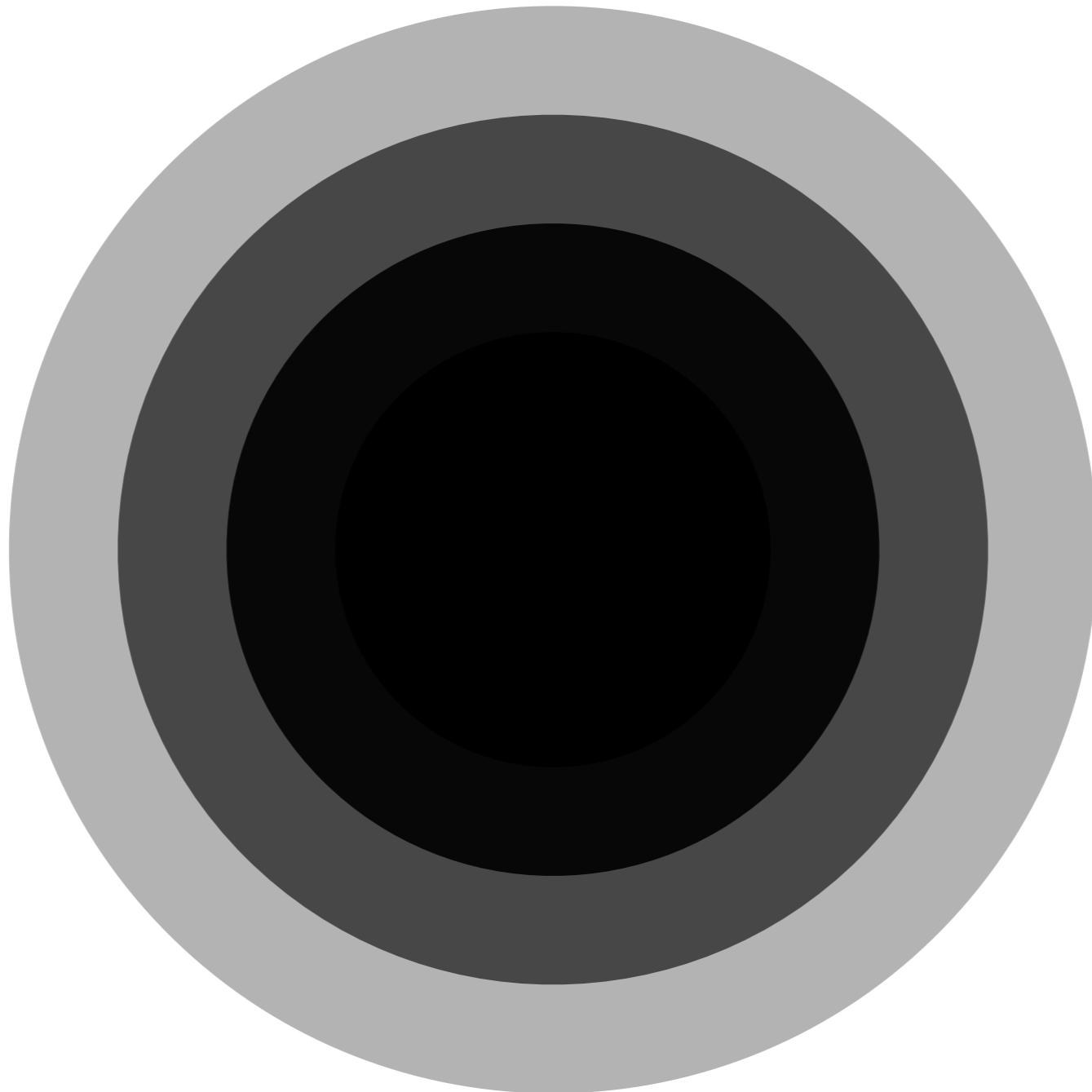


# Black disc limit

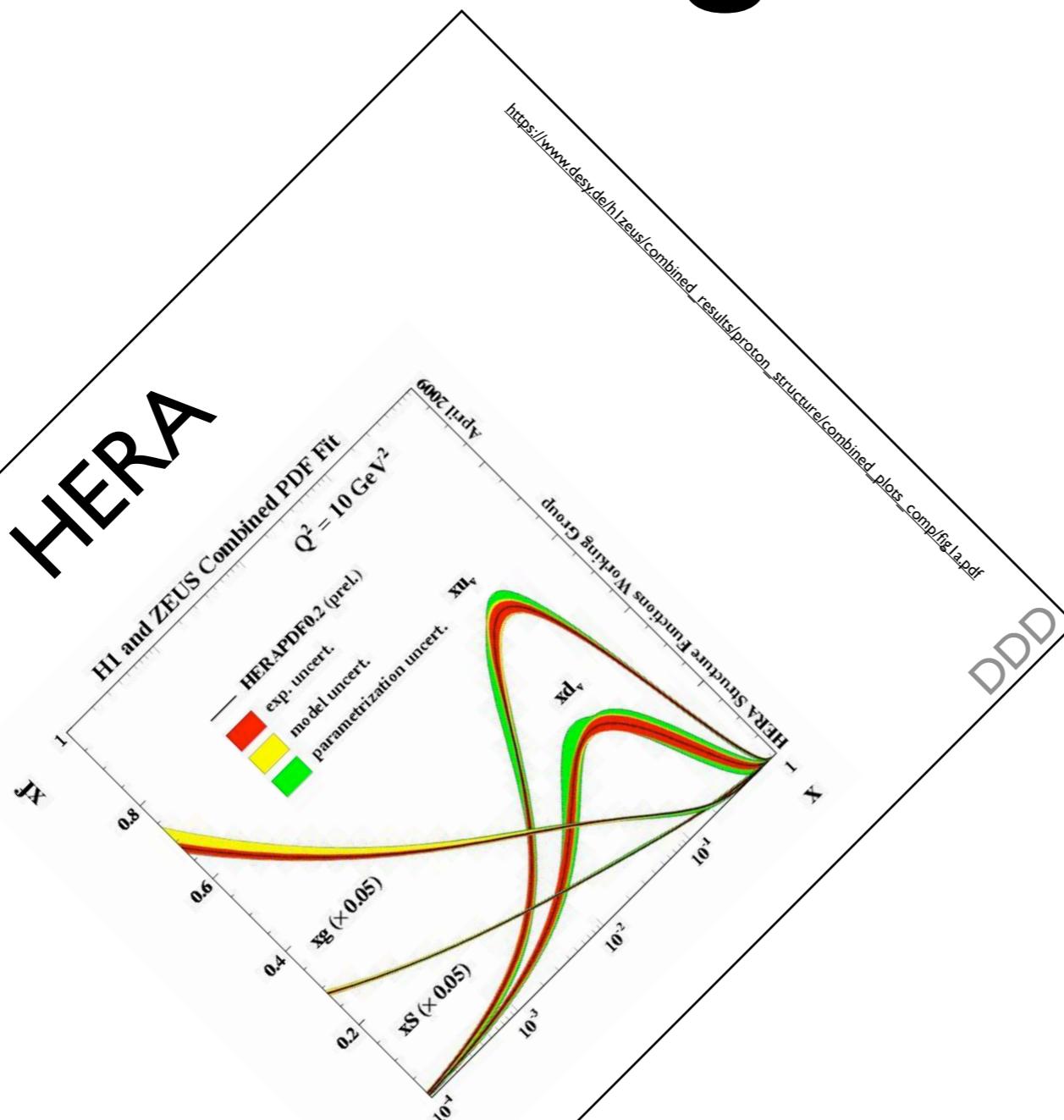


DDD

# Black disc limit



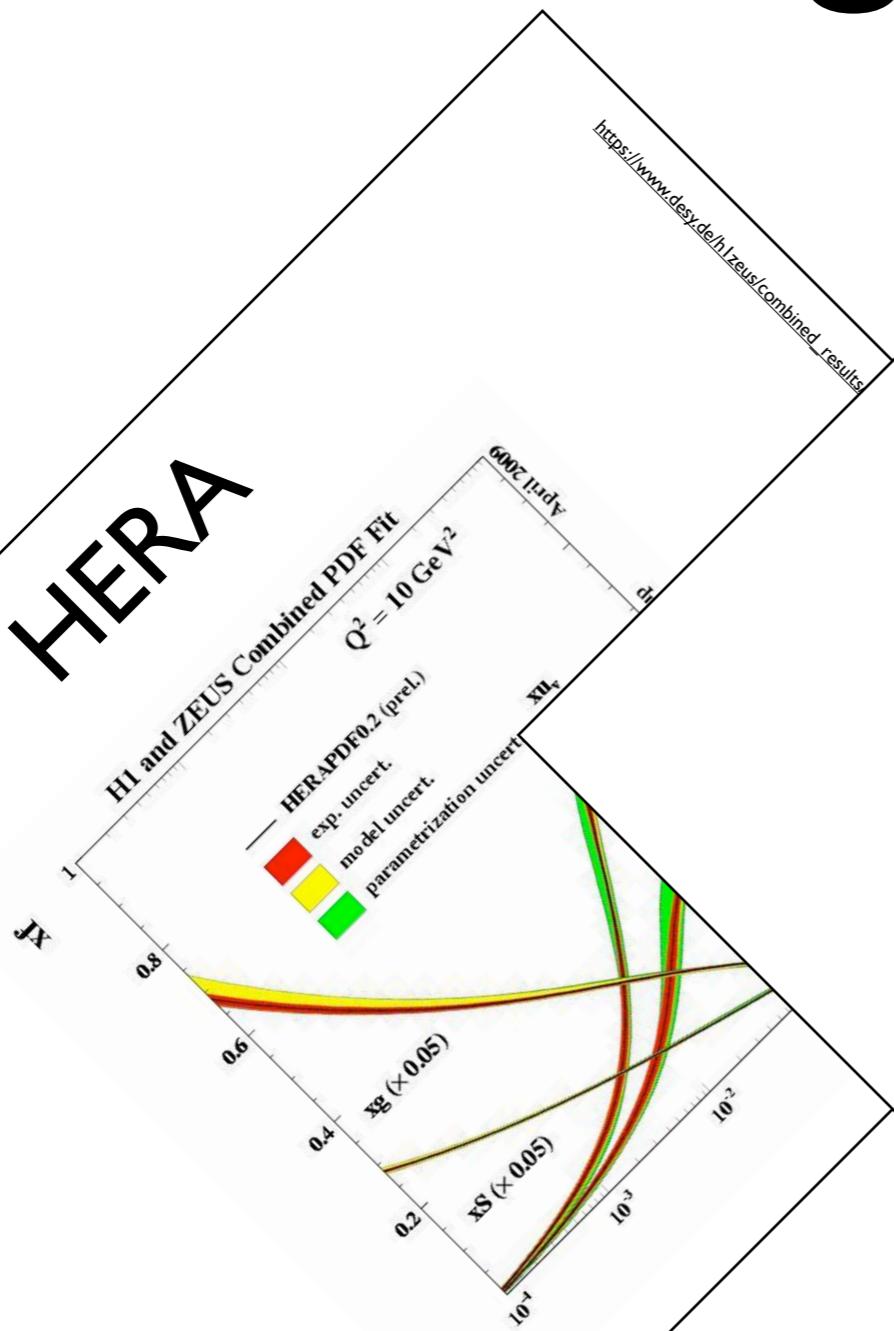
