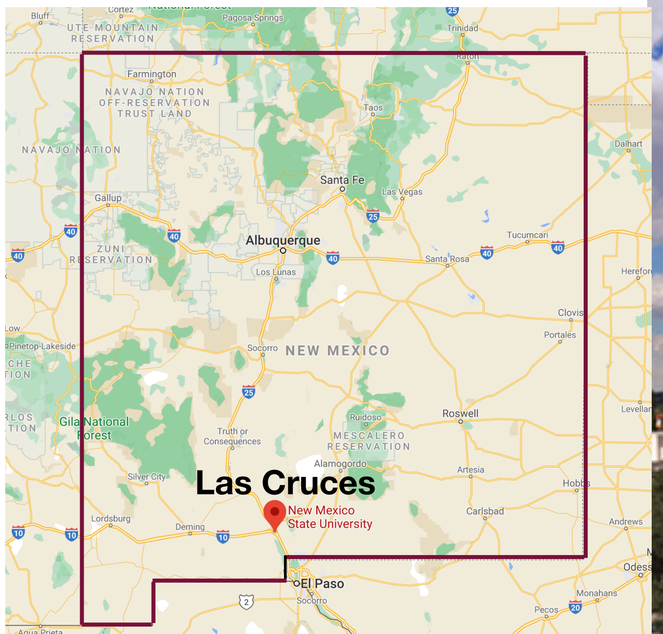
New Mexico State University

Michael Paolone

Mew Mexico State University at a glance

- Before 1900:
  - NMSU was first founded in 1888 as Las Cruces College.
  - Became the first degree-granting institution of the territory in 1890 a land-grant Agricultural College and Experiment Station, under the name "New Mexico College of Agriculture and Mechanic Arts"
- In 2020:
  - 14,000 students from 49 states and 89 foreign countries.
  - A Hispanic-Serving Institution.
  - A NASA Space-Grant College and home to the very first Honors College in New Mexico.
  - Dept. of Physics has 3 experimental nuclear faculty.

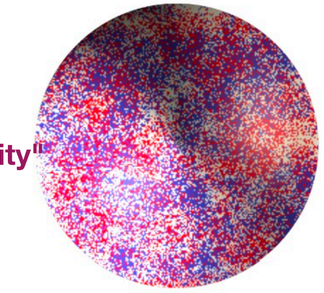


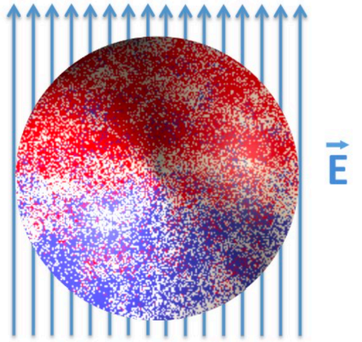
Current Member Application: Just Me

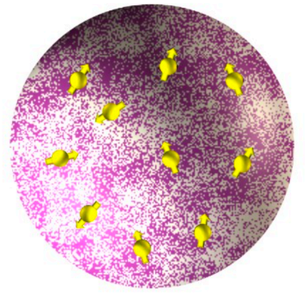
- Personnel:
  - Now: Michael Paolone (Assistant Professor of Physics)
  - Near Future: Graduate Students, Post-Docs, (other faculty?)

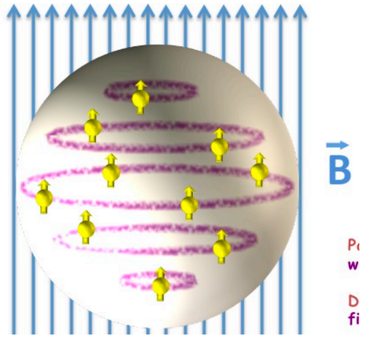
- My academic/CLAS history:
  - 2004 - 2012: Graduate Student and Post-Doc with University of South Carolina (CLAS Member)
  - 2012 - 2020: Assistant Research Professor with Temple University (CLAS member)
  - 2020+: Assistant Professor: New Mexico State University (application to become CLAS Member)

CLAS6 physics interests:

