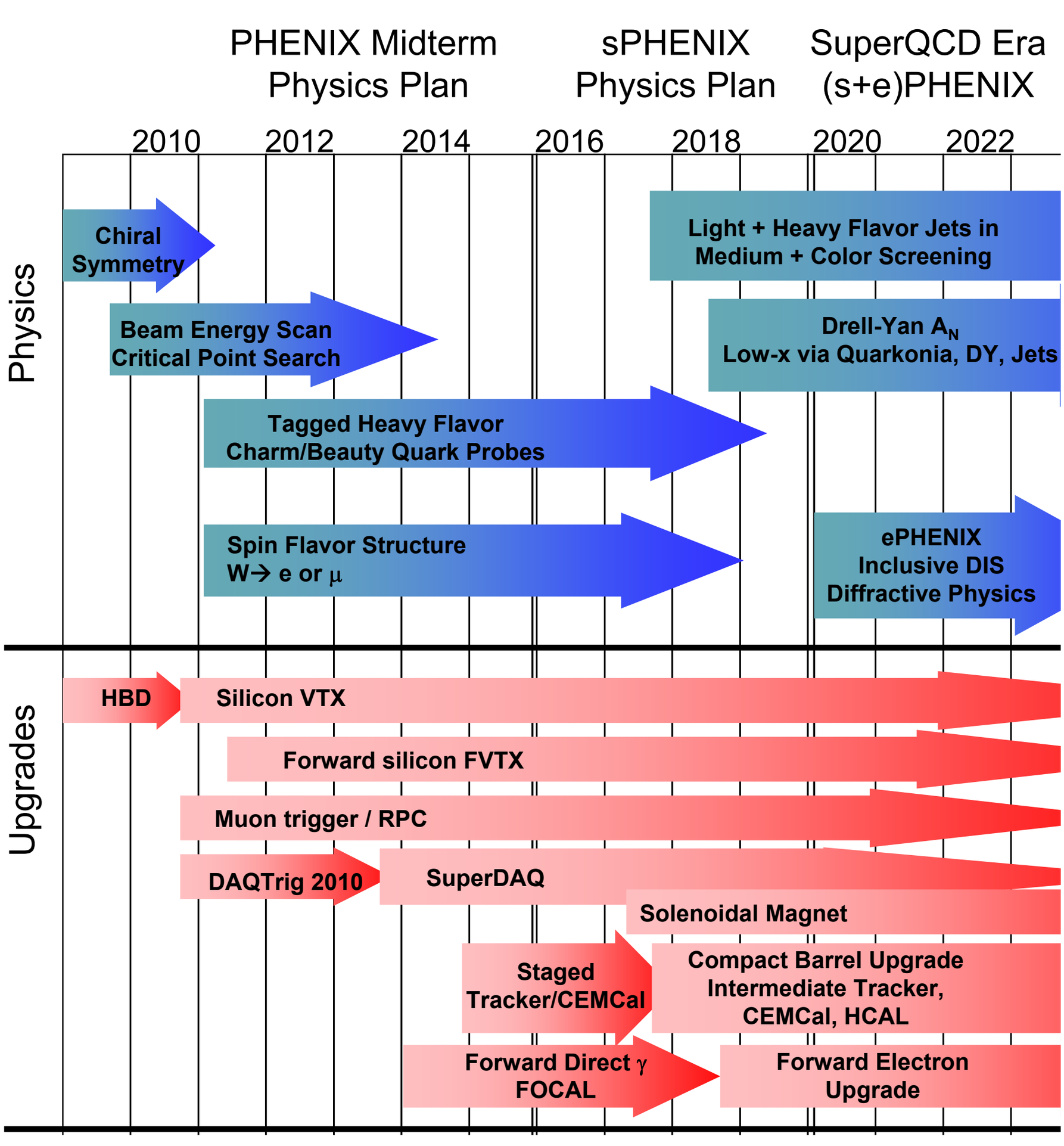
PHENIX plans for the next decade

Dave Morrison


PHENIX Midterm Physics Plan
sPHENIX Physics Plan
SuperQCD Era (s+e)PHENIX
2010
2012
2014
2016
2018
2020
2022
Physics
Chiral Symmetry
Beam Energy Scan Critical Point Search
Light + Heavy Flavor Jets in Medium + Color Screening
Drell-Yan A_N Low-x via Quarkonia, DY, Jets
Tagged Heavy Flavor Charm/Beauty Quark Probes
Spin Flavor Structure W→ e or μ
ePHENIX Inclusive DIS Diffractive Physics
Upgrades
HBD
Silicon VTX
Forward silicon FVTX
Muon trigger / RPC
DAQTrig 2010
SuperDAQ
Solenoidal Magnet
Staged Tracker/CEMCal
Compact Barrel Upgrade Intermediate Tracker, CEMCal, HCAL
Forward Direct γ FOCAL
Forward Electron Upgrade

