

Duke Application to CLAS12

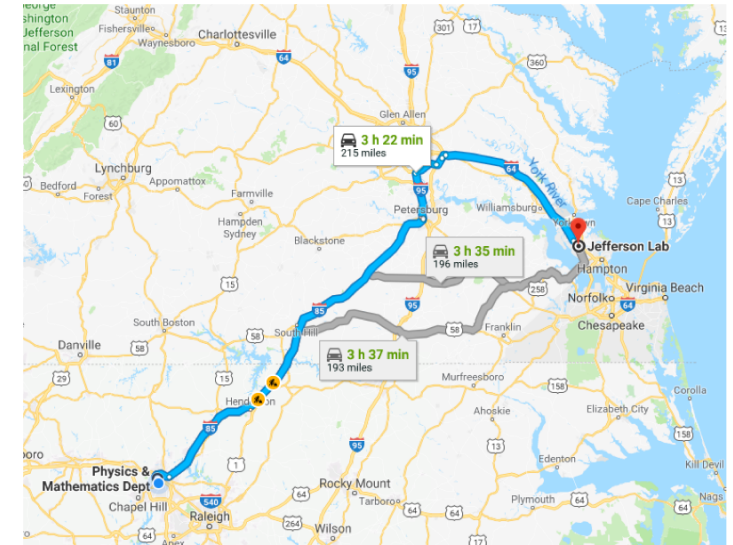
Anselm Vossen



Duke University

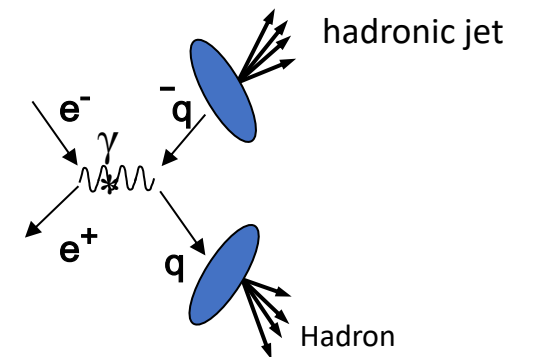
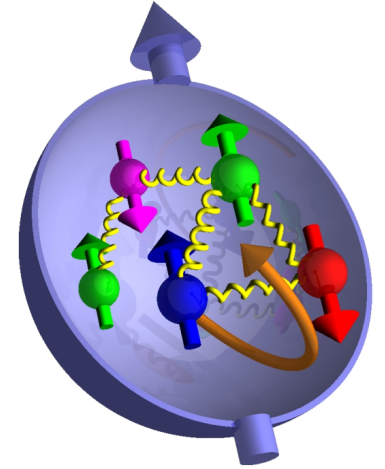


- Private University in Durham, NC
 - About 3.5 hours by car
- Physics department has about 30 faculty members (primary appointment), active in a variety of HEP and nuclear physics experiments
- Existing Jlab connections
 - Prof. H. Gao's group is a leading contributor to the SoLID, PRad experiments
 - Research scientist Zhiwen Zhao already CLAS member
- Resources include the Triangle Universities Nuclear Laboratory which is located on the Duke Campus



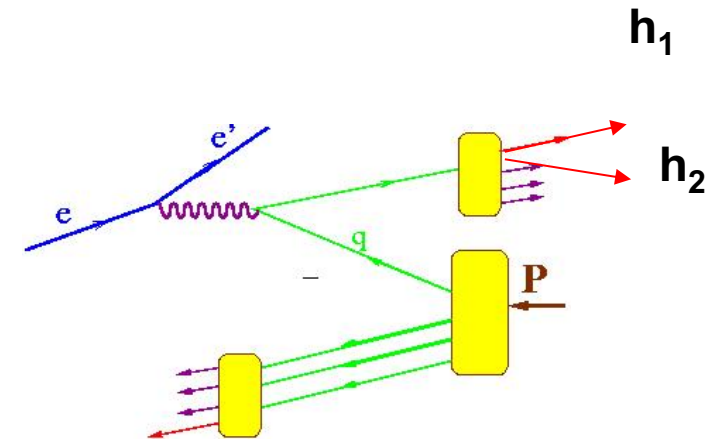
Duke Group at CLAS12

- Anselm Vossen
 - Since 1/2018 Asst. Prof. , JLab bridge position
 - Previously worked on spin physics at COMPASS, PHENIX, STAR
→ access transversity h_1 in di-hadron correlations
 - Complementary work on hadronization at Belle/Belle II
→ spin dependent FFs needed for the extraction of h_1 , Λ^\uparrow production
- Currently Hiring
 - Postdoc
 - Graduate & undergraduate students
- Service tasks
 - TBD, most likely early software contributions but interest in future upgrade projects