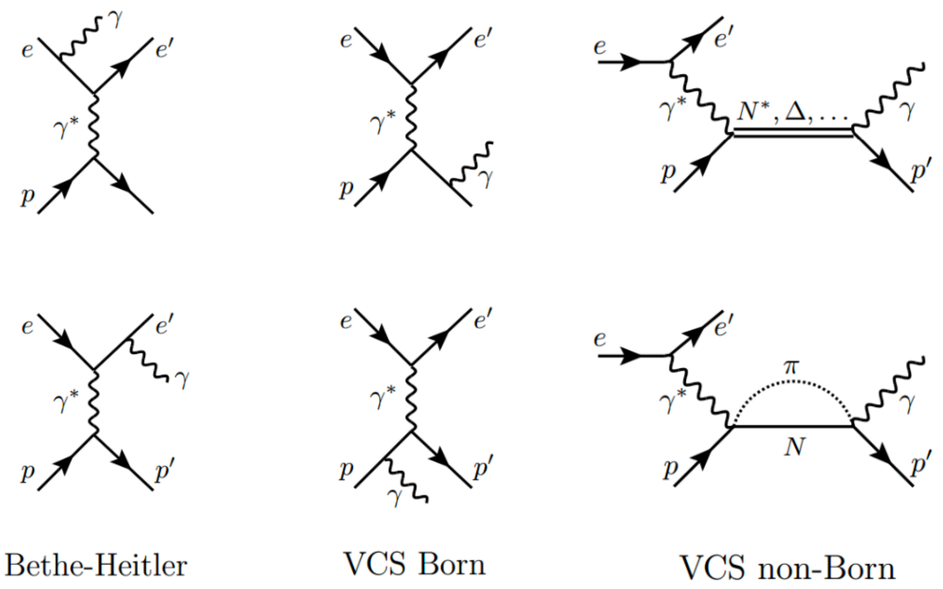








- CLAS6 data-mining:
  - The polarizability of the nucleon describes it's electromagnetic "stretchability" or "alignability": an important property needed to fully describe the nucleon's structure.
  - The primary mechanism to study the polarizability of the proton comes from virtual Compton scattering (VCS).
  - A very similar reaction to π^0 production off the proton (i.e. a resonance excitation and decay, like $\Delta^+(1232) \rightarrow p + \pi^0$ (~99.5%) or $\Delta^+(1232) \rightarrow p + \gamma$ (0.5%).



