EUROPEAN PHYSICAL SOCIETY HEP2015

Light Hadron Spectroscopy at BESIII

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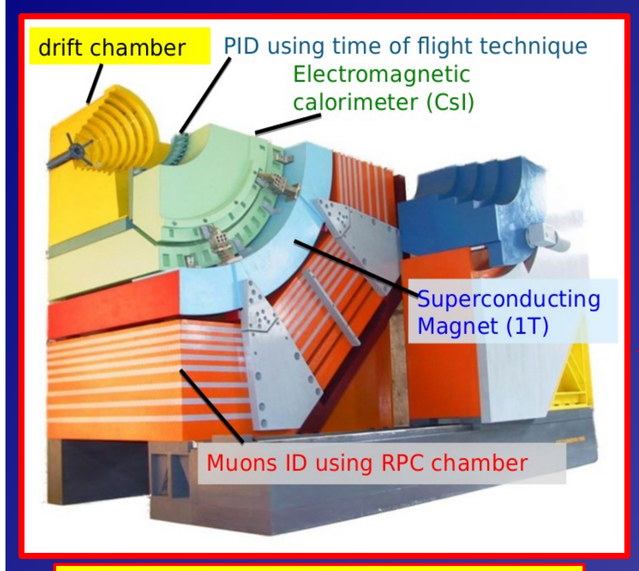
on behalf of the BESIII Collaboration



Charged particle:
- dp/p (1 GeV/c) = 0.5 %
- dE/dx (1 GeV/c) = 6%

Photon:
- Energy resolution (1 GeV) = 2.5% (5%) in barrel (endcap)

Time resolution (TOF) = 80 (110) ps in barrel (endcap)

Collects data from BEPCII

Center-of-mass energy:
2 – 4.6 GeV
Design Luminosity
10^{33} cm^{-2} s^{-1}

World's Largest sample of Charmonia:
1.3B J/ψ
0.5 B ψ'
2.9 fb^{-1} ψ(3770)

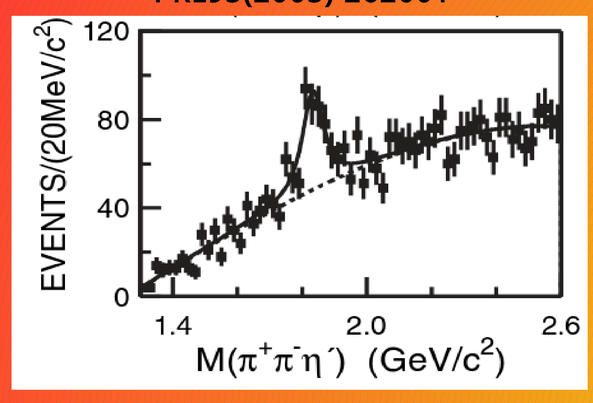
X(1835) & X(pp̄) spectroscopy

Different hypotheses about its nature:
- pp̄ bound state
- η second radial excitation
- glueball

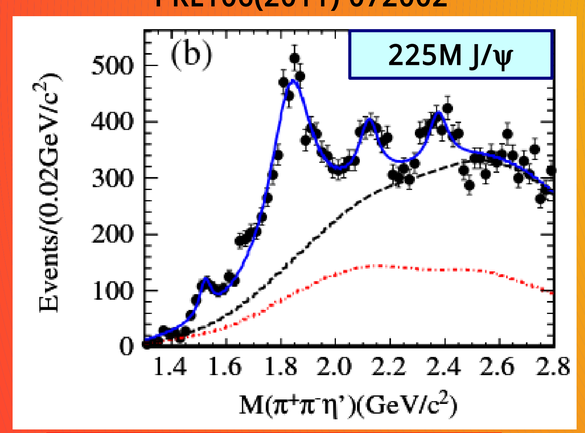
To shed new light on its nature:
PWA of $J/\psi \to \gamma K_s K_s \eta$
Arχiv:1506.04807

X(1835)

