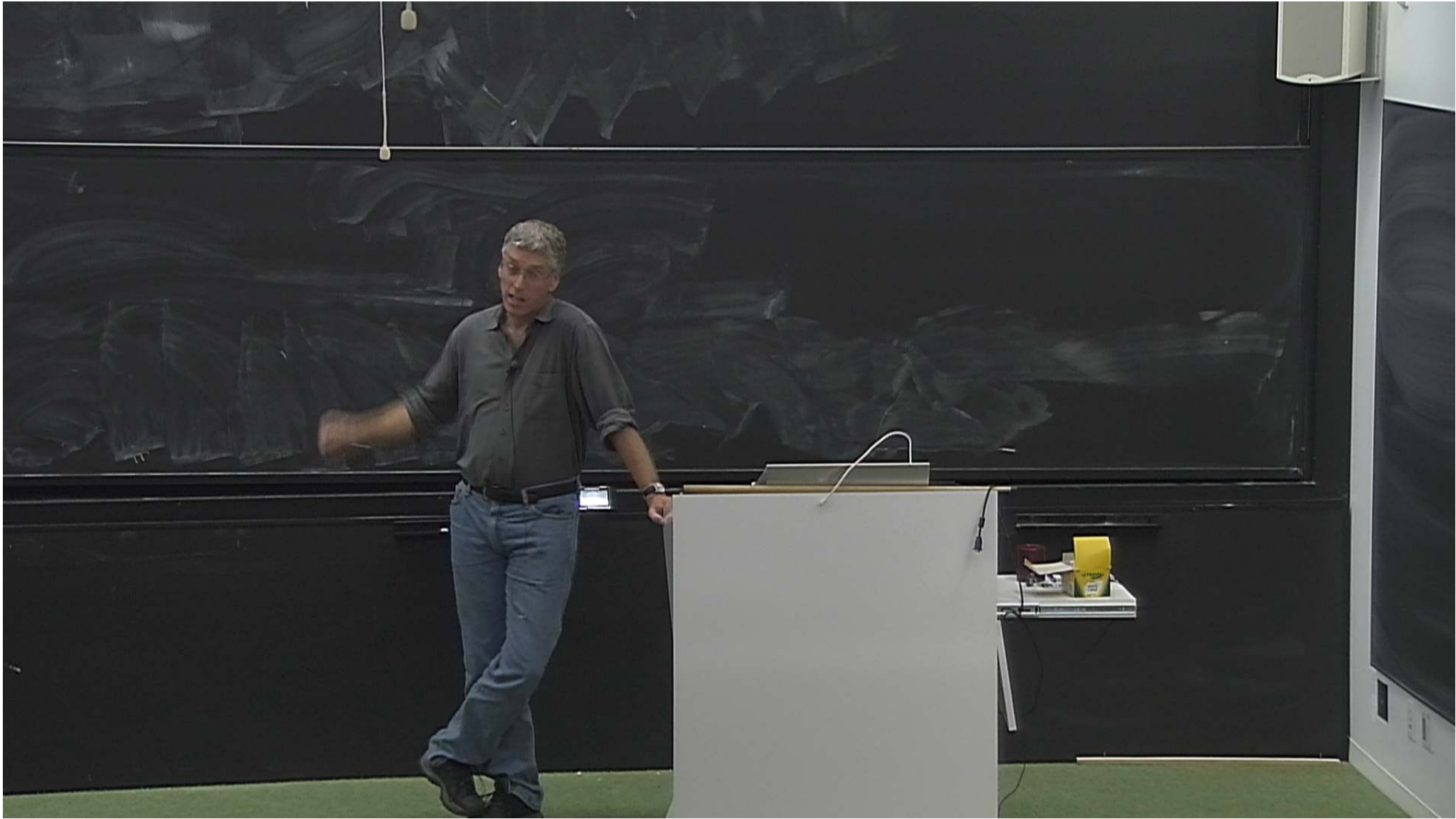


Title: Researcher Presentation: Cliff Burgess

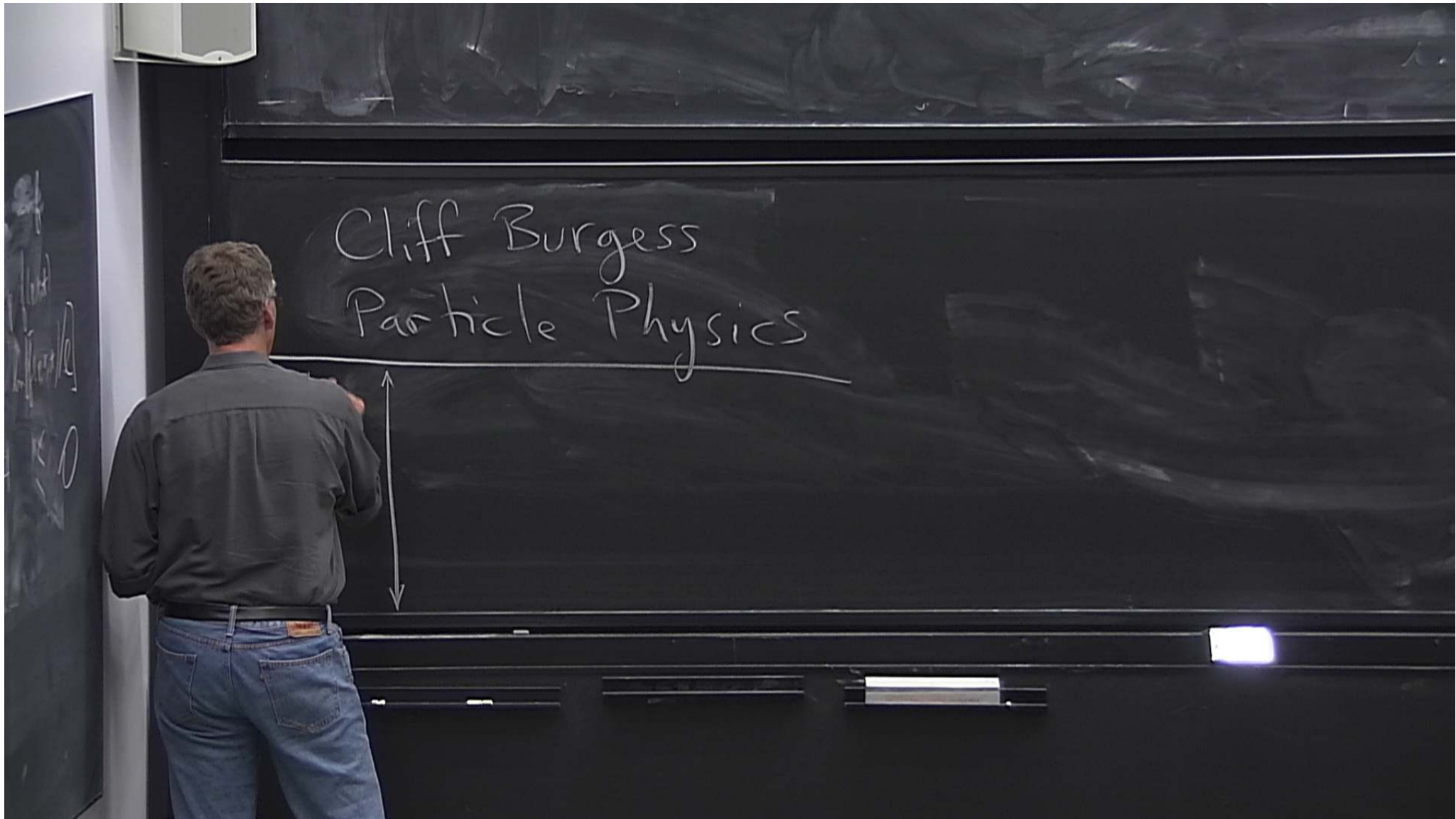
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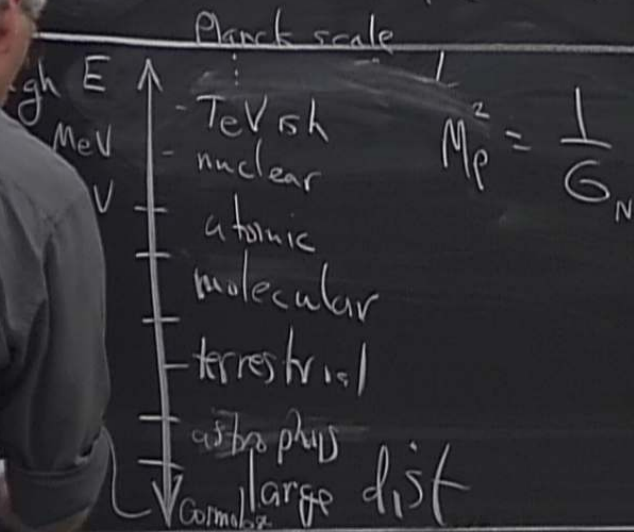