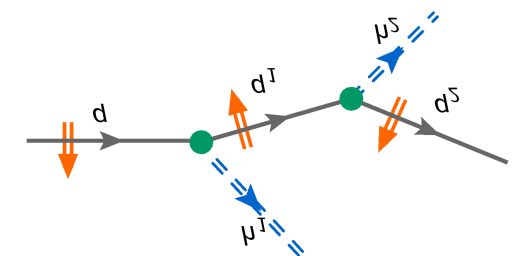
Physics plans

- Use di-hadron production in SIDIS to access quark-gluon correlations in the nucleon and study spin-orbit correlations in hadronization
- Advantages of di-hadrons over single hadron SIDIS lies in the additional degree of freedom
 - Disentangle different contributions to asymmetries
 - Angular momentum in the final system can be measured independent of TMD
 - Transverse spin dependence in collinear factorization
 - Longitudinal spin dependent FFs into pion pairs \rightarrow test spin momentum correlations in models of hadronization
- Lots of recent progress and activity (theory)
 - First global fit to extract transversity from SIDIS, ee, **pp** (Does not exist for single hadrons) (Pavia)
 - Monte Carlo models of fragmentation (Adelaide)
 - Full SIDIS, e+e- x-section at twist3 including partial wave expansion (Pavia, Adelaide, UNAM)
 - Access quark-gluon correlations in SIDIS! E.g. $e(x)$ “transverse force on quarks”
 - Access to fracture functions in back-to-back production (Torino)

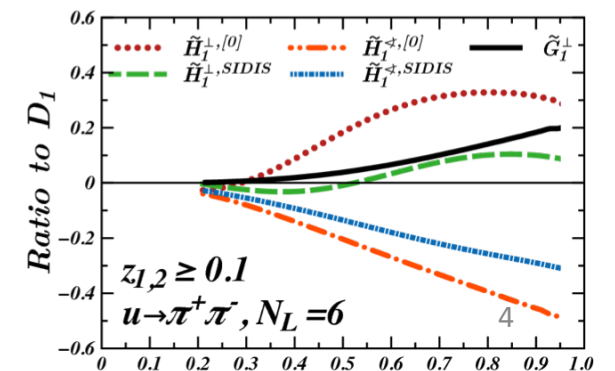


Additional Observable:

