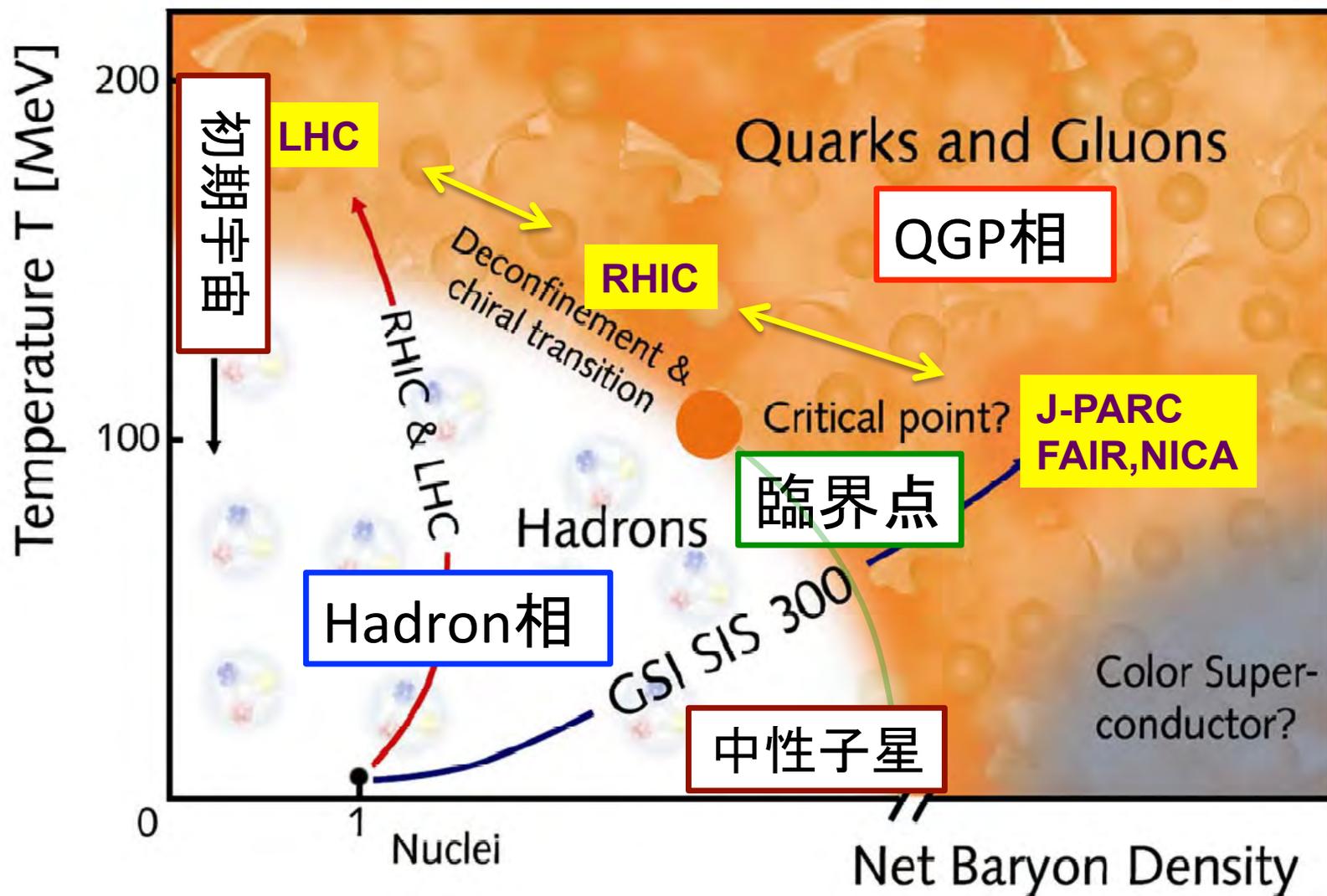
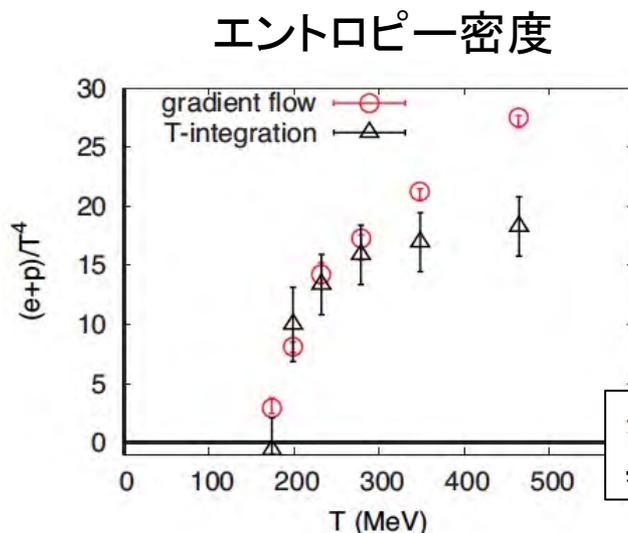


Hadron Phase & Quark Gluon Plasma Phase

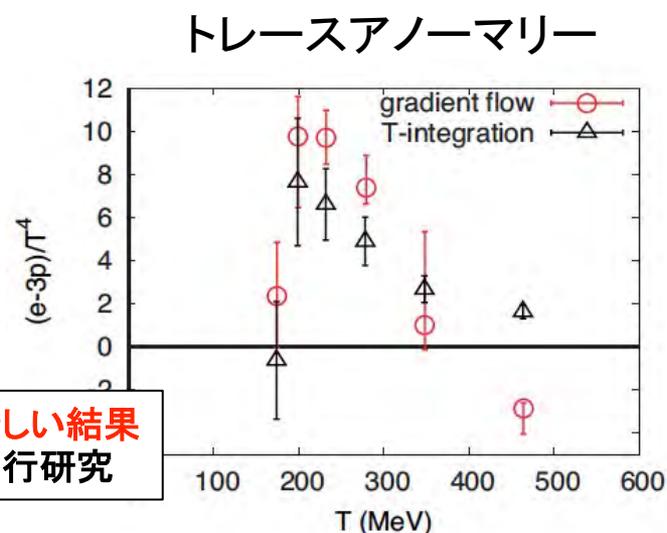


Lattice QCD 計算による勾配流法を用いたQCD熱力学量の計算

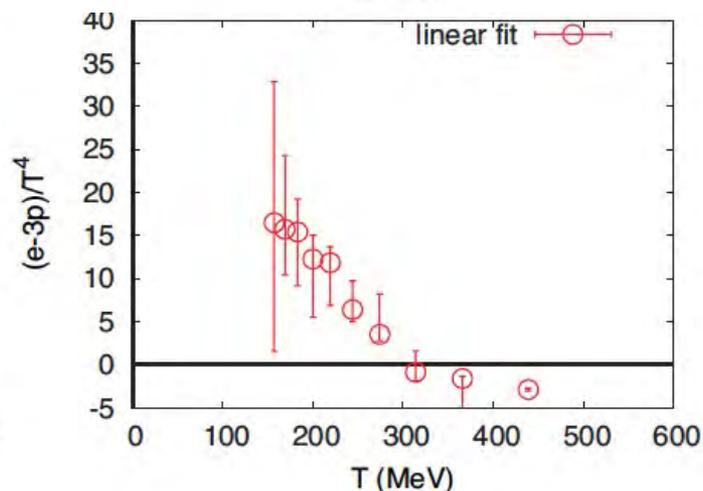
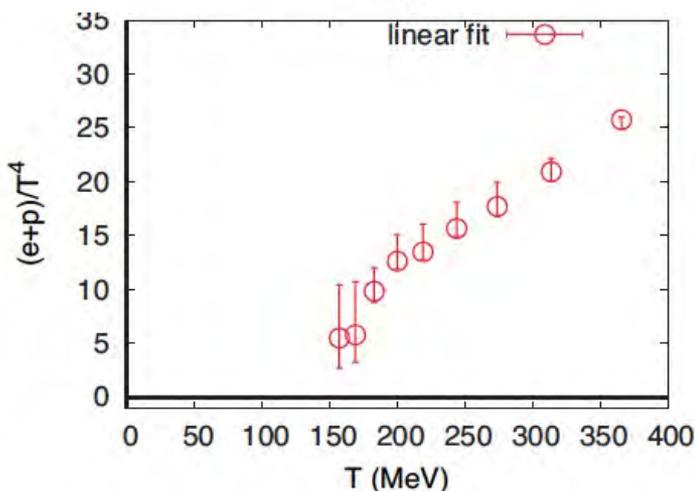
クォークが
現実より重い
有限温度
2+1 flavor QCD
状態方程式



