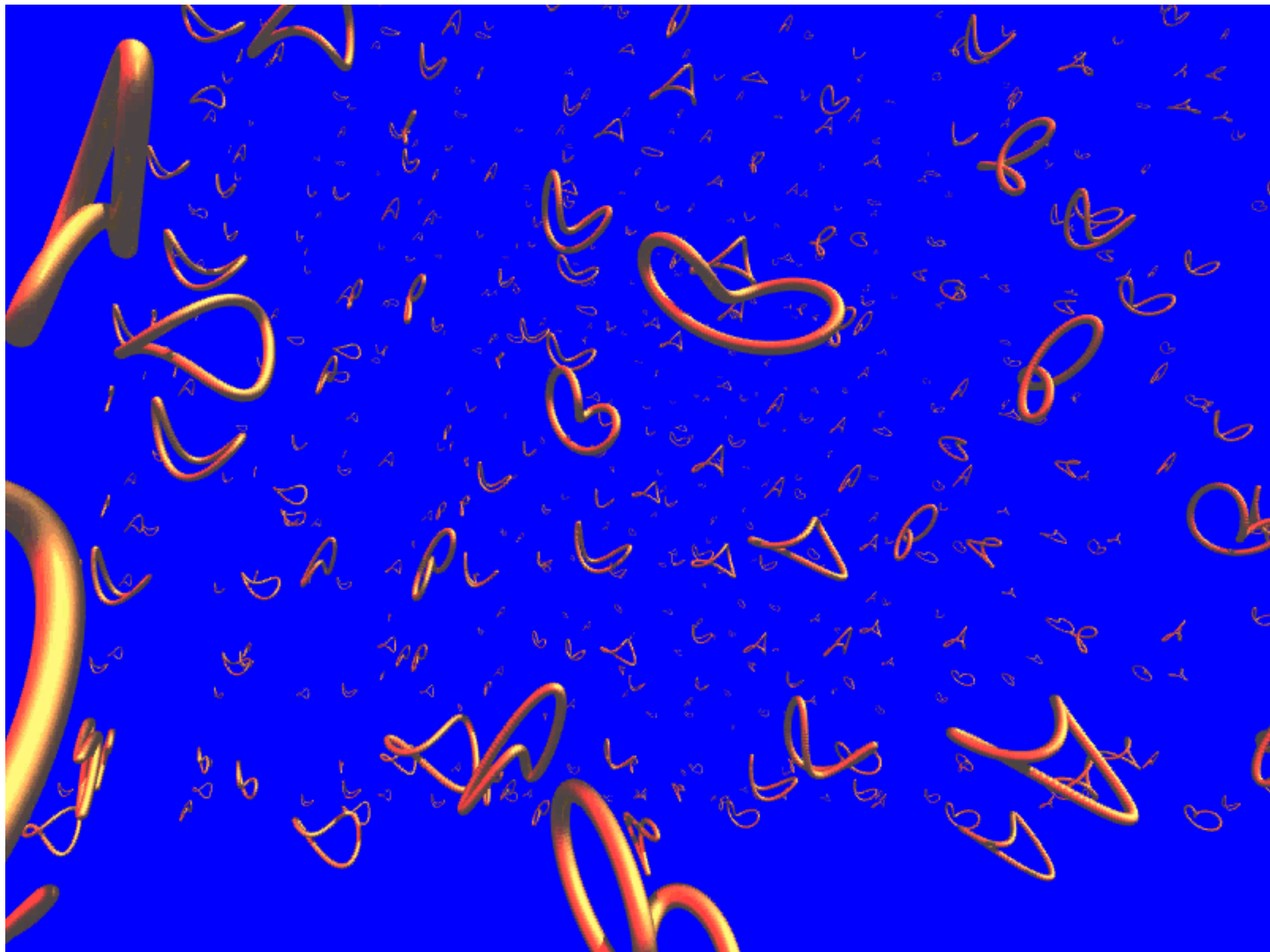


Strings 2006, Beijing


Summary Talk







Robbert Dijkgraaf
University of Amsterdam






*Summary of the most important
developments of this week*





Group A							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Germany	3	3	0	0	8	2	9
 Ecuador	3	2	0	1	5	3	6
 Poland	3	1	0	2	2	4	3
 Costa Rica	3	0	0	3	3	9	0

Group B							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 England	3	2	1	0	5	2	7
 Sweden	3	1	2	0	3	2	5
 Paraguay	3	1	0	2	2	2	3
 Trinidad and Tobago	3	0	1	2	0	4	1

Group C							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Argentina	3	2	1	0	8	1	7
 Netherlands	3	2	1	0	3	1	7
 Côte d'Ivoire	3	1	0	2	5	6	3
 Serbia and Montenegro	3	0	0	3	2	10	0

Group D							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Portugal	3	3	0	0	5	1	9
 Mexico	3	1	1	1	4	3	4
 Angola	3	0	2	1	1	2	2
 Iran	3	0	1	2	2	6	1