# Taking stock



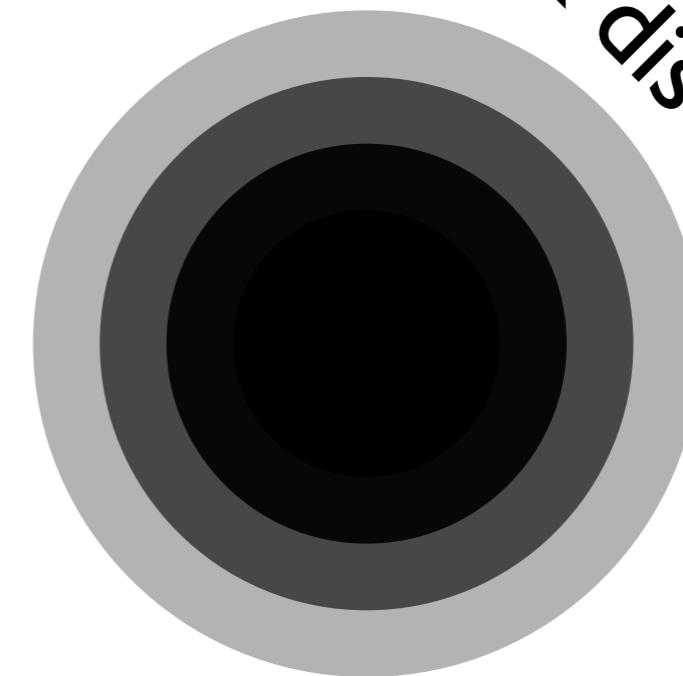
DDD

# Taking stock

HERA



Black disc limit

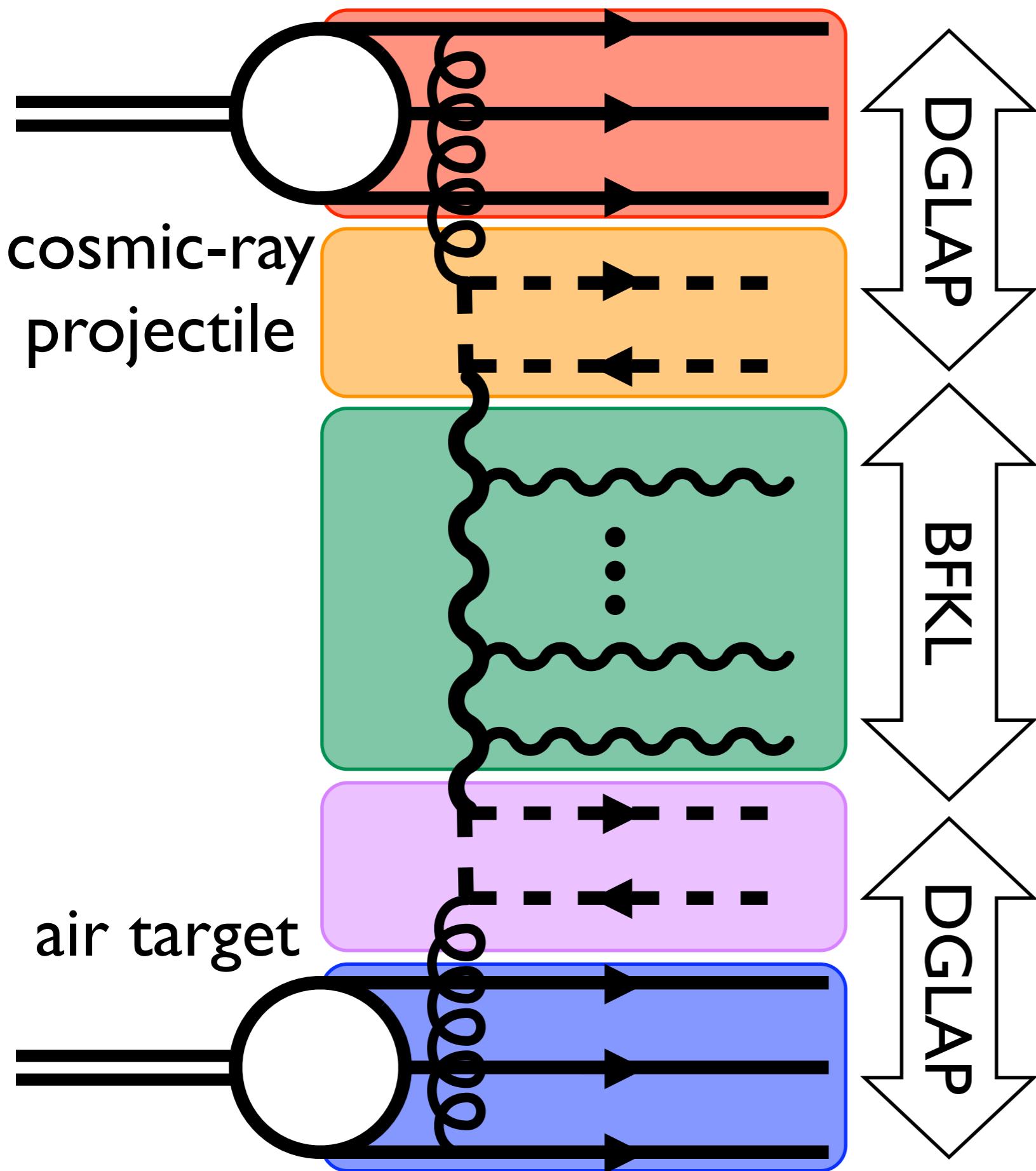


