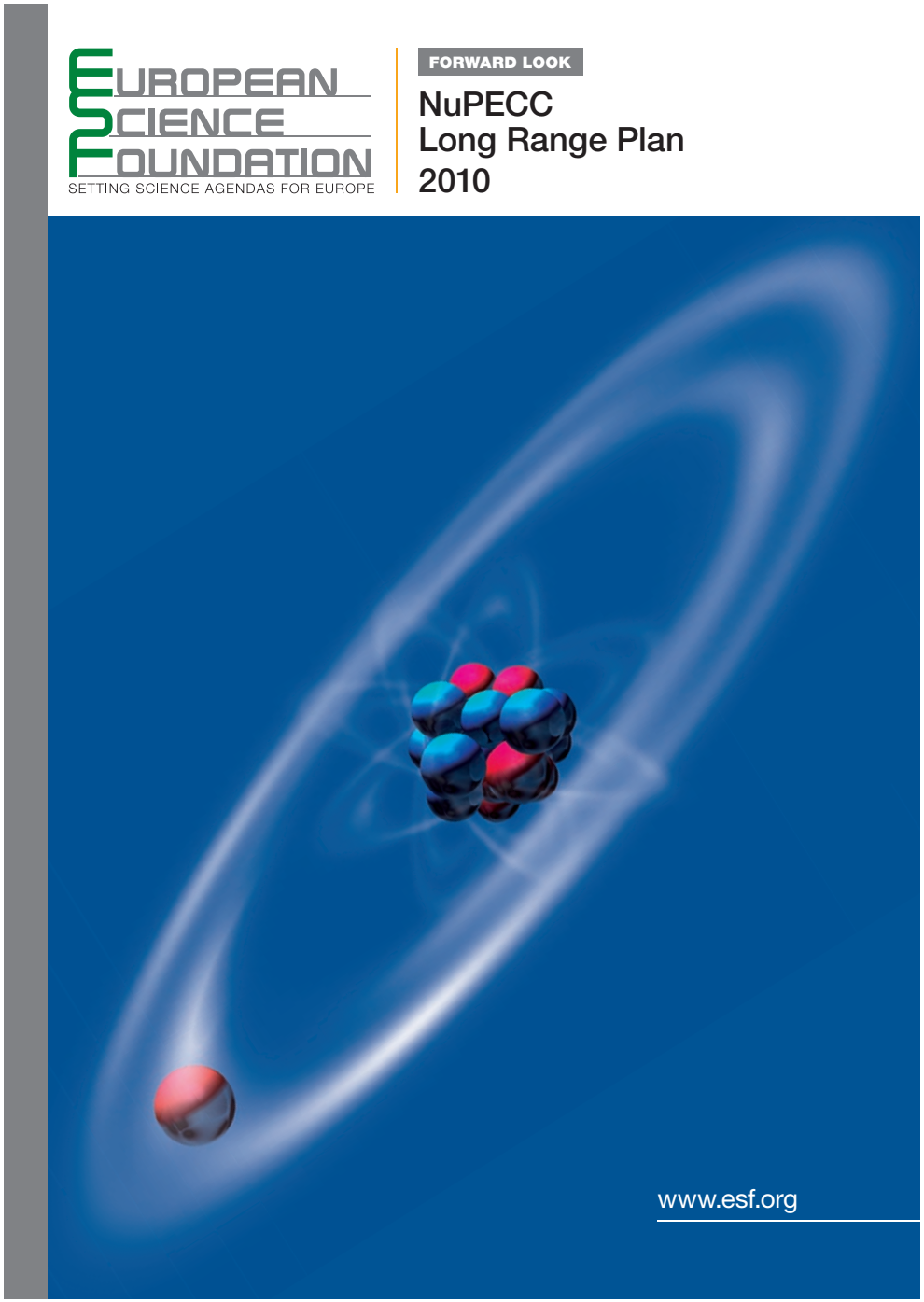
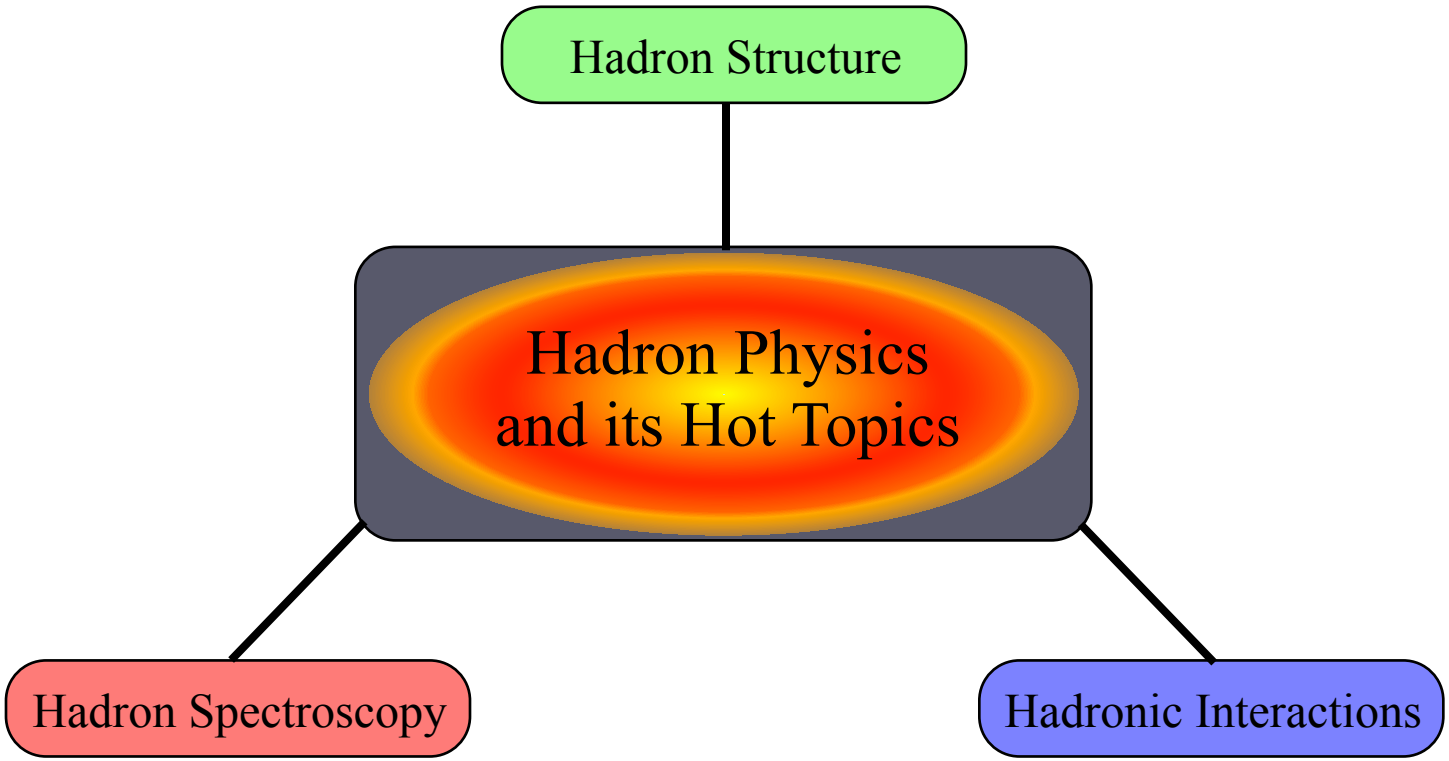
Status von PANDA