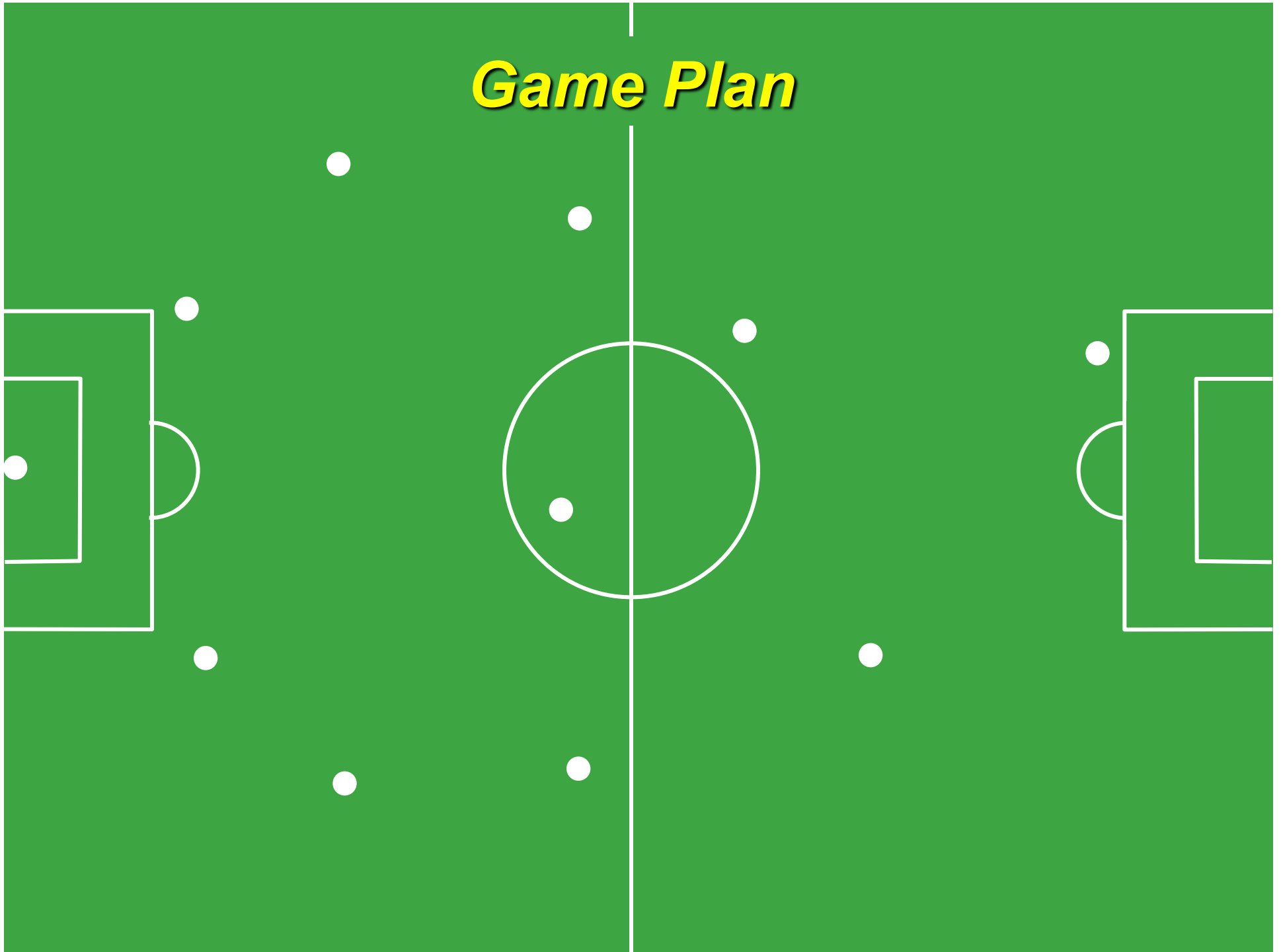
Group E							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Italy	3	2	1	0	5	1	7
 Ghana	3	2	0	1	4	3	6
 Czech Republic	3	1	0	2	3	4	3
 USA	3	0	1	2	2	6	1

Group F							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Brazil	3	3	0	0	7	1	9
 Australia	3	1	1	1	5	5	4
 Croatia	3	0	2	1	2	3	2
 Japan	3	0	1	2	2	7	1

