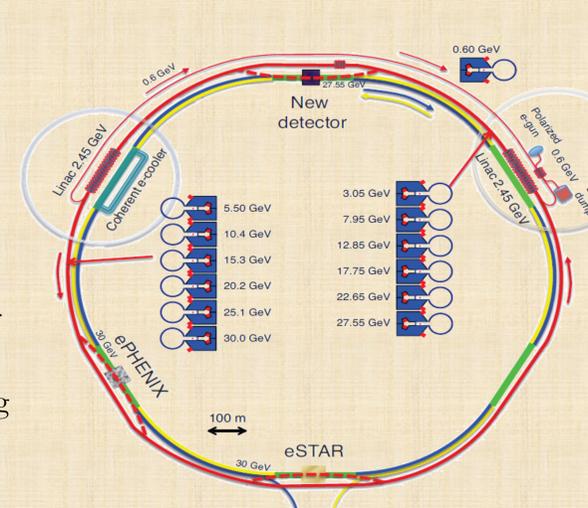
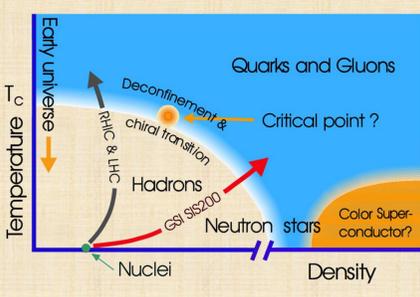
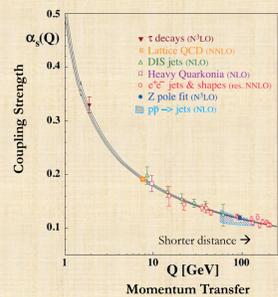
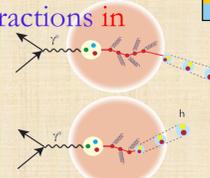
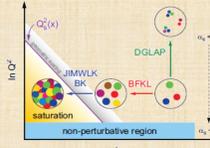
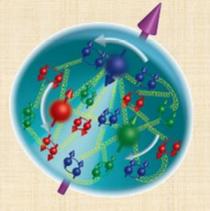


Abstract: An Electron Ion Collider (EIC) is being considered as the next generation QCD facility to understand how the visible universe is built up [1]. More specifically, the EIC will probe with unprecedented precision the low Bjorken-x domain where gluons and sea quarks dominate for both nucleons and nuclei. A possible realization of the accelerator facility based on the (currently operating) Relativistic Heavy Ion Collider (RHIC), called eRHIC, has been proposed [2]. The STAR detector, one of the two major experiments at RHIC, has planned to evolve into eSTAR with a suite of upgrades optimized for the EIC physics program. The major components of the baseline upgrades will be introduced. The eSTAR detector performance and a broad range of flagship measurements, which have been identified as part of the EIC science case, are demonstrated through simulation. eSTAR has been found to be well suitable for an initial stage of eRHIC [3].

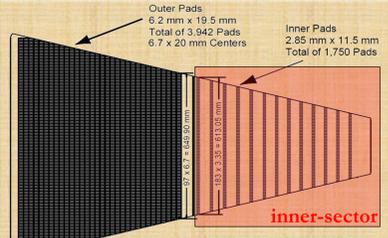
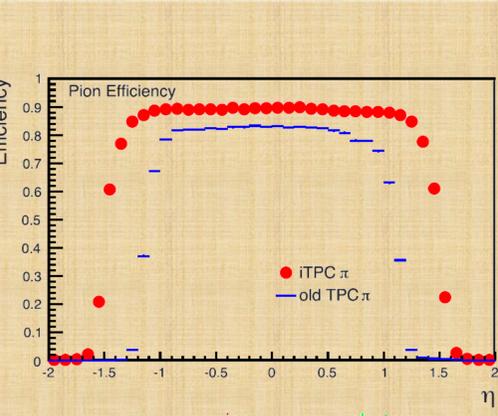


- How are the sea quarks and gluons, and their spins, distributed in space and momentum inside the nucleon?
- Where does the saturation of gluon densities set in?
- How does the nuclear environment affect the distribution of quarks and gluons and their interactions in nuclei?