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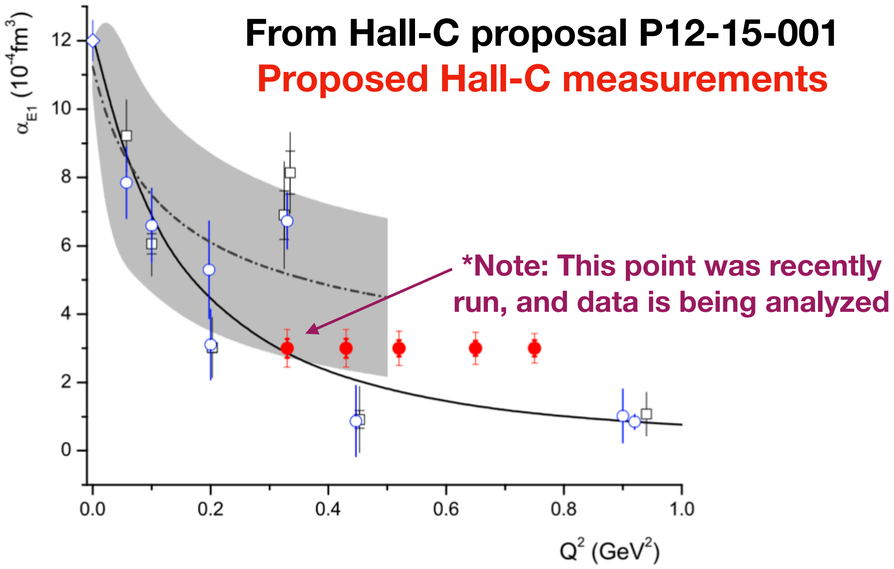
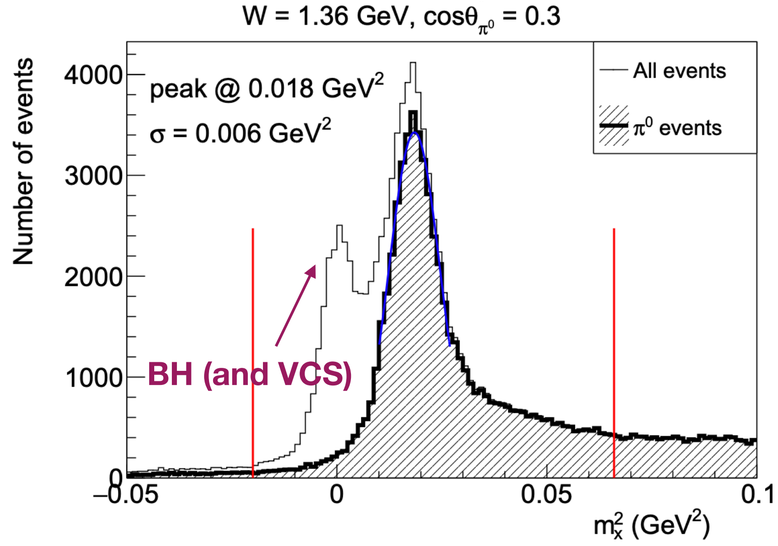
  - Experiment E12-15-001 in Hall-C ran in 2019 to study $Q^2 = 0.3 - 0.8$ GeV^2
  - Recent CLAS publication using the e1e data-set: N. Markov, "Exclusive π^0 Electroproduction in the Resonance Region" in Phys. Rev. C 101, (2020)
    - $Q^2 = 0.4$ to 1 GeV^2 and $W < 1.8$ GeV is in the region of interest!
    - VCS treated as background
    - Currently doing feasibility studies (how well can we isolate the VCS signal?)

From Hall-C proposal P12-15-001
Proposed Hall-C measurements



From N. Markov Analysis of e1e data (PRC101):



CLAS6 physics interests

- CLAS6 data-mining:
- In-medium properties of mesons:
  - Absorption studies of omega and phi mesons inside nuclear targets show an increased absorption over expectations (CLAS publication with the g7 dataset: M. H. Wood, "Absorption of the ω and ϕ Mesons in Nuclei." Physical Review Letters 105 (2010)),
    - If one wants to avoid hadronic final state corrections, the purely electromagnetic process is desirable, photoproduction of the dilepton channel: $\gamma + A \rightarrow X + VM \rightarrow X + e^+ + e^-$
    - Counting the lightest vector meson yields are dependent on our understanding of the interference between states.

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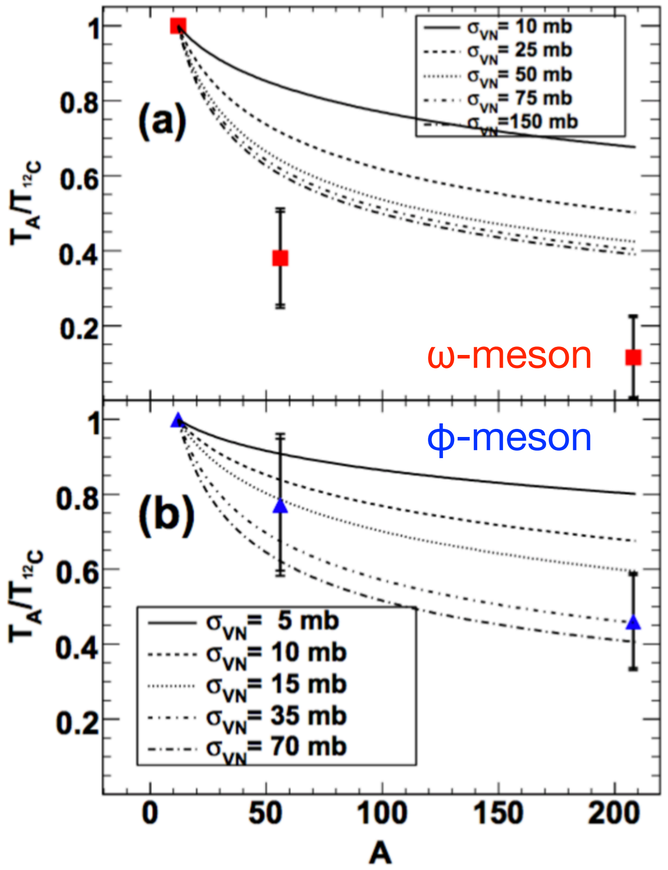