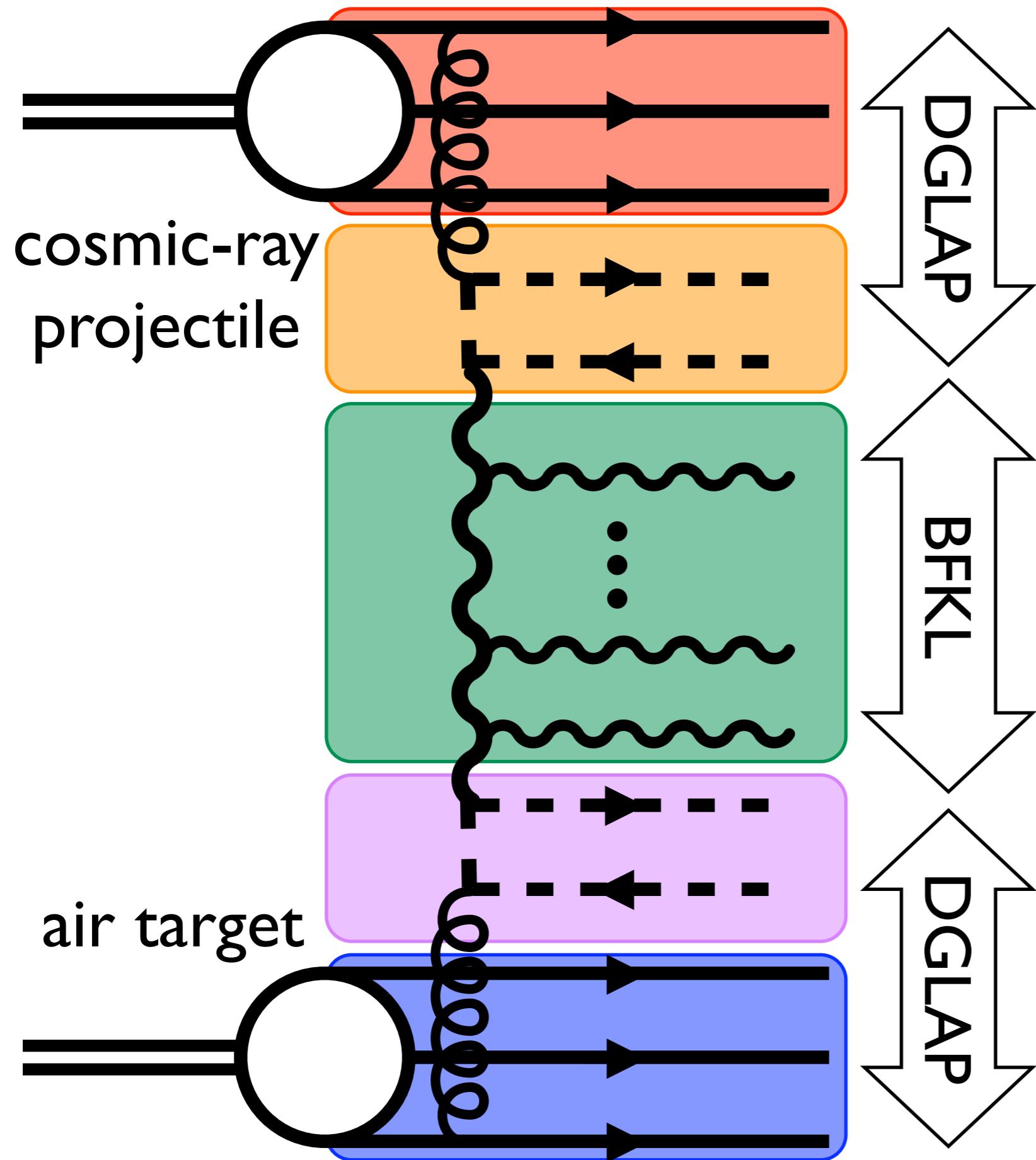
DDD

DDD

# Techni- colour

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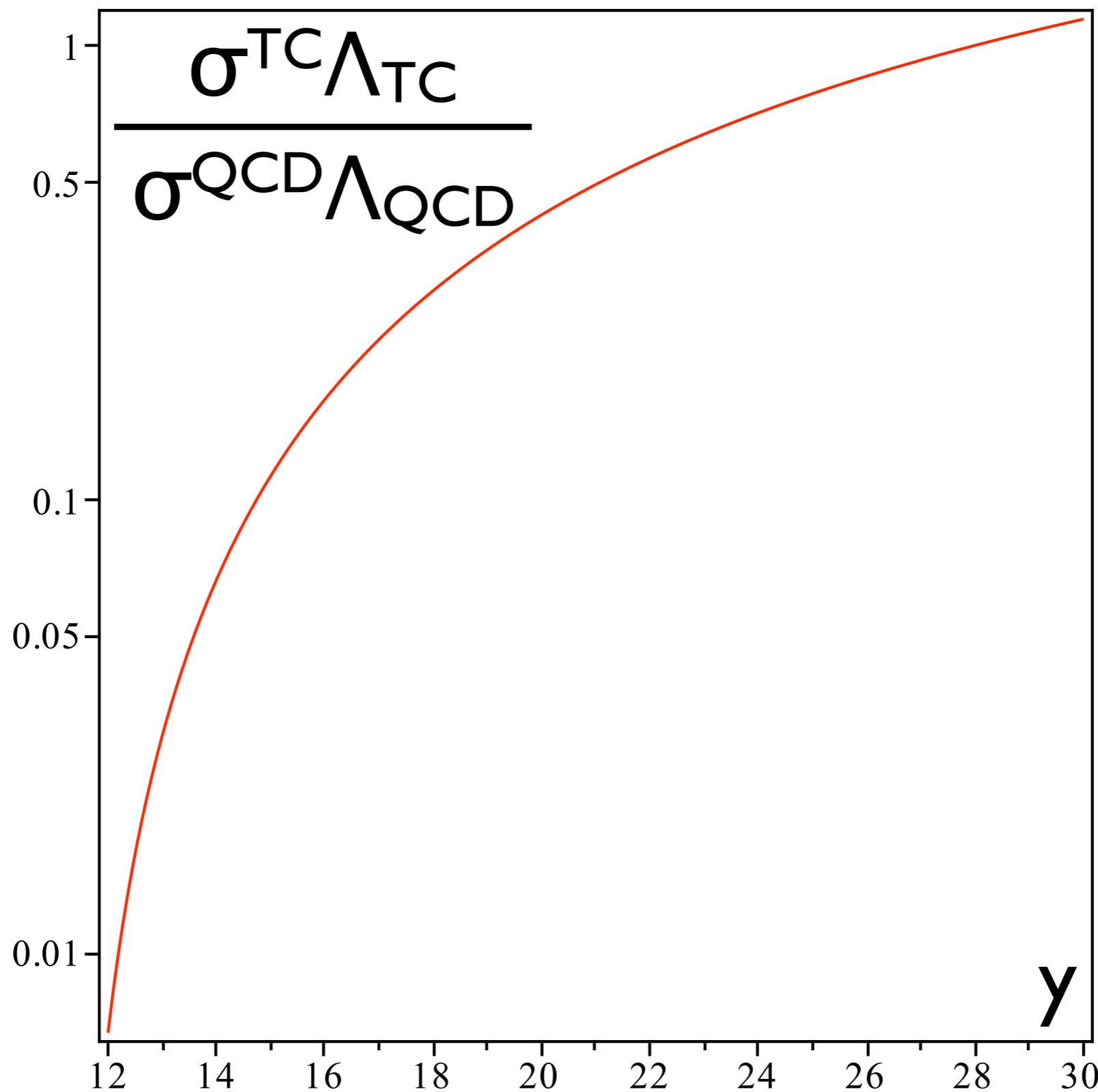