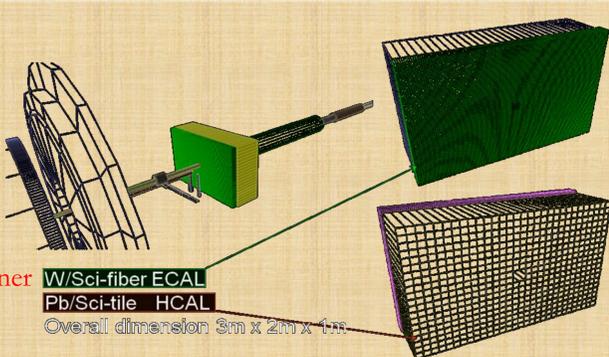


Understanding the strong interaction and the emergence of nucleons and nuclei from the properties and dynamics of quarks and gluons in QCD is a fundamental and compelling goal of nuclear science [1].

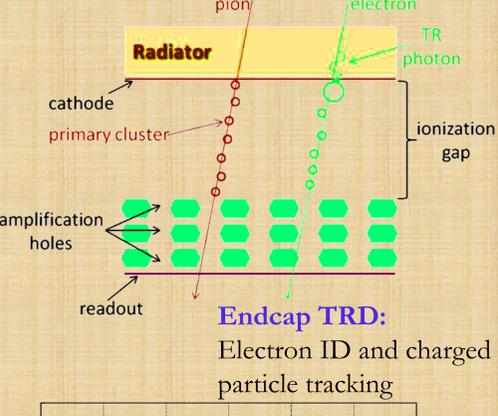
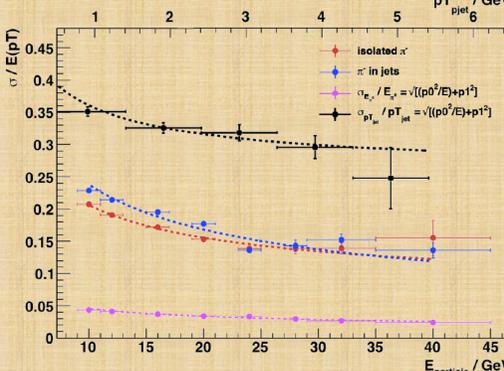
- Little is known at large distance
- Initial condition unknown in AA



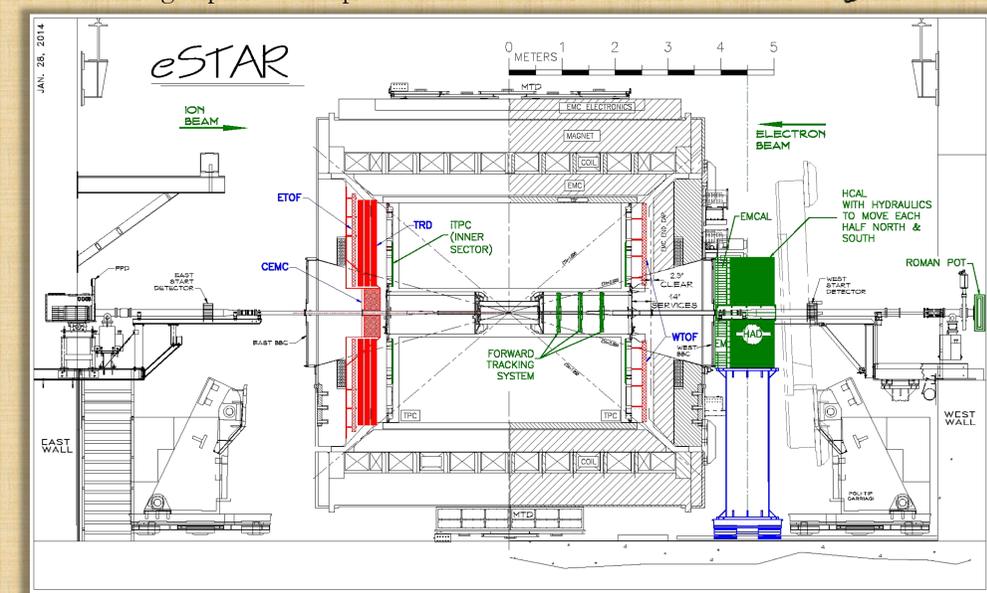
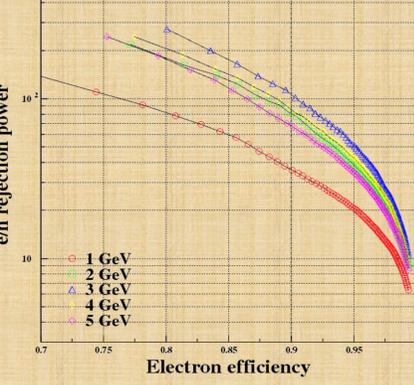
iTPC upgrade: Re-instrument the inner sectors of Time Projection Chamber, extended charged particle acceptance