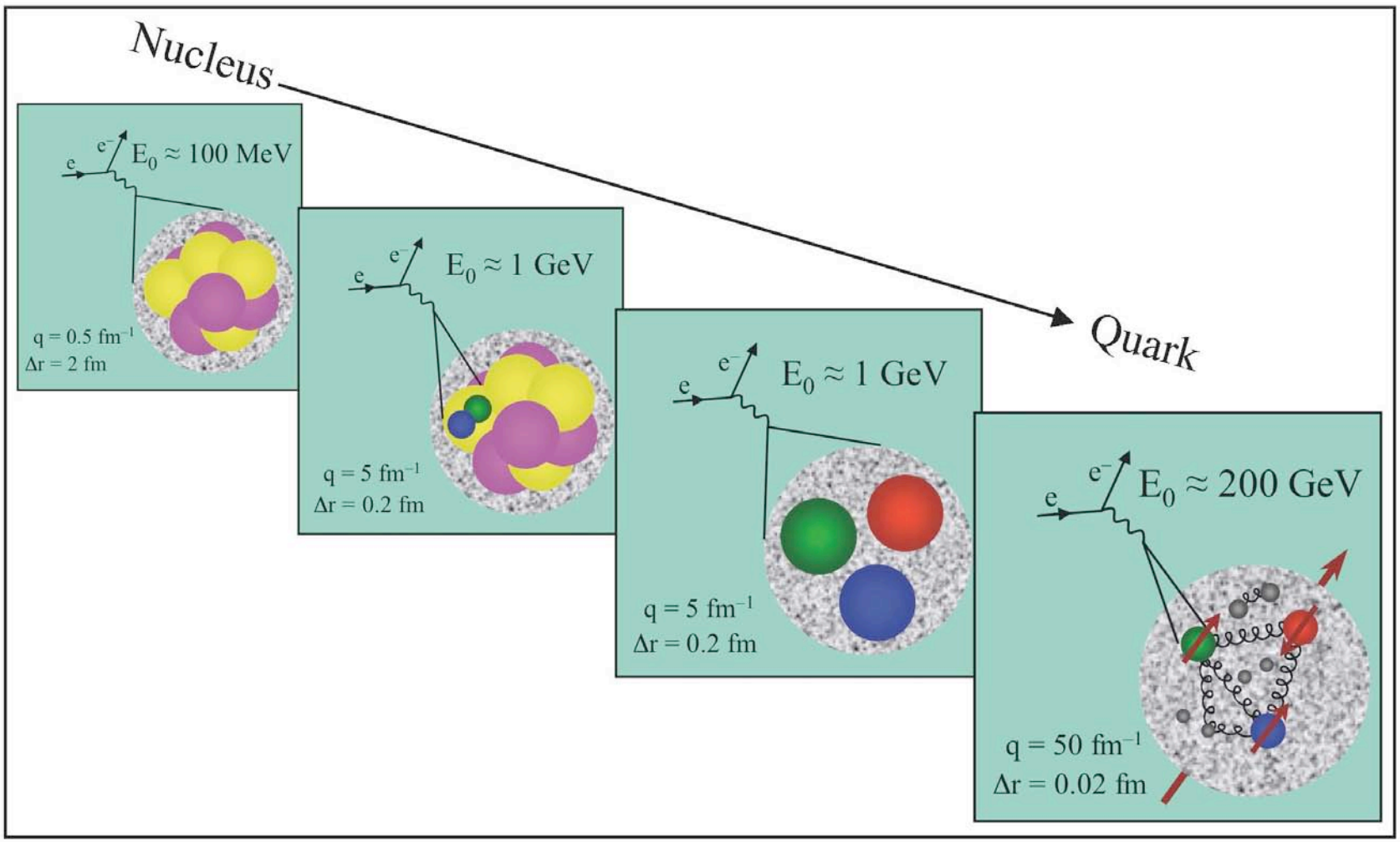
Ulrich Wiedner
Ruhr-Universität Bochum

KHuK-Treffen, Bad Honnef, 3.12.2010

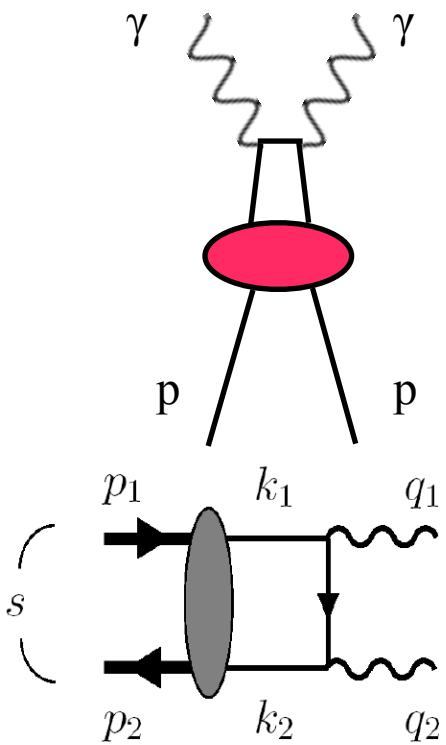

EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE
FORWARD LOOK
NuPECC
Long Range Plan
2010
www.esf.org


Hadron Structure
Hadron Physics
and its Hot Topics
Hadron Spectroscopy
Hadronic Interactions

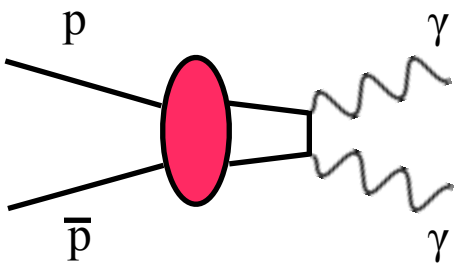
Hadronenstruktur



Electromagnetic Processes: $\bar{p}p \to \gamma\gamma$



crossed-channel
Compton scattering



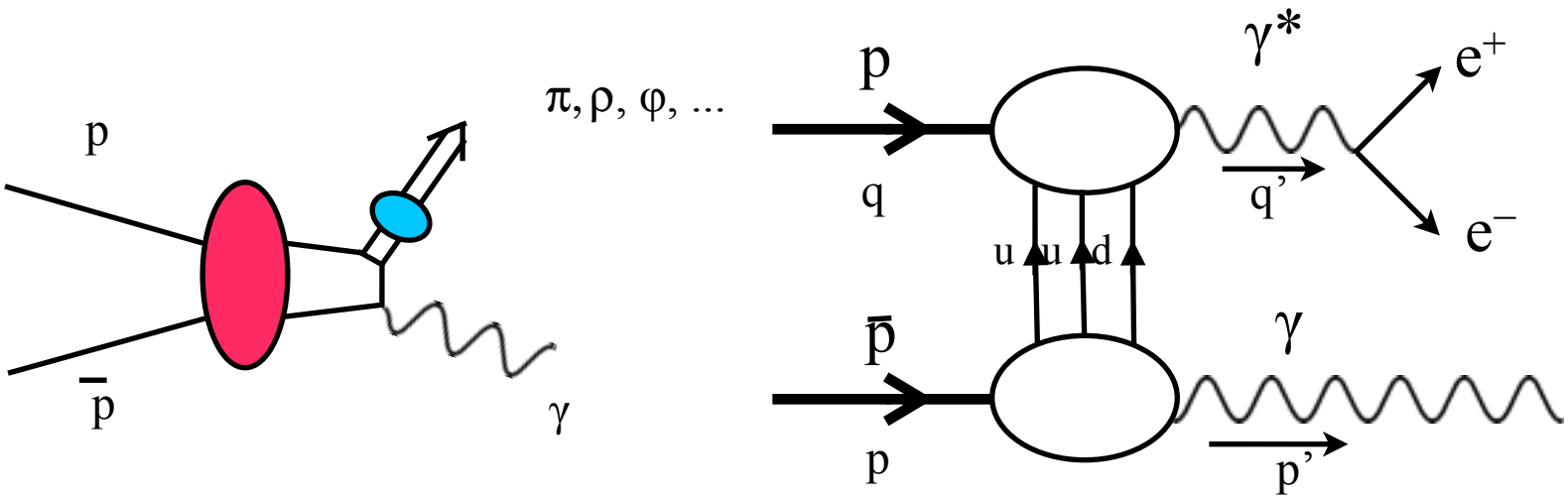
Handbag diagram separates a soft part described by GPDs from a hard $\bar{q}q$ annihilation process

Predicted rates*: several thousand / month or above

Exp. problem: Background channels like $\pi^0\gamma$ or $\pi^0\pi^0$ 5× - 100× stronger.

*A. Freund, A. Radyushkin, A. Schäfer, and C. Weiss, Phys. Rev. Lett. 90, 092001 (2003).

Related exclusive annihilation processes studies:



➥ check of factorization.

