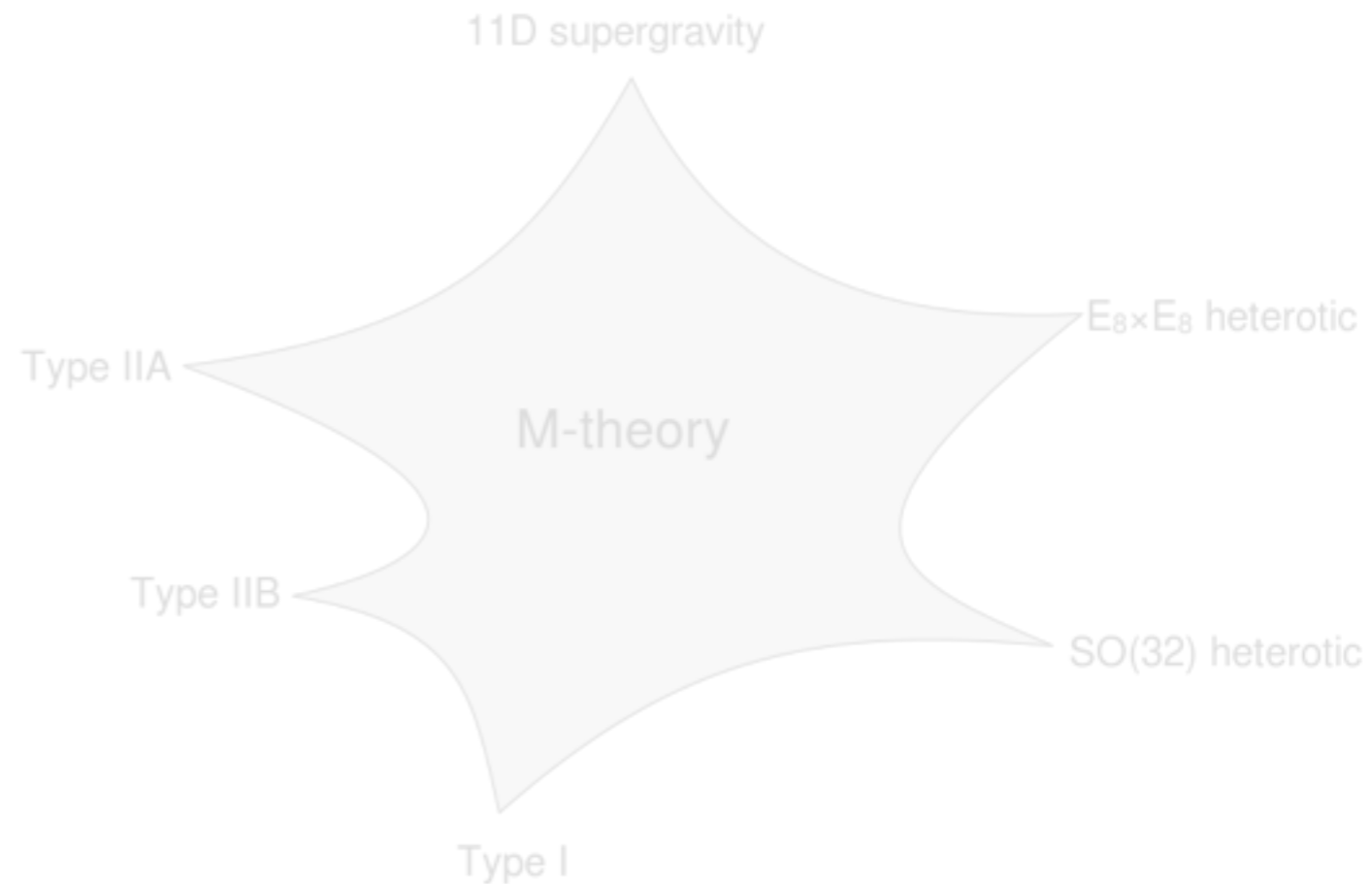
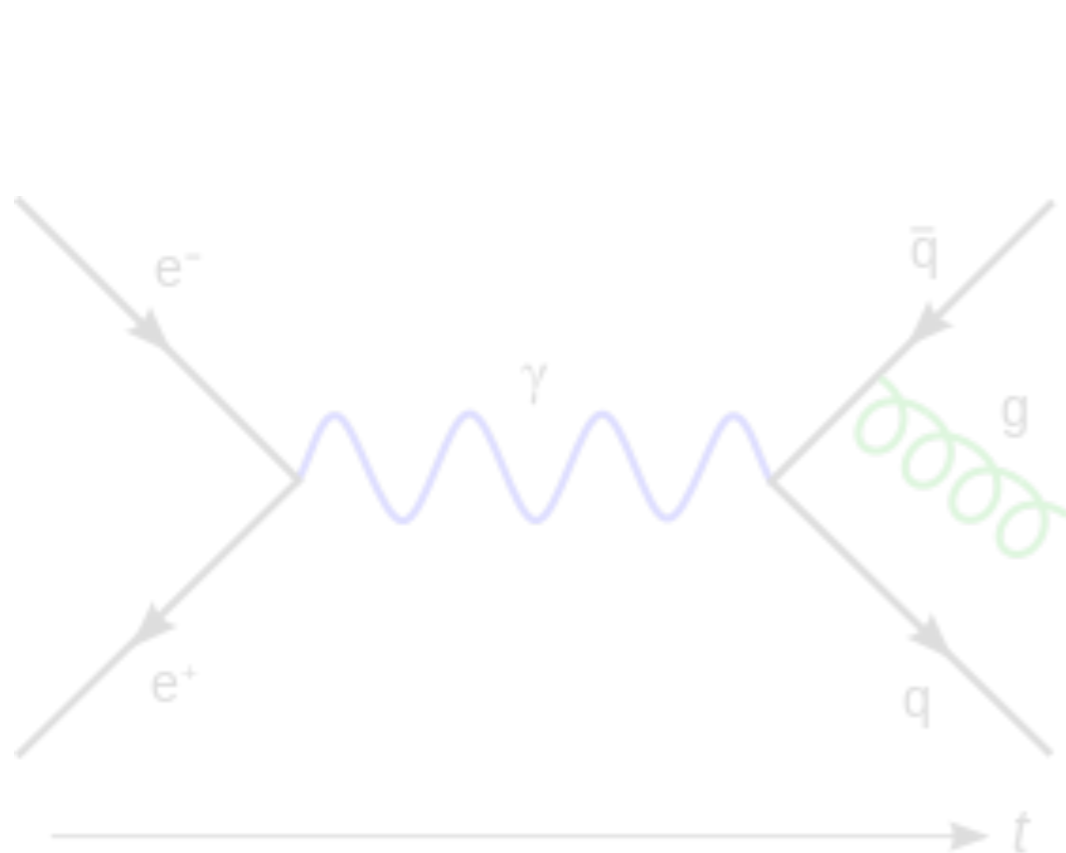