RPC3

South Muon Magnet

Central Magnet

North Muon Magnet

RPC3

MPC

BBC

ZDC South

ZDC North

10.9 m = 36 ft

MuID

(F)VTX

MuID

MuTr

South

Side View

North

18.5 m = 60 ft

ral Magnet

North Muon Magnet

RPC3

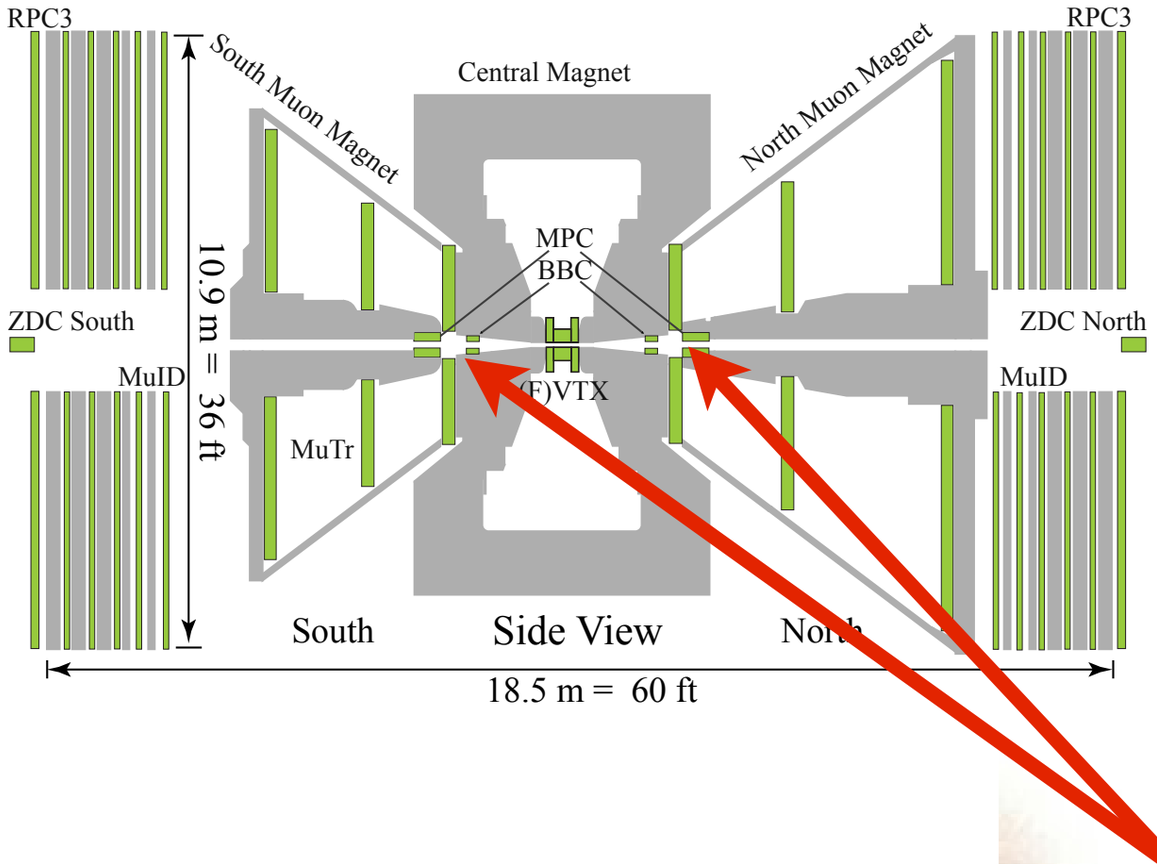
MPC

BBC

(F)VTX

ZDC North

MuID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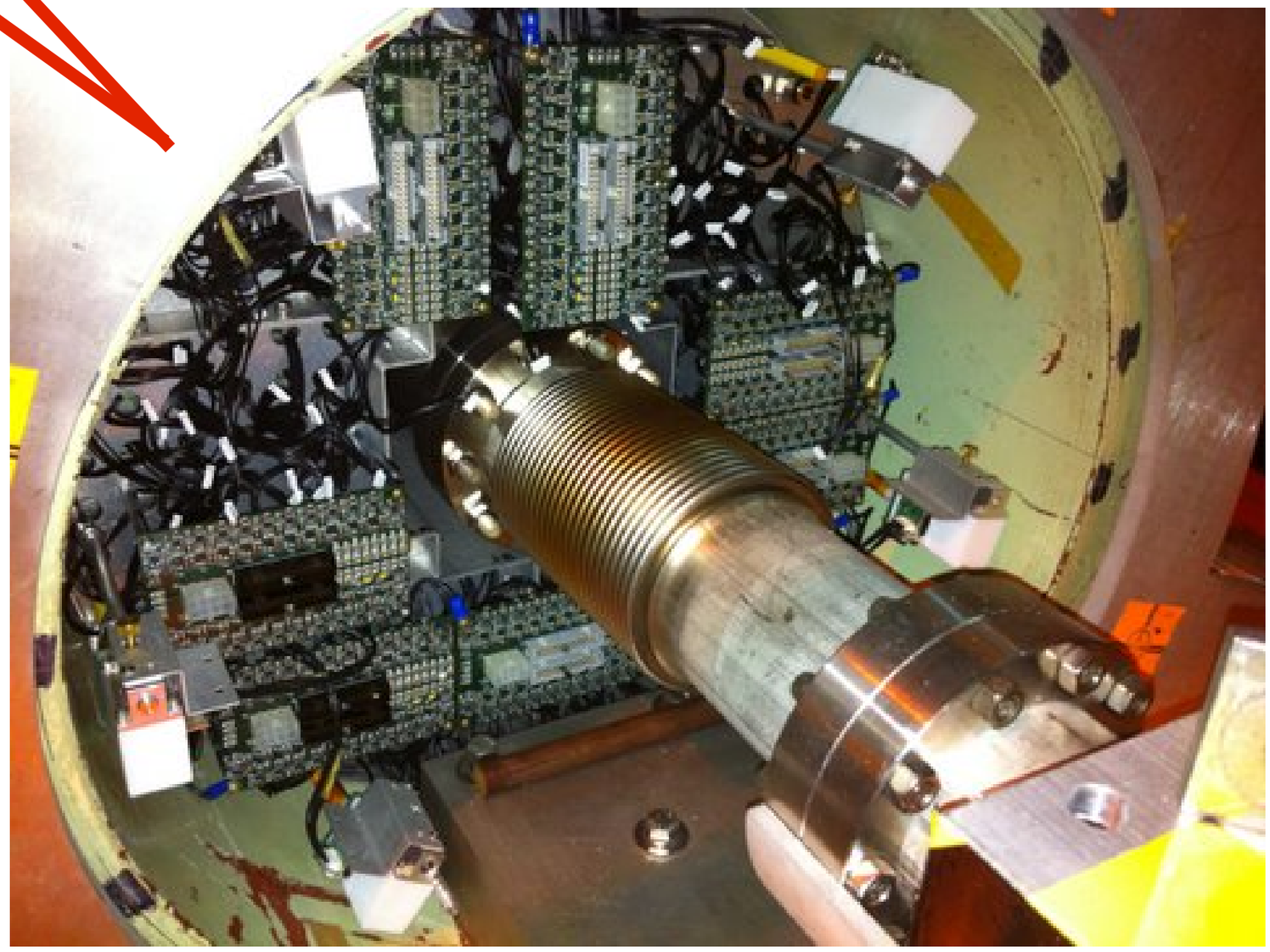
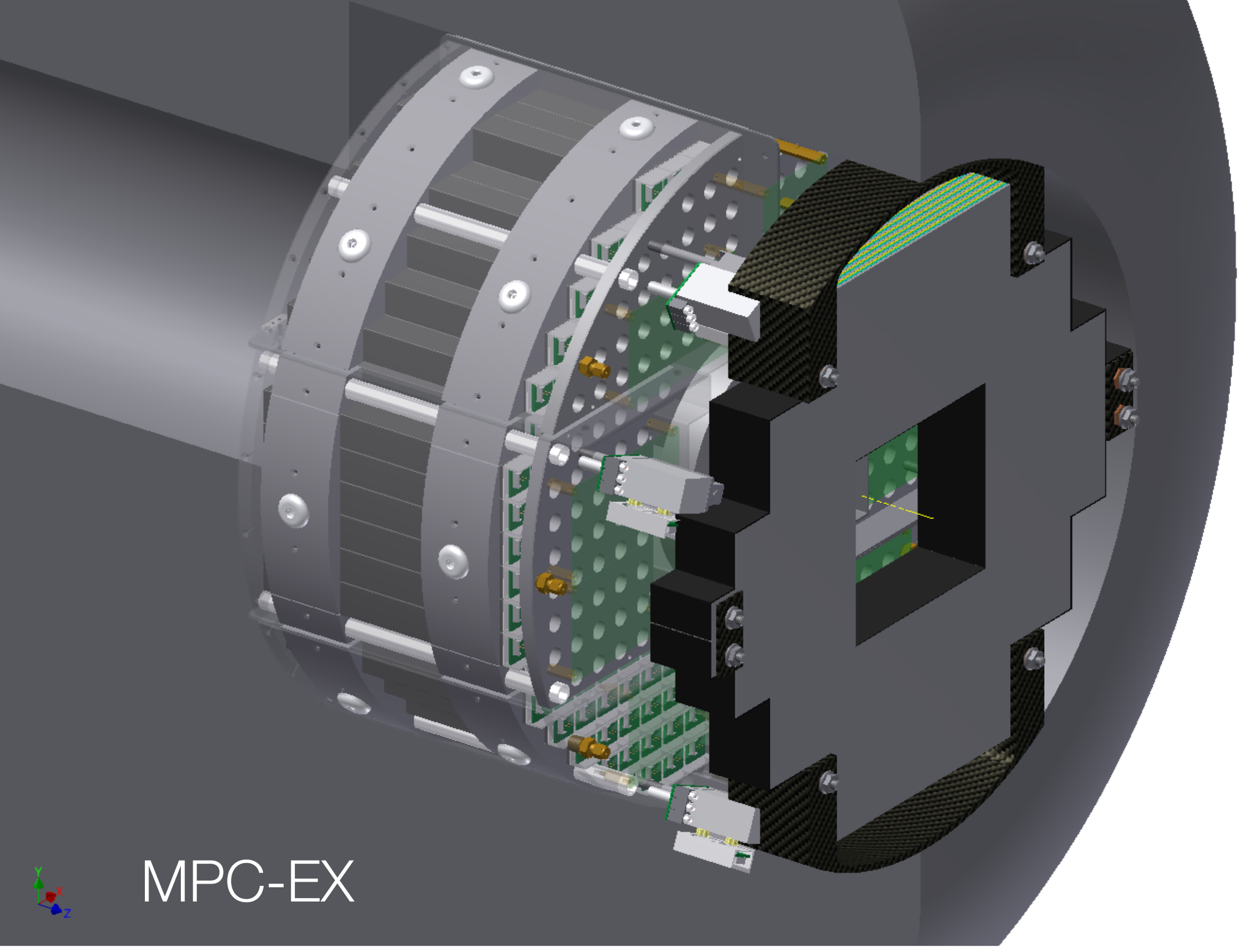
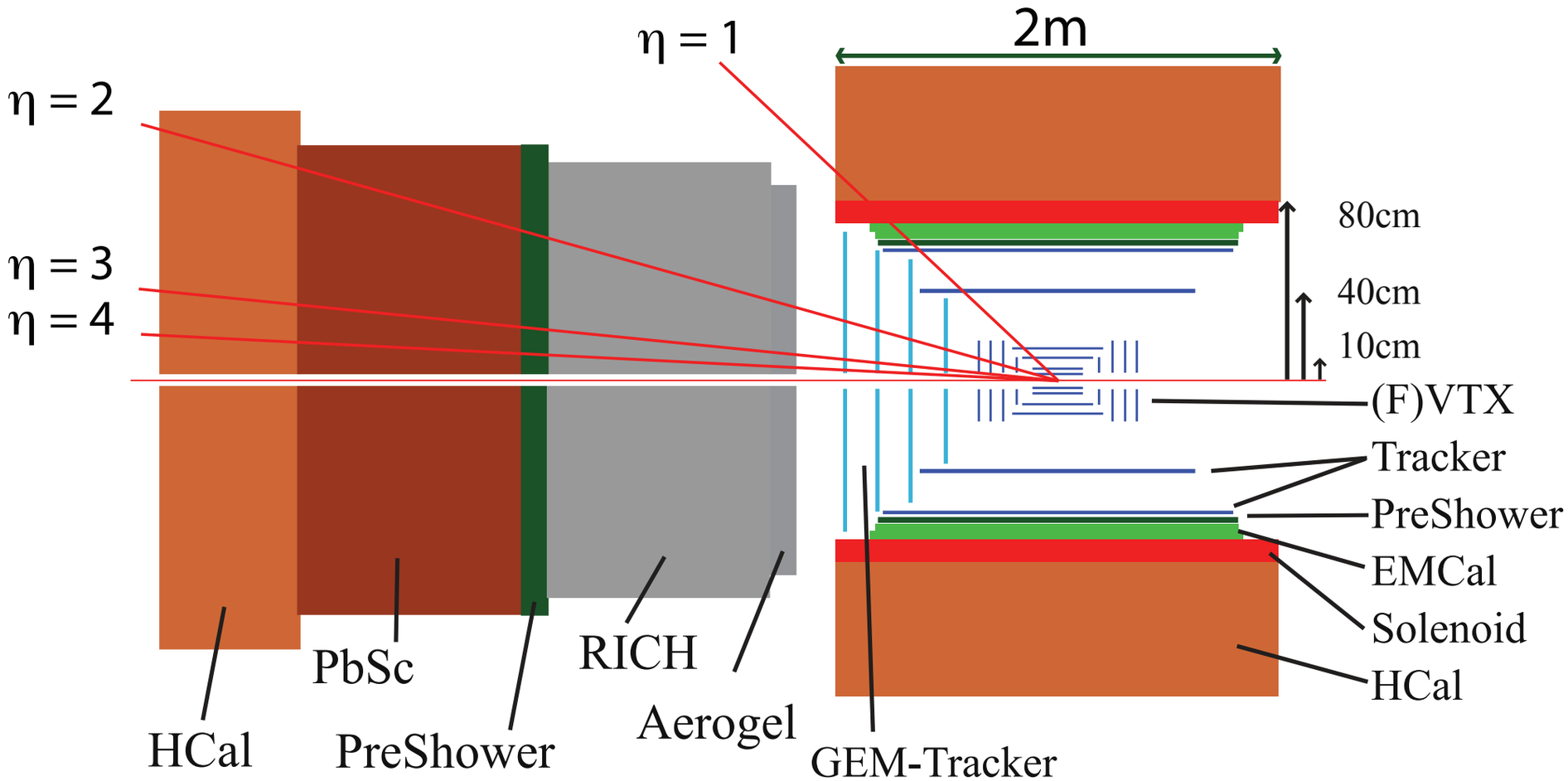