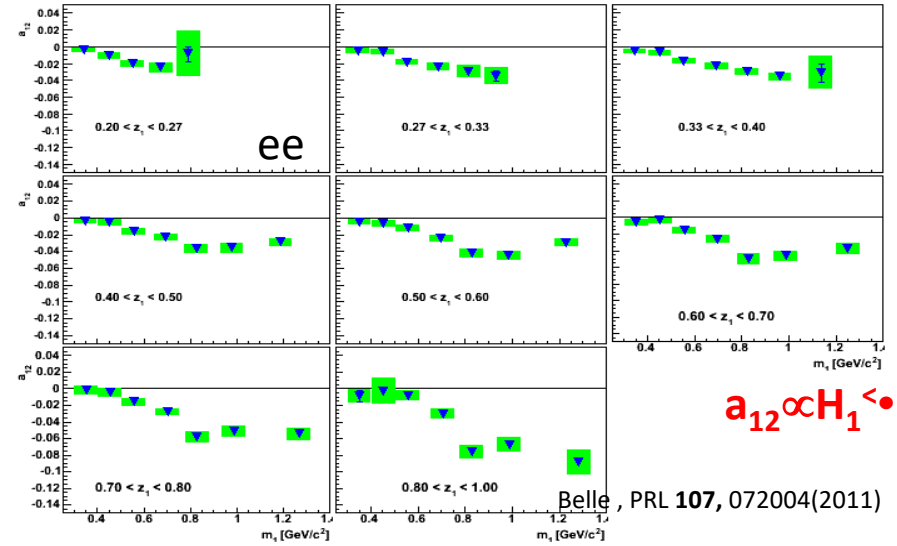
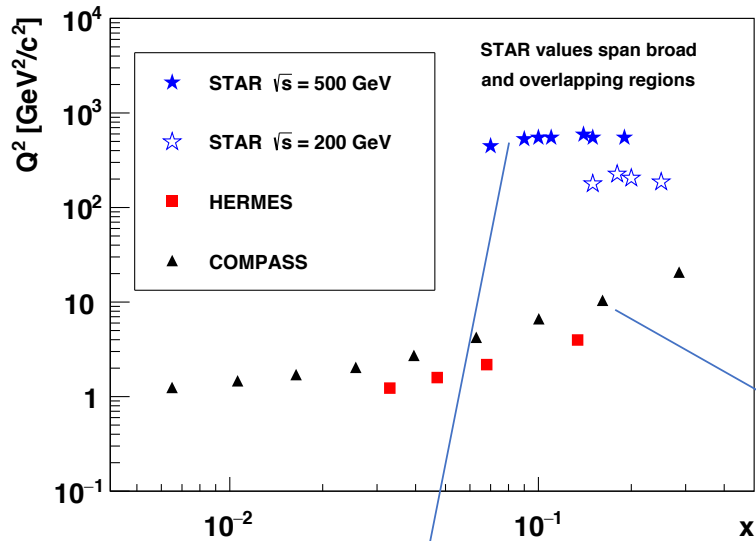
$$\vec{R} = \vec{P}_1 - \vec{P}_2 :$$



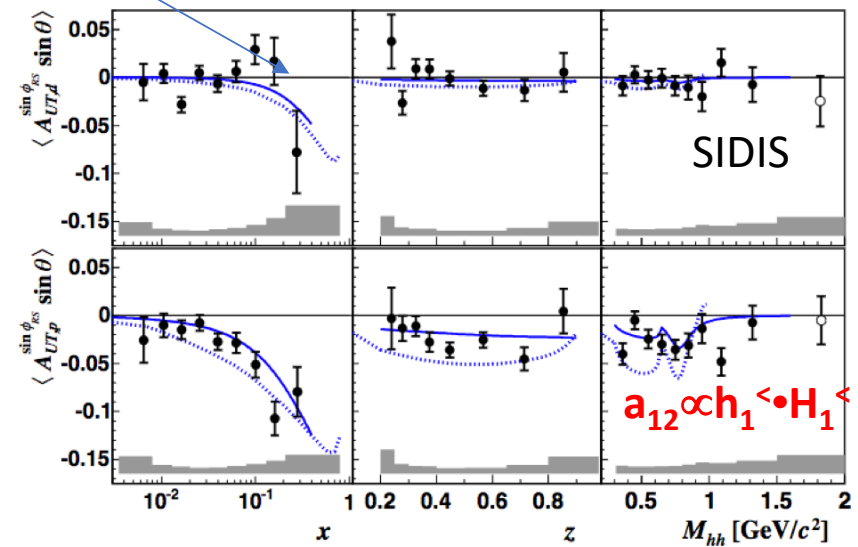
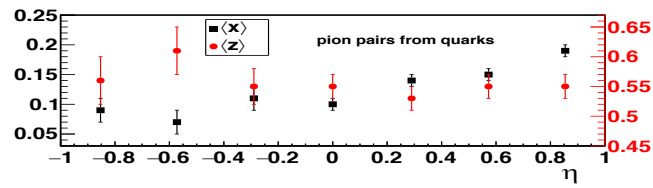
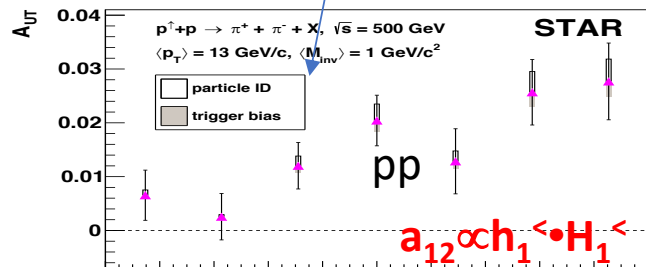
Matevosyan et al. Phys.Rev. D96 (2017) no.7, 074010