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    - Counting the lightest vector meson yields are dependent on our understanding of the interference between states.
    - Using the g12 dataset, I am finalizing an analysis of the $\gamma + p \rightarrow p + VM \rightarrow p + e^+ + e^-$ reaction with emphasis on the ρ-ω interference.
      - Final stages include a systematic study of the Bethe-Heitler subtraction: I expect an analysis review early next year.

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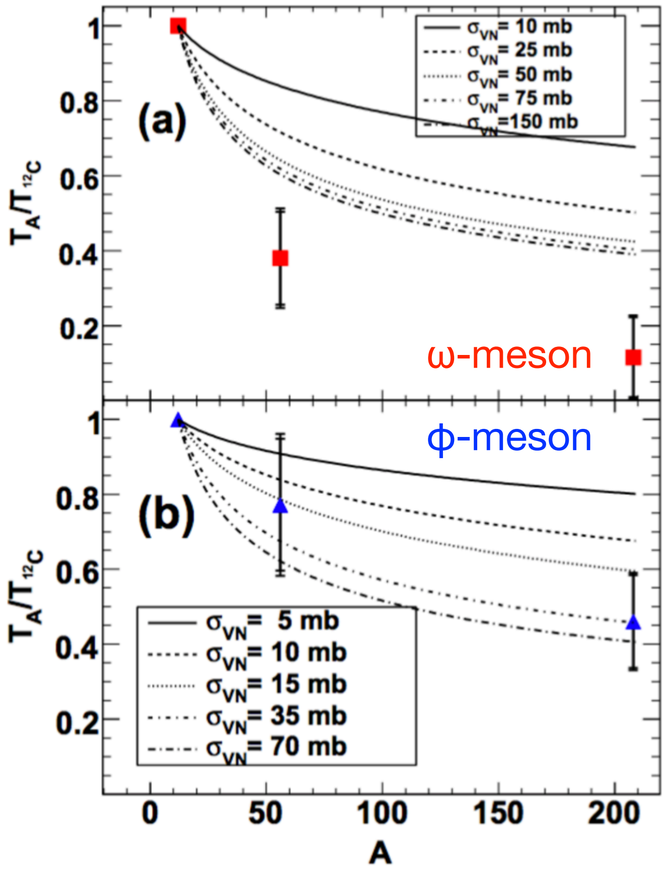
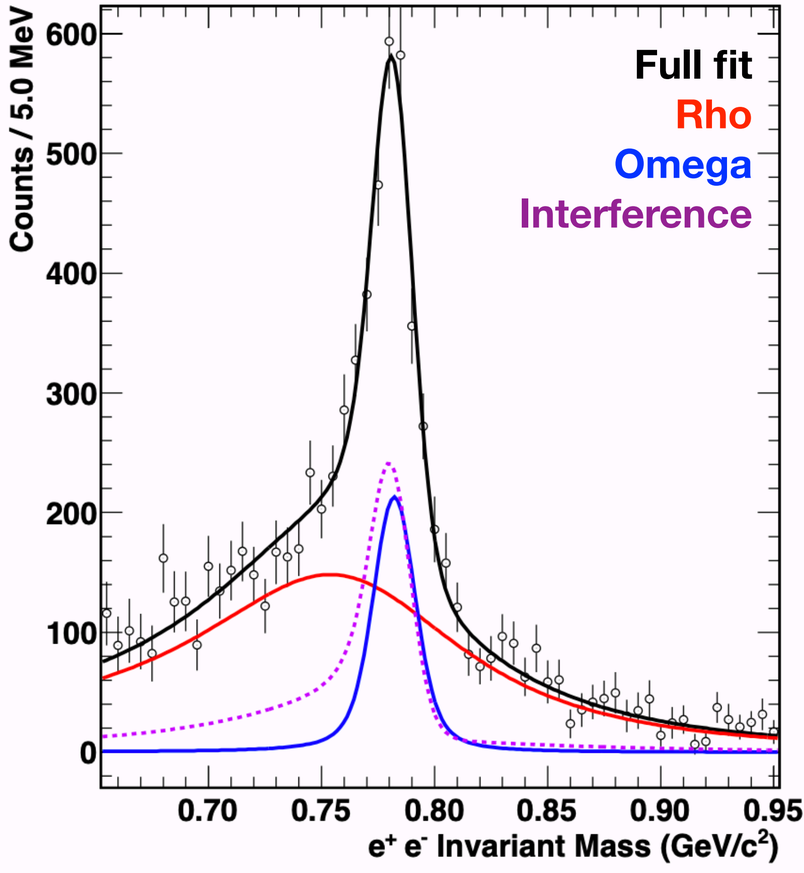