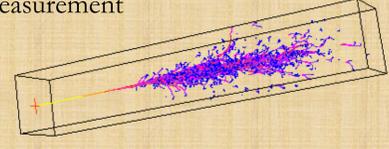
Forward Calorimeter System: High energy hadrons and jets



Endcap TRD: Electron ID and charged particle tracking

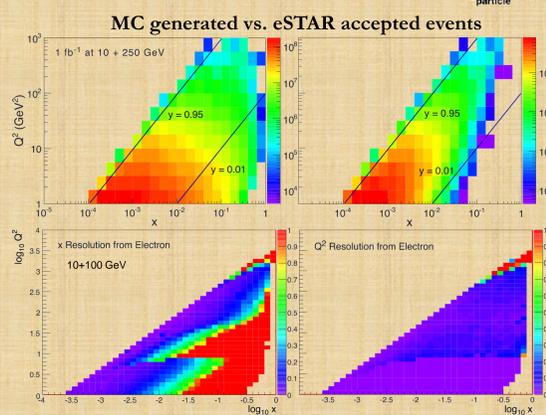


Crystal EM Calorimeter (CEMC): Electron ID and precise energy measurement

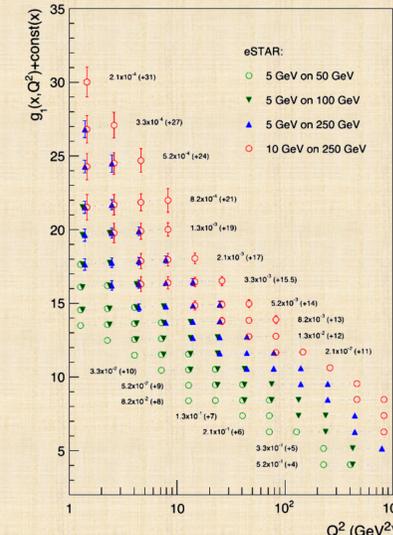


Expected eSTAR performance: Detector characteristics and DIS kinematics

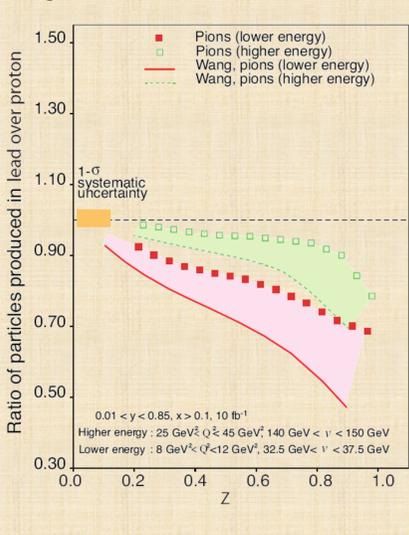
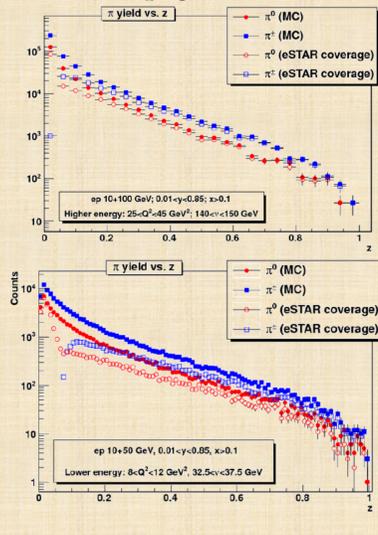
Coverage	Orientation	Tracking	EMC	HCAL	Resolution (momentum or energy)
-4 < eta < -2	Electron Beam direction; EAST	iTPC+ETRD+ETOF	BSO		$\sigma_E/E = 2\%/\sqrt{E} \oplus 0.75\%$ $\sigma_p/p = 1/(p_T/p_z - 1/6) \times (0.45\% p_T \oplus 0.3\% \oplus (p_T/p_z) \times 0.2\%/p/\beta)$
-1 < eta < 1	Middle Rapidity	TPC+TOF	SMD+EMC		$\sigma_E/E = 14\%/\sqrt{E} \oplus 2\%$ $\sigma_p/p = 0.45\% p_T \oplus 0.3\% \oplus 0.2\%/p/\beta$
1 < eta < 1.7	Hadron Beam direction; WEST	iTPC+TOF			$\sigma_p/p = 1/(p_T/p_z - 1/4) \times (0.45\% p_T \oplus 0.3\% \oplus (p_T/p_z) \times 0.2\%/p/\beta)$
1.7 < eta < 2		FTS	SMD+EMC		$\sigma_E/E = 16\%/\sqrt{E} \oplus 2\%$
2.5 < eta < 5			W-fiber EMC	HCAL	$\sigma_E/E = 12\%/\sqrt{E} \oplus 1.4\%$ $\sigma_E/E = 38\%/\sqrt{E} \oplus 3\%$



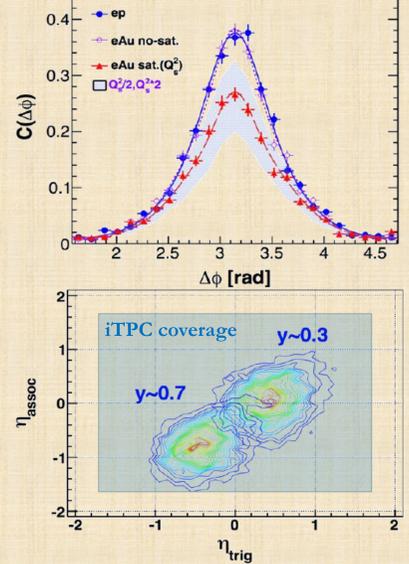
quark and gluon helicity distributions



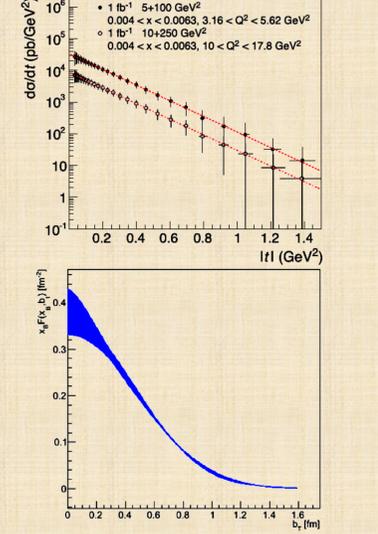
Propagation of a color charge in cold QCD Matter