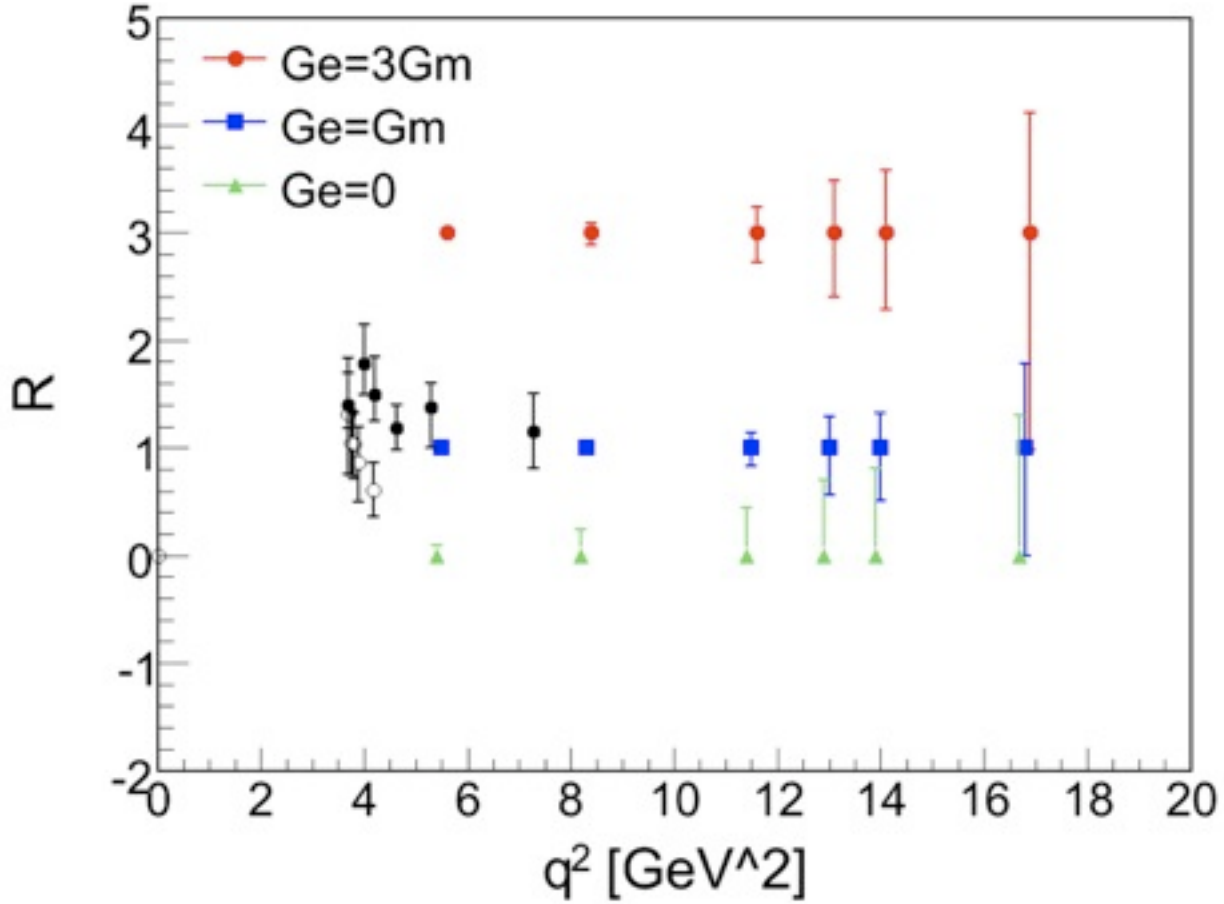
Electromagnetic form factors of the proton

... can be extracted from the cross section: $\bar{p} + p \rightarrow e^+ + e^-$

$$\frac{d\sigma}{d(\cos\theta^*)} = \frac{\pi\alpha^2\hbar^2c^2}{2xs}\left[|G_M|^2(1+\cos^2\theta^*) + \frac{4m_p^2}{s}|G_E|^2(1-\cos^2\theta^*)\right]$$

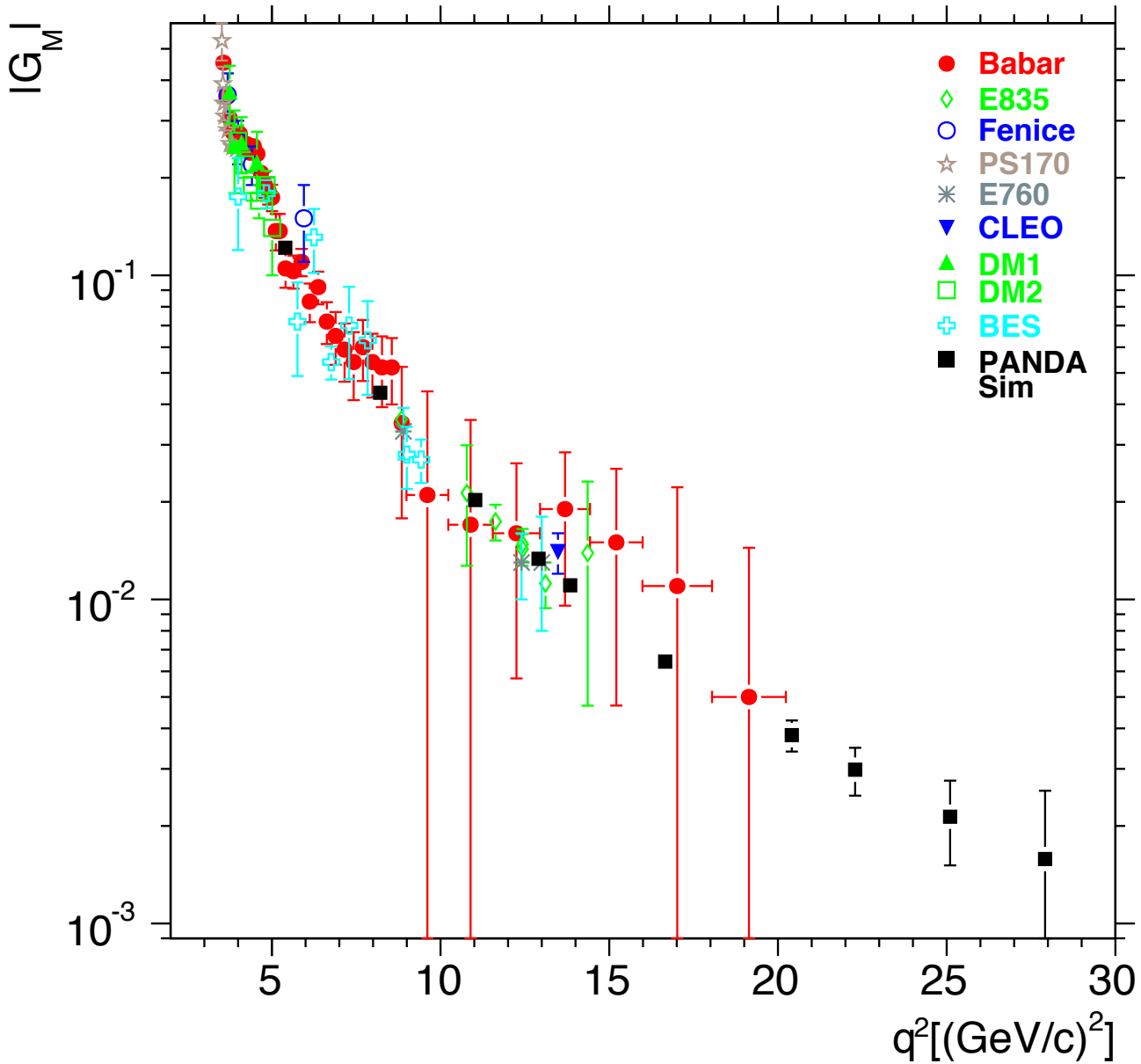
(first order QED prediction)

Data at high Q^2 test QCD predictions for the asymptotic behavior of the form factors and spacelike-timelike equality at corresponding Q^2.



$$R = \frac{G_E}{G_M}$$

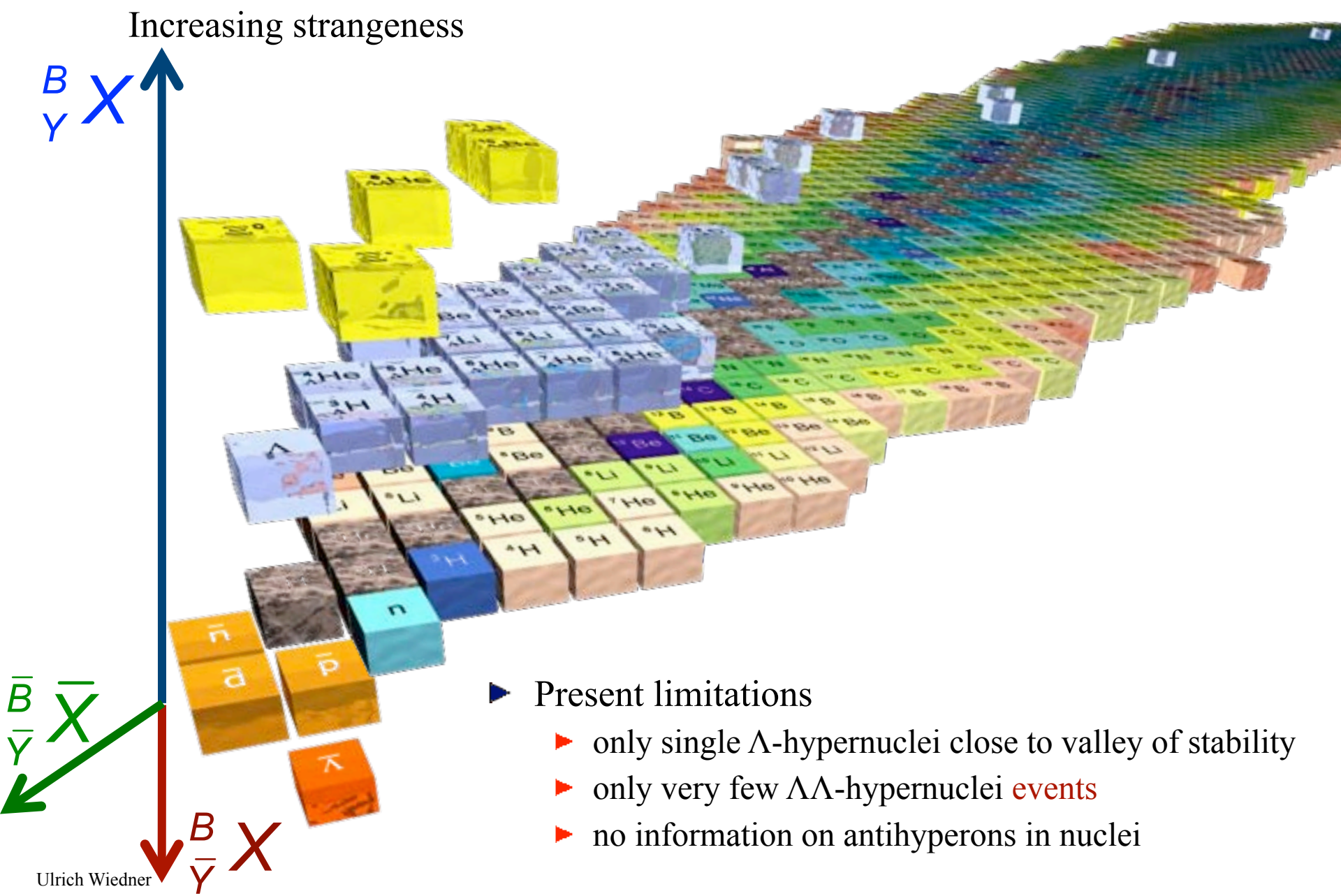
PANDA will measure the form factors in the biggest Q^2 range for a single experiment up to values of ~20 GeV^2/c^4 (beam time dependent).


