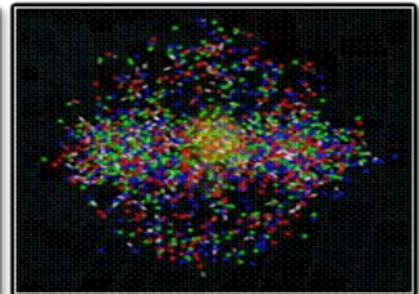
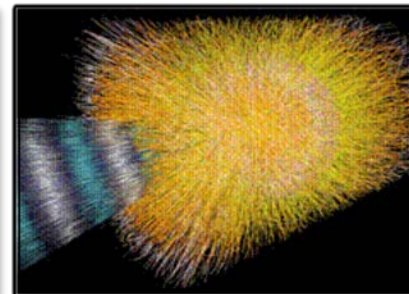
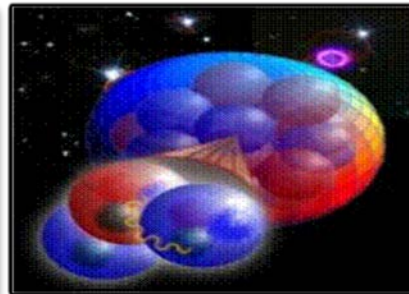
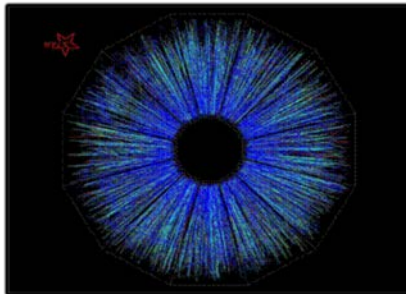




NP Intro. SciDAC-3 Pls Meeting

22 - 24 July 2015

- I. Some DOE-NP HPC News
- II. Major DOE-NP Experimental Facilities (2 of 3)
- III. NP SciDAC-3 Projects (facilities relevant!)



I. DOE-NP HPC News

NSAC Long Range Plan (2014 - 2015)

(exercise announced by NSAC 4/24/2014; should be complete by ~ Oct. 2015)

NP HPC community “Town Meeting” 7/14-15/2014

-> Propose a recommendation for the LRP regarding HPC in NP, including

- New investments in SciDAC and related, to support the **expt.** NP program
- Computational NP workforce development
- Deployment of capacity computing to augment Leadership Class comp.

Ramp support through 5 years towards a level of \$ $\times\times$ M / yr.

Subsequent Town Hall meetings endorsed this plan.

(Usually not the specific funding level.)

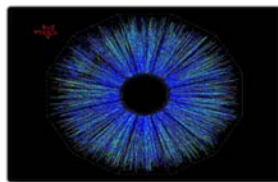
Program for a Computational Initiative presented at NSAC LRP Resolution meeting, Kitty Hawk, NC, 4/16/2015. Response (appeared to me to be) strongly favorable.

II. Major DOE-NP Experimental Facilities (2 of 3)

RHIC (BNL) = Heavy Ion NP



The **Relativistic Heavy Ion Collider (RHIC)** is the only dedicated machine in the world colliding heavy ions at near light speed

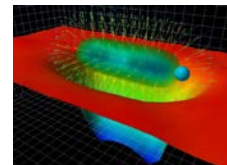


QCD phase diagram;
Quark – Gluon Plasma

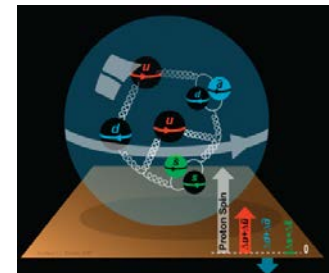
JLAB = Medium Energy NP



The **Continuous Electron Beam Accelerator Facility (CEBAF)** is the world's most powerful probe for studying the nucleus of the atom



Quark Confinement,
Exotic Mesons



Structure of
Hadrons

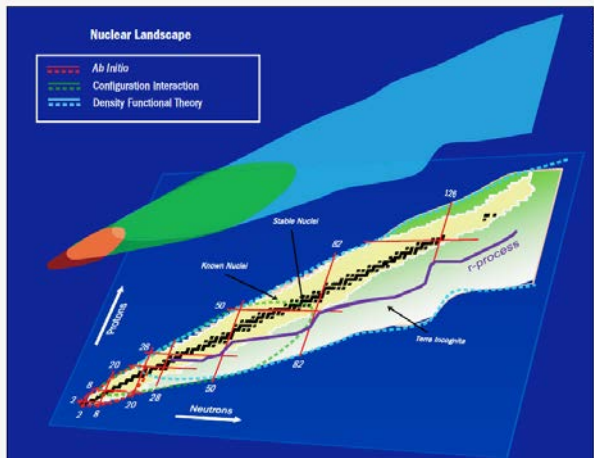
FRIB (MSU) = Low Energy NP, t.b.c.