赤:新しい結果
黒:先行研究



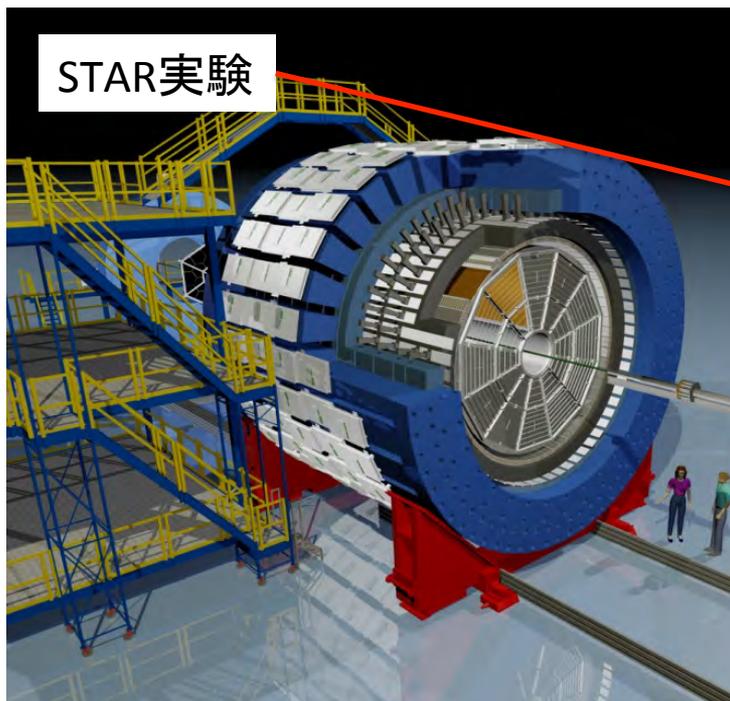
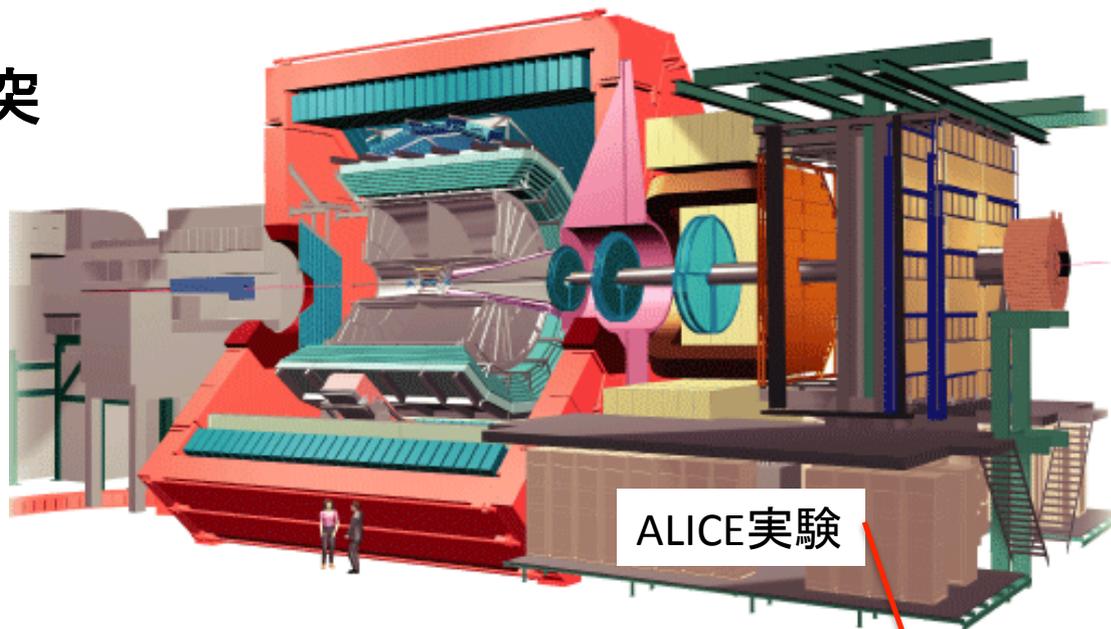
現実のクォーク
質量での
有限温度
2+1 flavor QCD
状態方程式
(中間結果)



