Search for exotic hadrons with the PANDA detector

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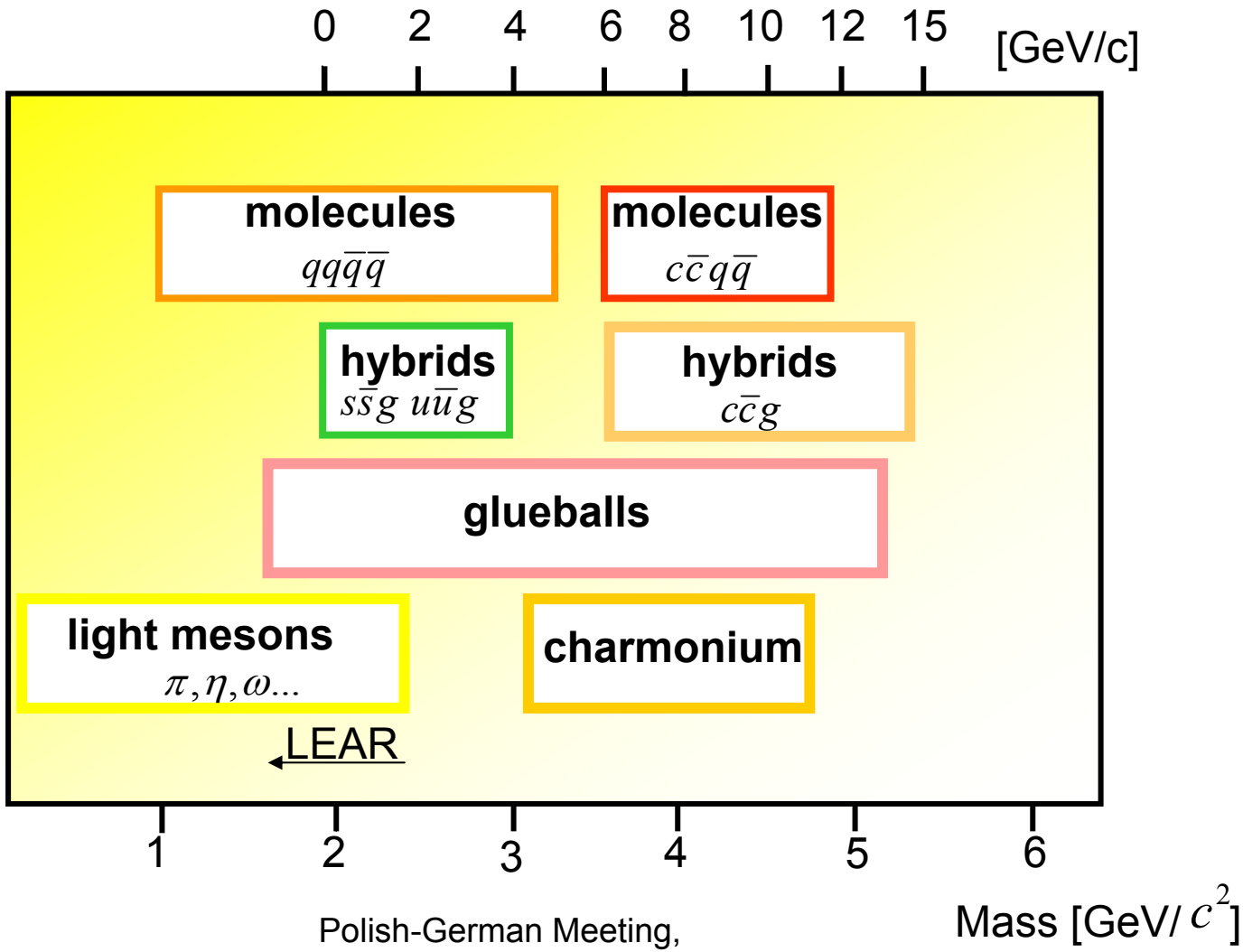
Exotic hadrons:

- Glueballs $(gg,\ ggg,...)$: made entirely out of glue
- Hybrids $(q\bar{q}g)$: $q\bar{q}$ pairs with an excited gluon
- Molecules $(q\bar{q}q\bar{q})$: $q\bar{q}$ pairs

Mesons and exotics to be studied with the PANDA detector



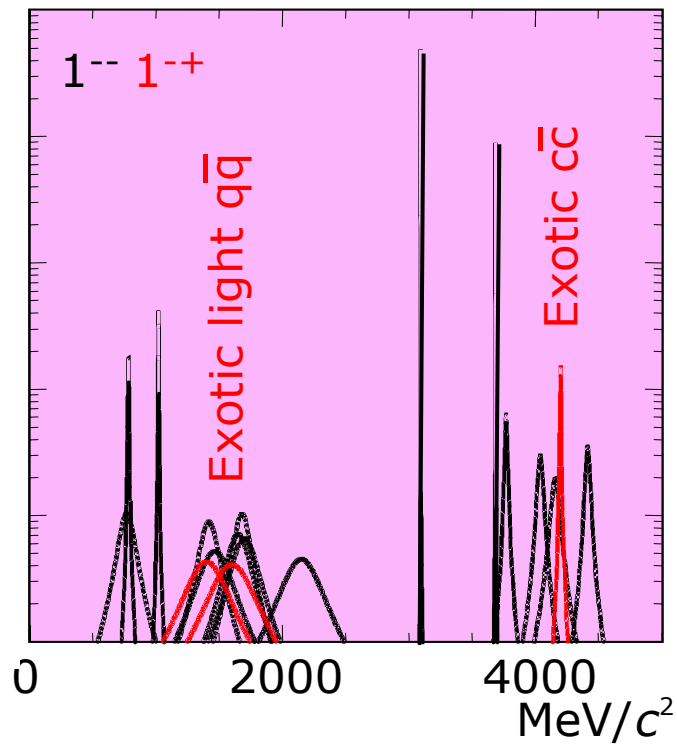
Exotic states mix with conventional $q\bar{q}$ states:

difficulties in observation

two possibilities

look for states with quantum numbers not accesilble to conventional $q\bar{q}$ states.