III. 3 NP SciDAC-3 Projects

(NP = lead office)

(8/2012 – 8/2017)

NP area expt. facility

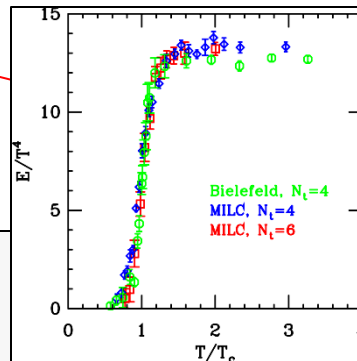
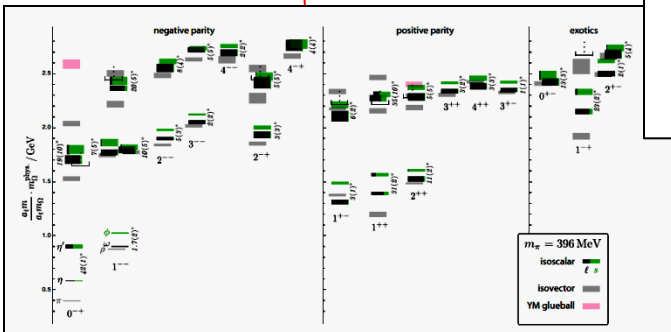


NUCLEI

CalLat

The 3 main areas of NP (4 with FIs added).

LQCD



NUCLEI (UNEDF') – **LENP** **FRIB** (MSU)

PD Joe Carlson (LANL)

co-PD sci. Witek Nazarewicz (MSU)

co-PD comp. Rusty Lusk (ANL)

LQCD (NP) – **HINP**, **MENP** **RHIC & JLAB**

PD Frithjof Karsch (BNL)

co-PD sci. David Richards (JLAB)

co-PD comp. Richard Brower (BU)

CalLat – **LE-ME NP bridge**

FRIB & JLAB

PD Wick Haxton (LBNL/UCB)

co-PD sci. Pavlos Vranas (LLNL)

co-PD comp. Esmond Ng (LBNL)

5-year multisite comp. NP projects,

esp. postdoc and g.s. support.

Total 5-year funding ca. \$23M,
fm. NP, ASCR, NNSA.

Strengthened LQCD and $0\nu\beta\beta$. 4

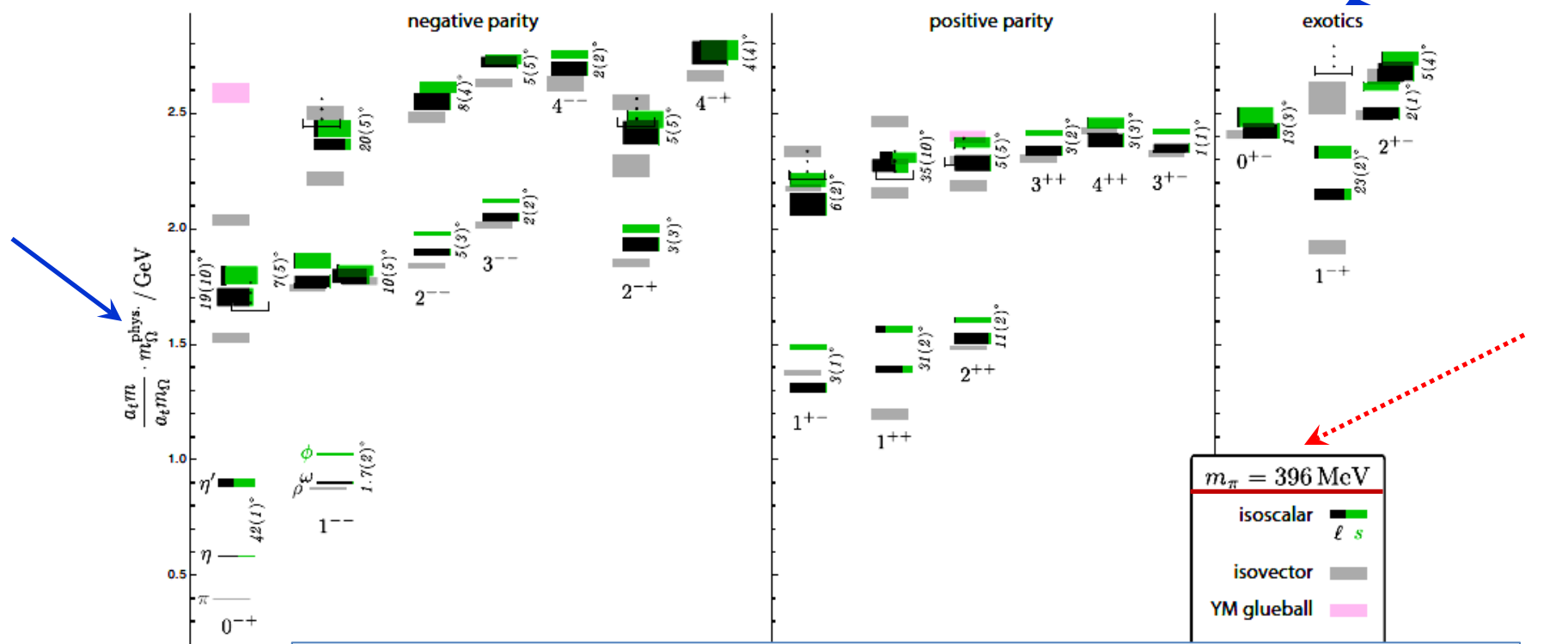
A bit thin on nuclear astrophysics.