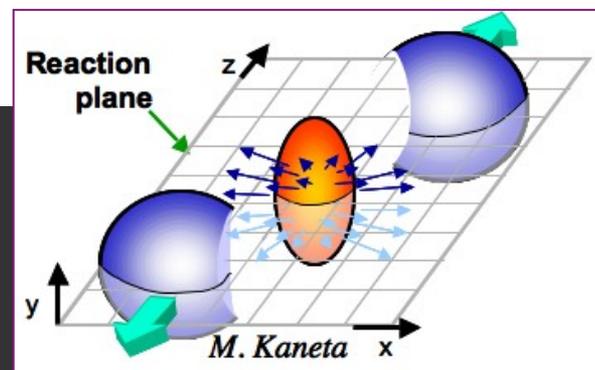
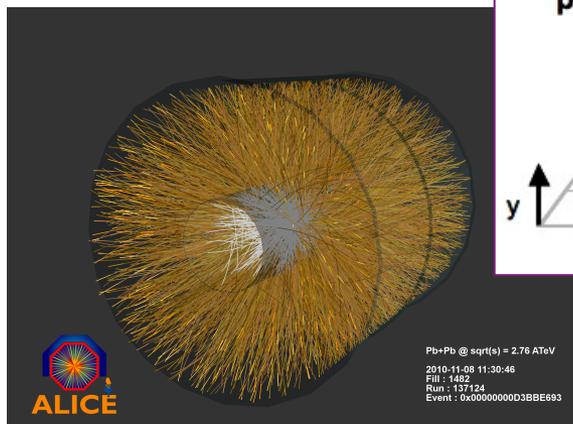
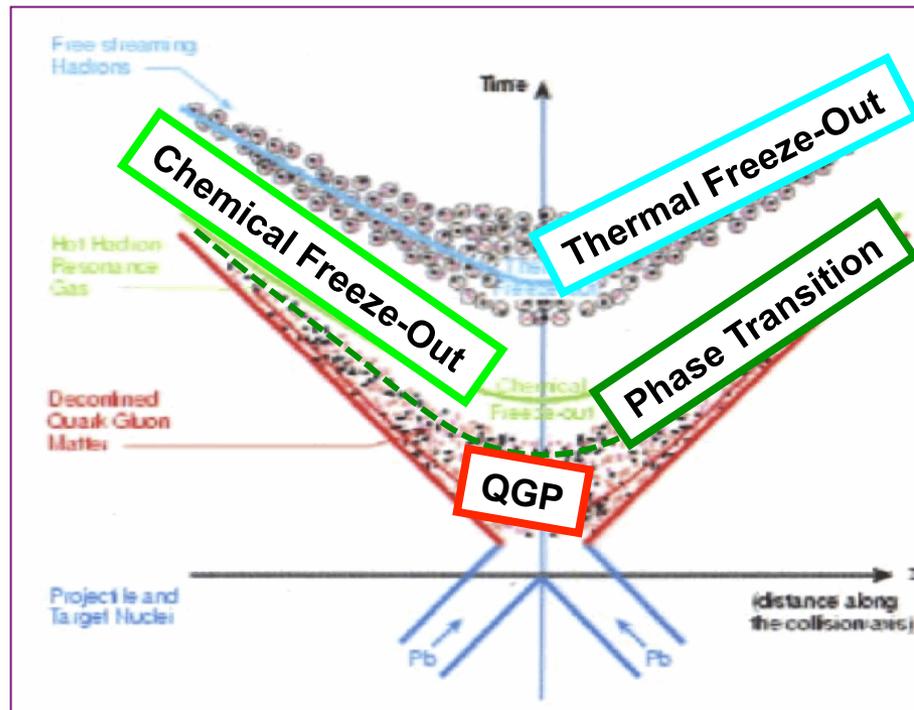
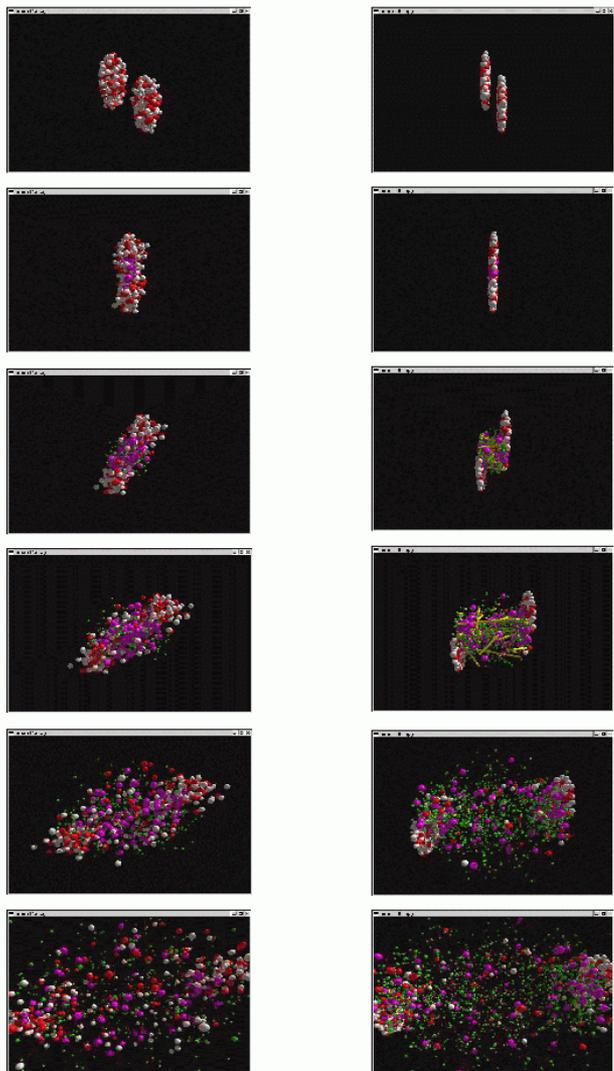
有限温度・有限密度の計算による一次相転移、潜熱、ゆらぎの計算などの進展

高エネルギー重イオン衝突

- BNL-RHIC加速器
PHENIX実験→STAR実験
- CERN-LHC加速器
ALICE実験

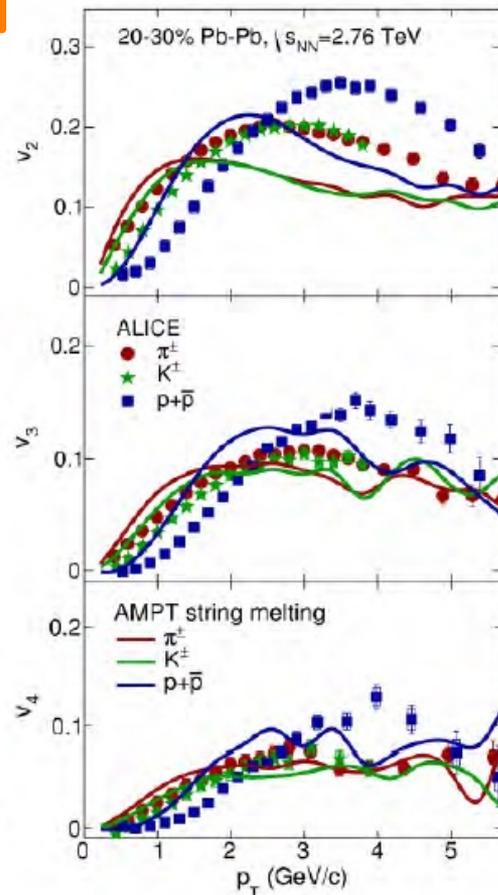
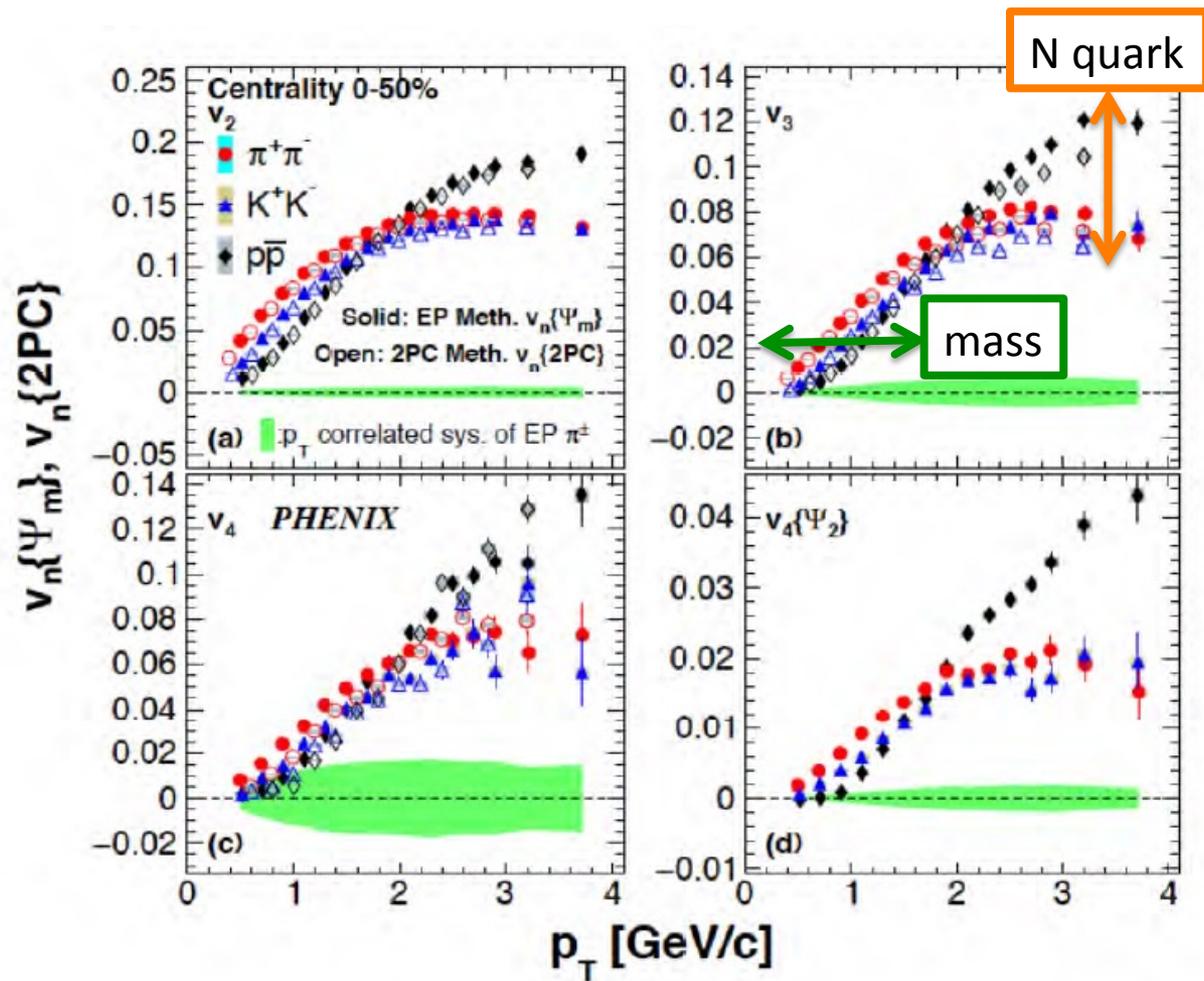
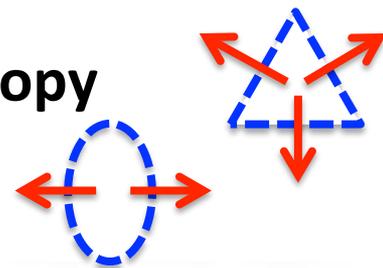