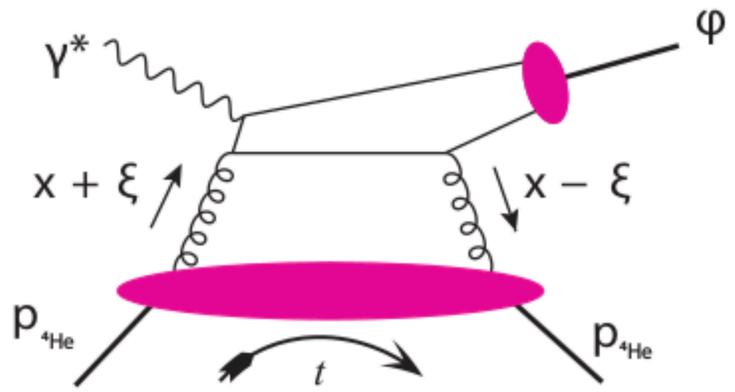
Preliminary g12 analysis on ρ-ω interference



CLAS12 physics interests

- DVMP and the gluon GPDs of ^{4}He with the ALERT detector:
  - With coherent electroproduction of stangeonium, one can limit the exchange mechanism between the phi-meson and proton or nuclei to be primarily gluonic (i.e. quark/meson exchange is suppressed since the phi is almost entirely composed of strange-quarks and the target is almost entirely of up/down-quarks).
  - Following a similar strategy of extracting quark GPDs, one can also extract gluon GPDs.
    - Using a nuclear target like ^{4}He, the interpretation of the GPD extraction becomes cleaner since the target is spin-0, and only one leading twist GPD contributes to the longitudinal cross-section.
    - In order to access the GPD, one needs a coherent scattering from 4He, and a large angle/low momentum detector that can cleanly identify and reconstruct the recoiling ^{4}He nucleus.

Handbag diagram for DVMP of phi off ^{4}He



$$\frac{d\sigma_L}{dt}(^4\mathrm{He}) \propto |\langle H_g \rangle|^2$$

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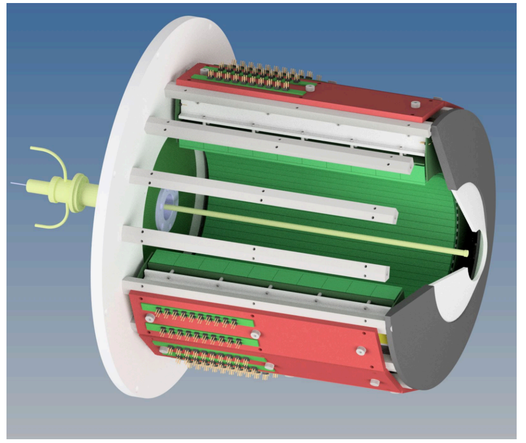
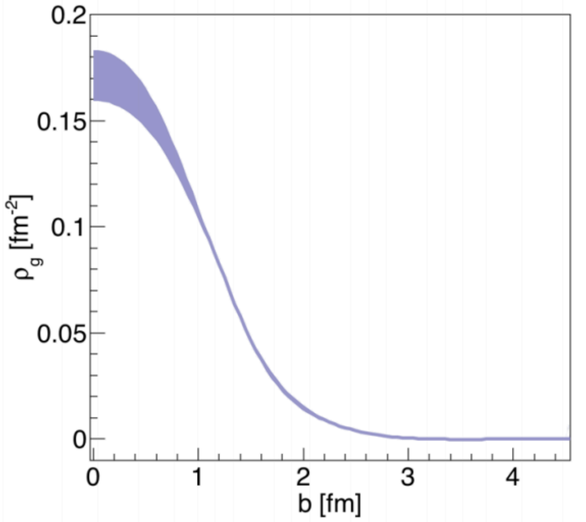
    - In order to access the GPD, one needs a coherent scattering from 4He, and a large angle/low momentum detector that can cleanly identify and reconstruct the recoiling 4He nucleus.
    - The ALERT detector is optimally designed for this measurement, and the extraction of gluon GPDs was part of the ALERT proposal group that was approved by PAC 45.
    - Currently the ALERT collaboration in coordination with Hall-B leadership and CLAS12 staff are preparing for experimental readiness review (ERR).