MENP from LQCD e.g. (JLAB)

What strongly interacting q & $qbar$ & g mesons (q - $qbar$, q - $qbar$ - g , ...) does QCD predict that JLAB experiments will produce after the \sim $\$0.35G$ 12 GeV upgrade?

{incl. **exotic mesons**} **Lattice QCD results:**

MC: 1) ask the right questions, 2) stomp on it



M, q.nos.; just what we need to know for expts! Exciting future: phys $m_{u,d}$, strong decays.

Spectrum of $I=0$ light mesons, including exotics, expected to be seen at JLAB (GlueX, post 12 GeV upgrade). J.J.Dudek et al, Phys.Rev. D83 (2011) 111502. (**Now** running at $m_\pi = 230$ MeV; phys = 135-140 MeV.)

A **Holy Grail**: QCD thermodynamics with *physical parameters*;
 $m_\pi = 140 \text{ MeV}$, finite size effects converged (eye of faith).

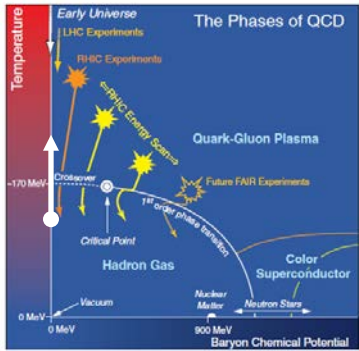
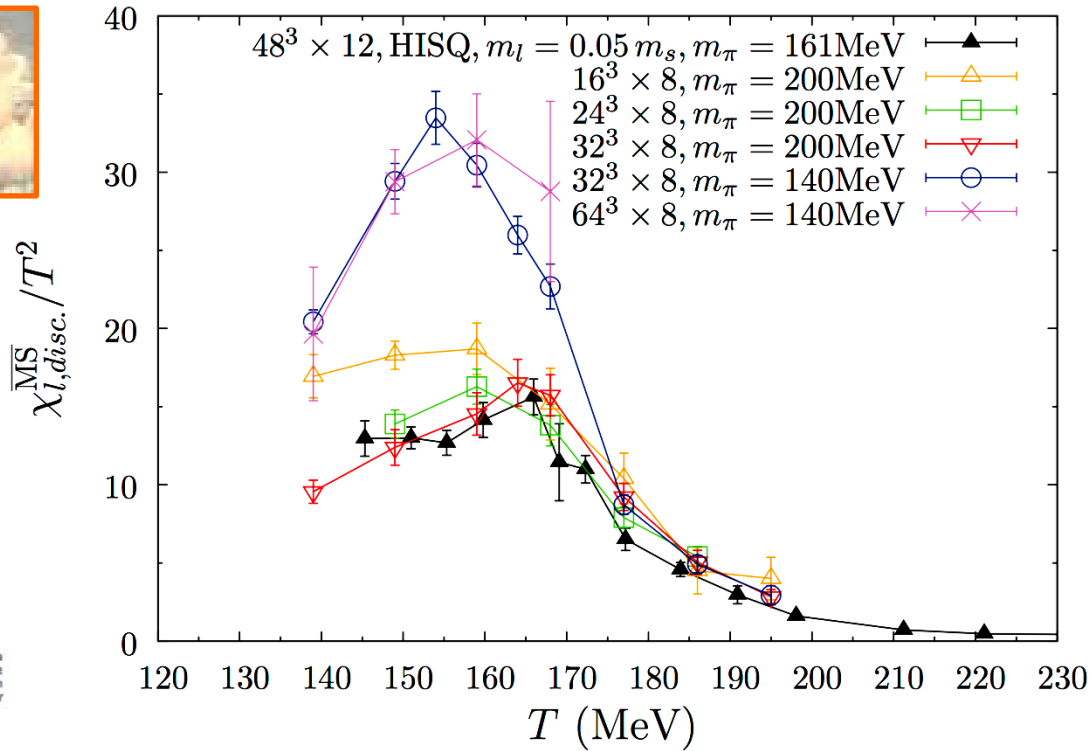


FIGURE 2.25 The phase diagram of QCD is shown as a function of baryon chemical potential (a measure of the matter to antimatter excess) and temperature. A prominent feature in this landscape is the location of the critical point, which indicates the end of the first-order phase transition line in this plane. SOURCE: DOE/NSF, Nuclear Science Advisory Committee, 2007, *The Frontiers of Nuclear Science: A Long Range Plan*.



Finite-T LQCD results for an order parameter (a susc.) at phys. params.
 (m_π and large L): **Tc = 155(1)(8) MeV.** Heroic effort. (Still $\mu_B = 0$.)

Bhattacharya et al. (hotQCD Collab.), PRL113, 082001 (2014)
LQCD SciDAC Project (LLNL LMBB)

END