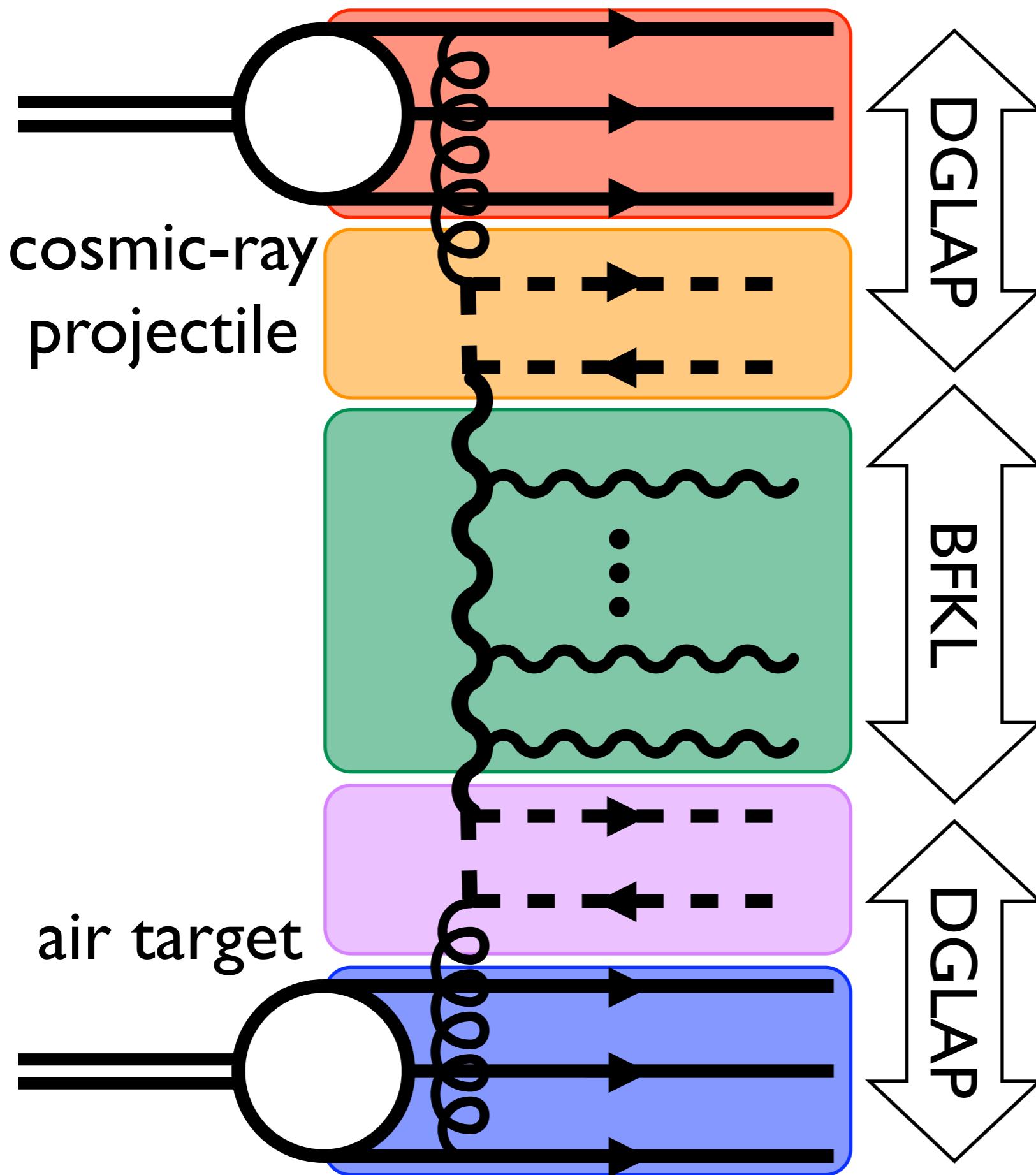
Techni-colour

$$\frac{\sigma_{\text{tot}}^{\text{TC}}}{\sigma_{\text{tot}}^{\text{QCD}}} \approx O(10^{-3})$$

# Transverse momentum



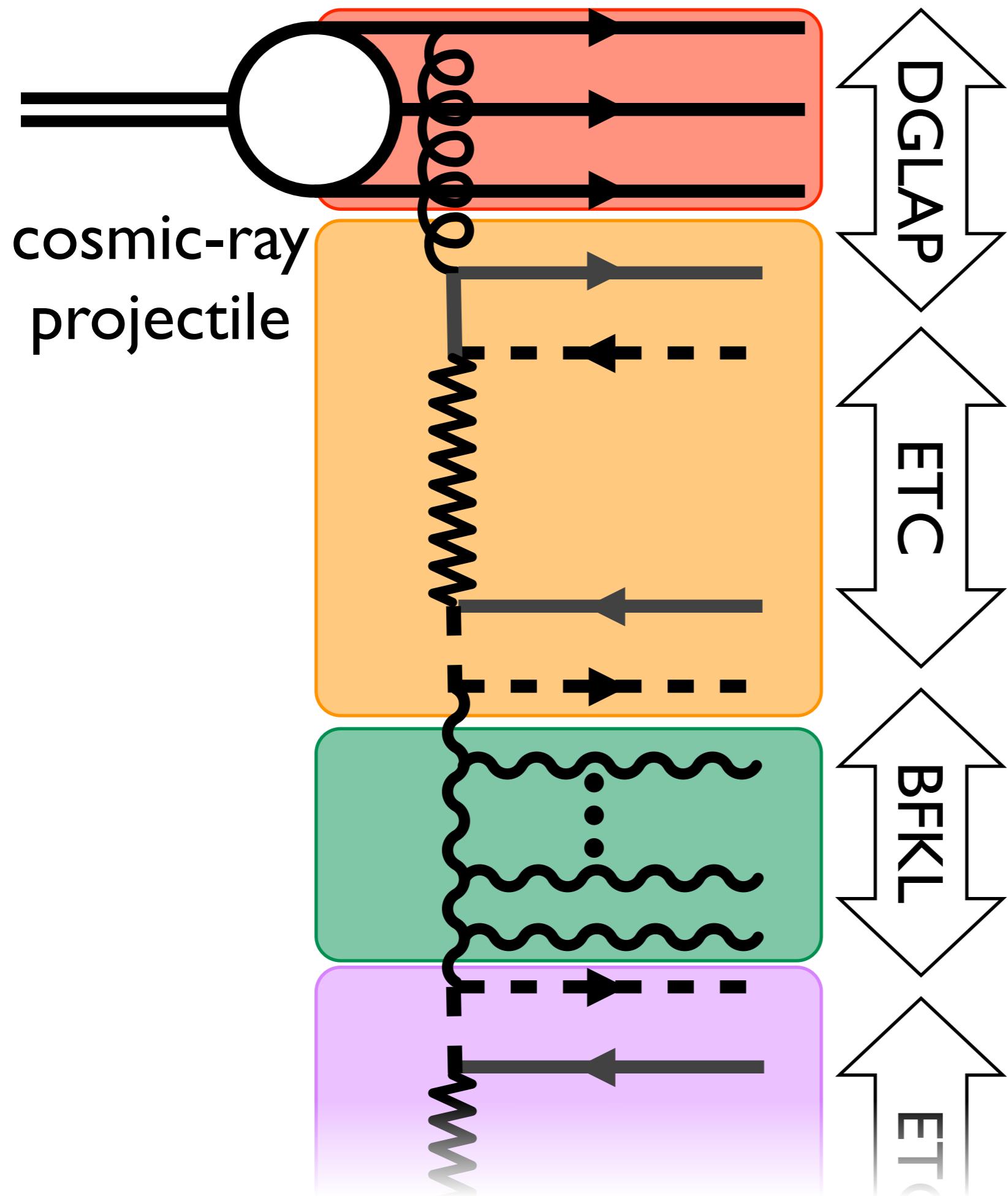
# Techni-colour



$$\frac{\sigma_{\text{tot}}^{\text{TC}}}{\sigma_{\text{tot}}^{\text{QCD}}} \approx O(10^{-3})$$

$$\frac{\sigma_{\text{tot}}^{\text{TC}}}{\sigma_{\text{tot}}^{\text{QCD}}} \frac{\Lambda_{\text{TC}}}{\Lambda_{\text{QCD}}} \approx O(1)$$