$|G_M|$
10^{-1}
10^{-2}
10^{-3}
5
10
15
20
25
30
$q^2[(GeV/c)^2]$
Babar
E835
Fenice
PS170
E760
CLEO
DM1
DM2
BES
PANDA Sim

Wechselwirkung zwischen Hadronen

Ulrich Wiedner

Adding the third dimension to the nuclear chart



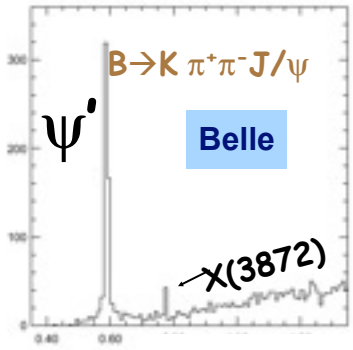
- Present limitations
  - only single Λ-hypernuclei close to valley of stability
  - only very few ΛΛ-hypernuclei events
  - no information on antihyperons in nuclei

Hadronen-Spektroskopie

Ulrich Wiedner

X and Y mesons

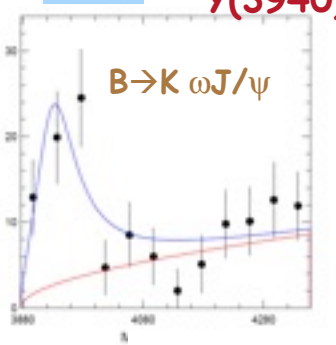
X(3872)



M(π⁺π⁻J/ψ)–M(J/ψ)

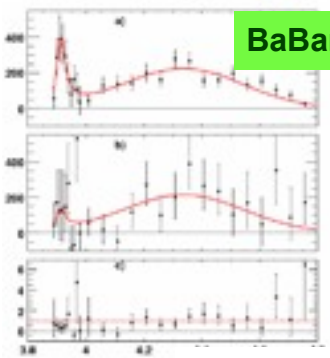
Y(3940)

Belle



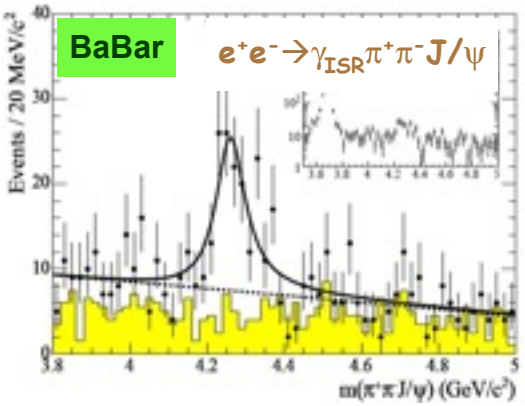
M(ωJ/ψ)

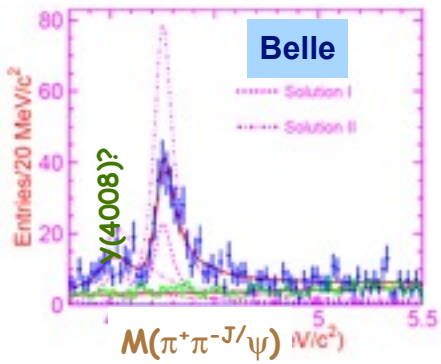
BaBar



M(ωJ/ψ)

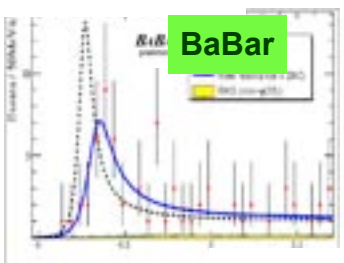
Y(4260)



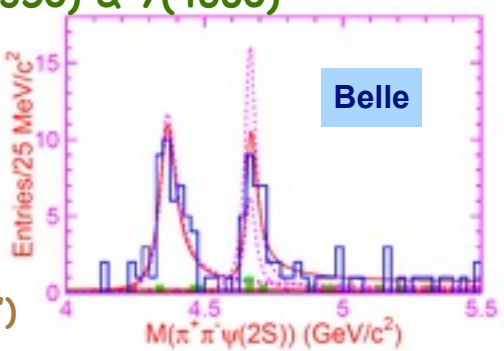


Y(4350) & Y(4660)

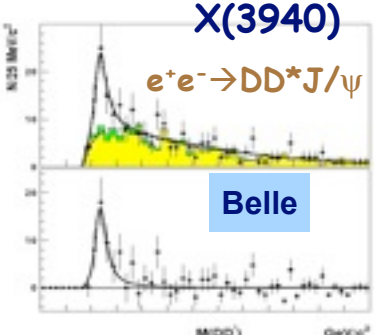
e⁺e⁻→γISRπ⁺π⁻ψ'



M(π⁺π⁻ψ')

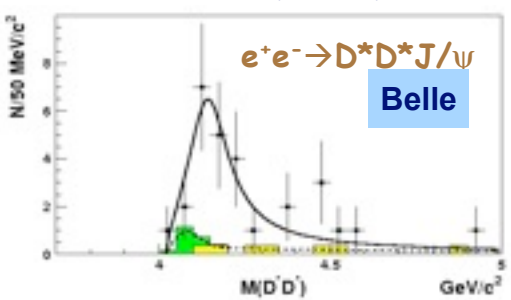


X(3940)



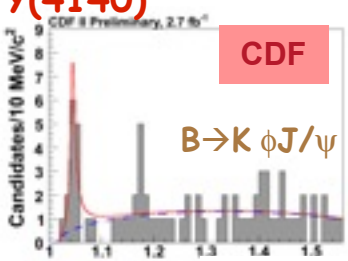
M(DD*)

X(4160)



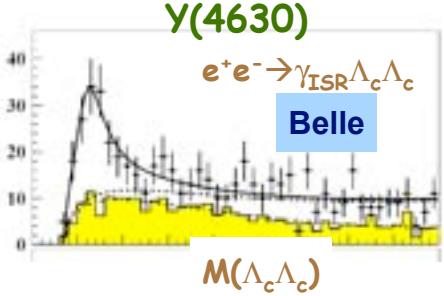
M(D*D*)

Y(4140)