重イオン衝突 における系の発展

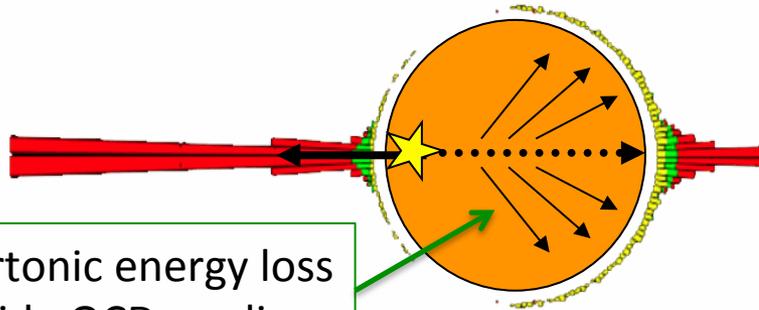


Collective expansion observed as azimuthal anisotropy

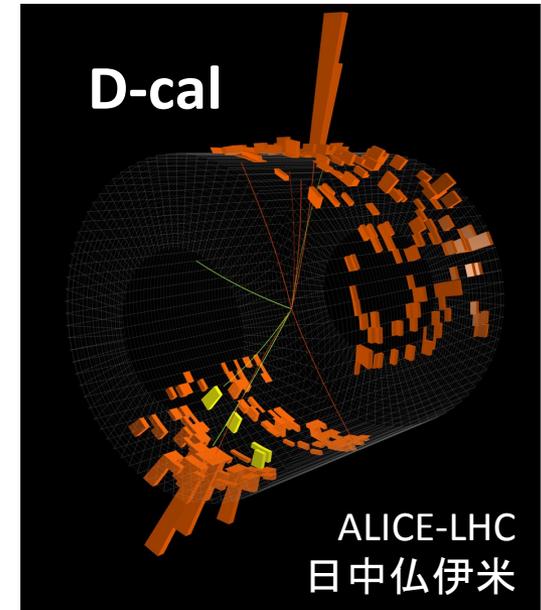
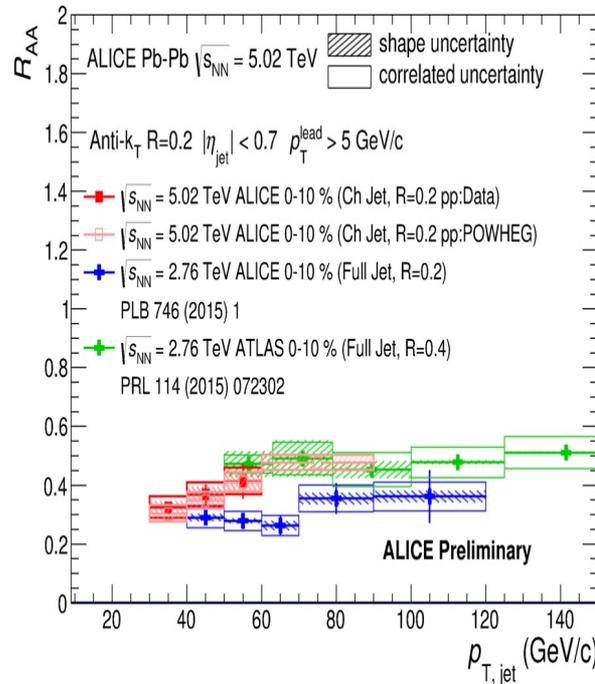
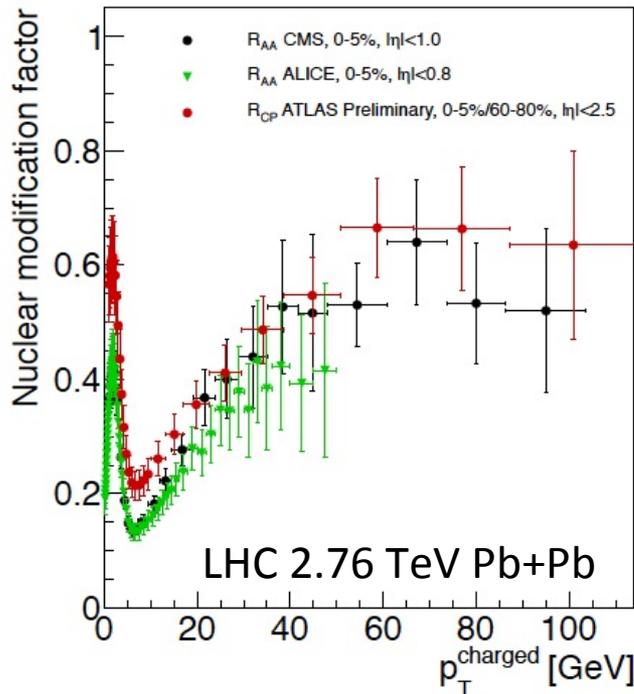
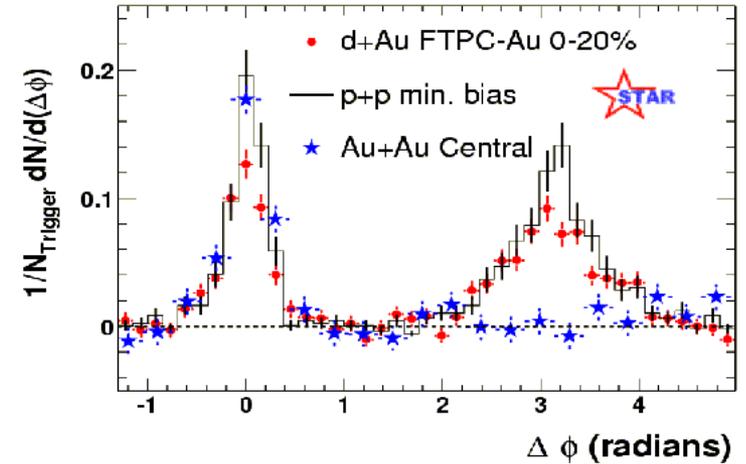
$$\varepsilon_2 \rightarrow v_2 \quad (\varepsilon_n \rightarrow v_n)$$



Jet quenching via energy loss



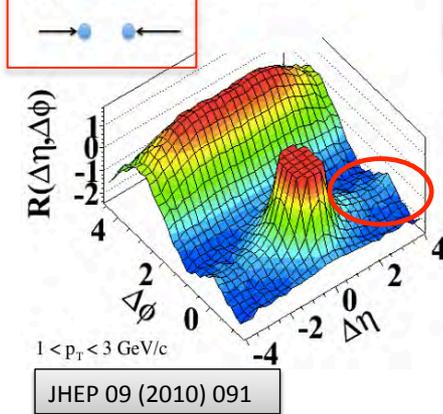
partonic energy loss
inside QCD medium



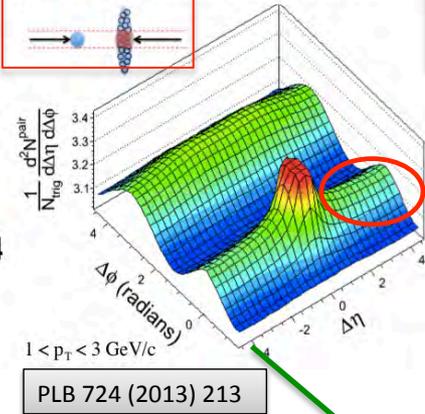
ALI-PREL-114186

QGP also in small systems?