MPC



external review scheduled for May 11

Decadal plan sPHENIX concept (ca. 2010)

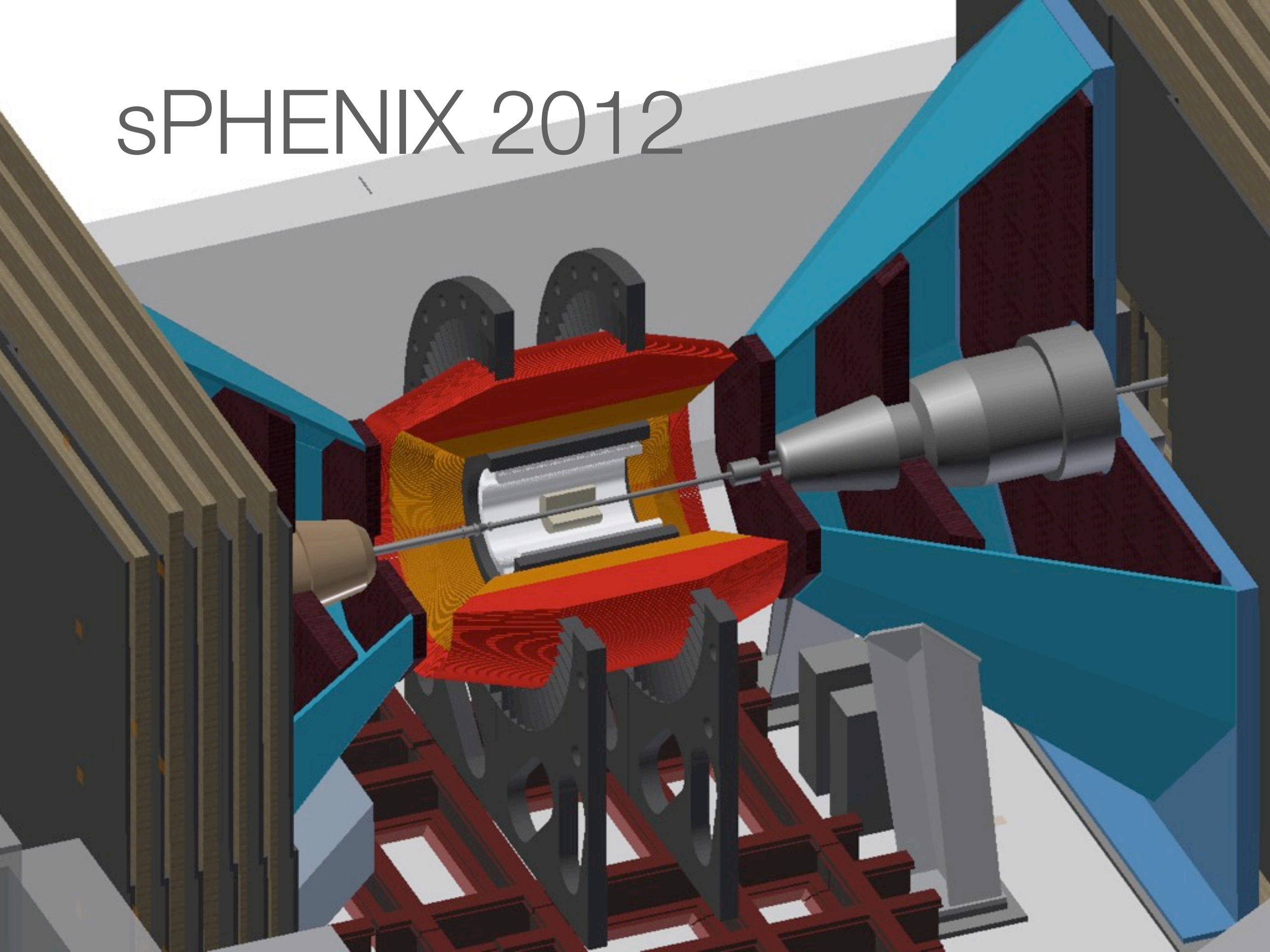


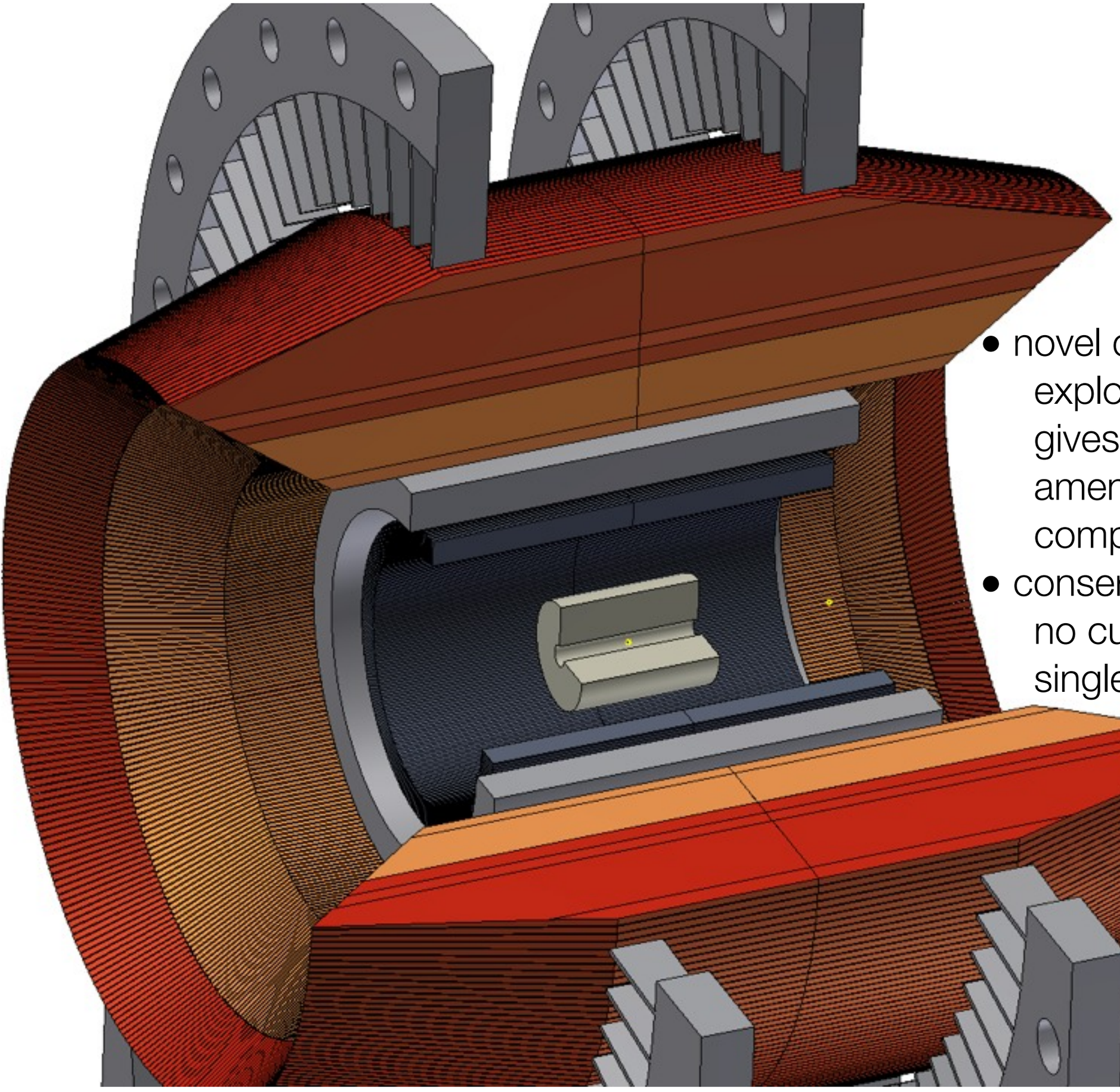
Factorization and evolution

sPHENIX = DOE MIE (strong focus on jets)
+ additional tracking
+ preshower
+ forward instrumentation
+ ...