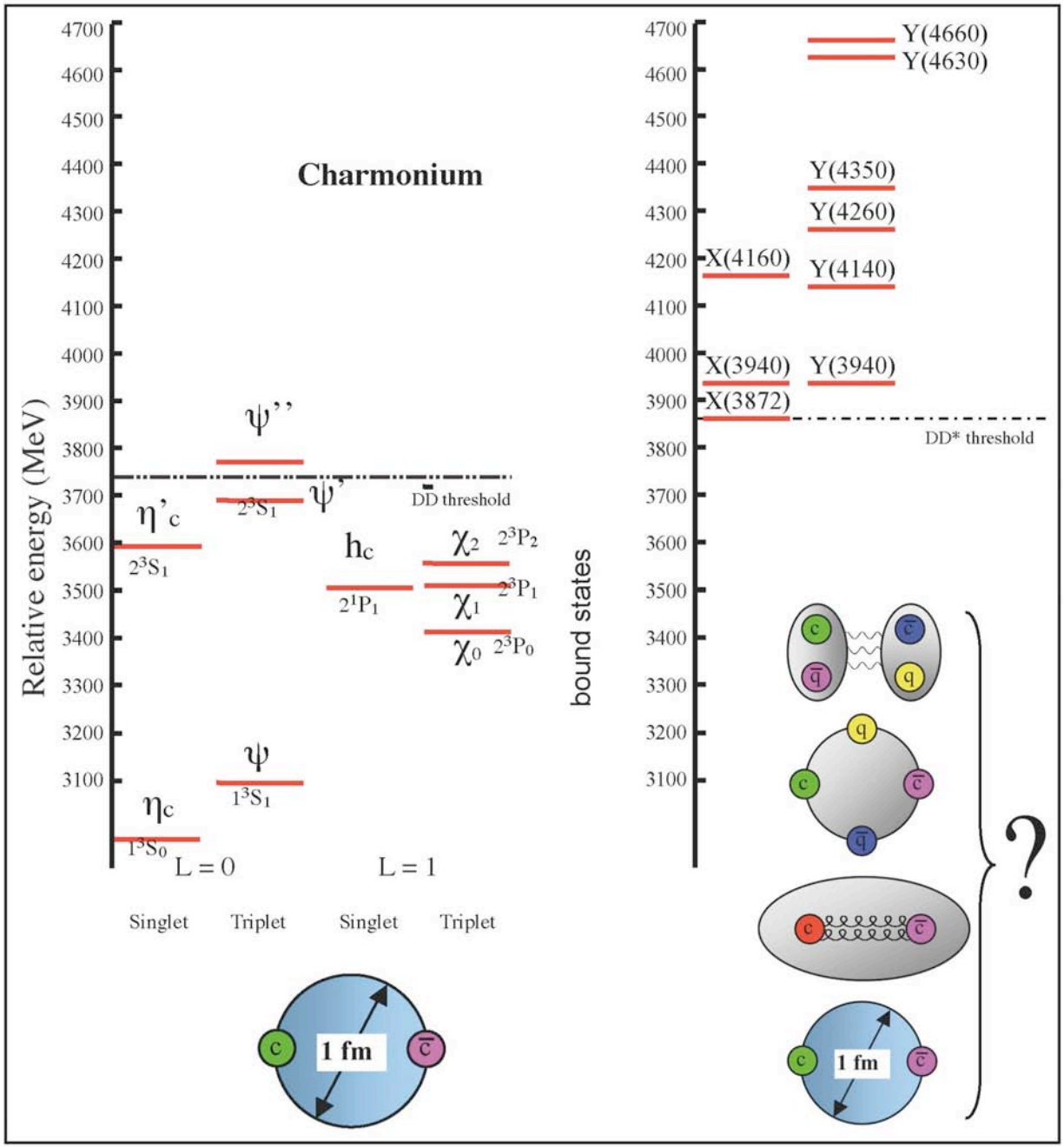


M(φJ/ψ)

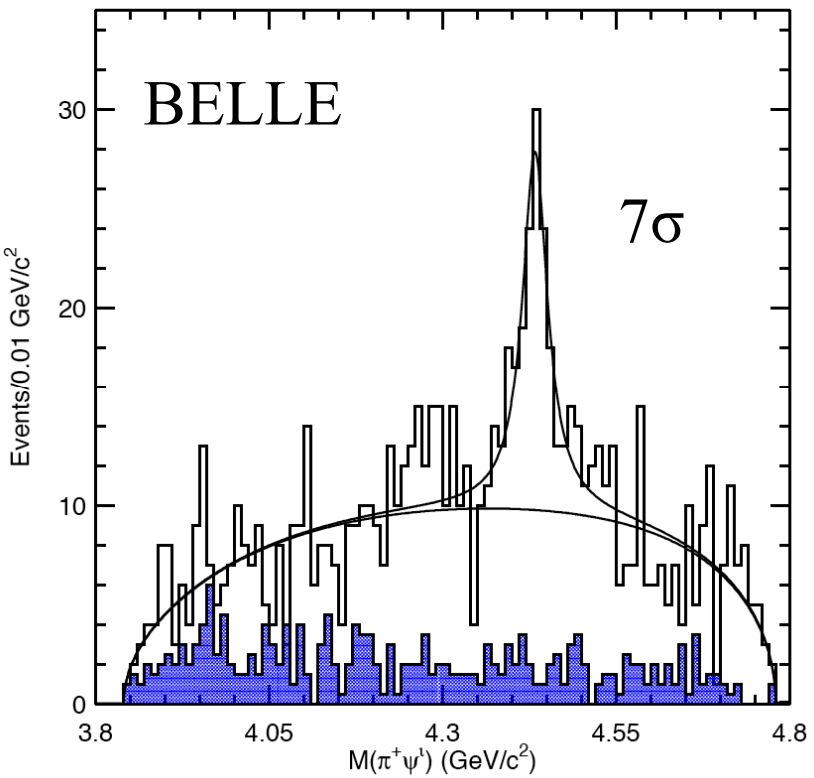
Y(4630)



M(ΛcΛc)


Charmonium
Relative energy (MeV)
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
ψ''
ψ'
2³S₁
DD̄ threshold
η'c
2³S₁
hc
2¹P₁
χ2 2³P2
2³P1
χ1
χ0 2³P0
ψ
1³S₁
ηc
1¹S0
L = 0
L = 1
Singlet
Triplet
Singlet
Triplet
1 fm
bound states
Y(4660)
Y(4630)
Y(4350)
Y(4260)
X(4160)
Y(4140)
X(3940)
Y(3940)
X(3872)
DD* threshold
?
1 fm

Z^+ (4430) - a new state of matter (tetraquark?) decaying into $\pi^+\psi'$



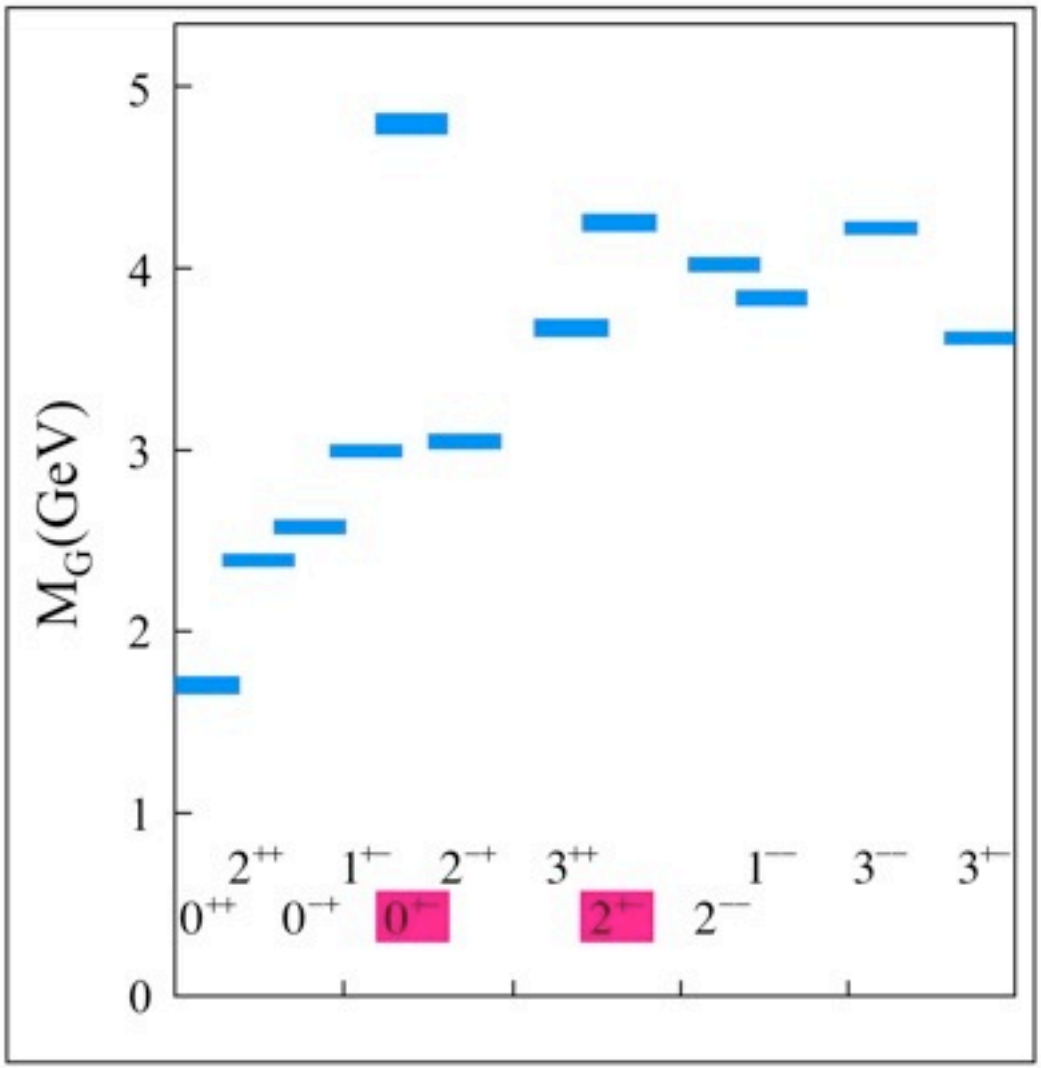
$$M = (4.433 \pm 0.004\ (stat) \pm 0.001\ (syst))\ GeV$$