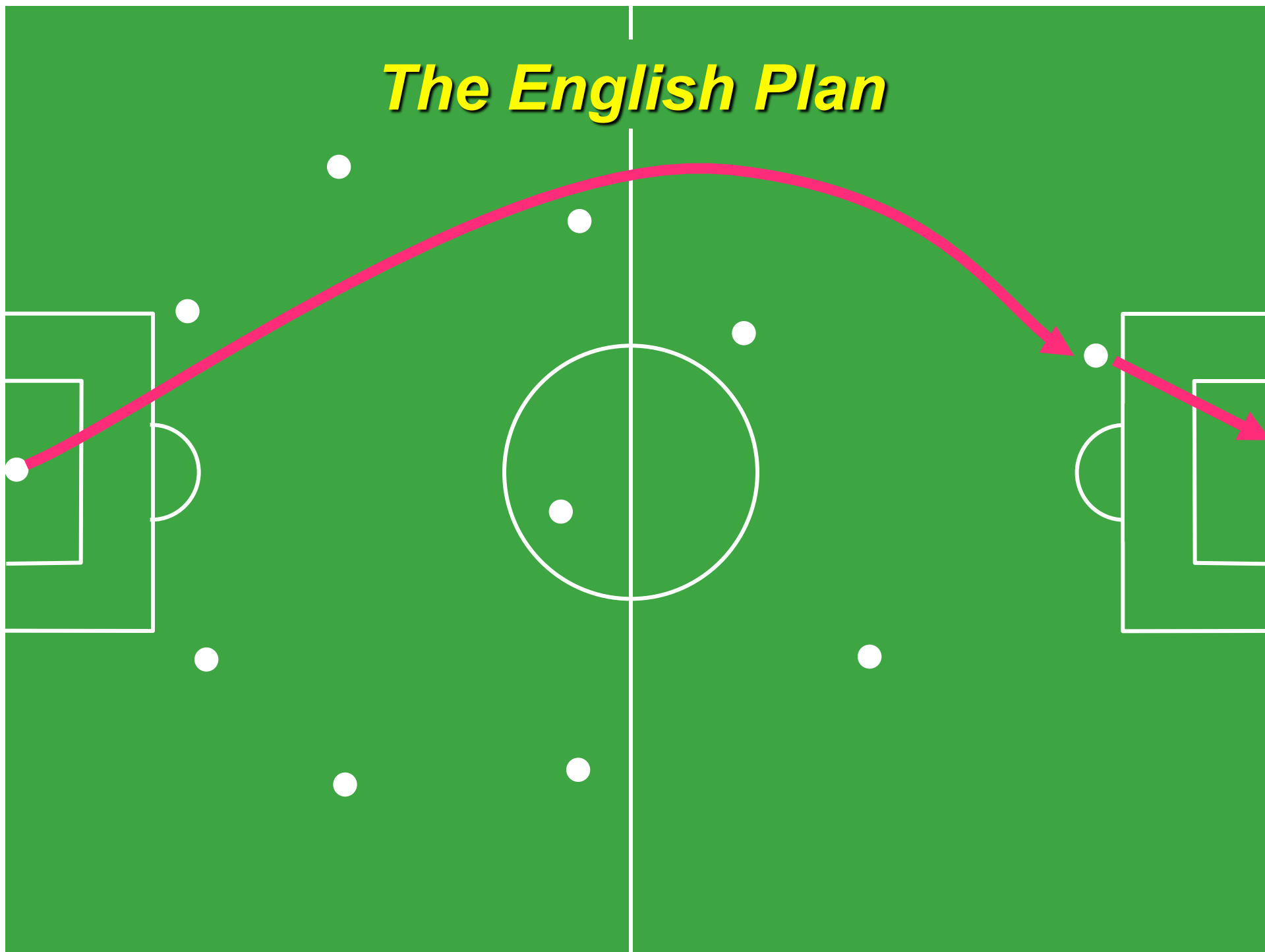
Group G							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Switzerland	2	1	1	0	2	0	4
 Korea Republic	2	1	1	0	3	2	4
 France	2	0	2	0	1	1	2
 Togo	2	0	0	2	1	4	0

Group H							
Overview News				Key			
Team	MP	W	D	L	GF	GA	Pts
 Spain	2	2	0	0	7	1	6
 Ukraine	2	1	0	1	4	4	3
 Tunisia	2	0	1	1	3	5	1
 Saudi Arabia	2	0	1	1	2	6	1