$$H\,|\mathrm{sPHENIX}\rangle \;=\; |\mathrm{ePHENIX}\rangle$$

sPHENIX 2012



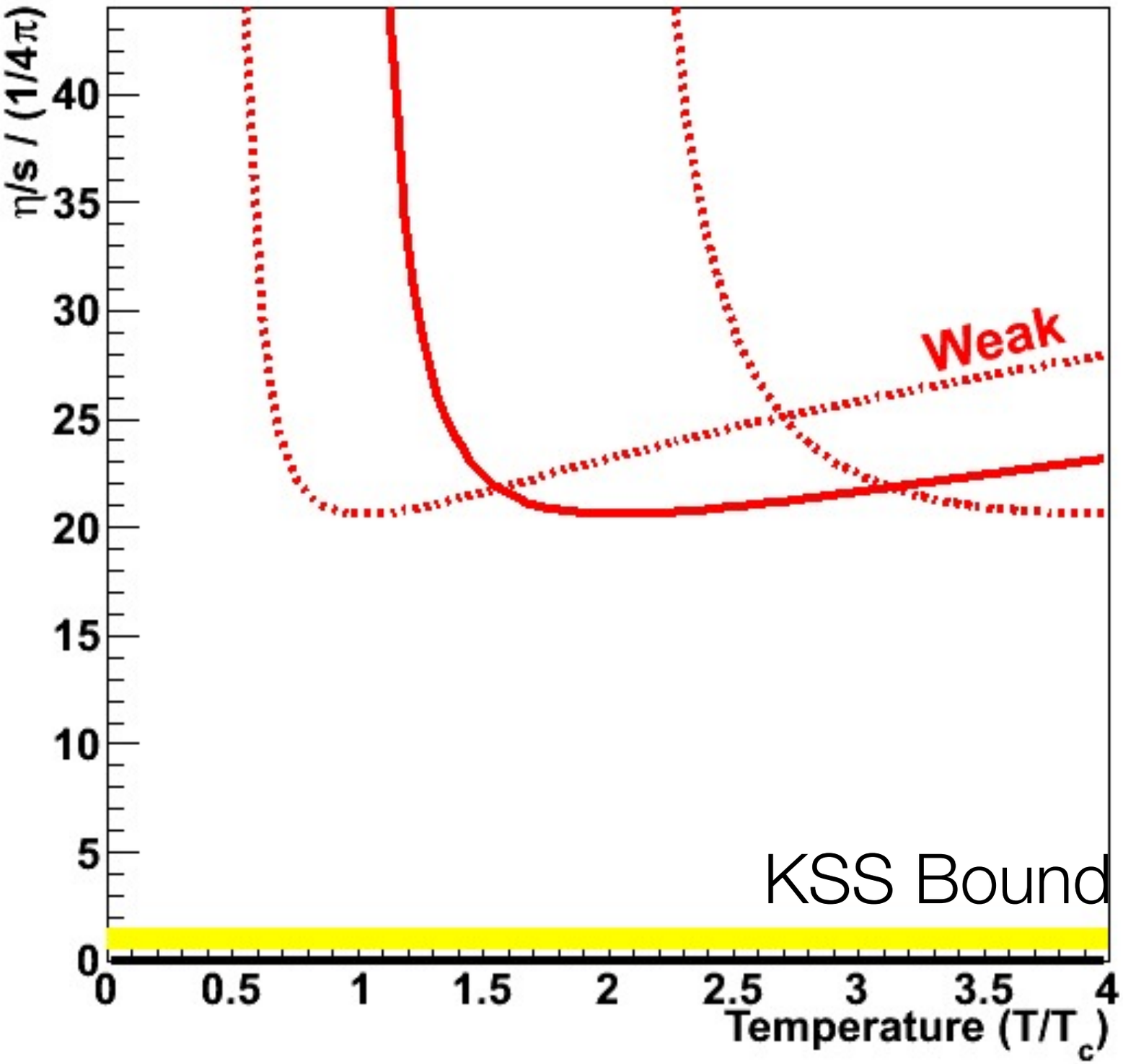


- novel detector concept
  exploits recent advances
  gives needed performance
  amenable to industrialization
  compact means less material
- conservative electronics
  no custom ASICs
  single sensor and readout

Quark-Gluon Plasma weak coupled pQCD calculation

Arnold, Moore, Yaffe

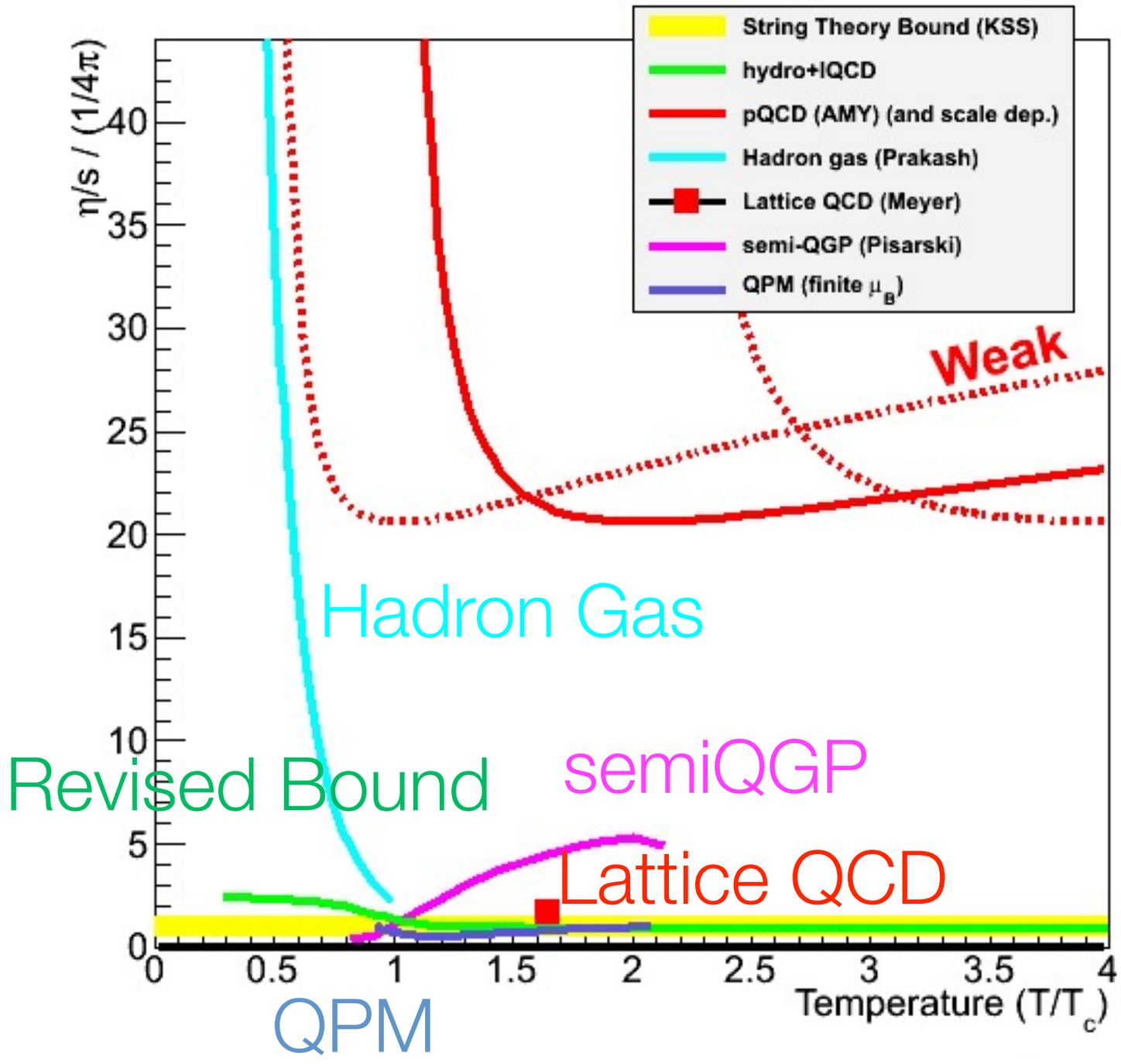
[http://arxiv.org/abs/hep-ph/0302165]



Calculation is 20 x the KSS Bound (1/4π)

Dashed curves show the scale dependence is very large.

Essentially not a reliable result for $T < 4 \times T_c$?



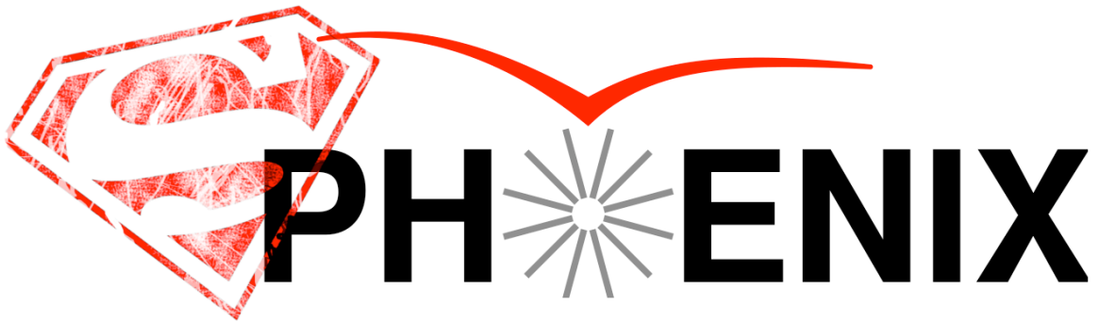
Hydro + lQCD calculation from Kovtun, Moore, and Romatschke http://arxiv.org/abs/arXiv:1104.1586

Hadron gas calculation from Prakash (almost 20 years ago) 1/T^4). http://www.sciencedirect.com/science/article/pii/037015739390092R

Lattice QCD result from Harvey Meyer (gluodynamics) http://arxiv.org/abs/0704.1801

QPM, finite mu_B calculation from Shrivistava and Singh http://arxiv.org/abs/1201.0445