$$\Gamma = (0.044^{+0.017}_{-0.011}\ (stat)^{+0.030}_{-0.011}\ (syst))\ GeV$$

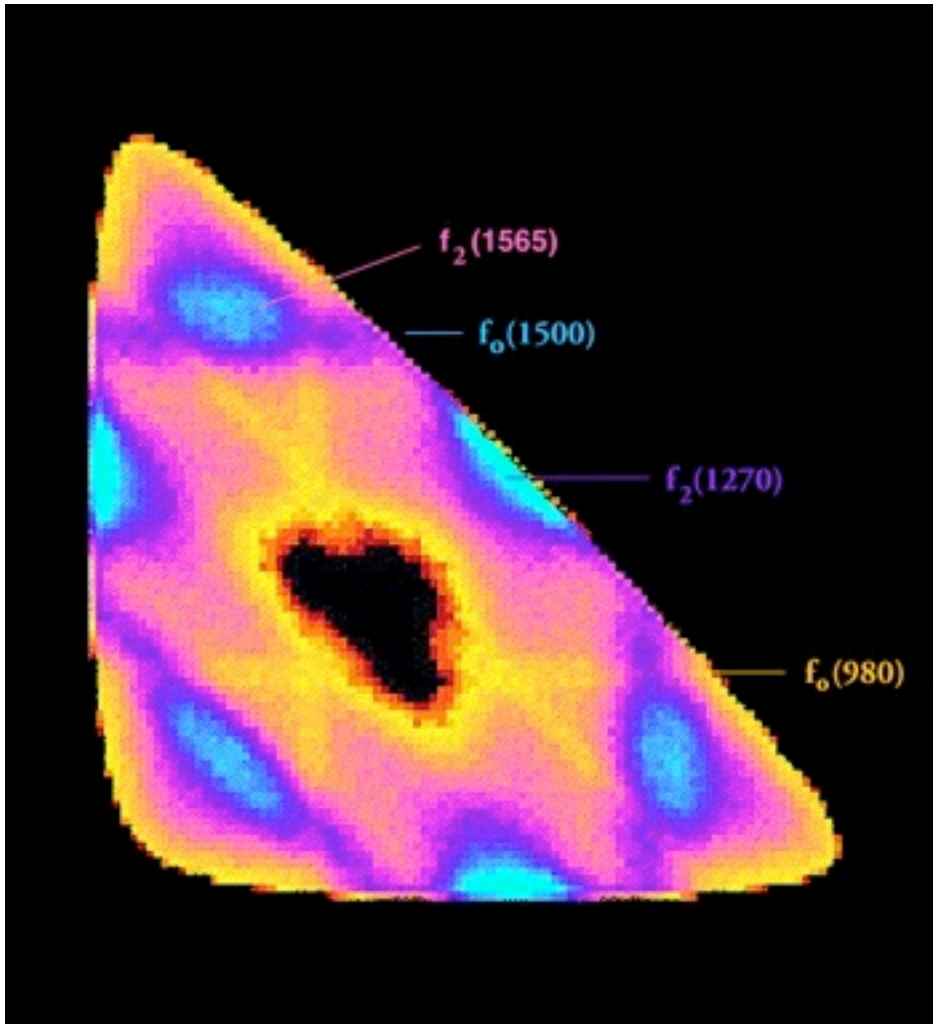
$$\mathcal{B}(B \to KZ(4430) \times \mathcal{B}(Z \to \pi^+\psi') = (4.1 \pm 1.0\ (stat) \pm 1.3\ (syst)) \times 10^{-5}$$

PRL 100, 142001 (2008)
arXiv:0708.1790 [hep-ex]

The glueball spectrum

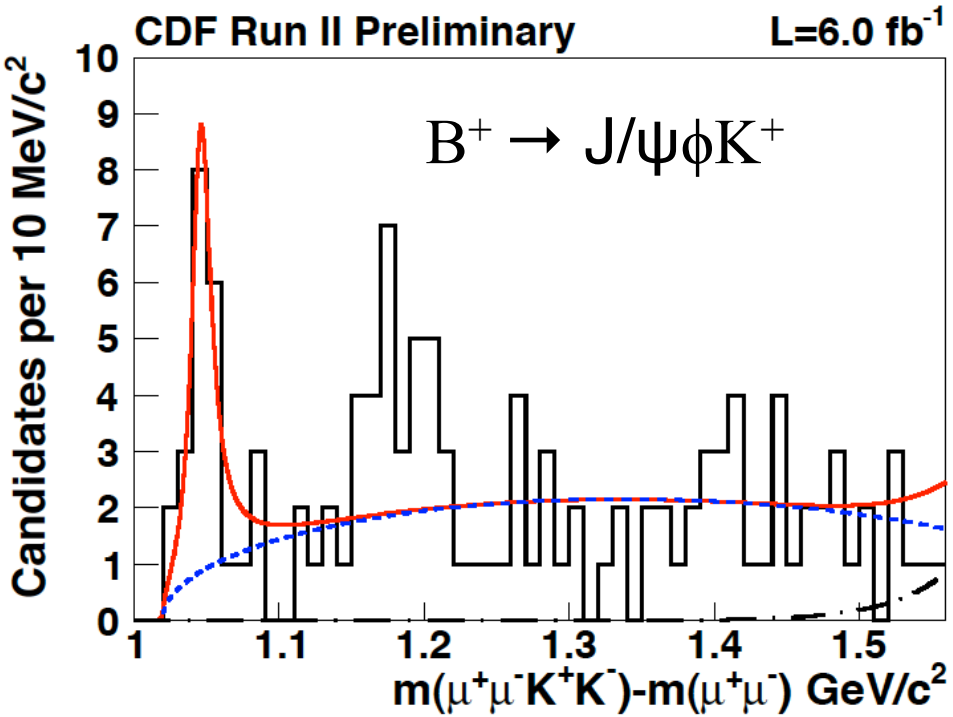


Crystal Barrel $\bar{p}p \rightarrow \pi^0\pi^0\pi^0$ Dalitz plot



700000 events = 6×700000 entries

The Y(4140)



$$M = 4143.4^{+2.9}_{-3.0}(\text{stat.}) + 0.6\ \text{MeV/c}^2$$

$$\Gamma = 15.3^{+10.4}_{-6.1}(\text{stat.}) \pm 2.5\ \text{MeV/c}^2$$

CDF collaboration, T. Aaltonen et al.;. Phys. Rev. Lett., 102:242002 (2009).
CDF/DOC/BOTTOM/PUBLIC/10244;
http://www-cdf.fnal.gov/physics/new/bottom/100701.blessed-jpsiphi6.0/cdf10244_y4140_public.pdf
Belle collaboration, Cp. Shen eta al., Phys.Rev.Lett.104:112004,2010.

PANDA Theory Advisory Group

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Ted Barnes (Knoxville)
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Stan Brodsky (Stanford)
Christine Davies (Glasgow)
Paul Hoyer (Helsinki)
Horst Lenske (Giessen)
Matthias Lutz (GSI)
Thomas Mannel (Siegen)
Krzysztof Meissner (Warsaw)
Ulf Meissner (Bonn / Juelich)
Ulrich Mosel (Giessen)
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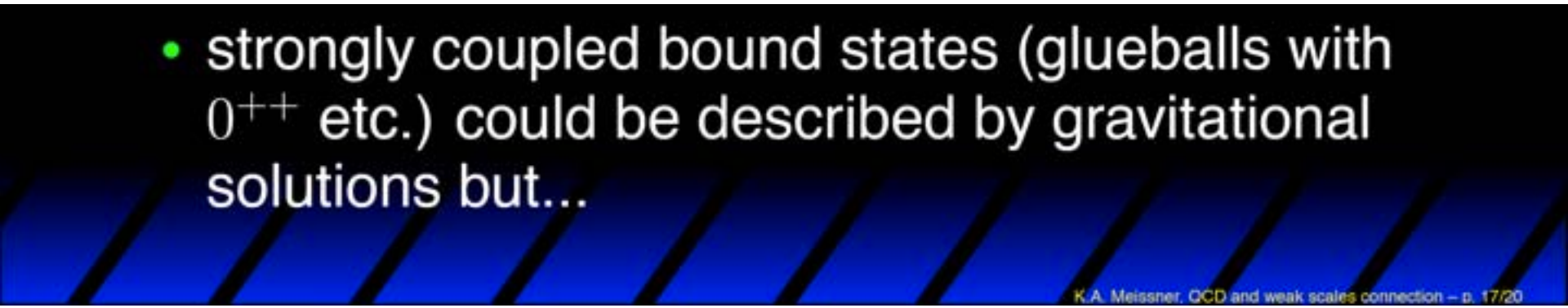
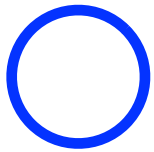
Olaf Scholten (KVI)
Eric Swanson (Pittsburgh)
Rob Timmermans (KVI)
Marc Vanderhaghen(Mainz)
Wolfram Weise (Muenchen)