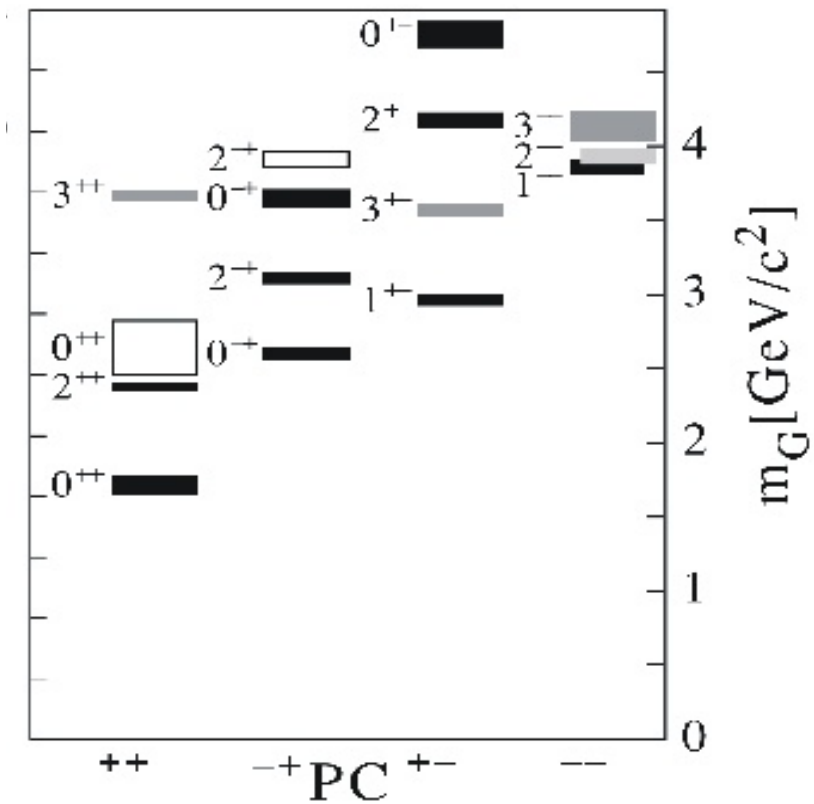
reduce mixing

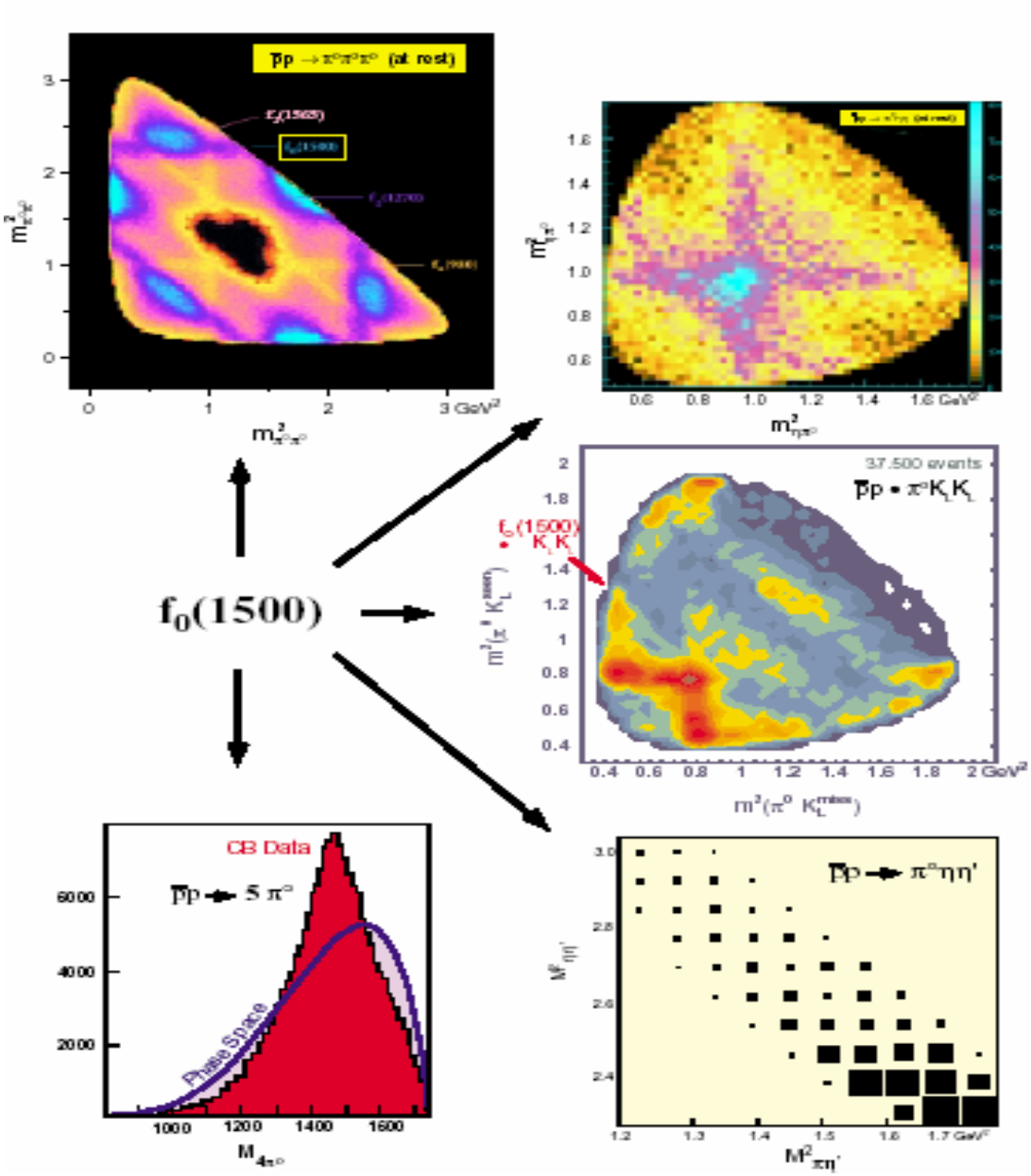


Search for glueballs

- glueballs bound gluon states
- quantum numbers:
  - →exotic, $J^{PC}=2^{+-},1^{-+},0^{--},\ldots$
  - →„normal", mixing with qq states
- production cross section ~ μb
- $f_0(1500)$ – candidate
  - →CB@LEAR
  - →mixed with scalar qq states