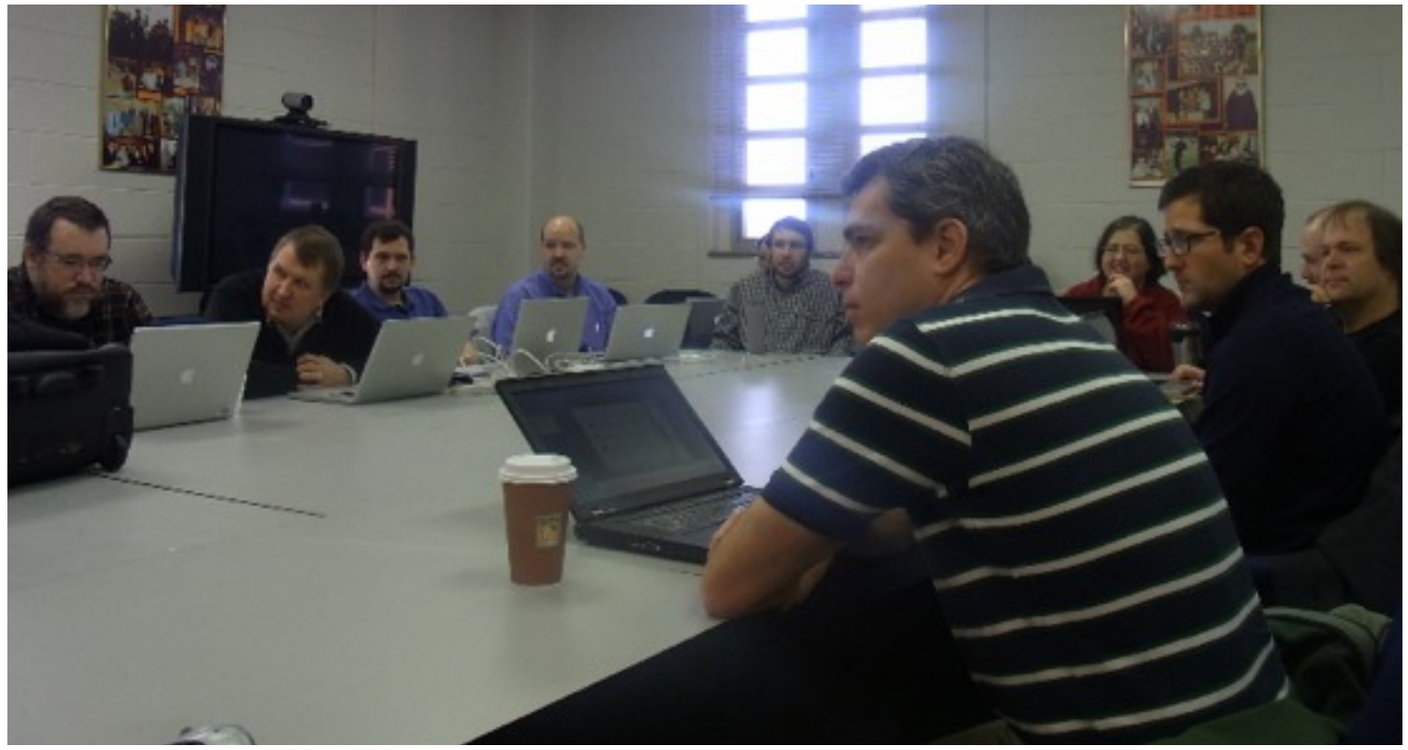
Semi-QGP calculation from Rob Pisarski with kappa = 8 http://arxiv.org/abs/arXiv:0912.0940



Use jets to explore transition from strong to weak coupling in QGP

Workfests and Task Forces

- Boulder, March 7–13, 2010
- Columbia, April 12–16, 2010
- BNL, September 12-16, 2011
- Boulder, December 12–16, 2011
- Knoxville, January 25–29, 2012
- Columbia, February 20–24, 2012
- Boulder, April 2–6, 2012



But wait! There's more ...

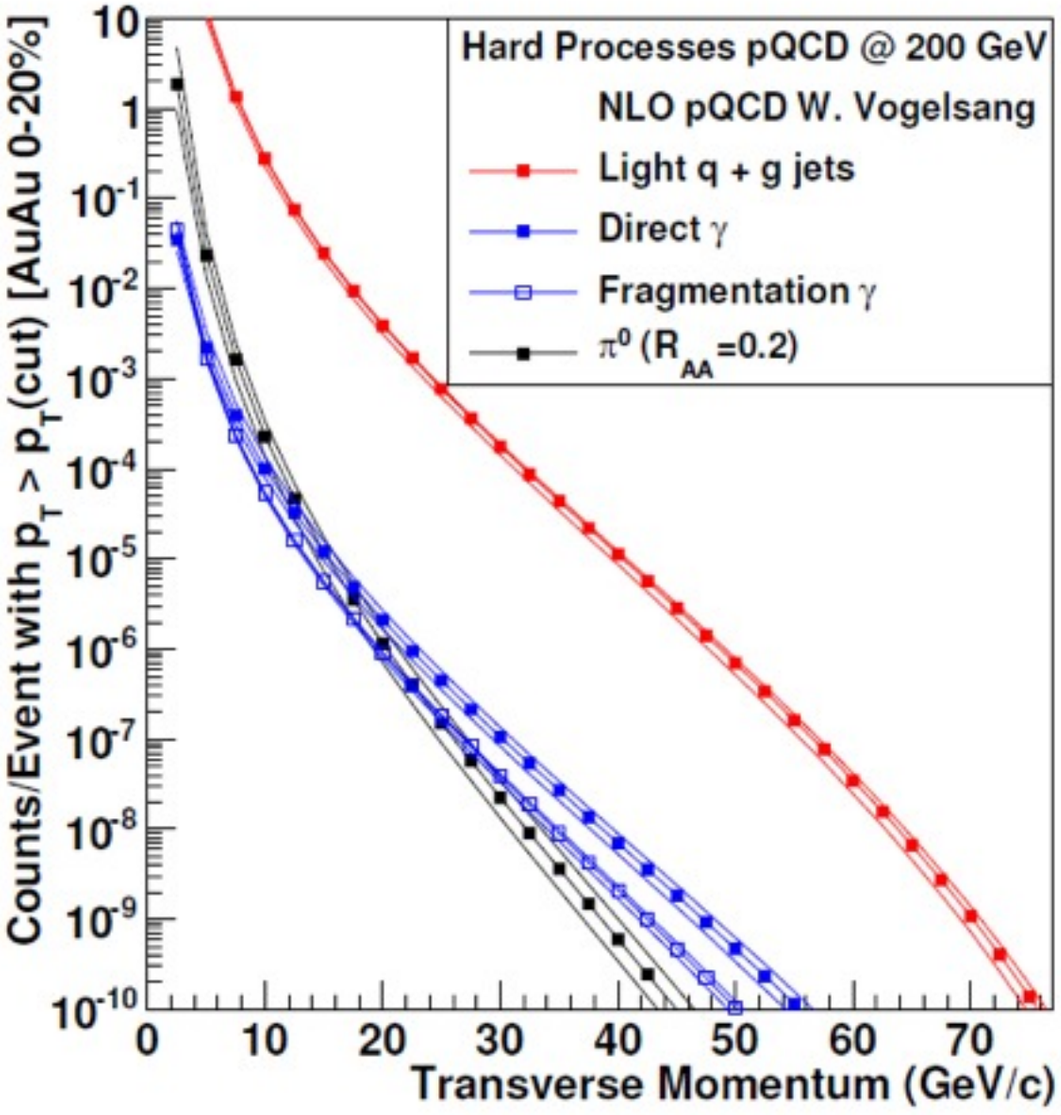
ePHENIX task force
+
forward sPHENIX task force

Jets @ RHIC Workshop

March 3-4, 2012 at Duke University
lots of interest from theoretical community
http://jet.lbl.gov/

EVO meeting just this morning (April 30) to follow-up on calculations spurred by Duke meeting.