Di-hadron correlations, probe gluon saturation effects in eA

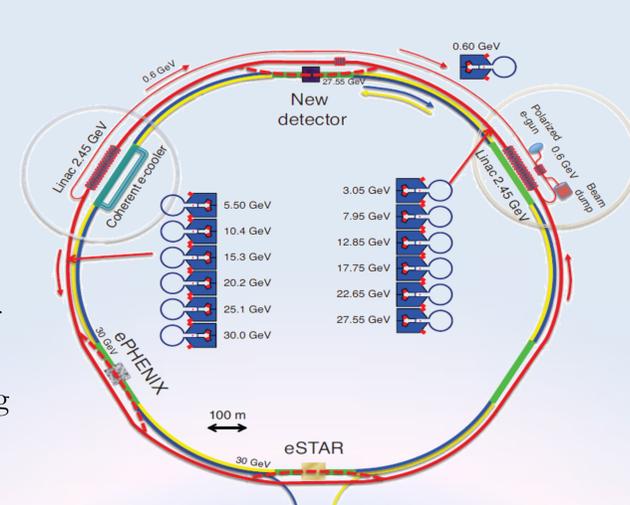
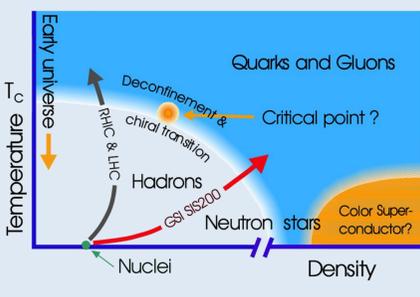
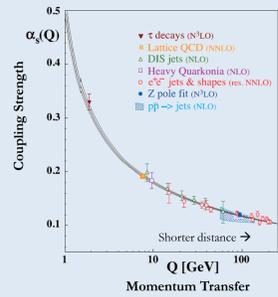


Use DVCS (or diffractive) measurement to extract the spatial distribution of partons