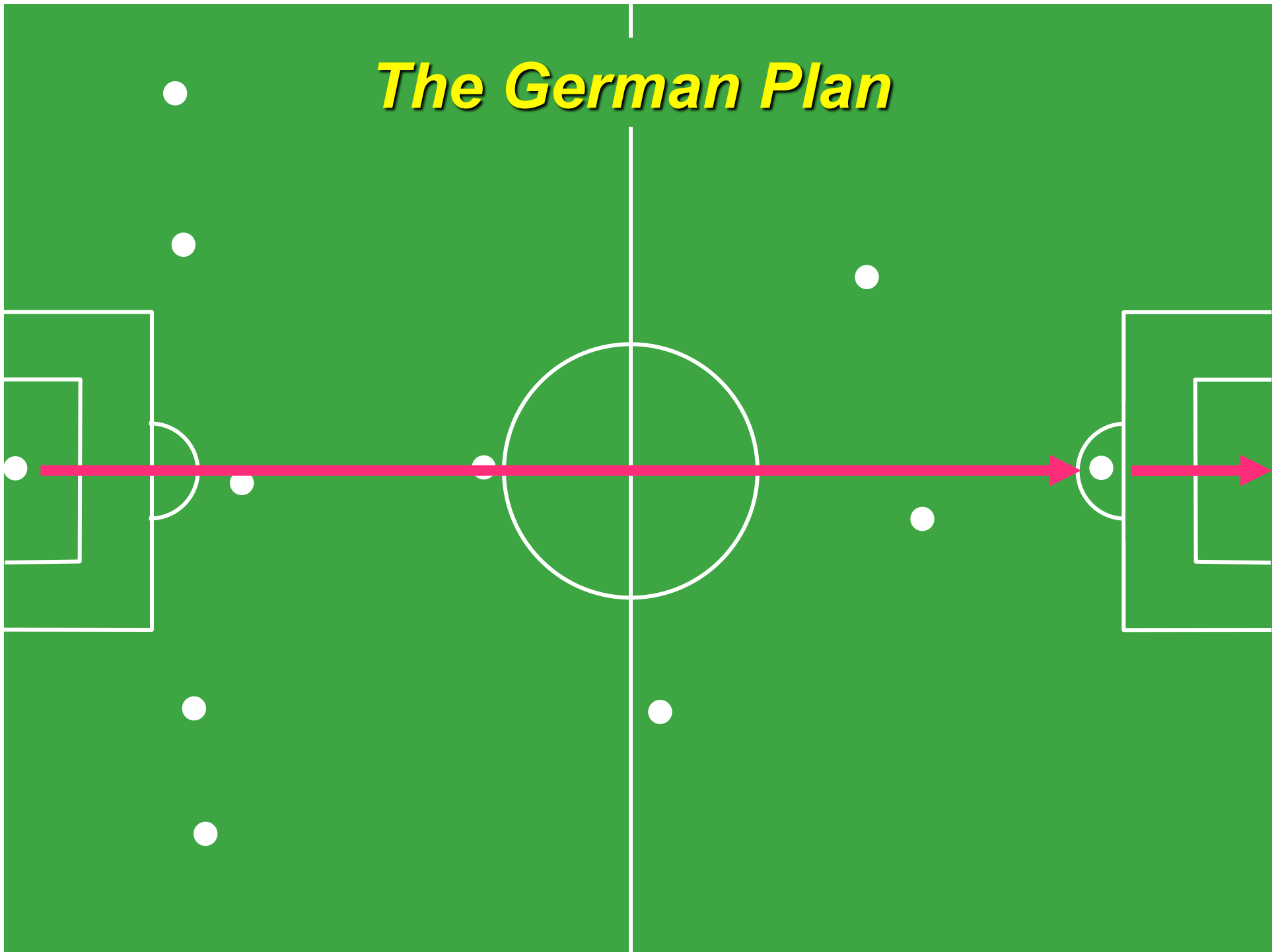
Game Plan



The English Plan



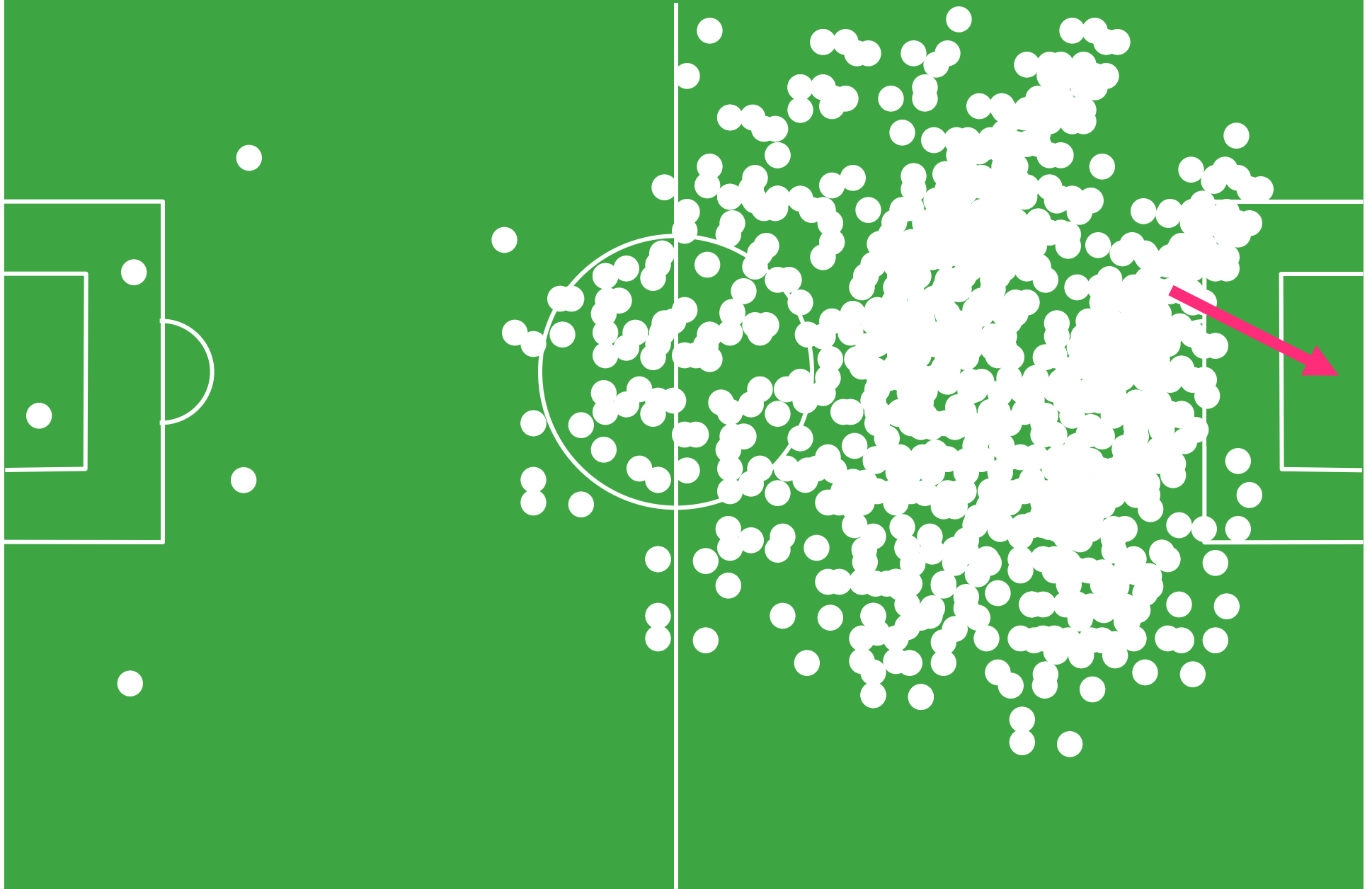
The German Plan



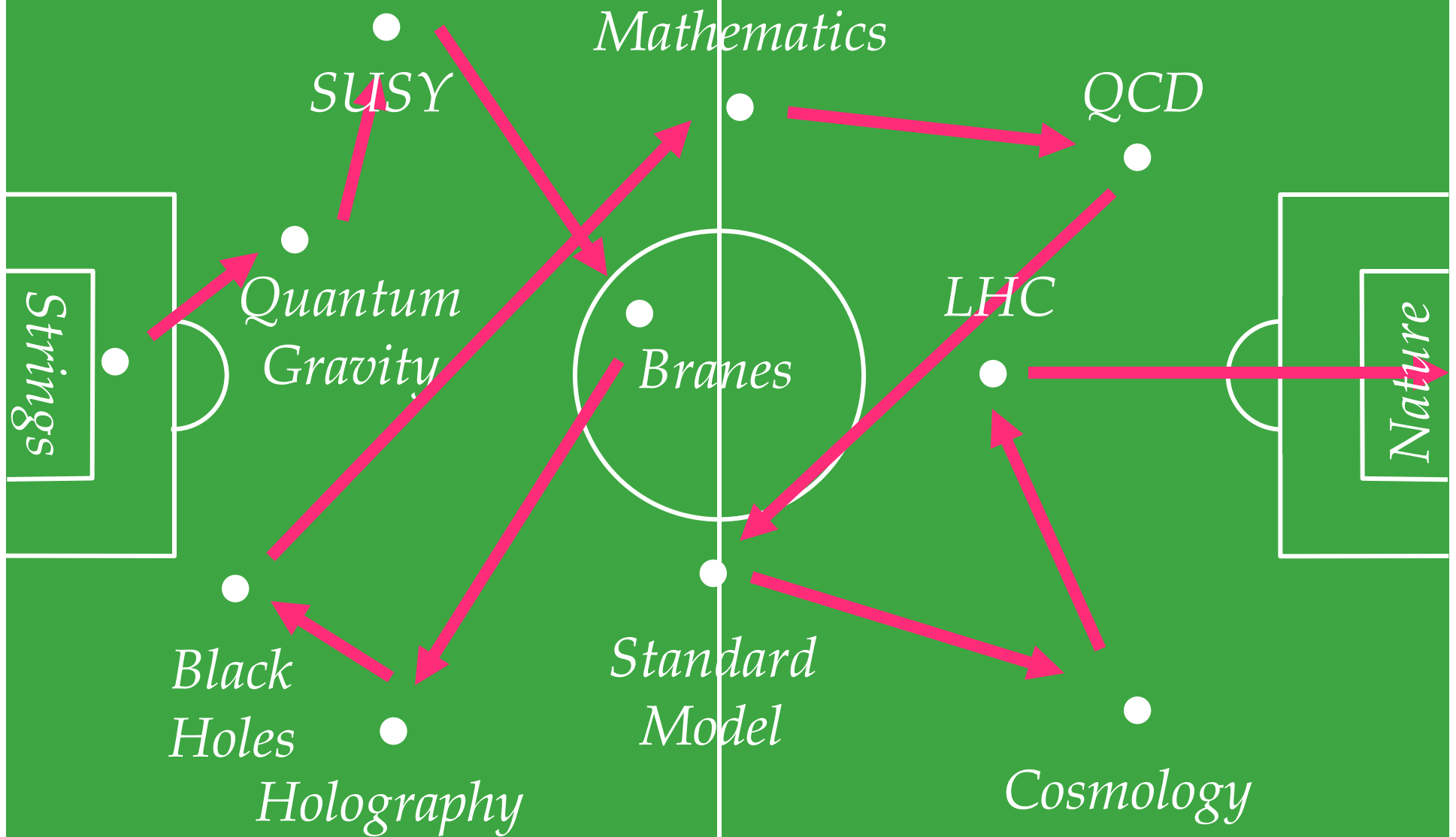
The Brazilian Plan



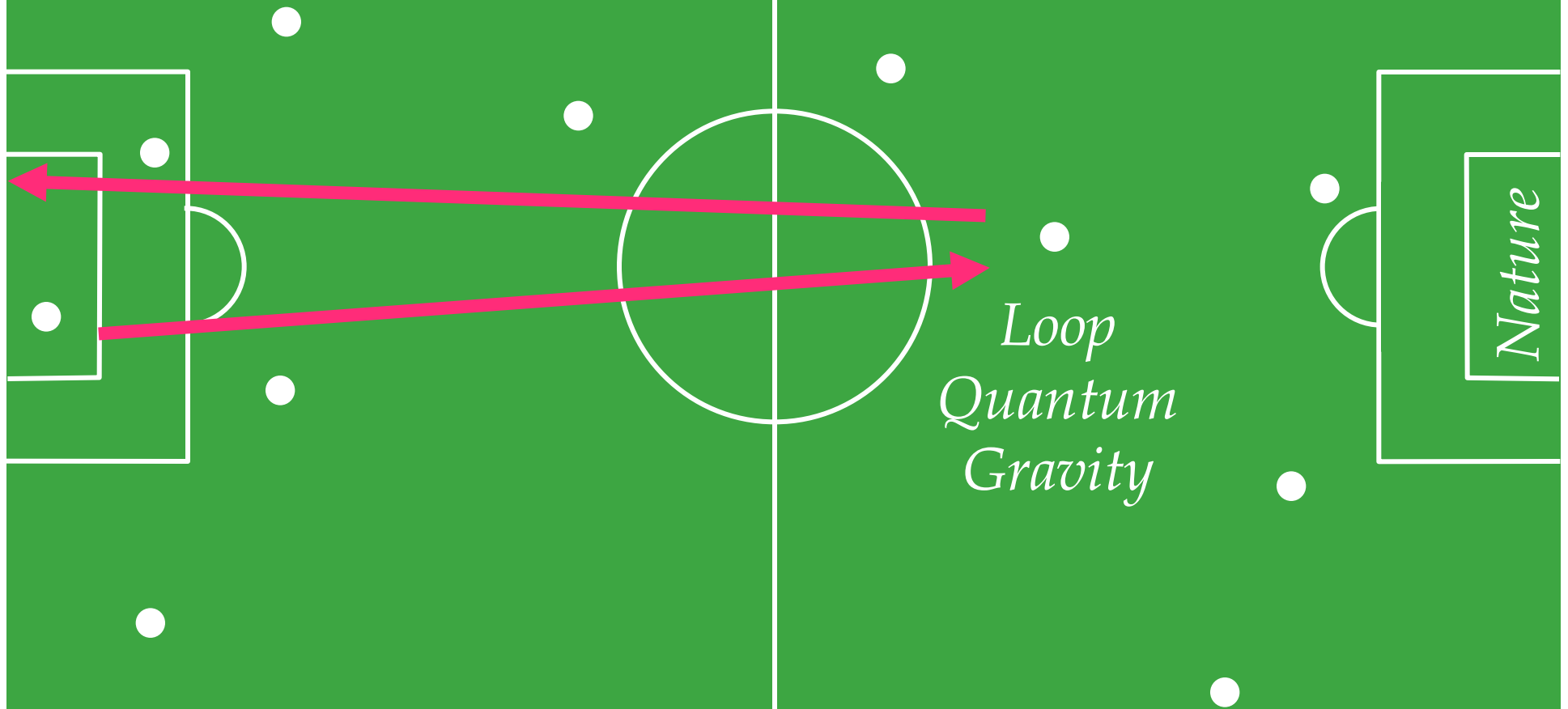
The Chinese Plan



The String Theory Plan



The “Alternative” Plan ;-)