K.A. Meissner:

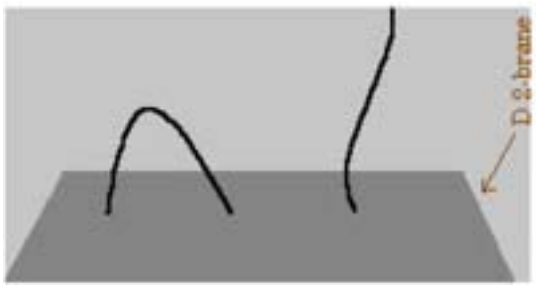

• strongly coupled bound states (glueballs with 0^{++} etc.) could be described by gravitational solutions but...
K.A. Meissner, QCD and weak scales connection – p. 17/20

Open Strings

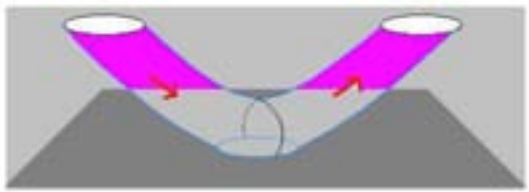
Closed Strings



String World

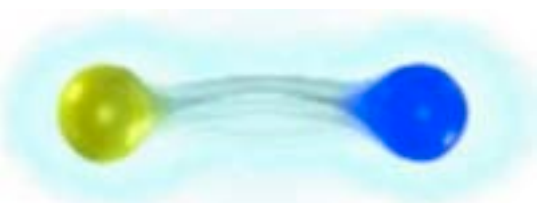


representing gauge theories

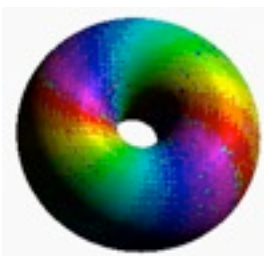


representing gravitation

Hadron World



meson



glueball

Summary

PANDA physics

LHC physics

sub-Planck physics

SPEAKERS include

David Asner (Carleton) t.b.c.
Diego Bettoni (Ferrara)
Ikaros Bigi (Notre Dame)
Simon Eidelman (Novosibirsk)
Christoph Hanhart (Jülich)
Gudrun Hiller (Dortmund)
Peter Kroll (Wuppertal)
Heiko Lacker (Berlin)
Alexander Lenz (Regensburg)
Jörg Marks (Heidelberg)
Brian Meadows (Cincinnati) t.b.c.
Nicola Neri (Pisa)
Alexei Petrov (Wayne State)
Lars Schmitt (GSI)
Tobias Stockmanns (Jülich)
Alexander Titov (Dubna)

SCIENTIFIC COMMITTEE

Achim Denig, co-chair (Mainz)
Thomas Mannel, co-chair (Siegen)
Miriam Fritsch (Mainz)
Wolfgang Gradl (Mainz)
Alexander Khodjamirian (Siegen)
Hartmut Wittig (Mainz)

LOCAL ORGANIZING COMMITTEE

Open Charm at PANDA

Mainz

Nov. 19.,20.2009

Wie können wir so schnell wie möglich zu dieser schönen Physik kommen?

FAIR hat einen vorgegebenen Zeitplan

➥ wir können nur versuchen sicherzustellen, dass PANDA am Tag 1 bereit ist

Dazu brauchen wir:

motivierte und qualifizierte Leute ✔

Platz zum Detektoraufbau

zeitlich passende Finanzierung

PANDA Collaboration

- At present a group of **460 physicists** from 54 institutions and 16 countries

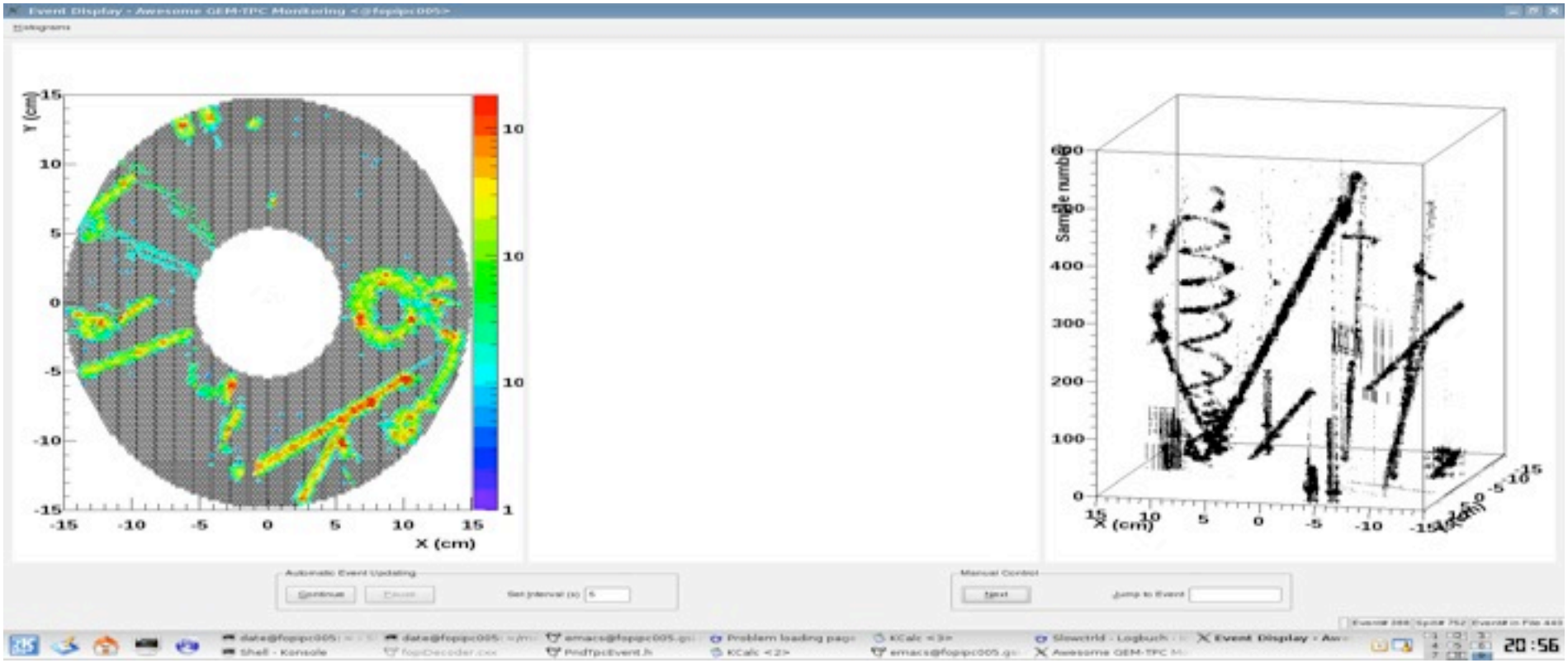
Austria – Belaruz – China – France – Germany – India – Italy – The Netherlands – Poland – Romania – Russia – Spain – Sweden – Switzerland – U.K. – U.S.A.