Discovered by BESII in $J/\psi \to \gamma\eta'\pi^+\pi^-$
PRL95(2005) 262001



Confirmed by BESIII:
PRL106(2011) 072002

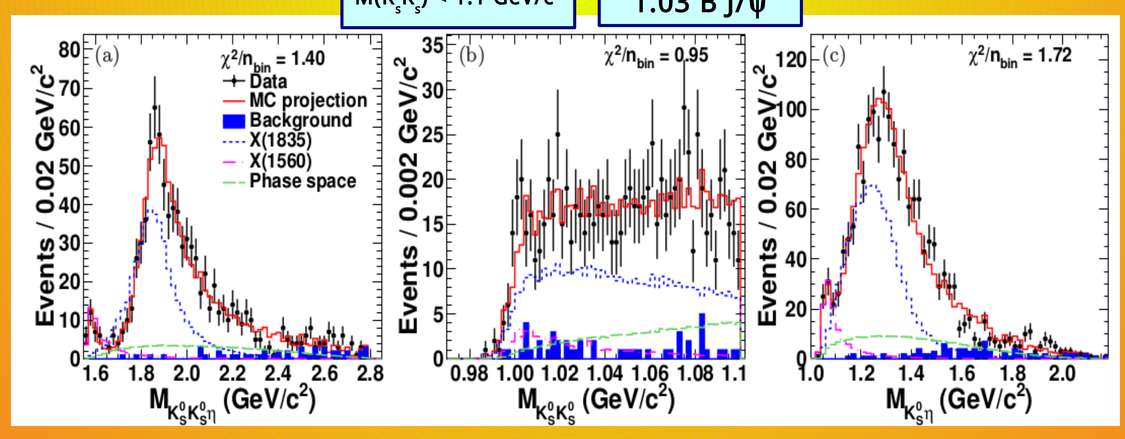


$X(1835)$
$M = 1836.5 \pm 3.0(\text{stat})^{+5.6}_{-2.1}(\text{syst})\ \text{MeV}/c^2$
$\Gamma = 190 \pm 9(\text{stat})^{+38}_{-36}(\text{syst})\ \text{MeV}/c^2$

J^P consistent with 0^-

BESIII PRELIMINARY RESULTS

$M(K_sK_s) < 1.1\ \text{GeV}/c^2$ | 1.03 B J/ψ



Confirmed X(1835)
$\text{Mass} = 1844 \pm 9(stat.)^{+16}_{-25}(syst.)\ MeV/c^2$
$\Gamma = 192^{+20}_{-17}(stat.)^{+62}_{-43}(syst.)\ MeV$
Confirmed $J^{PC} = 0^{-+}$
significance $= 12.9\sigma$

Observed new X(1560)
$\text{Mass} = 1565 \pm 8(stat.)^{+0}_{-63}(syst.)\ MeV/c^2$
$\Gamma = 45^{+14}_{-13}(stat.)^{+21}_{-28}(syst.)\ MeV$
Confirmed $J^{PC} = 0^{-+}$
significance $> 8.9\sigma$

X(pp̄)

Discovered by BESII in 2003
in $J/\psi \to \gamma p\bar{p}$

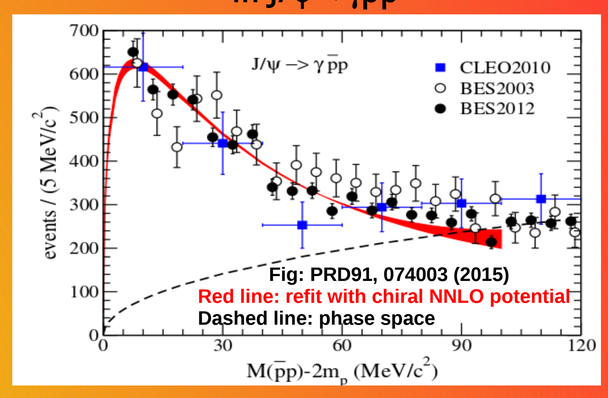
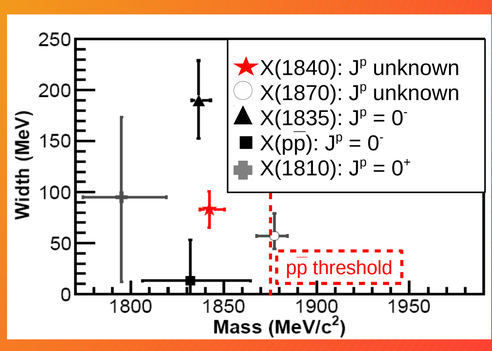


Fig: PRD91, 074003 (2015)
Red line: refit with chiral NNLO potential
Dashed line: phase space

Confirmed by
CLEO(2010) and BESIII(2012)
BESIII also claimed $J^{pc} = 0^{-+}$ with PWA
PRL 108, 112003 (2012)

X(18xx) at BESIII:
- X(1840): PRD 88,091502
- X(1870): PRL 107,182001
- X(1835): PRL 106, 072002
- X(pp̄): PRL 108,112003
- X(1810): PRD 87, 032008



Observation of the Dalitz Decay $\eta' \to \gamma e^+e^-$

1.03 B J/ψ

-Phys. Rev D 92, 012001

Theoretical prediction on a_μ are dominated by hadronic correction.
Hadronic Light-by-Light (HLbL) scattering contribution to a_μ includes two meson photon verticies than can be related to form factor in $P \to \gamma\gamma^* \to \gamma e^+e^-$