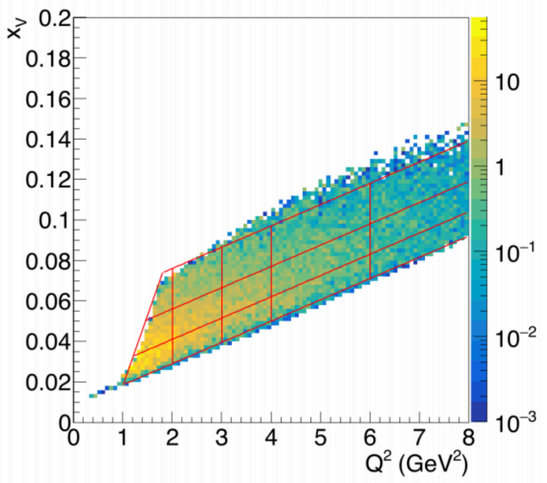
The ALERT detector design

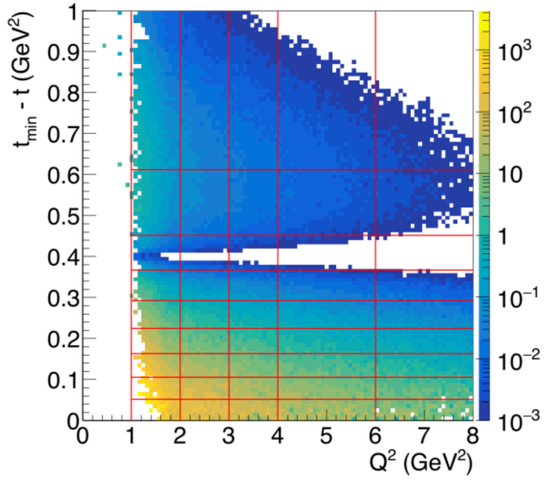


Gluon GPD projection for a single kinematic bin



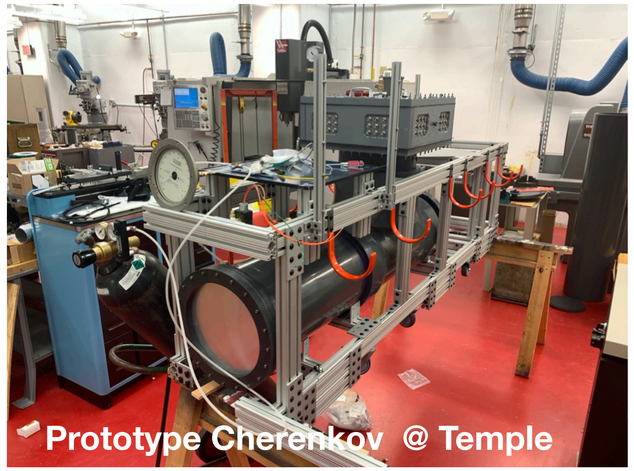
Expected Kinematic coverage in t, x, and Q2