Glueball mass spectrum (LQCD)



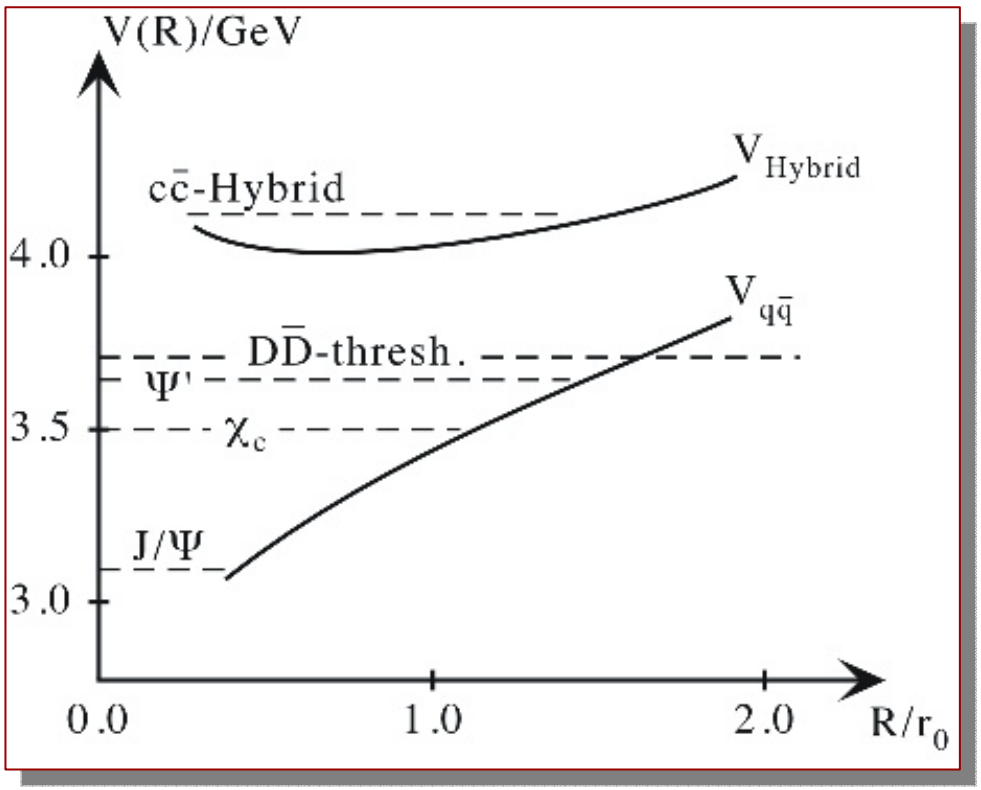


Crystal Barrel $f_0(1500)$ data:

- high statistics, full solid angle, low threshold (~20 MeV) in EM calorimeter, kaons identification
- study of different decay channels (branching ratios)
- partial wave analysis (coupled channel analysis)

Search for charmed hybrids $(c\bar{c}g)$:

Π-potential of excited gluon flux in addition to Σ-potential for one-gluon exchange may lead to bound states.



LQCD predictions for charmed hybrids:

- **Mass: lowest state 4.2- 4.5GeV/c^2**
- **Quantum numbers: ground state $J^{PC}=1^{-+}$ (exotic), but many allowed**
- **Width: 5- 50MeV (narrow states)**

Schematic view of PANDA detector on High Energy Storage Ring (HESR)