Theoretical physics

*Very impressive, dear
colleague!
But does it also work
in theory?*



*String theory has been guided by
important physical principles*

Landscape of Ideas

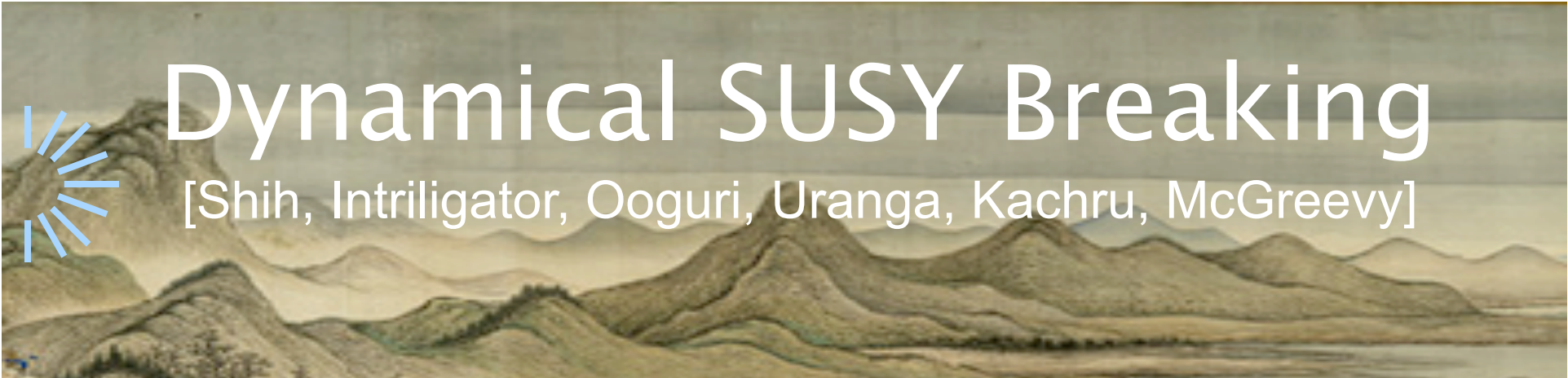


General Impressions of Strings 2006

- *Intellectual diversity, broad “portfolio” of questions and strategies, mature field.*
- *Remarkable depth of the circle of ideas.*
- *Technical progress in difficult long-term projects.*
- *Promise of experimental observations (LHC, astro-particle, Planck,...)*
- *Exciting new data! = actual computations!*
- *Physics & beauty is in the details.*