Recent Experimental results accessing transversity



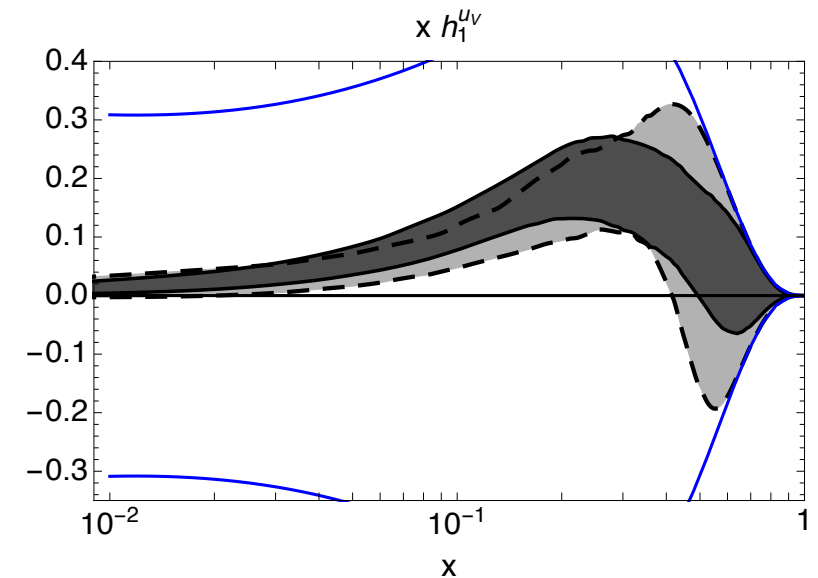
$$a_{12} \propto H_1^{\leftarrow} \bullet H_1^{\leftarrow}$$



Compass, Phys.Lett. B713 (2012) 10-16

Example: IFF to extract transversity

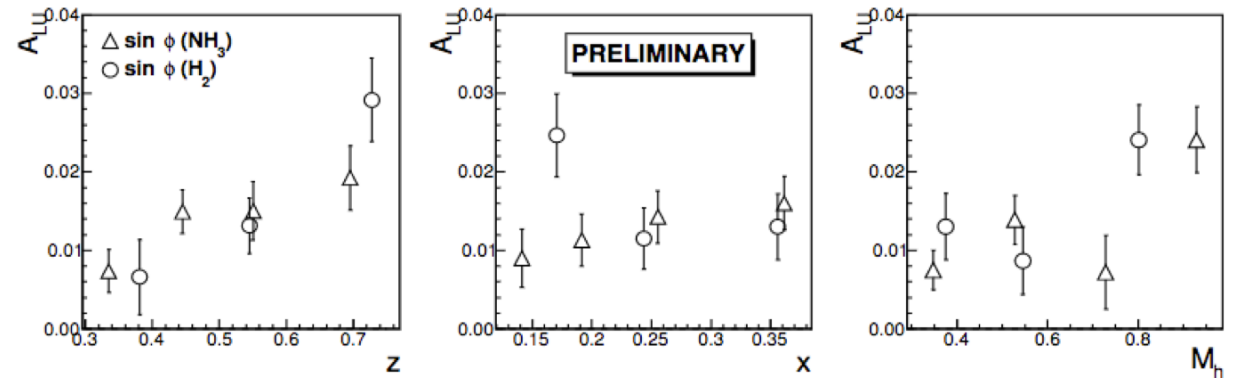
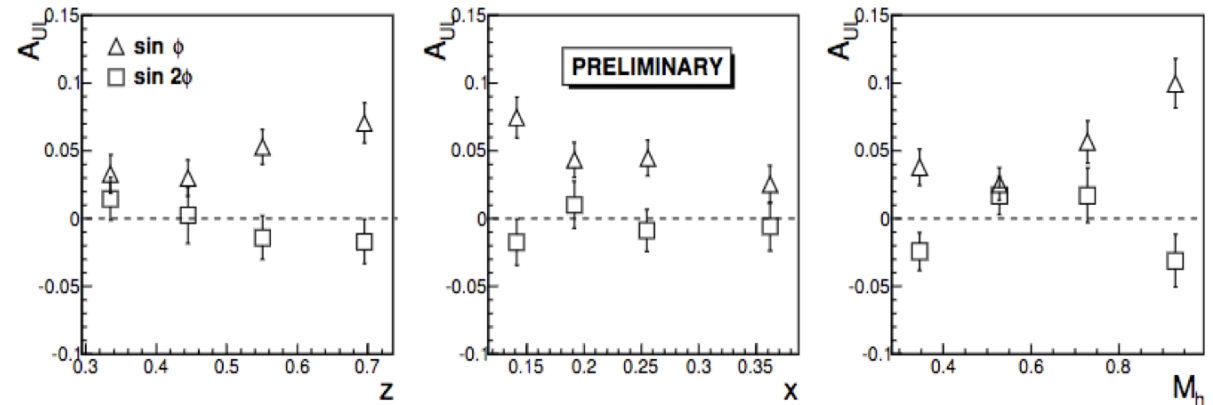
- Use Belle, STAR (only 2006) and Compass results
 - $\rightarrow h_u$ from this fit has better precision than single hadron fits due to inclusion of pp data (for h_d still need pp xsection measurement)