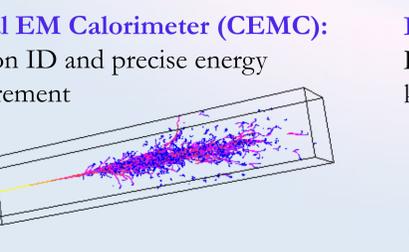
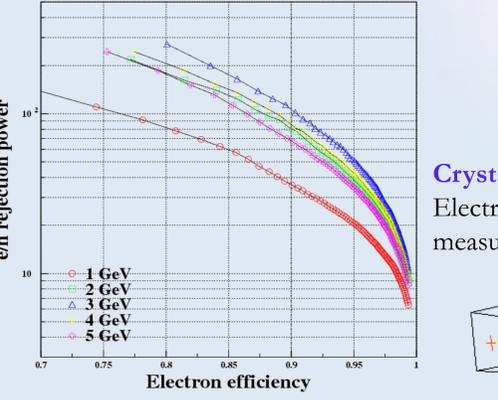
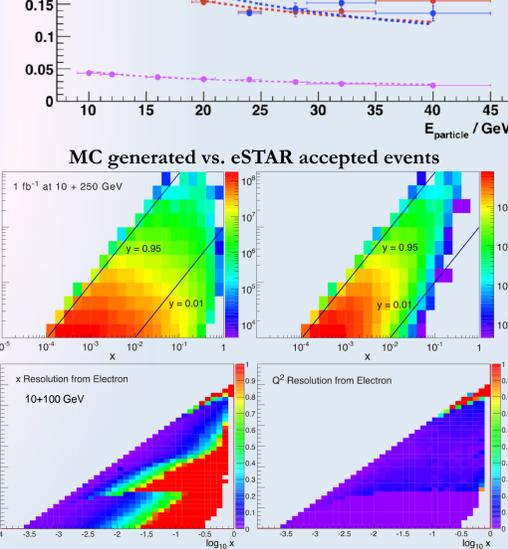
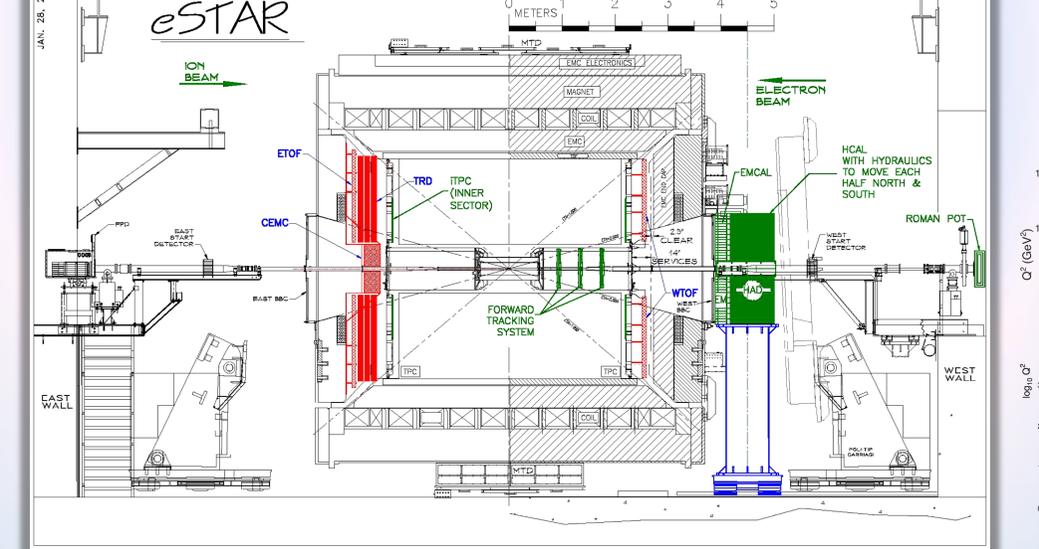
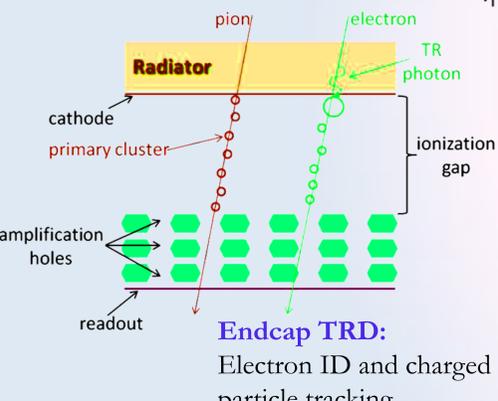
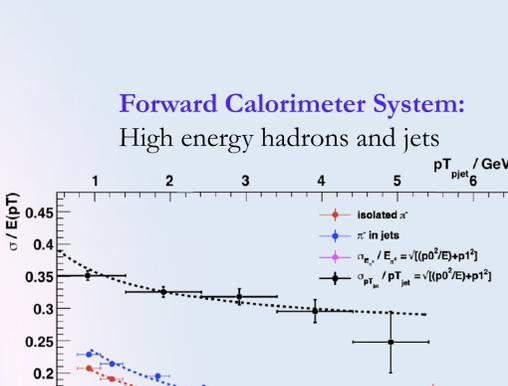
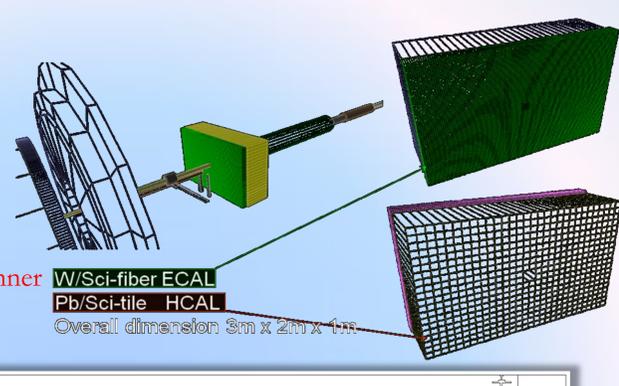
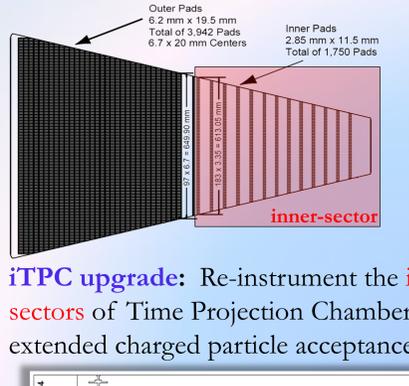
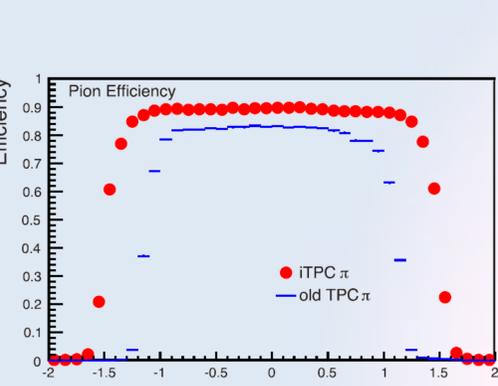
Abstract: An Electron Ion Collider (EIC) is being considered as the next generation QCD facility to understand how the visible universe is built up [1]. More specifically, the EIC will probe with unprecedented precision the low Bjorken-x domain where gluons and sea quarks dominate for both nucleons and nuclei. A possible realization of the accelerator facility based on the (currently operating) Relativistic Heavy Ion Collider (RHIC), called eRHIC, has been proposed [2]. The STAR detector, one of the two major experiments at RHIC, has planned to evolve into eSTAR with a suite of upgrades optimized for the EIC physics program. The major components of the baseline upgrades will be introduced. The eSTAR detector performance and a broad range of flagship measurements, which have been identified as part of the EIC science case, are demonstrated through simulation. eSTAR has been found to be well suitable for an initial stage of eRHIC [3].