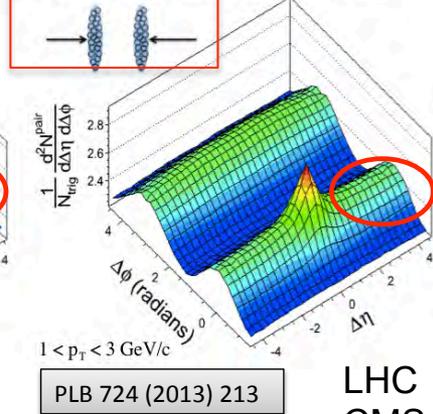
(a) pp $\sqrt{s} = 7$ TeV, $N_{\text{trk}}^{\text{offline}} \geq 110$



(b) pPb $\sqrt{s_{\text{NN}}} = 5.02$ TeV, $220 < N_{\text{trk}}^{\text{offline}} \leq 260$

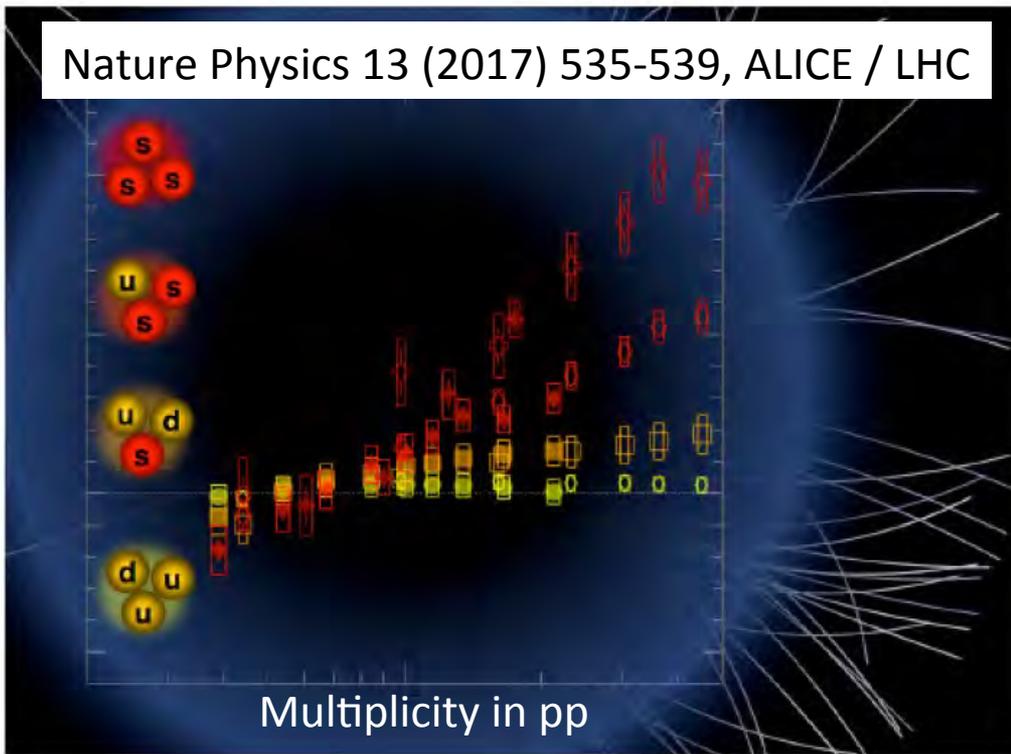


(c) PbPb $\sqrt{s_{\text{NN}}} = 2.76$ TeV, $220 < N_{\text{trk}}^{\text{offline}} \leq 260$