Bacchetta, Radici [arXiv:1802](https://arxiv.org/abs/1802)

Recent progress experiment: Longitudinal

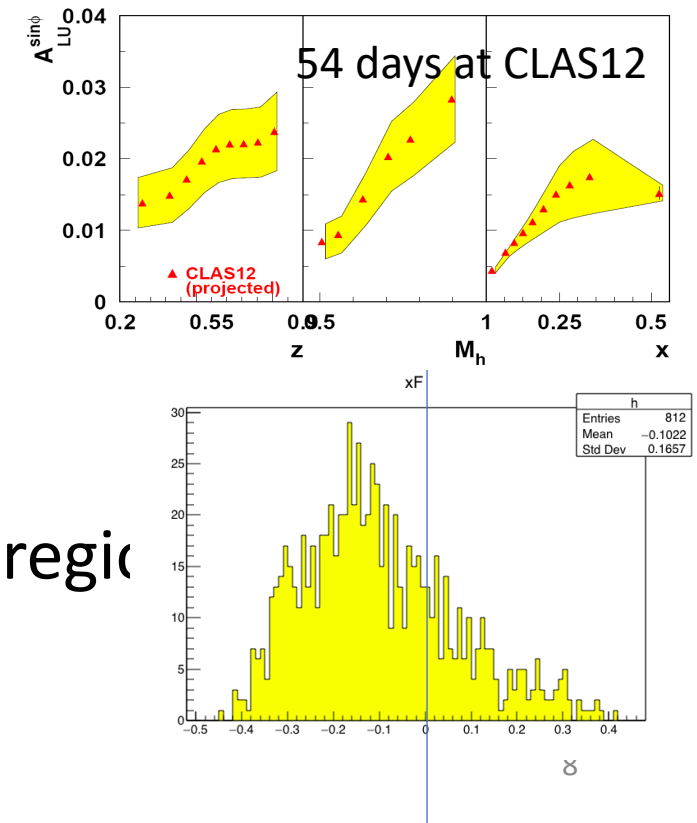
- Significant signals in A_{LU} and A_{UL} at CLAS and COMPASS (A_{UL}) (trans-helicity and $e(x)$)



S..A. Pereira, PoS DIS2014 (2014) 231

Plan for first SIDIS experiment (E12-06-112B)

- Understand di-hadron x-section, modulations, partial wave expansion
- Focus initially on extraction framework using experience from previous experiments
- Analysis
 - Cross-section and PW expansion?
 - $e(x)$ from A_{LU}
 - $G_1^\perp \rightarrow$ combine with Belle II measurement
 - Exploring Λ polarization
 - Exploring back-to-back correlations
- Explore Λ production in the current fragmentation region



Summary, Outlook, Questions?

- CLAS12 with high luminosity, acceptance very well suited to study di-hadron correlations
- I am excited to take advantage of this opportunity and contribute to the success of the CLAS12 physics program