Basel, Beijing, Bochum, IIT Bombay, Bonn, Brescia, IFIN Bucharest, Catania, IIT Chicago, AGH-UST Cracow, JGU Cracow, IFJ PAN Cracow, Cracow UT, Edinburgh, Erlangen, Ferrara, Frankfurt, Genova, Giessen, Glasgow, GSI, FZ Jülich, JINR Dubna, Katowice, KVI Groningen, Lanzhou, LNF, Lund, Mainz, Minsk, ITEP Moscow, MPEI Moscow,TU München, Münster, Northwestern, BINP Novosibirsk, IPN Orsay, Pavia, IHEP Protvino, PNPI St.Petersburg, KTH Stockholm, Stockholm, Dep. A. Avogadro Torino, Dep. Fis. Sperimentale Torino, Torino Politecnico, Trieste, TSL Uppsala, Tübingen, Uppsala, Valencia, SINS Warsaw, TU Warsaw, AAS Wien

Spokesperson: Ulrich Wiedner (Bochum)

http://www.gsi.de/panda

Tracks Kr Beam



Platz für Detektoraufbau

Diskussionen mit GSI und FZ Jülich

Detektorkomponentenaufbau und Strahltests

Teststrassen für Detektorkomponenten

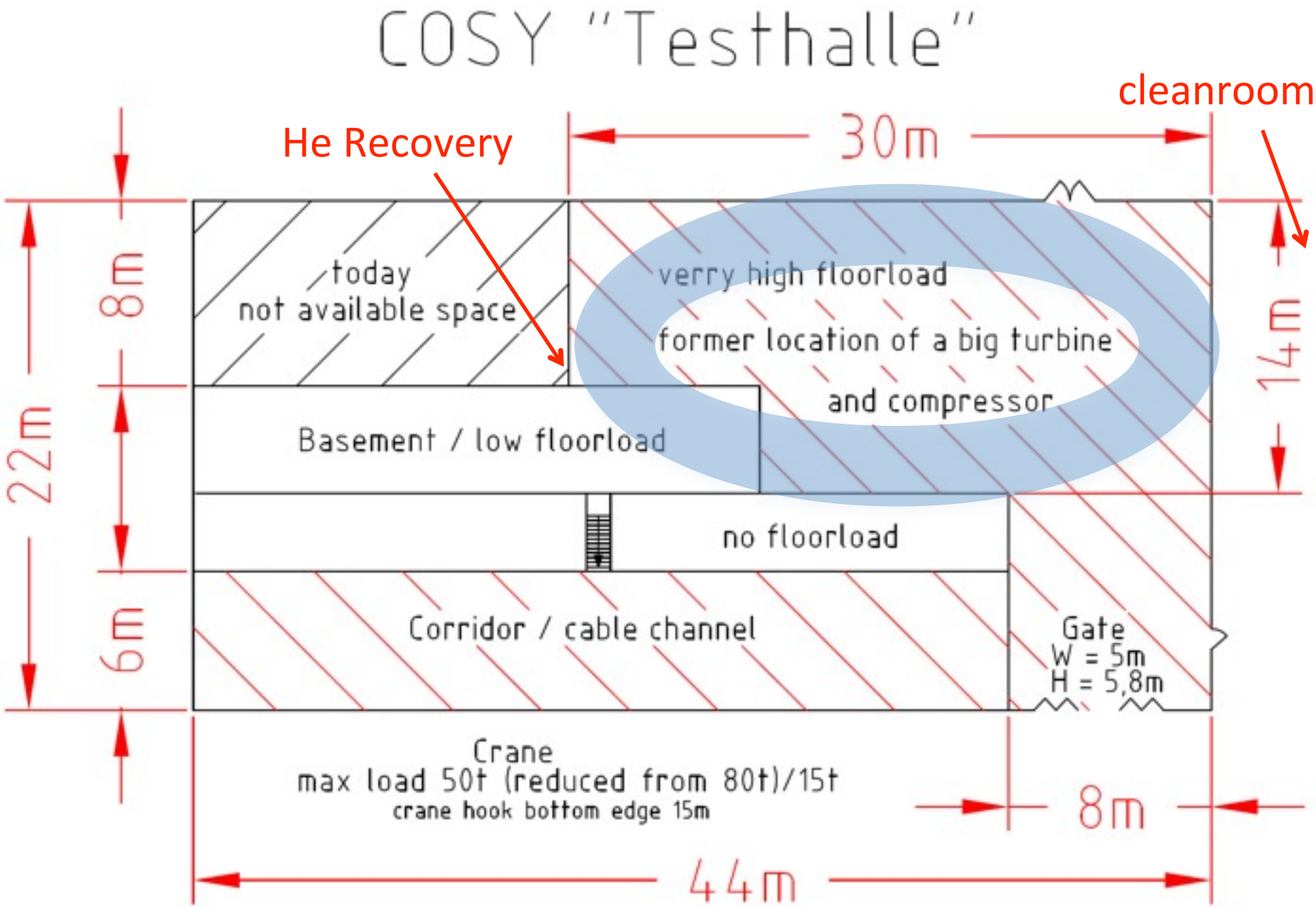
} GSI

Gesamtaufbau von PANDA in Jülich vor 2017

Strahltests, Subkomponentenaufbau ...

} Jülich

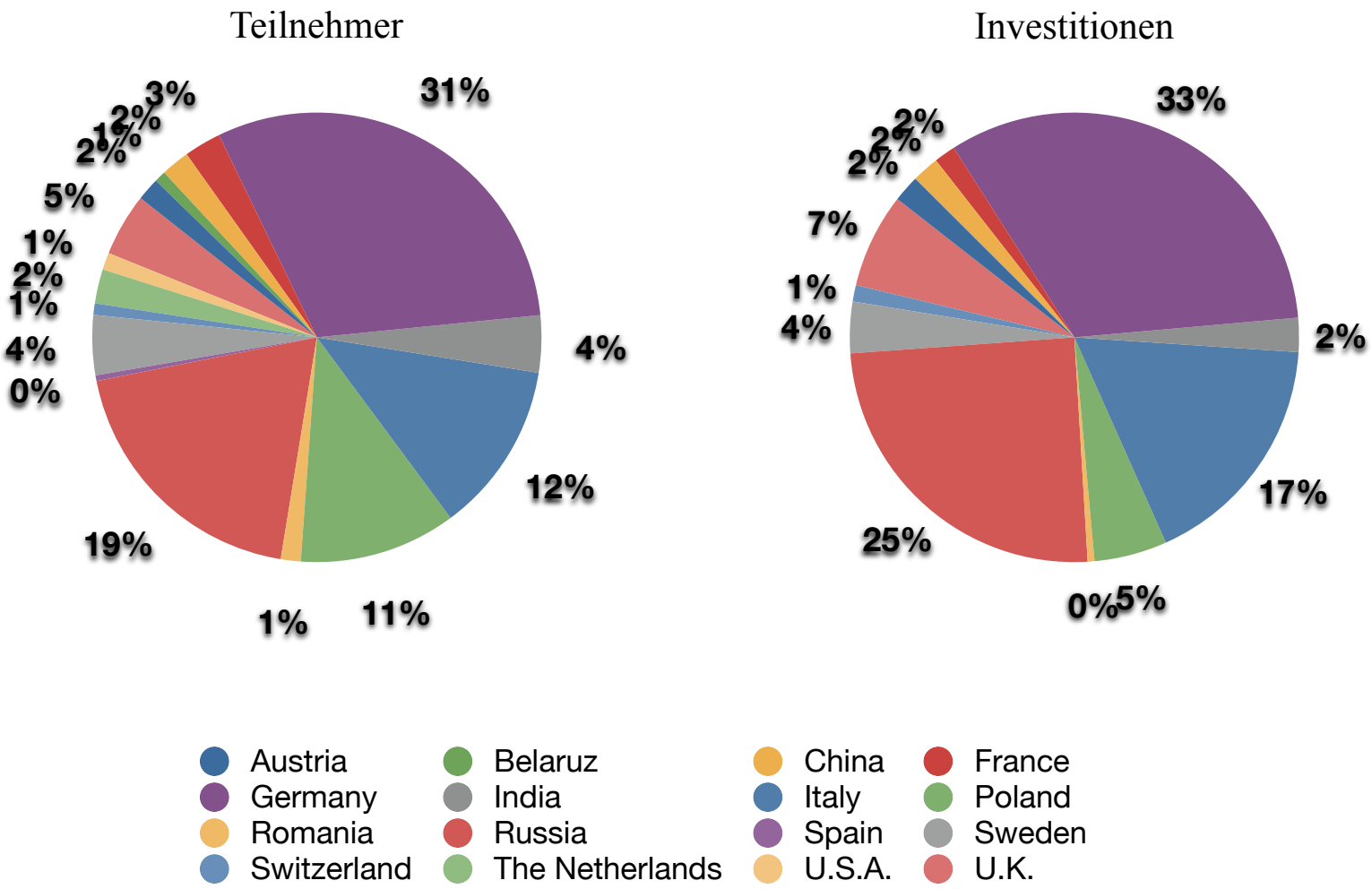
Zusätzliche Infrastrukturkosten werden von Jülich getragen.


COSY "Testhalle"
cleanroom
He Recovery
30m
8m
22m
14m
today
not available space
verry high floorload
former location of a big turbine
and compressor
Basement / low floorload
no floorload
Corridor / cable channel
6m
Gate
W = 5m
H = 5,8m
Crane
max load 50t (reduced from 80t)/15t
crane hook bottom edge 15m
8m
44m

Aggressiver Zeitplan

Setting up PANDA

1.1. Definition of timelines, milestones, critical pathways
1.1.1. R&D → TDRs: sub-systems → complete system → interfaces with FAIR civil construction / accelerators 2011
1.1.2. Technical Reviews 2011/12
1.1.3. Funding 2011/12
1.1.4. Detailed engineering designs 2012
1.1.5. Tender 2012
1.1.6. Construction 2013-2015
1.1.7. Installation 2016
1.1.8. Commissioning 2017
1.1.9. Initial Running 2018-2020



Missing funds due to limited funding of experiments within FAIR.

Danke für Ihre Aufmerksamkeit