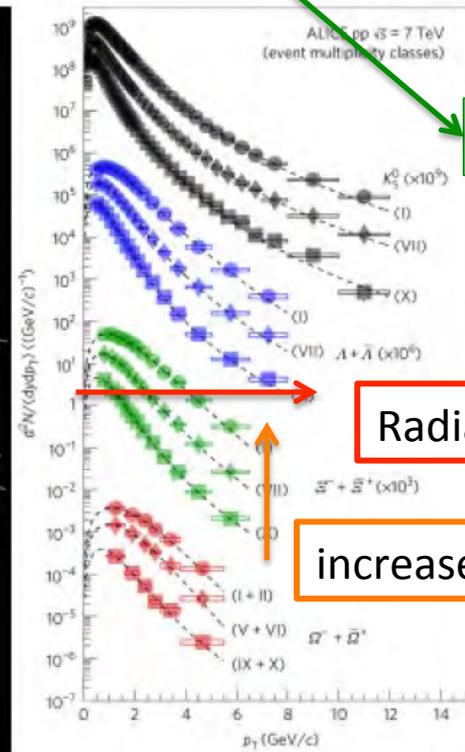


LHC
CMS

Nature Physics 13 (2017) 535-539, ALICE / LHC



Multiplicity in pp



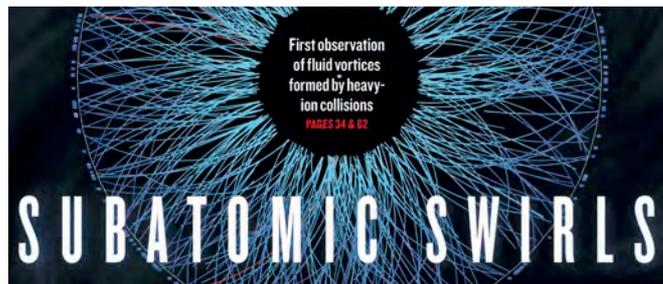
elliptic flow

Radial flow

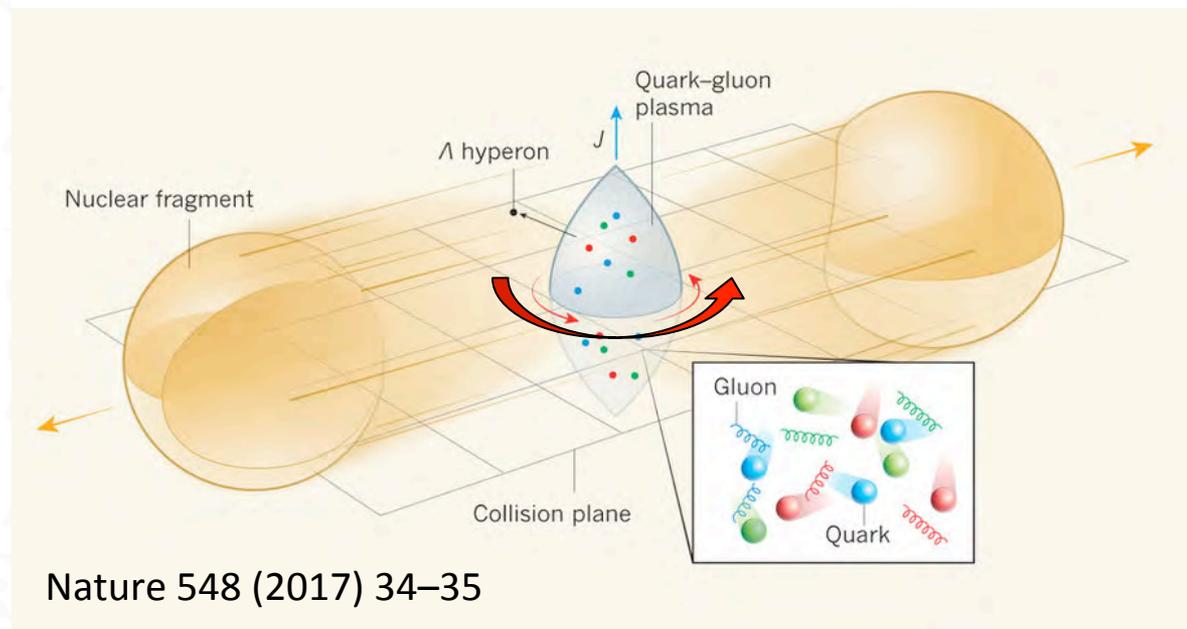
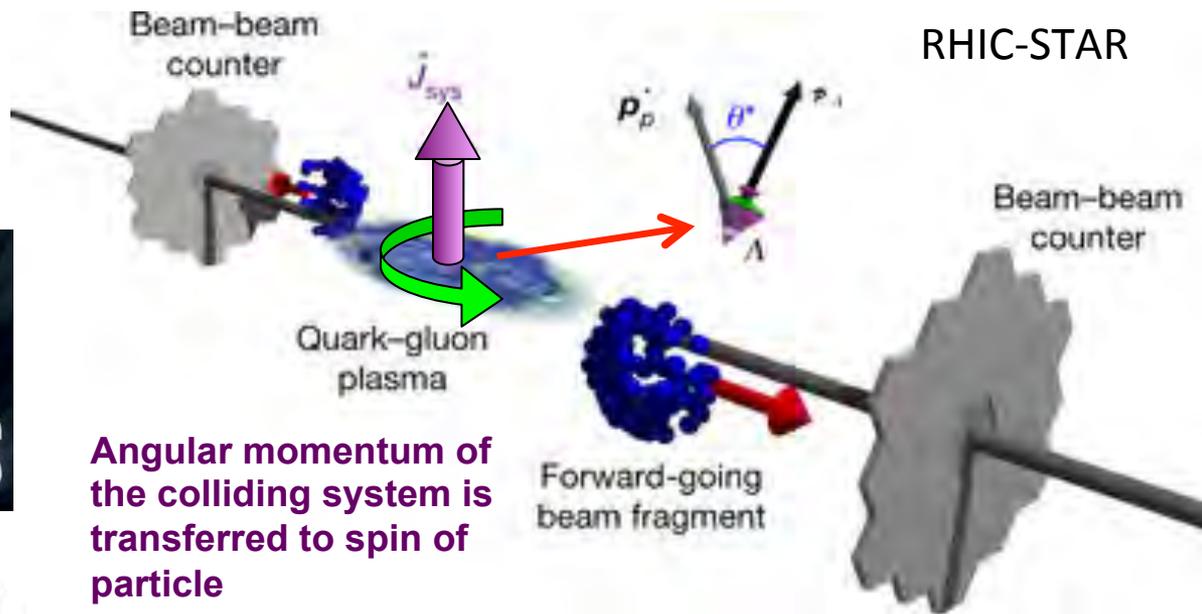
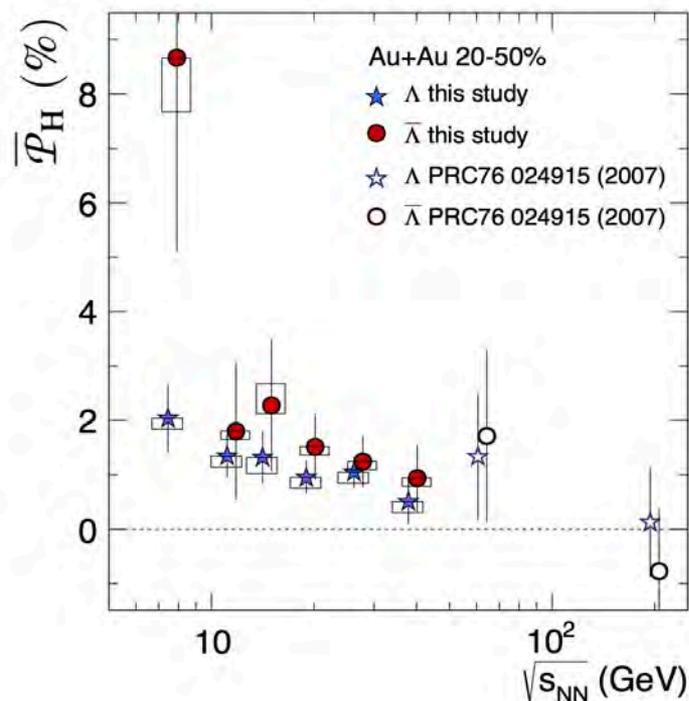
increased yield

Future upgrade
with Focal in ALICE

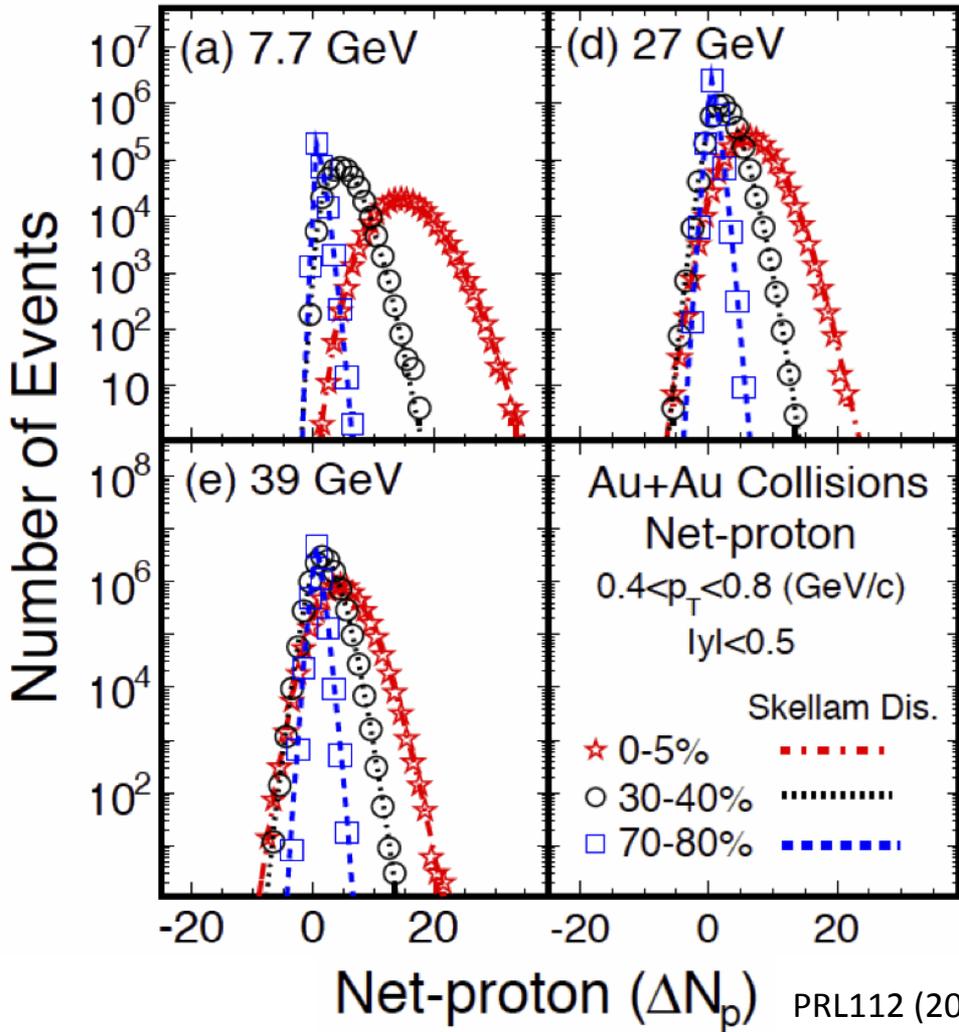
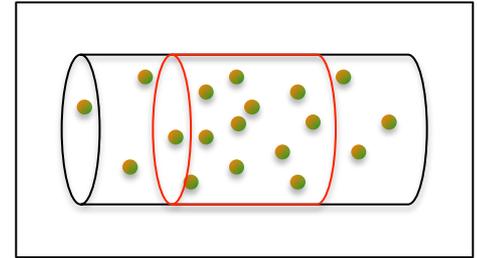
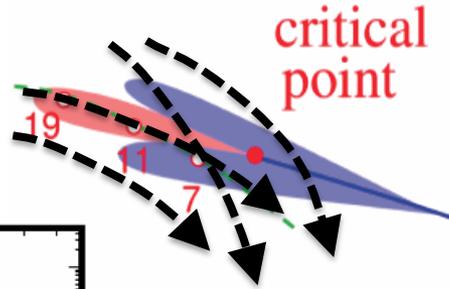
Global Polarization of Vortical Fluid