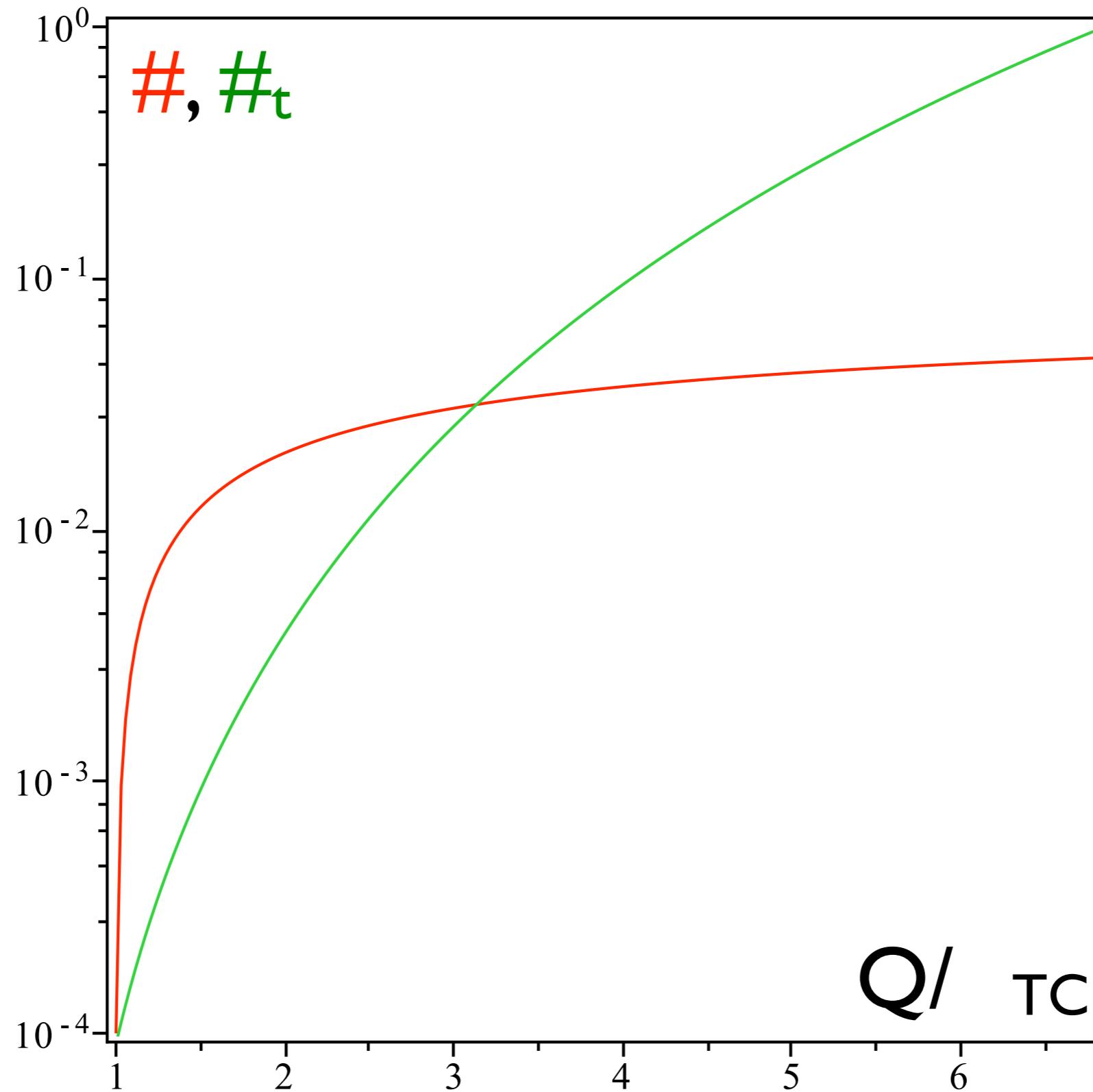
DDD



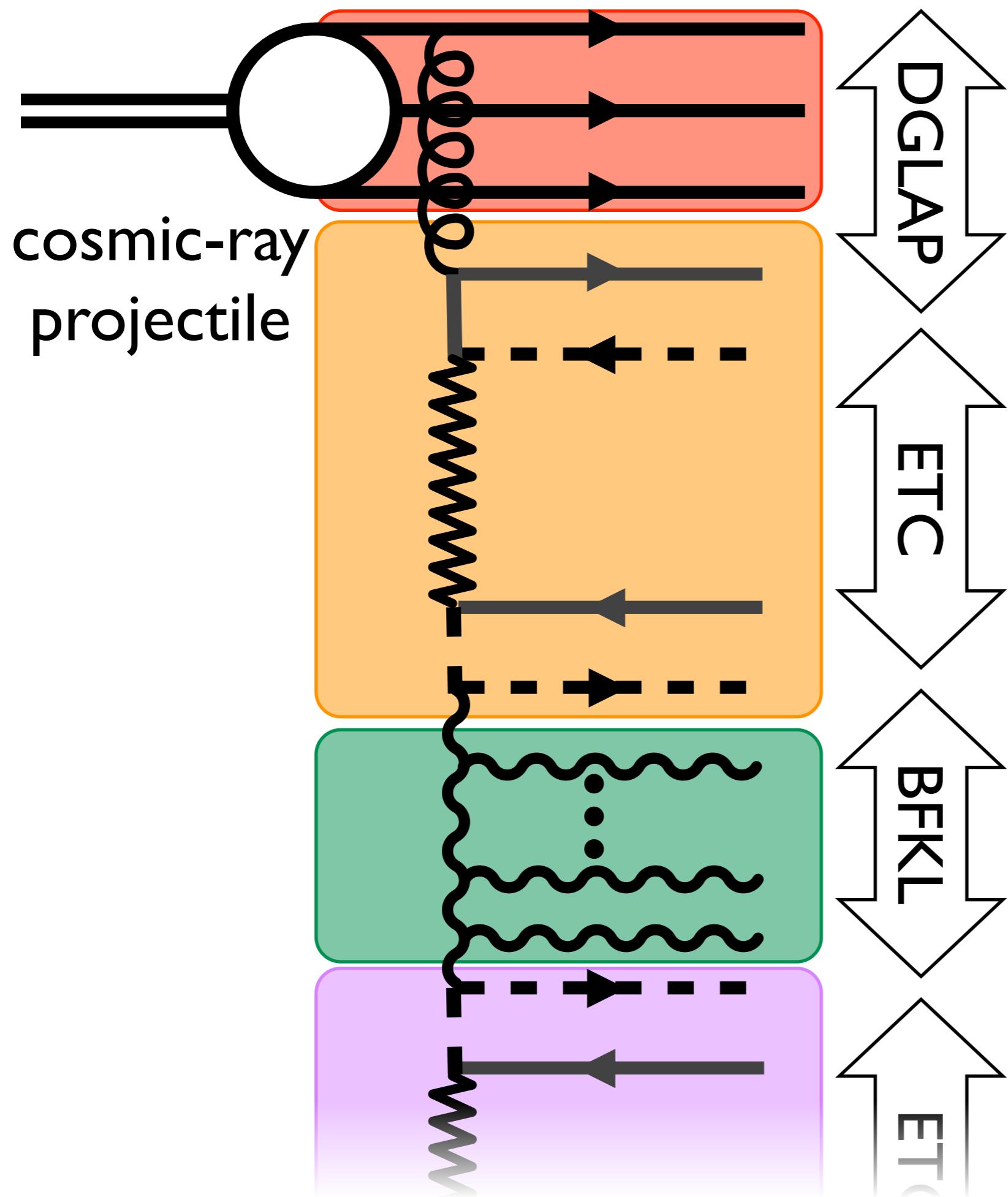
Techni-colour 2

DDD

# TC1 vs. TC2



2

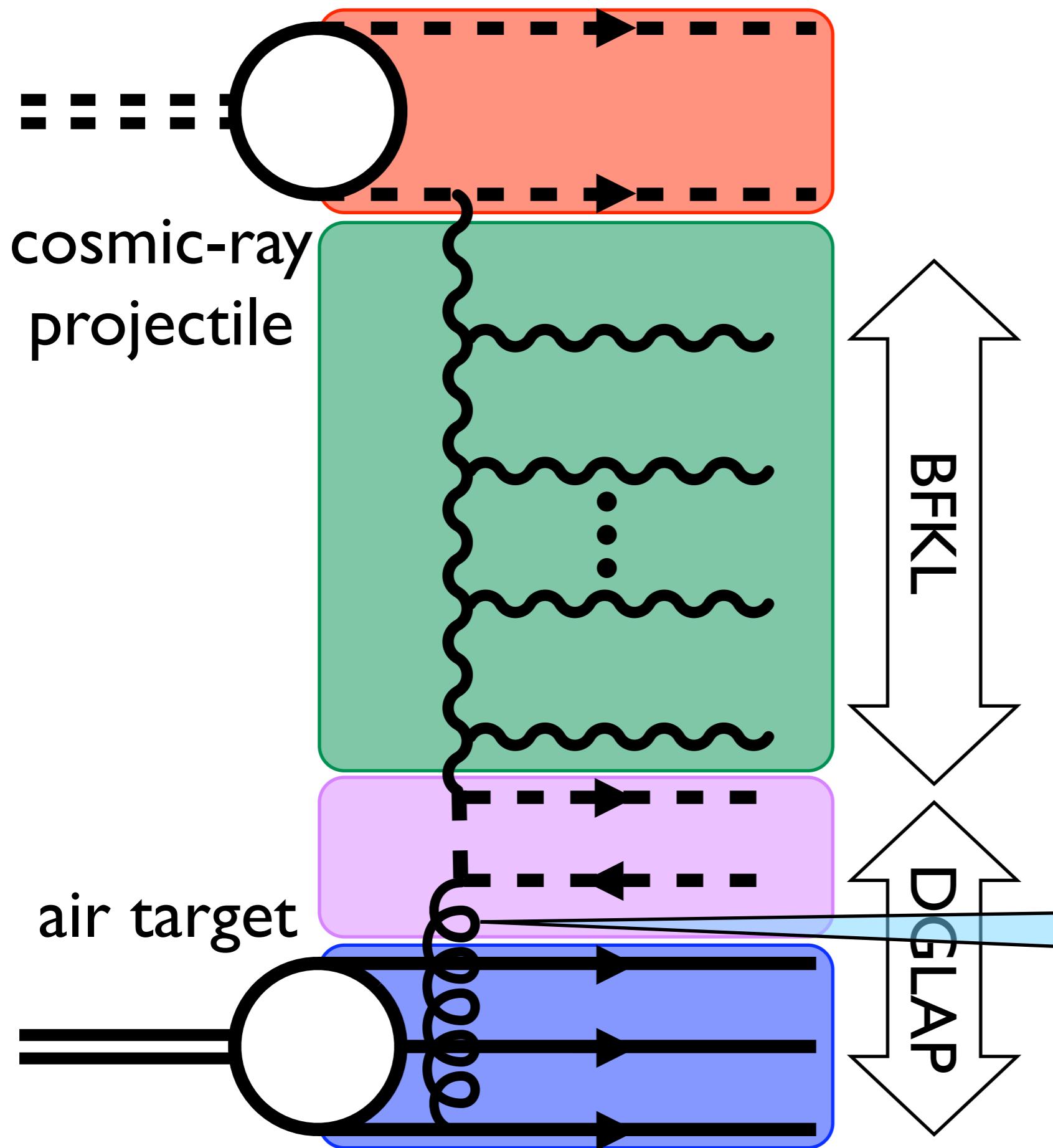


Techni-  
colour

DDD

# Fast forward

- Technicolour
  - 3<sup>rd</sup> generation ETC few TeV
  - Topcolour - if unification w/ SU(3)  
    ⇒ small coupling
  - Composite Higgs  $\xi = (v/f)^2 \approx 1$  “TC limit”  
    requires completion to judge !?
  - Little Higgs - heavy SU(2)  $\approx 2$  TeV
  - $SU(2)_L$  - coupling to weak