- How are the sea quarks and gluons, and their spins, distributed in space and momentum inside the nucleon?
- Where does the saturation of gluon densities set in?
- How does the nuclear environment affect the distribution of quarks and gluons and their interactions in nuclei?

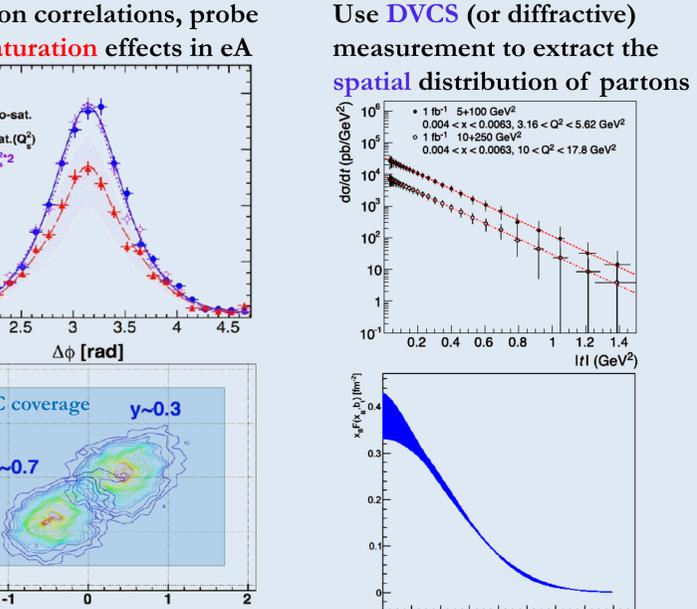
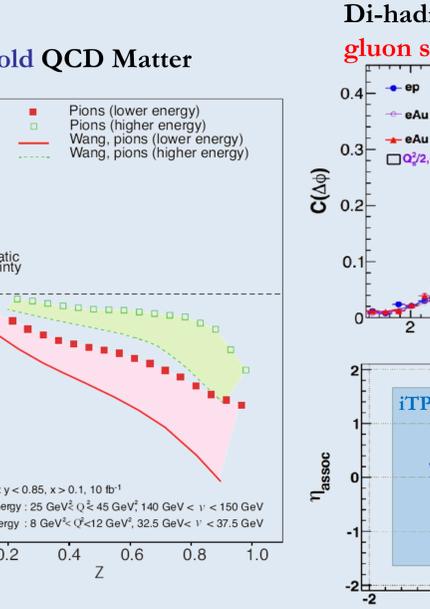
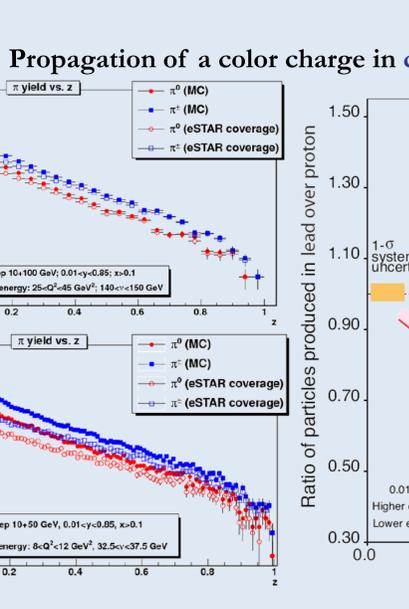
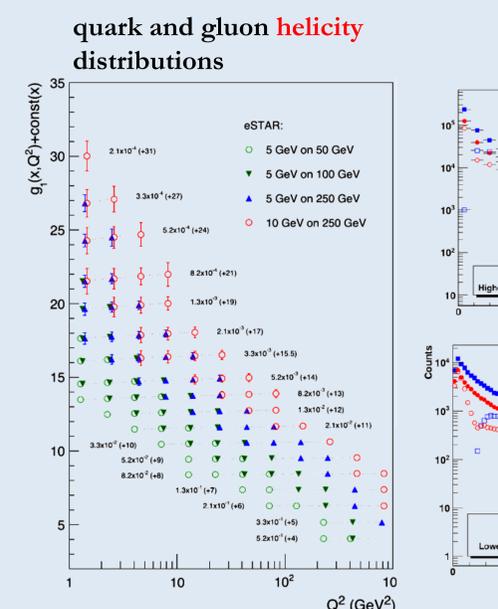
Understanding the strong interaction and the emergence of nucleons and nuclei from the properties and dynamics of quarks and gluons in QCD is a fundamental and compelling goal of nuclear science [1].