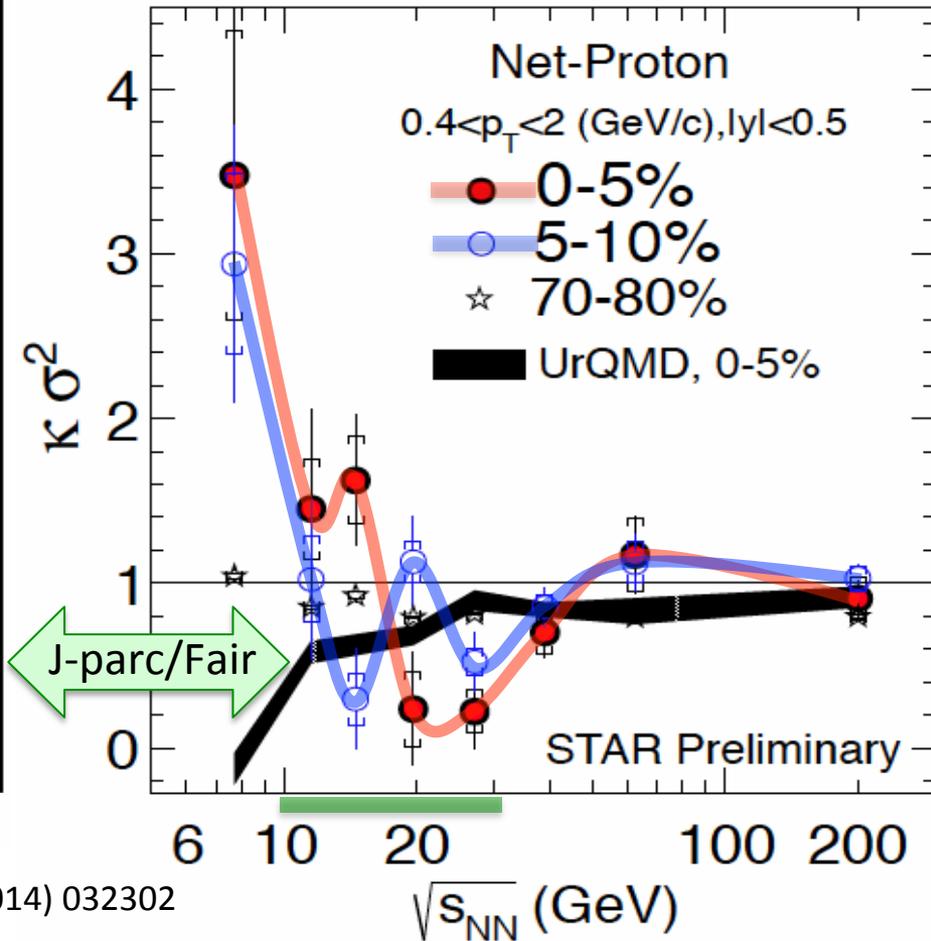
Nature 548 (2017) 62–65



Possible signal from Critical Point?

