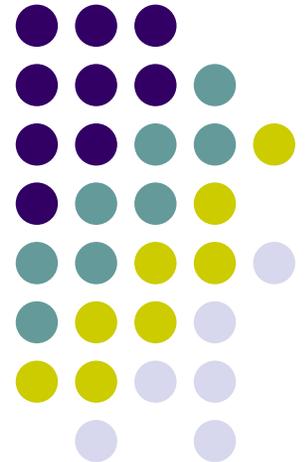


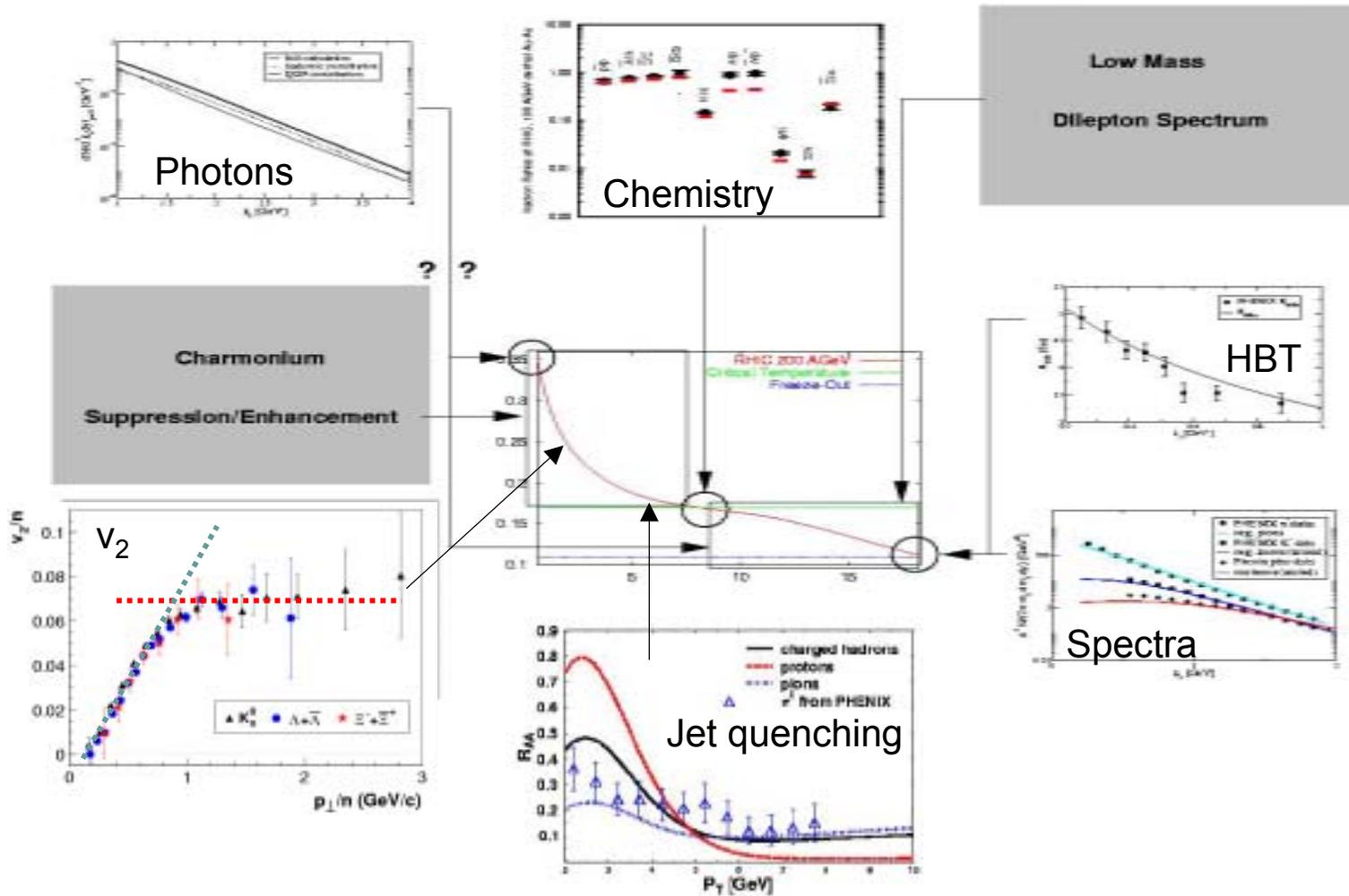
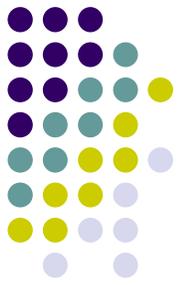
Evolution of Physics Goals and Resource Needs

NSAC Subcommittee on
Heavy Ion Physics

BNL – June 2-4, 2004



RHIC - The puzzle is coming together...