- Little is known at large distance
- Initial condition unknown in AA



Expected eSTAR performance: Detector characteristics and DIS kinematics

Coverage	Orientation	Tracking	EMC	HCAL	Resolution (momentum or energy)
-4 < η < -2	Electron Beam direction; EAST	iTPC+ETRD+ETOF	BSO		$\sigma_E/E = 2\%/\sqrt{E} \oplus 0.75\%$ $\sigma_p/p = 1/(p_T/p_z - 1/6) \times (0.45 p_T \oplus 0.3\%) \oplus (p_T/p_z) \times 0.2\%/p/\beta$
-1 < η < 1	Middle Rapidity	TPC+TOF	SMD+EMC		$\sigma_E/E = 14\%/\sqrt{E} \oplus 2\%$ $\sigma_p/p = 0.45 p_T \oplus 0.3\% \oplus 0.2\%/p/\beta$
1 < η < 1.7	Hadron Beam direction; WEST	iTPC+TOF	SMD+EMC		$\sigma_p/p = 1/(p_T/p_z - 1/4) \times (0.45 p_T \oplus 0.3\%) \oplus (p_T/p_z) \times 0.2\%/p/\beta$
1 < η < 2		FTS	W-fiber EMC		$\sigma_E/E = 16\%/\sqrt{E} \oplus 2\%$
2.5 < η < 5				HCAL	$\sigma_E/E = 12\%/\sqrt{E} \oplus 1.4\%$ $\sigma_E/E = 38\%/\sqrt{E} \oplus 3\%$



References:
 1. The EIC Whitepaper, The Electron Ion Collider: The Next QCD Frontier, <http://arxiv.org/abs/1212.1701>
 2. eRHIC design study, <https://indico.bnl.gov/conferenceDisplay.py?confId=727>
 3. eSTAR: The Letter of Intent, the STAR Collaboration, <https://drupal.star.bnl.gov/STAR/starnotes/public/sn0592>