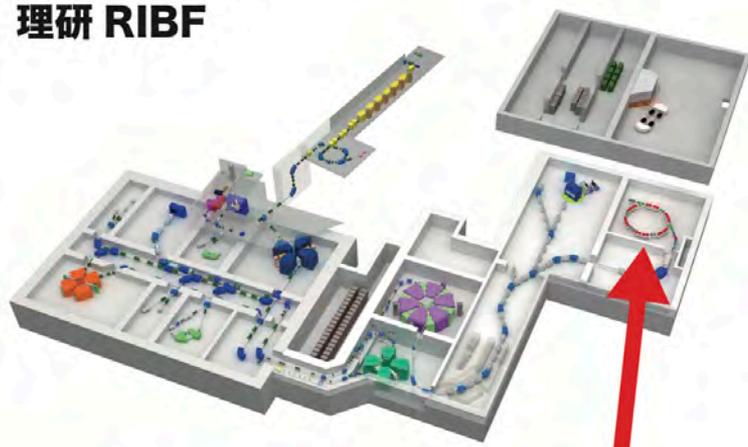


PRL112 (2014) 032302



低エネルギー重イオン衝突による宇宙元素合成の研究

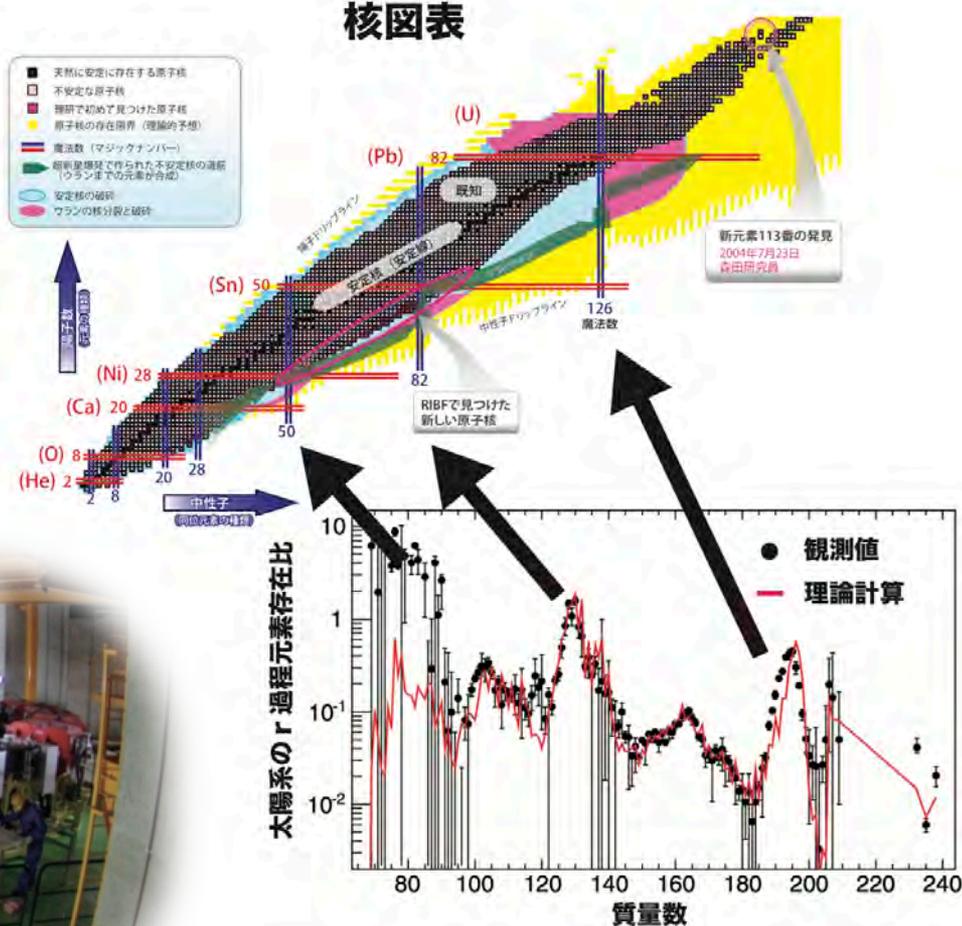
理研 RIBF



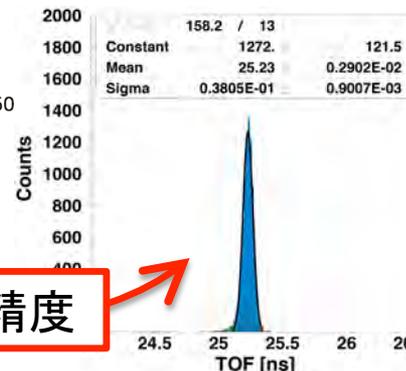
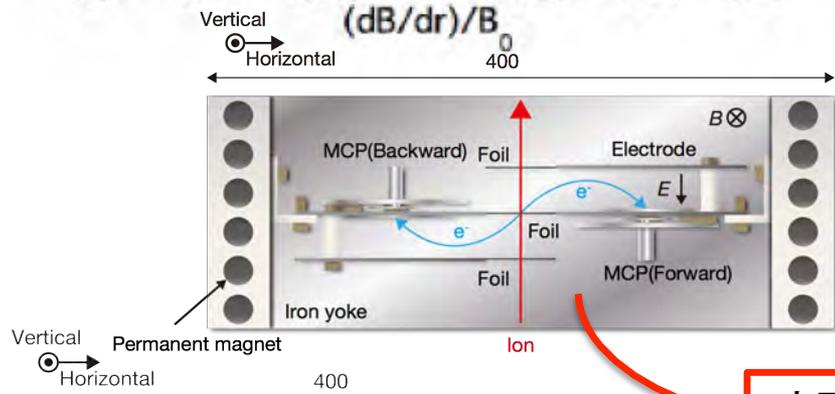
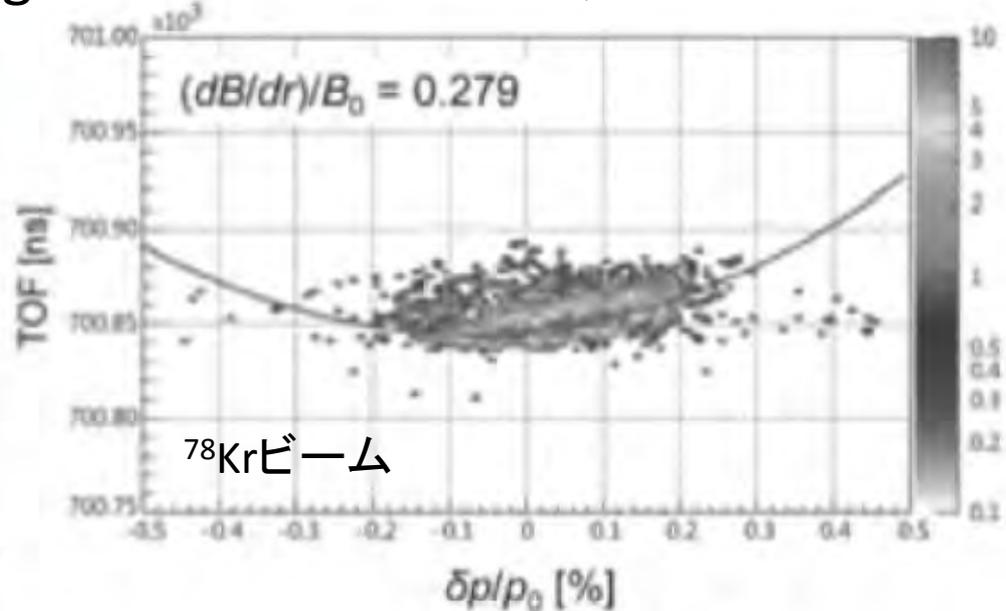
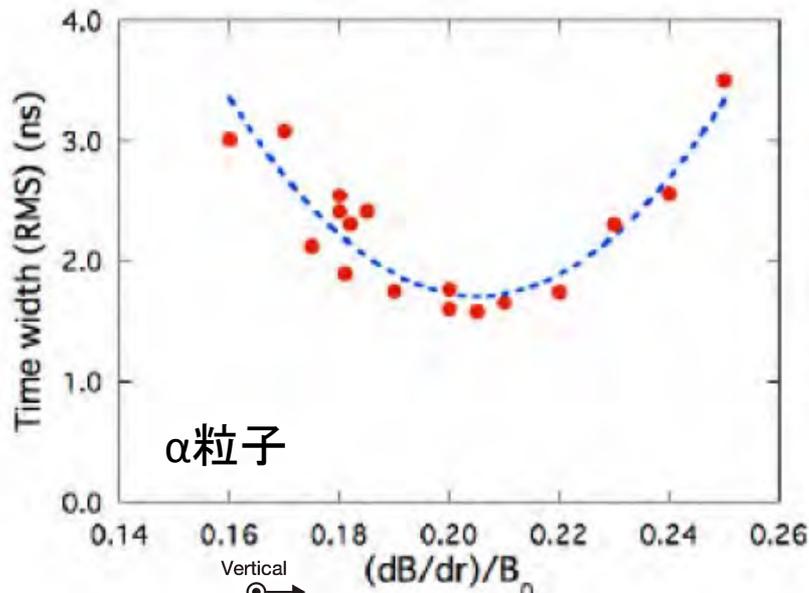
希少RIリング (Rare-RI Ring)



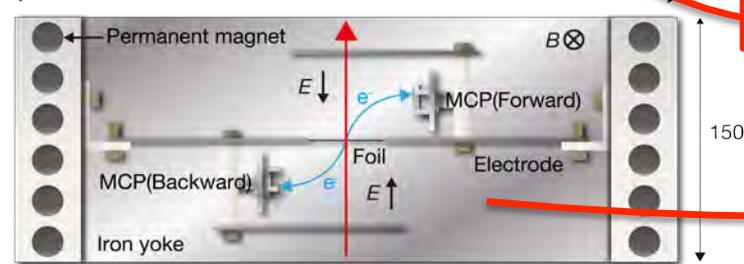
核図表



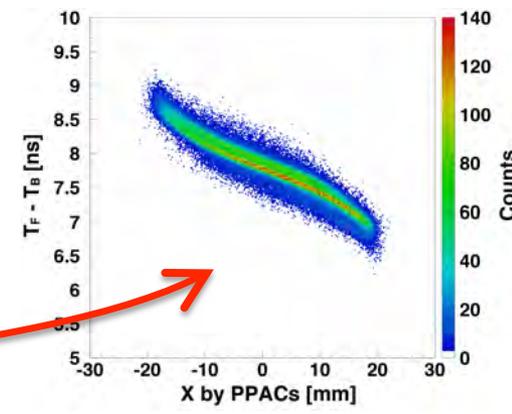
希少RIリング (Rare-RI Ring) における等時性磁場の検証



時間精度



位置精度



まとめと展望

■ 宇宙史研究センター

- 南極天文学研究部門
- 素粒子構造研究部門
- クォーク・核物質研究部門
- 光量子計測器開発部門

- Lattice QCD グループ
- QGP実験グループ
- 元素合成グループ

グループ間、部門間の連携強化