RHIC Jet Rates



rates based on full stochastic cooling, but no additional accelerator upgrades

	Au+Au (central 20%)	p+p	d+Au
>20GeV	10^7 jets 10^4 photons	10^6 jets 10^3 photons	10^7 jets 10^4 photons
>30GeV	10^6 jets 10^3 photons	10^5 jets 10^2 photons	10^6 jets 10^3 photons
>40GeV	10^5 jets	10^4 jets	10^5 jets
>50GeV	10^4 jets	10^3 jets	10^4 jets

Huge rates allow differential measurements with geometry (v_2, v_3, A+B, U+U, …)

precise control measurements (d+Au and p+p)

Over 60% as dijets!

sPHENIX

- **high rate calorimetric jet measurements at RHIC**
  - jets, dijets, γ-jets, jet v_N, jet-hadron correlations
  - heavy quark jets: requires additional tracking beyond VTX (Japanese RIKEN funding anticipated)
  - variety of systems: control initial state effects and geometry
- **together with LHC constrain physics of energy loss**
- **innovative detector concept**
  - exploits recent technological advances
  - staged approach includes forward spin & p+A program
  - key feature: sPHENIX evolves into EIC ePHENIX

MIE proposal to PHENIX early June, to Steve Vigdor
early July, BNL administered review early August

backup slides

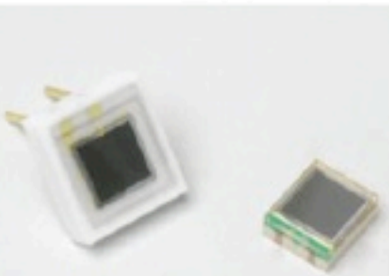
Innovative EMCal design

SiPMs or APDs

HAMAMATSU

MPPC® (multi-pixel photon Counter)

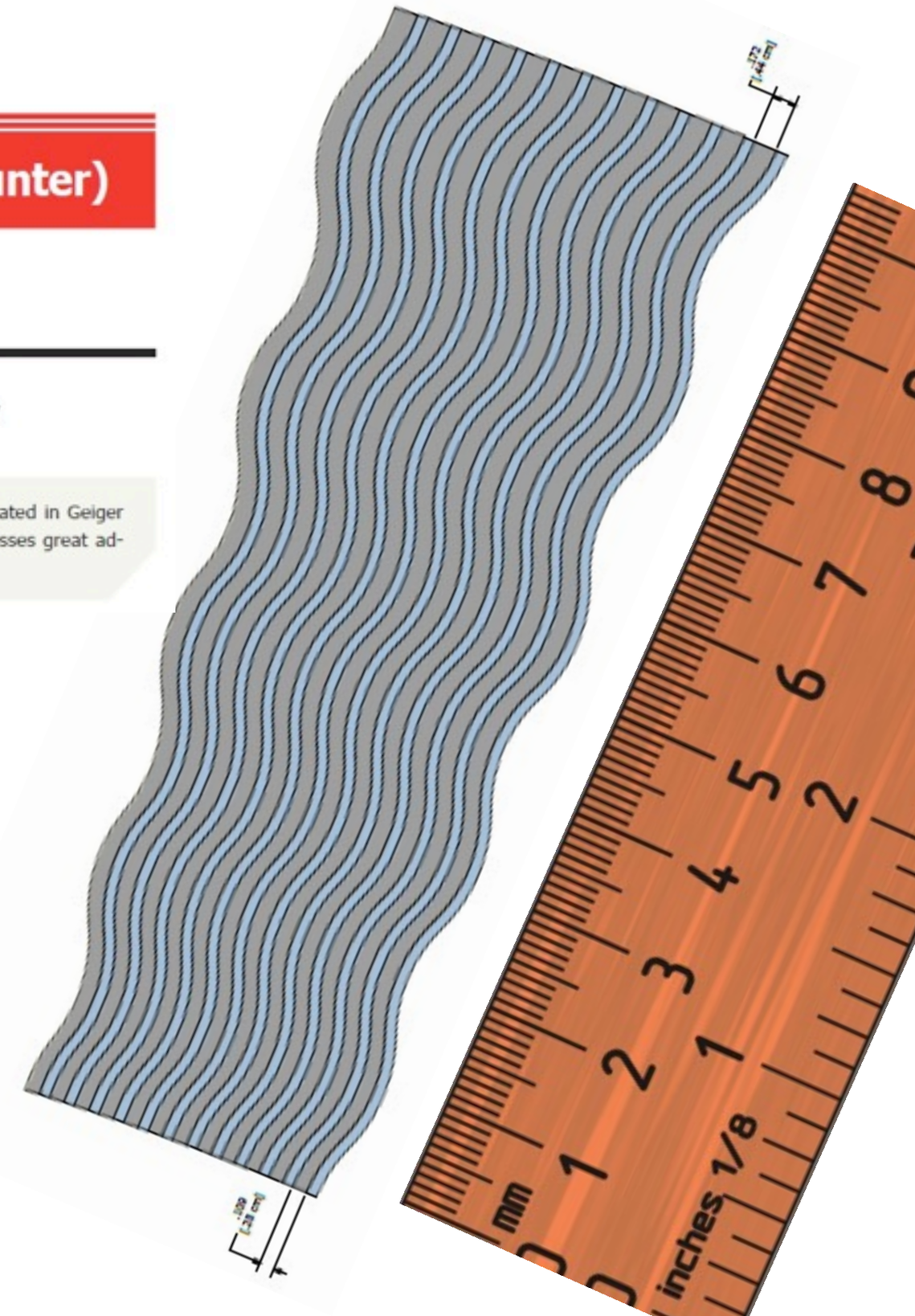
S10362-33 series S10931 series



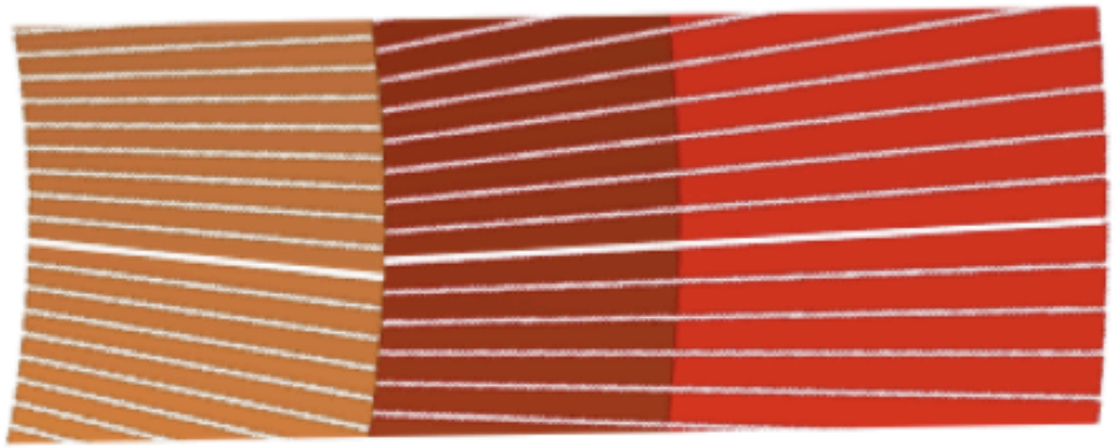
New type of Si photon-counting device,
Active area: 3 × 3 mm

The MPPC is a new type of photon-counting device made up of multiple APD (avalanche photodiode) pixels operated in Geiger mode. The MPPC is an opto-semiconductor device with excellent photon-counting capability and which also possesses great advantages such as low voltage operation and insensitivity to magnetic fields.