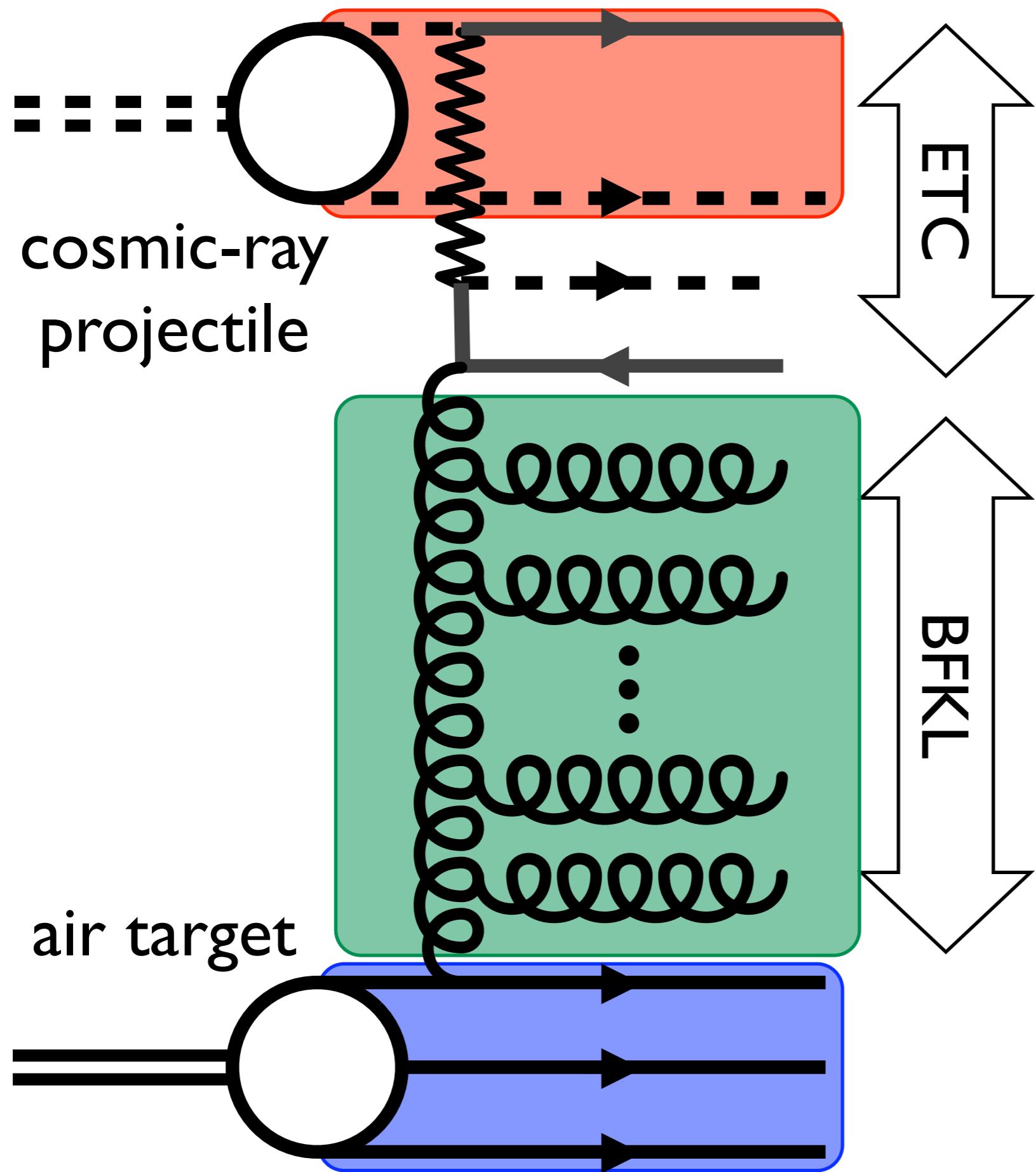


non-SM  
cosmic  
ray

air target

alternatively  
top-quark portal

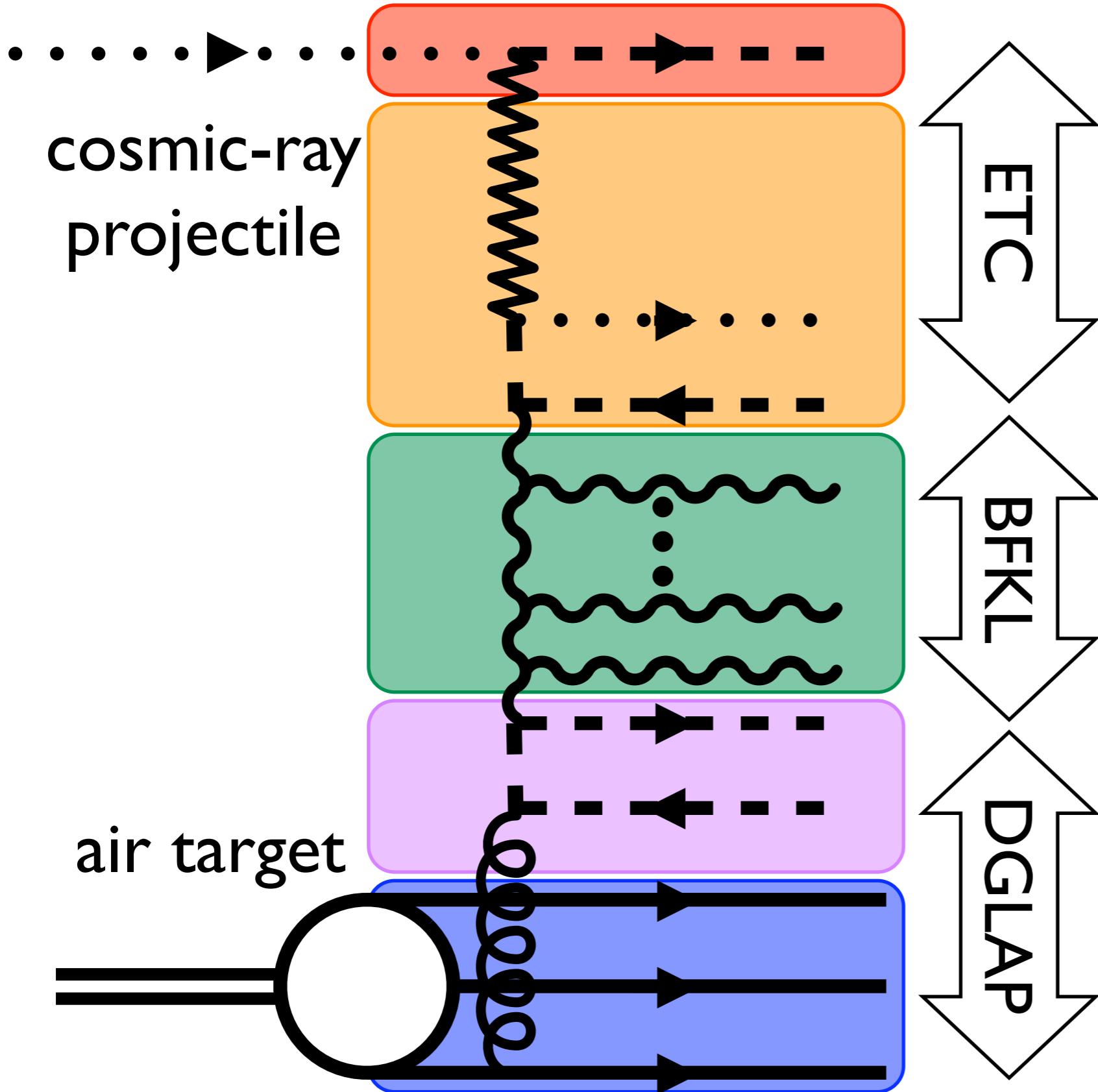
DDD



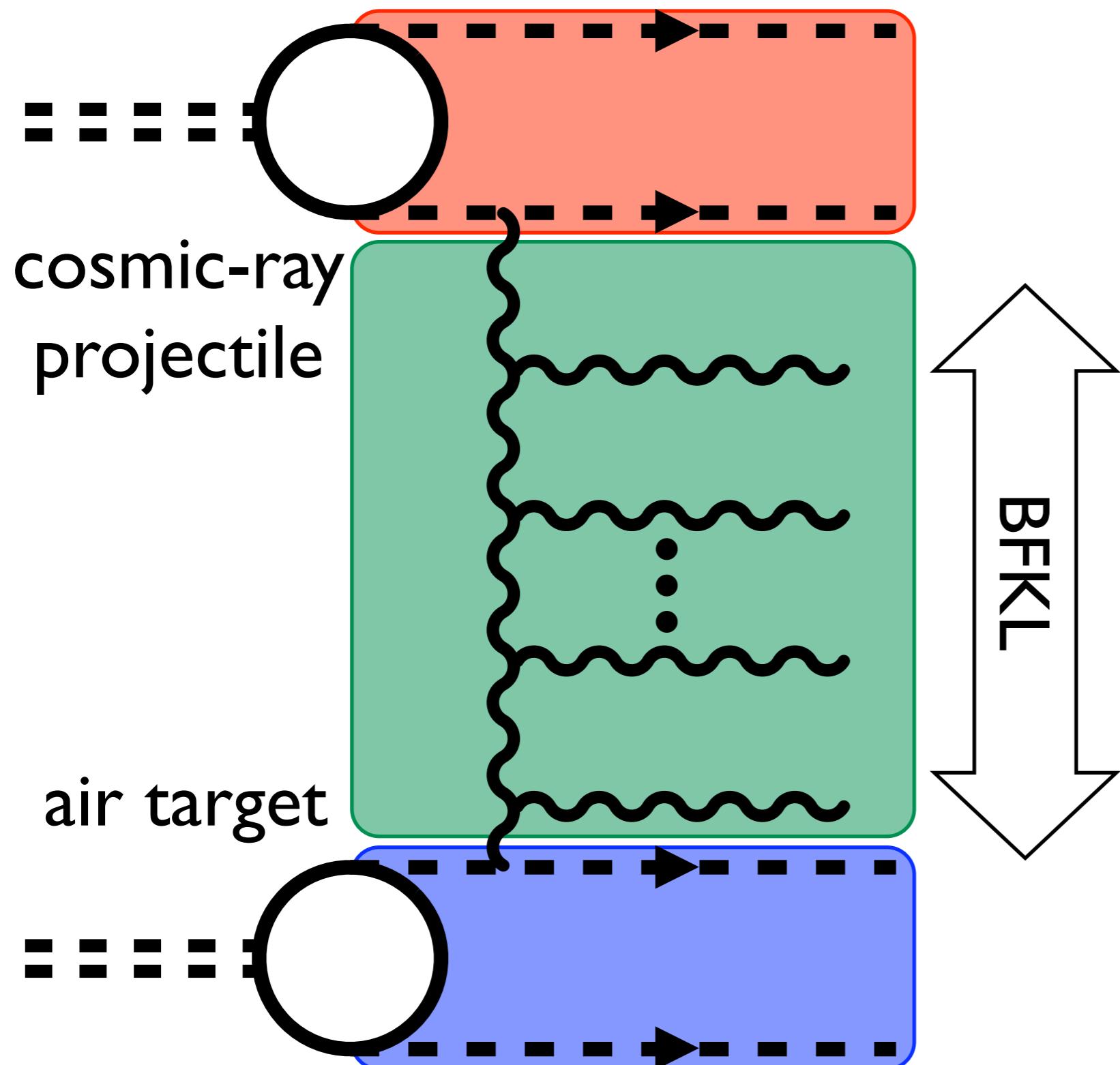
non-SM  
CR  
& QCD

DDD

Heavy  
lepton  
(e.g.  $\nu$ )



