Communications, common PWG session:
Light Mesons (LM), Charmonium (CC) and Charmonium-like Exotics (CCE)

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GU Frankfurt / GSI Darmstadt, RU Bochum

Outline

- Publication / release issues
- Ongoing analyses and new manpower
- CCE-SubTask force with theorists started

Publication / release issues

Phase One Paper

- Drafting ongoing, see report by physics coordinators
  - ➢ CCE: Xscan

Dedicated X(3872) scan paper (CCE)

- Precision energy scan measurements using the example X(3872)
  - ✓ Extension and completion of release
    - *Parameter space extended, and*
    - *Systematics estimated and included*
  - ✓ Presented and discussed in PWG
  - ✓ Release Note draft circulated within PWG
  - ✓ Review Committee formed by PubCom:
    - *M. Fritsch (chair)*
    - *J. Meschendorp (replacing K.Schoenning, representing PubCom)*

→ Collaboration wide talk: Plenary talk on Fri by Klaus Goetzen et al.

Ongoing Analyses

CCE:

- ppbar → $X(3872) \rightarrow \chi_{c1}\pi^+\pi^-$,
  Search for $Z^{\pm}(3730) \rightarrow \chi_{c1}\pi^{-/+}$ (L.Bianchi et al., FZJ)
  - FullSim studies started/ongoing
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- pbar d → $Z_c(3900)^- p_{spec} \rightarrow J/\psi\pi^- p_{spec}$,
  Production and decays in pbar d (A.Blinov et al., INP)
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- X(3872) energy scan (K.Götzen et al., GSI)
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- X(3872) → DD*bar decays (M.Barabanov et al., JINR)
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- X(3872) → J/ψ ρ and J/ψ ω (S.Poslavsky et al., IHEP)
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  - Nothing released yet

Ongoing Analyses

CCE ctnd:

- ppbar → $\tilde{\eta}_{c1}\eta$, with $\tilde{\eta}_{c1}$ → $\chi_{c1}\ \pi^0\ \pi^0$ (Markus Moritz, U Giessen)
  - Charmonium hybrid state
  - Studied for old performance report and fastSim (MP)
    - *A good channel showing importance of fully equipped EMC*
  - FullSim studies started

    (inline with needs of extending the fastSim studies to fullSim)
  - First status report today

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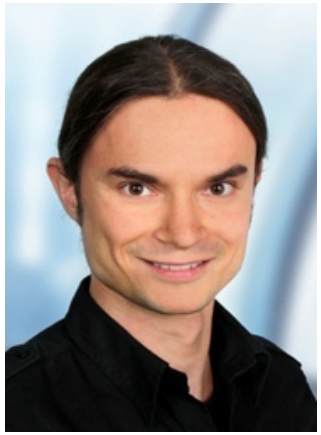


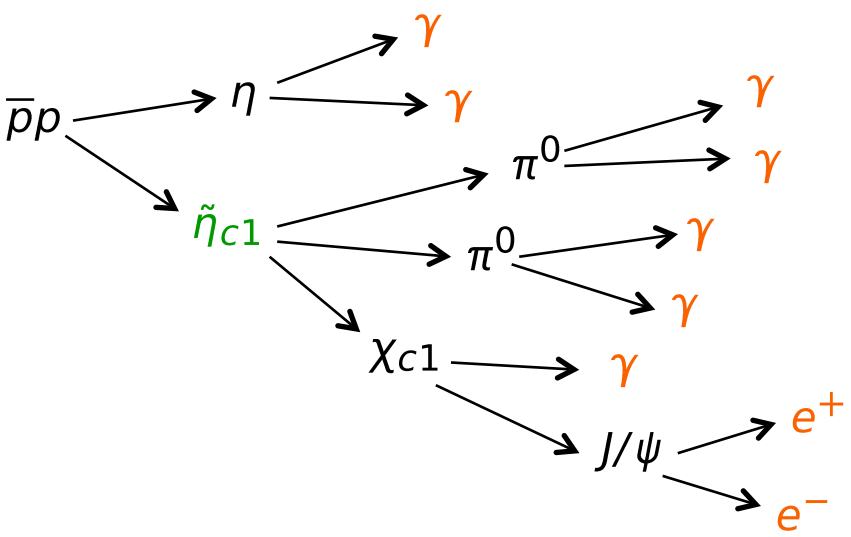
New active analyst on a CCE channel:

→ Welcome, Markus!

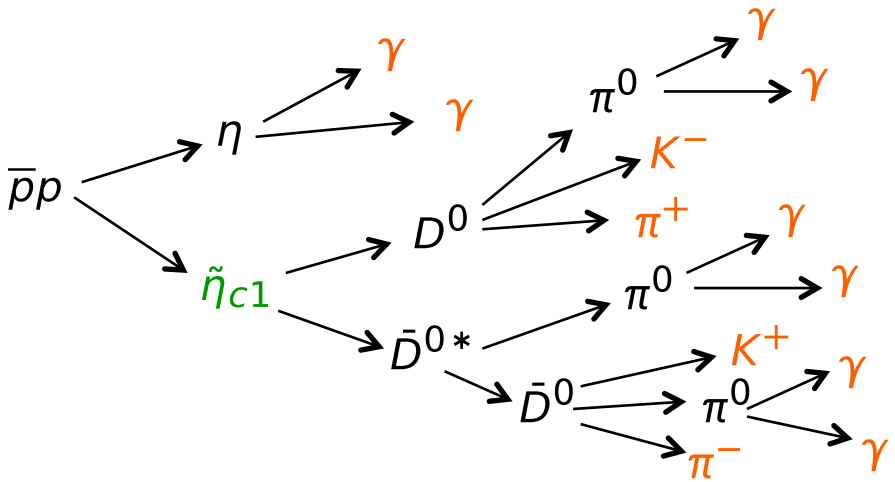
Charmonium Hybrid Candidate $\tilde{\eta}_{c1}$