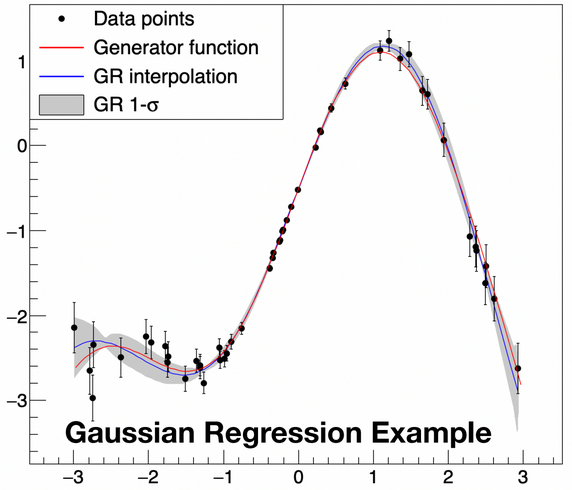




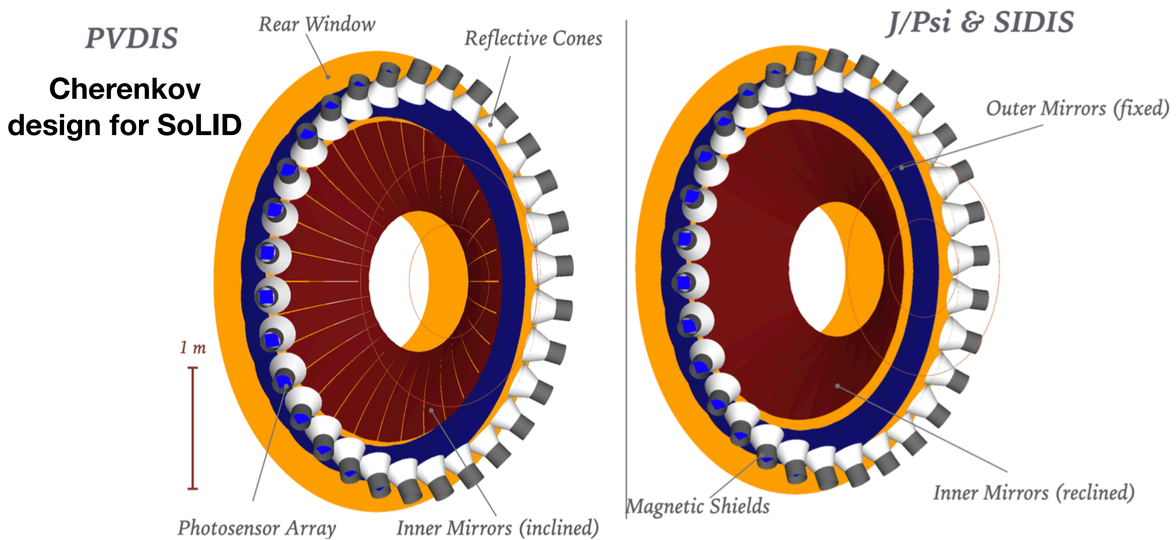
What I can provide to the collaboration

- With the University of South Carolina:
  - I wrote optimizing algorithms for standard kinematic fitting packages
  - I facilitated the conversion of the 32-bit CLAS6 general software package to 64-bit comparability.
- With Temple University:
  - I assisted with coating and testing of WLS coating of PMTs for the LTCC.
  - I designed and am continuing to help write the ALERT detector calibration software.





- Technical Skills:
  - I'm a competent programmer and know several physics-useful languages: (Python, C++, JAVA, FORTRAN, Perl, Ruby...)
  - I've adapted machine learning algorithms into root-friendly packages (specifically a supervised-learning n-dimensional gaussian regression algorithm as an interpolator/predictor over large irregular data-sets)
  - Hardware/software expertise with modern Cherenkov detectors. (Lead design for SoLID Cherenkov)



Summary

- I have a history of working with the CLAS collaboration.
- My primary interests right now include data-mining CLAS6 data and preparing for the RGL ALERT program with CLAS12
  - In the intermediate term, I can help make the CLAS12 program as strong as it can be, and my physics interests reach into other CLAS12 projects (such as RG-A and RG-F).
- I am excited to continue working with the CLAS collaboration and expand NMSU's contribution within the collaboration.