Major insights – to date

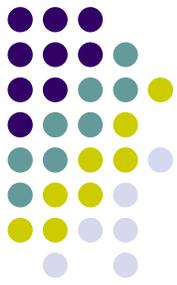
- Large jet energy loss and v_2 saturating hydro limit establish formation of dense dissipative, pressurized QCD matter at early times (1 – 3 fm/c).
- Baryon enhancement at 2 – 4 GeV/c explained as recombination of quarks from thermal medium.
- Deconfinement signals:
 - Universality of v_2 per constituent quark
 - dN_G/dy (energy loss) \approx dN/dy (multiplicity)



Next goals

- What is the QGP at RHIC: pQGP with $g \approx 2$ or sQGP ?
- Can we identify the dynamical degrees of freedom?
- How relevant is gluon saturation (CGC) initially?
- How and when exactly does the plasma thermalize?
- Can we uniquely fix the space-time evolution?
- Do gluons play a role in hadronization?
- Quantitatively determine transport coefficients!

- Use hard probes unique to RHIC (jets & charm) to probe QGP transport properties.



Goals for the LHC

- If RHIC is a “**discovery facility**” (nature of *final and initial* state), the LH(I)C will be a “**confirmation facility**”.
- LHC will provide quantitative tests of the models developed to describe the RHIC data:
 - Saturation of the initial gluon density
 - (Almost) ideal hydrodynamic evolution of matter (v_2)
 - Scaling of parton energy loss with $\int \rho \tau d\tau$
 - Color screening, quark recombination
 - Major new probes: **contained jets** and **b-quarks**, permitting much improved control of theoretical predictions.
- Best LHC strategy for U.S. community ?
 - Involvement in visible and significant way
 - ALICE vs. CMS and ATLAS



RHIC strategy in “LHC era”

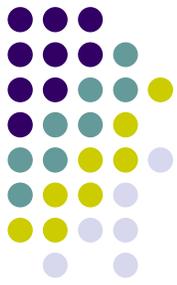
- High luminosity to extend p_T range and allow access to rare processes is essential.
- Extended particle ID and high-quality vertexing needed.
- Exploit greater flexibility of detector upgrades.
- Exploit QCD reach of p+A program to study nuclear structure at low-x, propagation of light-cone states in cold nuclear matter, and A+A backgrounds.
- Add high-luminosity e+A option.
- **“The sum is better than any one of its parts”:**
RHIC + LHC provide almost ideal coverage of large \sqrt{s} range 50 – 5000 GeV per nucleon pair.



Essential resources

1. **More and better theory:**
 - QCD-based, sophisticated phenomenology.
2. **More and better theory:**
 - Quality controlled transport theories, openly available codes.
3. **More and better theory:**
 - Lattice gauge simulations with dynamical quarks.

Requires the timely implementation of the NSAC theory recommendations (topical centers, community building initiatives, 10++ Teraflops) and the continued support and encouragement of the experimental community.



The OSCAR malaise

Open Standard Codes and Routines

List of Codes

1. Partonic/String Transport

[AMPT](#) [HIJING](#) [HIJING/B-anti-B](#) [MPC](#) [neXus](#) [PCPC](#) [PSM](#) [VNI](#) [VNIb](#) [ZPC](#)

2. String/Hadronic Transport

[AMPT](#) [ART](#) [BEM](#) [BNC](#) [HSD](#) [JAM](#) [JPCIAE](#) [LEXUS](#) [LUCIAE](#) [RQMD](#) [UrQMD](#)

3. Transport Tools

[GCP](#)

4. Correlation Builders

[CRAB](#)

5. Hydrodynamics

[BJ](#) [HYDRO](#)



Only a single boost-inv. hydro code!!!