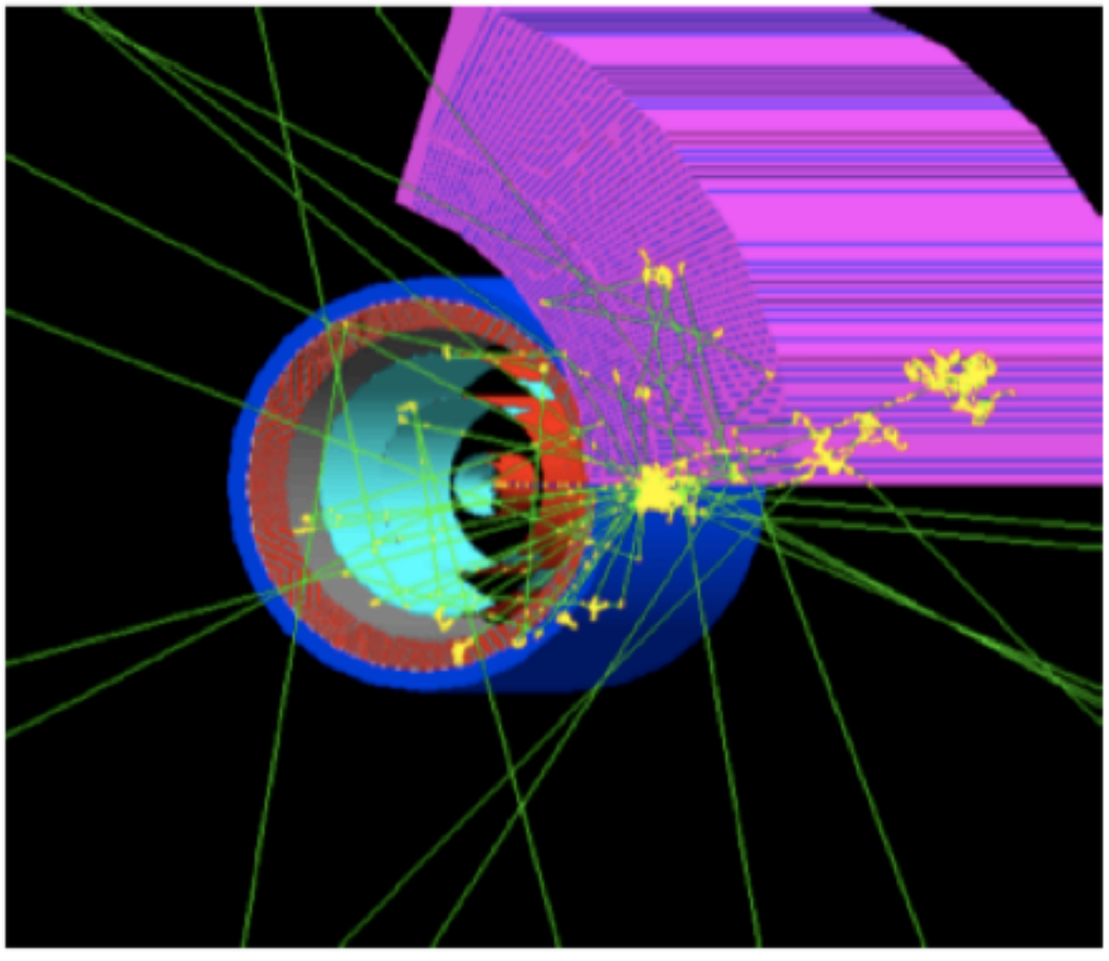
ρ(sintered W) ~ 0.9ρ(pure W)
formed in arbitrary shapes
& SiPMs
↓
compact EMCal

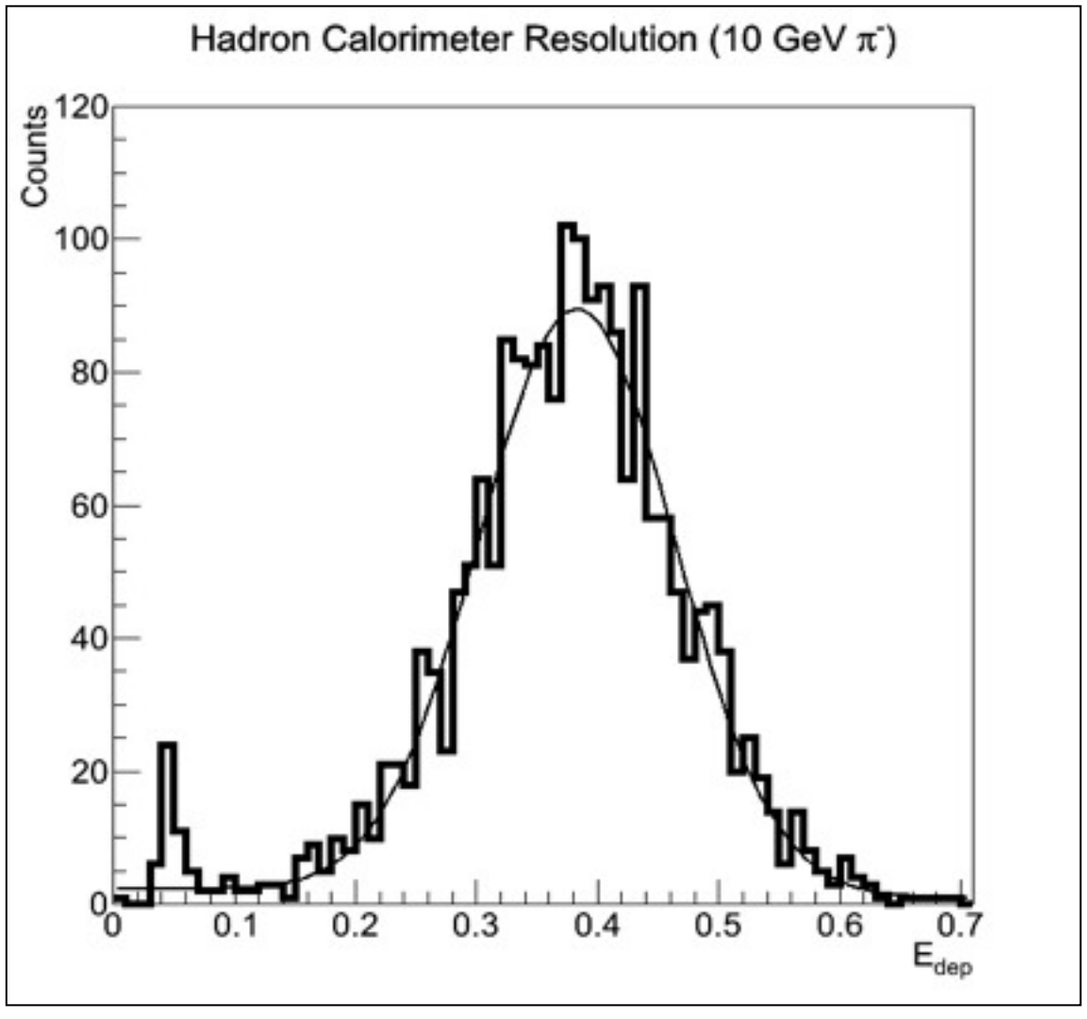


HCal Design & GEANT-4 Response



Steel-Scintillator Design
Flux Return for Magnet
Fiber Coupled to SiPM Readout
Common Electronics with EMCal





Corresponds to 75%/√E