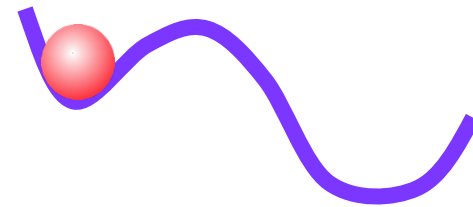
Scenic Tour



Dynamical SUSY Breaking

[Shih, Intriligator, Ooguri, Uranga, Kachru, McGreevy]

- *Moving away from SUSY!*
- *Controlled analysis of meta-stable vacua with broken supersymmetry using Seiberg-dual description.*
- *Can be geometrically engineered in string theory.*
- *Instanton effects = D-branes.*
- *DSB generic phenomenon in QFT, string theory.*
- *Geometric description of vacua? (anti-branes, fluxes).*





Non-Susy Black Holes

[Sen]

- *Attractor mechanism for non-susy extremal black holes using action functional on horizon.*
- *“Analytic continuation” (S_{BH} independent of couplings)*
- *Near-horizon geometry AdS_2 .*
- *Microscopic description?*
- *Relation to non-susy vacua?*



Quantum Black Hole Entropy

[Yin, Strominger, Denef, E. Verlinde, Mathur]

- *Important steps towards exact computation of microscopic entropy for general $N=2$ black holes.*
- *Intuitive derivation of OSV conjecture in terms of branes & anti-branes.*
- *Modular forms (S-duality), Farey tail = sum over geometries.*
- *Zoo of possible non-perturbative corrections.*



- *Black holes as probes of quantum gravity & catalysts in cosmology.*
- *Black holes can create bubbles of meta-stable vacua by Hawking evaporation of massive particles.*
- *Creation of bubbles of nothing in KK black holes. Evidence of unique state at singularity.*



- *Major technical progress towards solvability of perturbative $N=4$ SYM.*
- *All loop Bethe Ansatz solution...*
- *Integrable scattering of magnons & strings on $AdS^5 \times S^5$*
- *“Magic” of multiloop Feynman diagrams (in part. MHV)*
- *Spectrum of $1/2^n$ BPS states $n=1,2,3,4$.*
- *New ideas about emergent geometry from matrix models, (thermal) instantons & open strings world-sheets.*



→ Standard Model

[H. Verlinde, Ibanez, Wu, Lüst]

- *LHC starts in 1 yr (real data in 3 yr)*
- *D-brane realization of MSSM:*
- *Del Pezzo singularities (quivers).*
- *(Coisotropic) branes on tori orientifolds.*
- *Fluxes on CY orientifold.*



- *“Geometric Swamplands Program”* [Vafa]
- *When can an effective QFT be lifted to string theory?*
- *Conjectures about moduli space: finite vol, ∞ diam, bounded dim, $\pi_1=1$, ...*
- *What is underlying physics (nature of gravity)?*
- *Vacua seem to cluster around singularities* [Eguchi]
- *Entropic analysis KKLT vacua* [Lüst]



Cosmology

[Feng, Shandera, Schalm, Klebanov, Hawking]

- *Preparing for important new data from cosmology & (astro)particle experiments.*
- *Dark matter at TeV seems likely (Super-Wimps?)*
- *D-brane inflation realistic model (non-Gaussianity, tensor/scalar ration)*
- *Tensor modes in CMB will probe inflation to Planck scale and perhaps even trans-Planckian effects.*



Topological Strings

[Aganagic, Marino, Liu, RD]

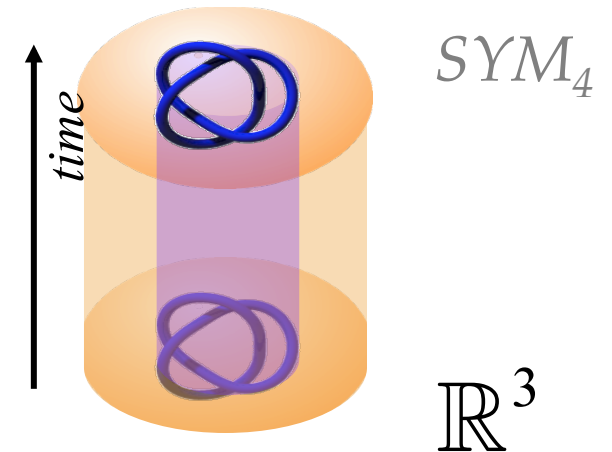
- *Embarrassment of (mathematical) riches.*
- *Getting very, very close to first closed formulas for all genus amplitudes on compact CY.*
- *Important role for duality groups (monodromies).*
- *Many physical conjectures proven mathematically.*
- *Is top string exactly solvable? Unique non-pert completion? New math?*



Mathematics

[Witten, Kapustin, Hitchin, Gukov]

- Remarkable application of 4d SUSY gauge theories to geometric Langlands program, knot invariants, CFT, ...
- Operators for lines, surfaces: math operations.
- S-duality/Mirror Symmetry.
- Generalized “stringy” geometries.
- Categ(l)orification





Many Other Important Results

- *Solution of Sen's conjectures* [Schnabl]
- *Going beyond BPS in topological QFT* [Nekrasov]
- *New 7d SE-manifolds & dual CFT_{1+1}* [Gauntlett]
- *New heterotic flux vacua* [K. Becker]
- *Quantum vortex strings* [Tong]
- ...