DDD



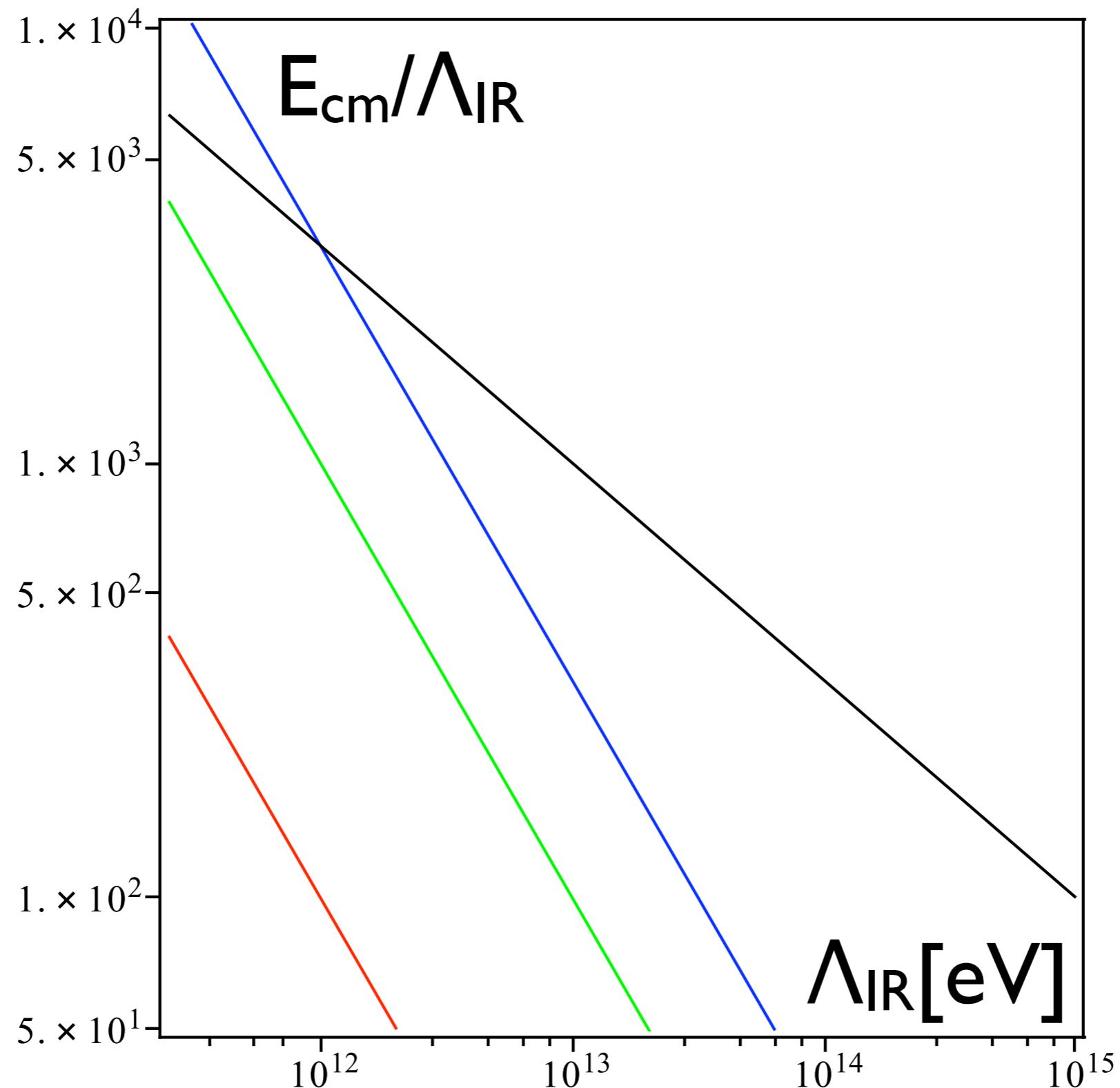
+ non-SM  
target

cosmic-ray  
projectile

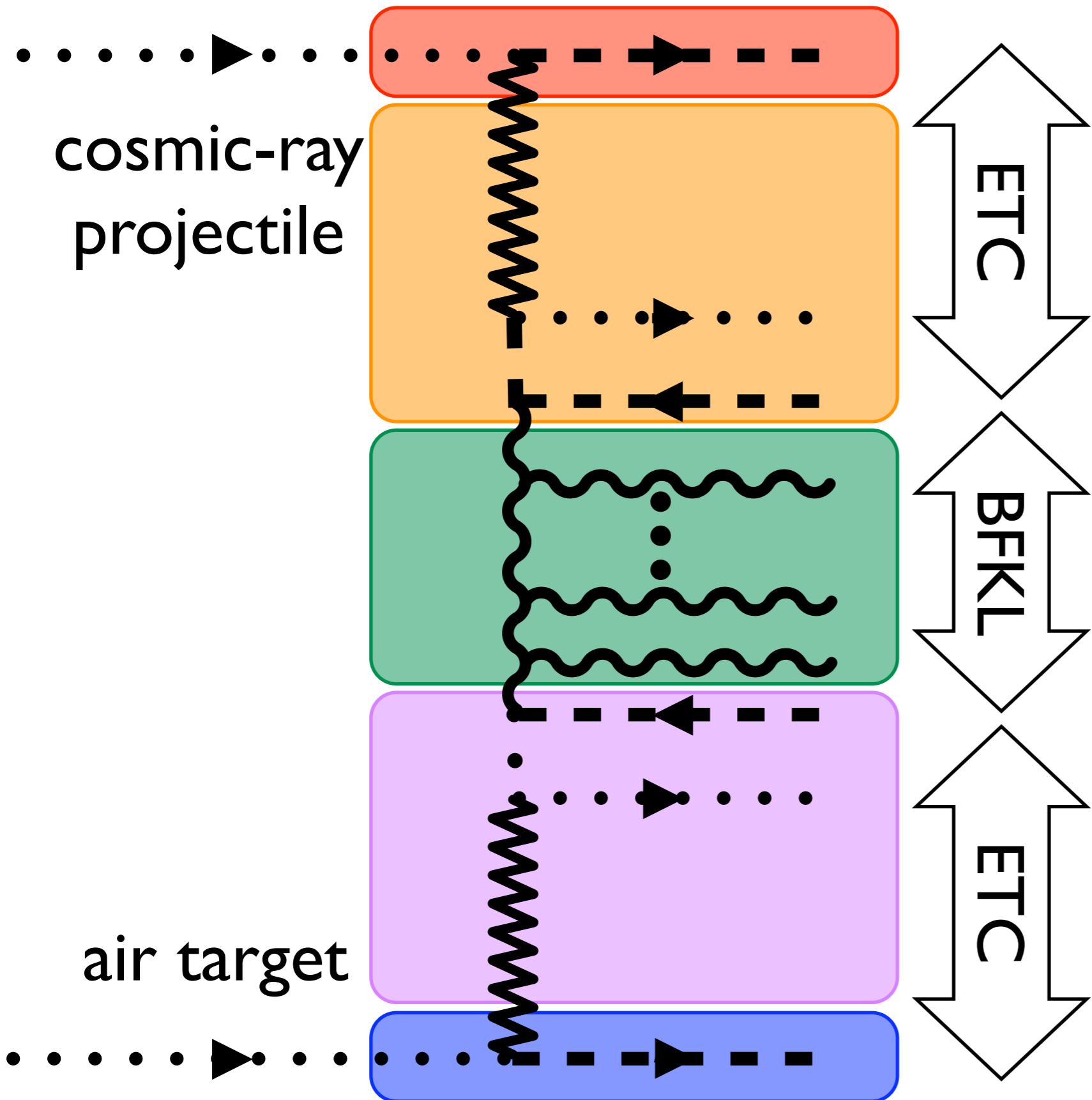
air target

similarly: heavy neutrino

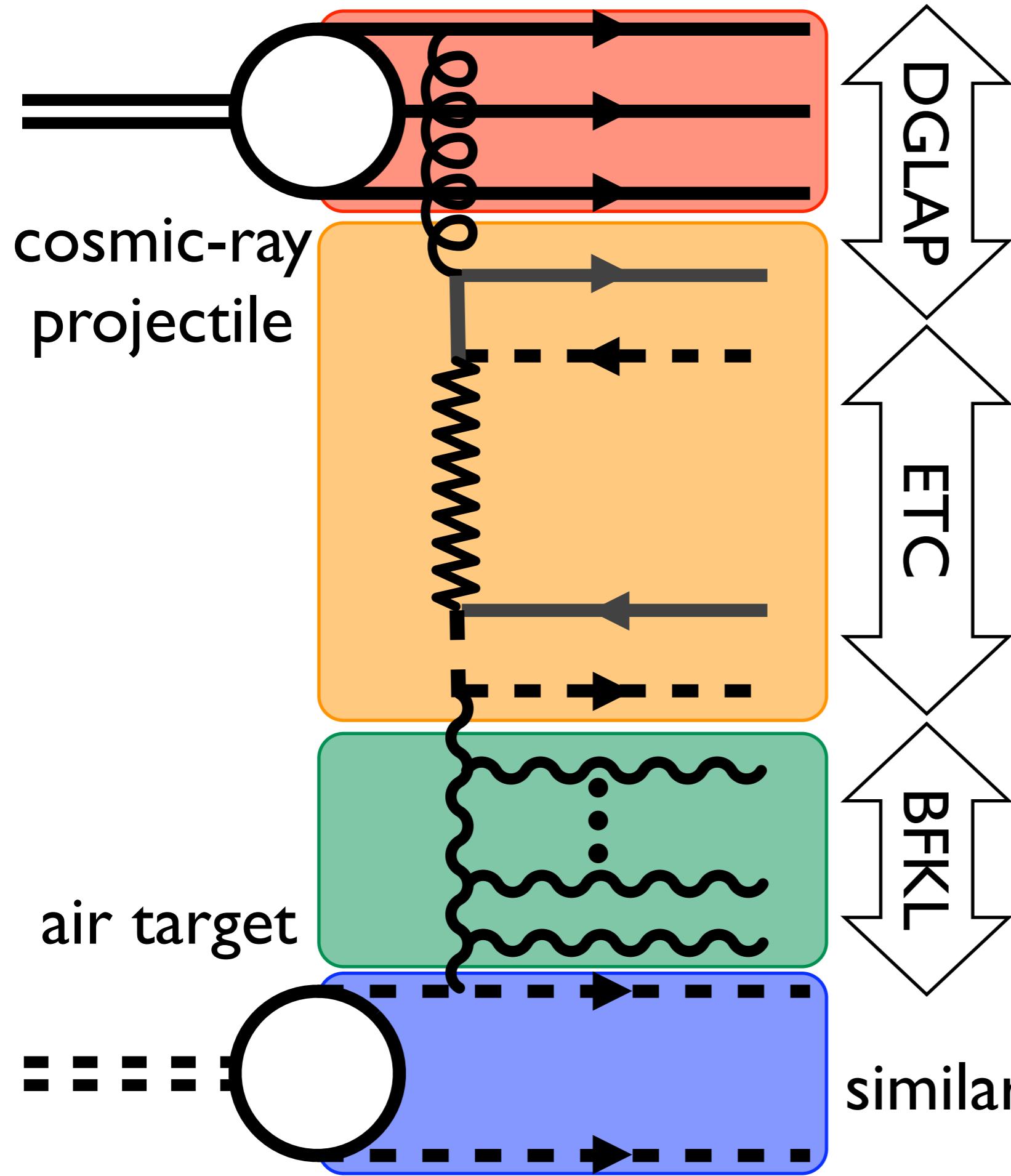
# Emissions



Two  
heavy  
leptons



DDD

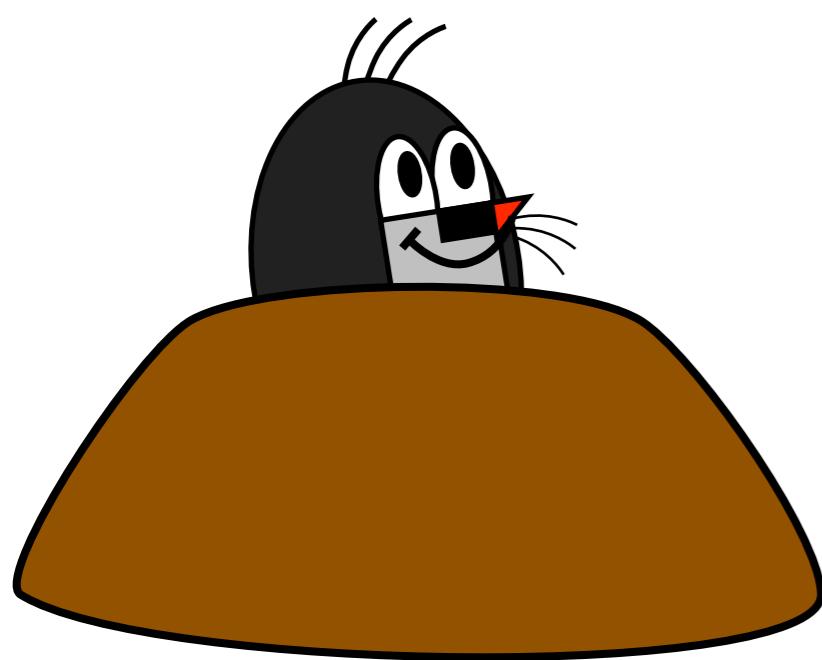


DDD

# Summary

- ankle structure where (low-scale) DEWSB would modify cross section
- @ composition: larger amount of produced  $p_t$   
 $X_{\max} \searrow$  lateral spread  $\nearrow$
- CR distinguish between elementary and effective theories
- @ GZK: DEWSB bound states & associated heavy leptons do not see cutoff
- required: more data on growth of (QCD) cross section from colliders, i.e.,  $pA@LHC$

**Thank you for your  
attention!**



DDD