Motivation:
Study of the Transistion Form Factor (TFF) $F(q^2)$ to better understand the anomalous muon magnetic moment a_μ

Vector Meson Dominance (VMD) describes the multipole form factor

$$F(q^2) = N \sum_V \frac{g_{\eta'\gamma V}}{2g_{V\gamma}} \cdot \frac{m_V^2}{m_V^2 - q^2 - i\Gamma_V m_V}$$

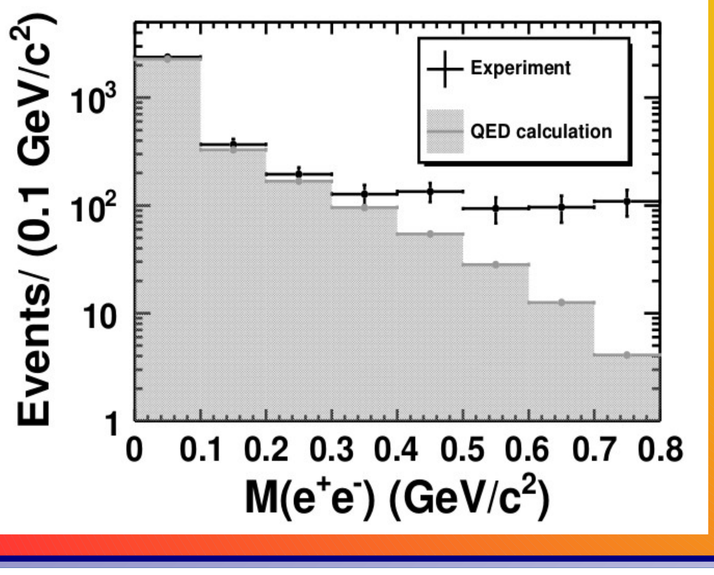
where F(0) = 1 and V = ρ, ω, ϕ
$g_{V\gamma}$ and $g_{\eta'\gamma V}$ are the respective coupling costants

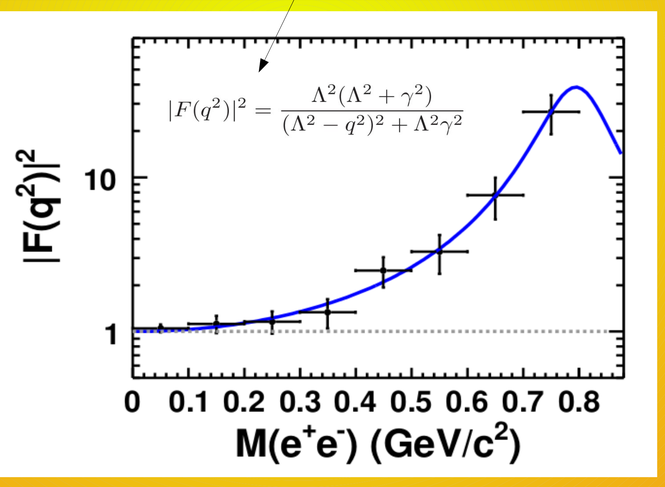
Experimentally is possible to extract the slope(derivative of form factor at $q^2 = 0$)

$$b = \left.\frac{dF}{dq^2}\right|_{q^2=0} = \Lambda^{-2}$$

where Λ is the effective virtual meson mass

$$\frac{d\Gamma(\eta' \to \gamma l^+ l^-)}{dq^2 \Gamma(\eta' \to \gamma\gamma)} = [\text{QED}(q^2)] \times |F(q^2)|^2$$
$$= \frac{2\alpha}{3\pi}\frac{1}{q^2}\sqrt{1-\frac{4m_l^2}{q^2}}\left(1+\frac{2m_l^2}{q^2}\right)\left(1-\frac{q^2}{m_{\eta'}^2}\right)^3 |F(q^2)|^2$$





From the fit:
Λ = (0.79 ± 0.04(stat.) ± 0.02(sys.))GeV
γ = (0.13 ± 0.06 (stat.) ± 0.03(sys.)) GeV
$b_{\eta'}$ = (1.60 ± 0.17 (stat.) ± 0.08(sys.)) GeV^{-2}

VMD prediction
$b_{\eta'}$ = 1.45 GeV^{-2} (Phys. Lett. B 104, 311 (1981) and Nucl.Phys. B 228, 301 (1983))

Up to this work the only results on η' Dalitz decay was $\eta' \to \gamma \mu^+\mu^-$ that set a result for the slope of $b_{\eta'}$ = (1.7 ± 0.4) GeV^{-2}
(Phys. Rept. 128, 301 (1985), Phys.Lett. B 88, 379 (1979))