In the meantime in Mathematics
**Proof of Poincaré Conjecture
and Geometrization Program**
[Yau]

- *Major ($1/10^2$ yr) mathematical breakthrough.*
- *Golden Age of Mathematics (Fermat's Last Theorem, Quantum Geometry, ...).*
- *Golden Age of Physics (TeV physics, cosmology,...)*

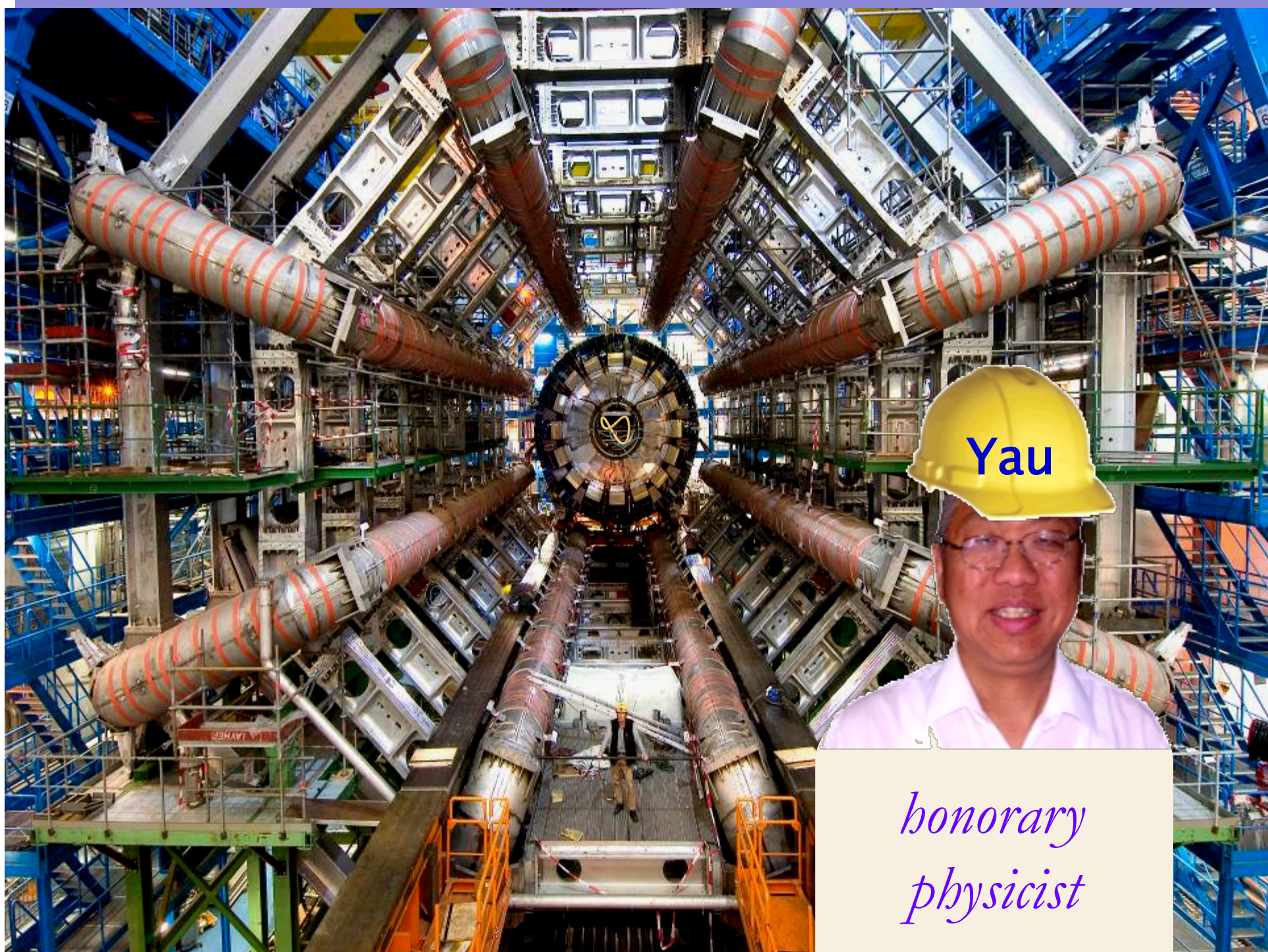
Some Things I Missed

*(and without these a Strings conference
is not a proper Strings conference)*

- *Embarrassing soul searching panel discussion being reported on the front-page of the New York Times.*
- *Voting about physics.*
- *(More) jokes in after-dinner speeches.*
- *Metaphysical multiversal babbling.*
- *Lubos Motl (behind Great Fire Wal; Woit is not.*
- *Some empty seats in the Great Hall of the People.*
- *Prof. Gross going seriously overtime.*
- *Prof. Yau giving an incomprehensible math talk.*
- *Imperfections in the organization.*

Warm thanks to all the local organizers!

Welcome, China!



Yau

*honorary
physicist*

The End