Formal theory

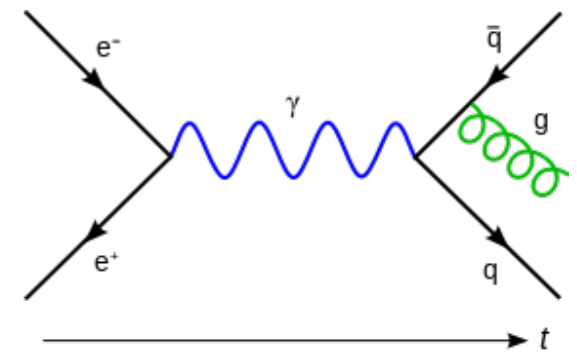


Toby Wiseman (Imperial)


STFC community meeting
Imperial College Sept 2015

What is formal theory?

- Remarkable tradition in UK - still going strong! US/UK dominant in formal theory.
- Distributed in many centres around the UK - (not well suited to CDT style funding)
- Formal quantum field theory (QFT)
 - Techniques to move beyond Feynman diagrams
 - Strong coupling; cf. QCD
- String theory - closely linked to gravity and QFT
 - Quantum gravity (- formal cosmology), Theory of Everything
 - Diversification; links to heavy ions and phenomenology (also mathematics and condensed matter)



String theory ↔ QFT

- Holography (AdS-CFT) - profound link between field theory and gravity
 - Developments in understanding - 'higher spin gravity'
 - Applications: eg. ALICE physics
 - Quantum gravity
 - Progress: quantum black hole evaporation - firewalls, micro state counting
- 
- Conformal symmetry in dimensions $> 1+1$
 - Bootstrap
 - Supersymmetry
 - Localization - reduce a QFT to a QM or even better

Esteem

- International esteem - the community is world leading
 - eg. numerous ERC grants - starting, consolidator and advanced (eg. group at IC has 2) - BUT these are highly localised in both *space* and *time*!
- International review organised by EPSRC in 2011:
 - “The UK continues to have world-class research programmes in several of the more mathematical areas of theoretical physics, including general relativity, cosmology, string theory...”
 - Mathematical physics was subsequently cut from EPSRC, and remains largely unfunded. Key concern - this area falls between the cracks
- Worth remembering social impact of theory - 2 major international films (Hawking and Interstellar)
 - This is a field that inspires the next generation.

Funding status

- Over the past 10 years universities have hired in theory (not just formal) - the community has expanded.
- BUT there have been deep and systematic funding cuts overall in formal theory, and cuts relative to other STFC areas eg. RA support in CG's 40%→30% from 2008 - 2013 - see S. Hands talk at Town meeting '14
- Current funding stream - CG13

	Grants Round	Total non-zero Ac posts funded	RAs funded (average FTE over 3 year period)	RAs / funded Ac	Average Ac fEC (for non-zero posts)	Maximum Ac fEC
Nuclear -	NPGP 2011	44	19	0.42	15%	20%
PP theory - {	PPGP(T) 2011	146	29	0.20	14%	20%
	PPGP(T) 2013	162	28	0.17	16%	20%
PP expt -	PPGP(E) 2012	167	116	0.69	17%	23%
Astronomy - {	AGP 2011	150	77	0.51	17%	30%
	AGP 2012	137	71	0.51	15%	30%
	AGP 2013	117	68	0.58	18%	30%

Outlook

- Formal theory is a very exciting area - many rapidly moving new areas, as well as continual progress in basic questions.
- The UK community is world-leading.
- We are producing great work, but there is definitely capacity to do better, as current funding is **minimal**.
- Further cuts will **definitely** cause long term damage - for example, mathematical physics is currently suffering.
- Would we want a situation where a future Einstein or Hawking were not funded?