- From LQCD calculations:
  Spin-exotic hybrid candidate $\tilde{\eta}_{c1}$ with m ≈ 4.3GeV/c², $J^{PC} = 1^{-+}$
- Exclusive reconstruction in two favoured channels:

$\bar{p}p \rightarrow \tilde{\eta}_{c1}\eta \rightarrow \chi_{c1}\pi^0\pi^0\eta$



$\bar{p}p \rightarrow \tilde{\eta}_{c1}\eta \rightarrow D^0\bar{D}^{0*}\eta$



- Production X-section assumed similar to $\bar{p}p \rightarrow \psi(2S)\eta$ (33pb)
  → *Need good calorimetry + good particle identification*

Ongoing Analyses

CC:

- $\psi(^3D_2) \rightarrow \gamma\chi_{c1}\ \pi^{-/+} \rightarrow \gamma\gamma J/\psi$ (Z.Liu, U Mainz))
  - D wave charmonium states (X(3823))
  - FullSim studies started/ongoing
  - First draft of a release note since a while ...
  - Updated with higher DPM stats, discussion and presentation in PWG needed in order to start release process

Ongoing Analyses

LM:

- ppbar → ϕϕ (Iman Keshk, RU Bochum)
  - Gluon rich (OZI suppressed) process
  - Search for a tensor glueball (m~2.5 GeV) by means of a resonance scan and a partial-wave analysis (PWA)
  - Feasibility of reconstruction previously studied for physics performance report and using FastSim (KG)
  - Extend FastSim studies to FullSim
  - Anlaysis started in November 2017 (update of status today)
  - Address PWA in the future (after finalising background studies)

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→ Welcome, Iman!

CCE SubTask Force with theoreticians

- Started during the scrutiny process and in view of a future physics book
  → *sharpening the uniqueness and competetiveness of PANDA*

- FullSim physics analyses to be carried out
  → *New, up-to-date material for conferences, and*
  → *Set of physics paper planned ... (towards physics book)*

Charmonium-like exotics at PANDA

- uniquely gluon-rich process: ppbar
  → *high cross section for states with gluonic excitations / exotics*
- unique in precise measurement of widths
  → *sub-MeV range, needed to understand X,Y,Z nature*
- unique in discovery potential for high spins:
  → *no angular momentum barrier (and no restriction spin)*

=> Only PANDA will enable to explore complete multiplets and clarify nature of X,Y,Z

Publication / release issues

In collaboration with Christoph Hanhart, we set up a Task Force on CCE

List of involved theorists, expertise

- Gunnar Bali (U. Regensburg)
- Nora Brambilla (TU Munich)
- Christian Fischer (U. Giessen)
- Christoph Hanhart (FZJ)
- Matthias Lutz (GSI)
- Juan M. N. Pamplona (U. Valencia)
- Eric Swanson (U. Michigan)

- Antonio Polosa (U. Roma I), *Tetraquarks*
- Sasa Prelovsek (U. Ljubljana), *LatticeQCD, Exotica*
- Christopher Thomas (U. Cambridge), *LatticeQCD*
  (member of the Hadron Spectrum Collaboration)
- Mikail Voloshin (U. Minnesota), *Exotica*

Request to / common goal with theorists

- **Extend the list of channels**
  - Which ones to be added?
  - Especially in view of uniqueness/competitiveness by PANDA
  - Get right priorities

- **Strengthen analysis outcome with input/calculations from your side**
  - Added a good example of the resonance energy scan study using the example of X(3872)
    → *see next slides [talk given at QWG 2016]*
  - Hahnhart et al provided line-shape predictions for virtual vs. bound state
    => Apart from simple BW shaped resonance assumption, dedicated study in addition for distinction between two nature interpretations / line-shapes

Summary

- Only a few analyses ongoing, or rather "ongoing" ....
  - At least two progressing rather slowly
  - Two new channels picked up (Bochum, Giessen)

- One released result progressing to a dedicated journal publication
  - X(3872) energy scan
  - Collaboration wide release talk this Friday
  - Paper draft under work

- Need more channels being analysed in fullSim
  - Also, better coverage of the our 3 physics topics, improving ...
  - Key channels and results to be worked out

- CCE SubTask Force with theorists successfully launched
  - Prioritised list of channels with dedicated input from theory
  - Expect first related report at the June CM

Ongoing Analyses

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  - ✓ Released, update for journal publication being reviewed
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  NB: Not only BW width but also distinction between line-shape ←→ nature of state

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  - Charmonium hybrid state *[G. S. Bali, Int.J.Mod.Phys. A21 (2006) 5610]*
  - FullSim studies to be started