Cliff Burgess  
Particle Physics



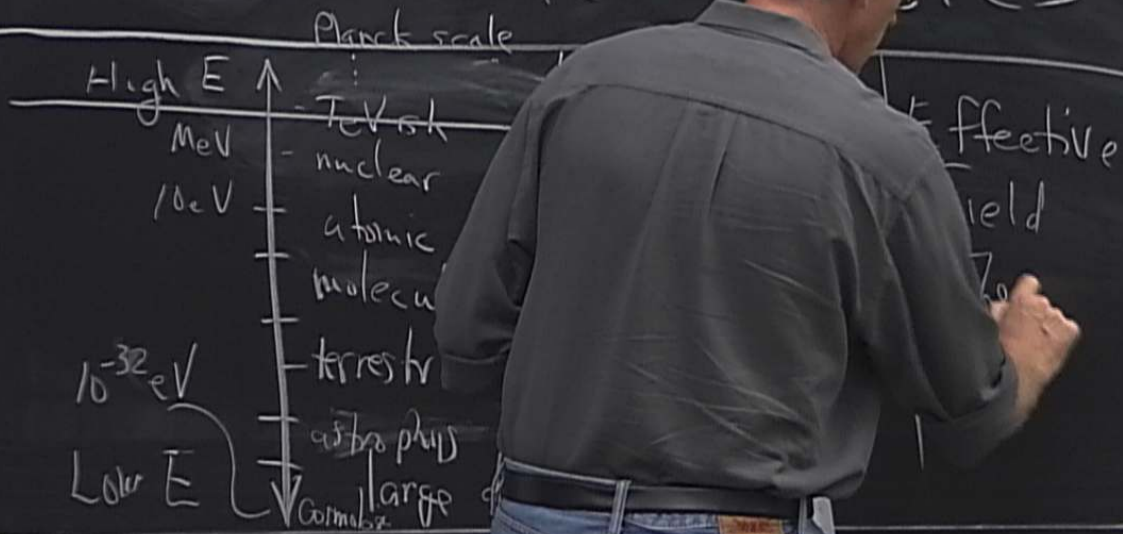
# Cliff Burgess

## Particle Physics



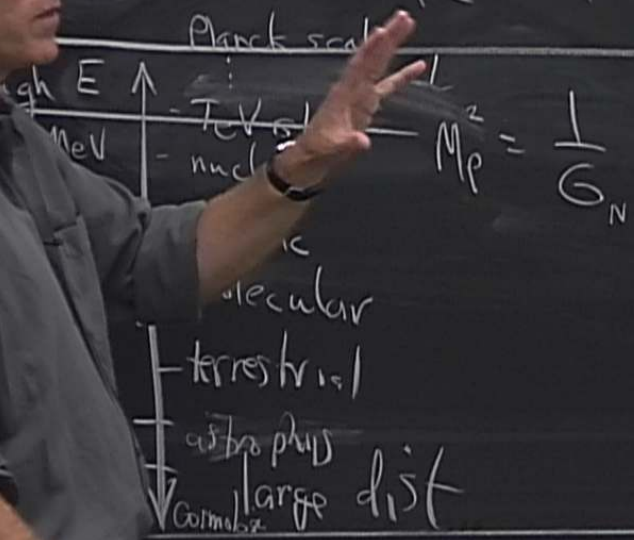
# Cliff Burgess

## Particle Physics



# Cliff Burgess

## Particle Physics

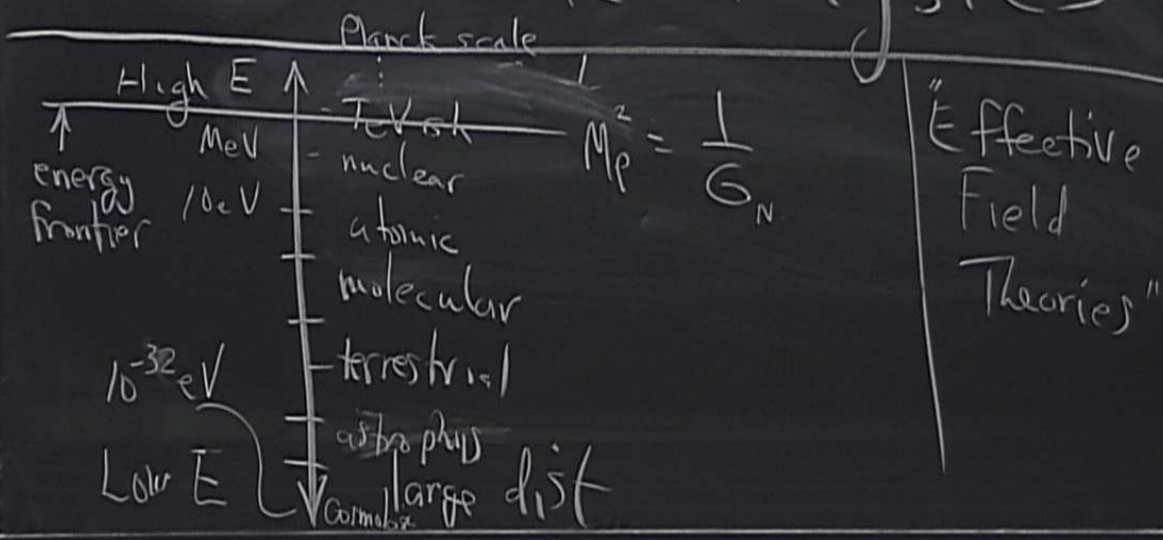


$$M_p^2 = \frac{1}{G_N}$$

Effective Field Theories

# Cliff Burgess

## Particle Physics



Standard Model

Burgess

le Physics

$$M_p^2 = \frac{1}{G_N}$$

dist

Standard Model

u d s c b t

$e \mu \tau \nu_e \nu_\mu \nu_\tau$

Burgess

le P CS

$M_p$

dist

Effective Field Theories"

# Standard Model

u d s c b t  
 $e \mu \tau \nu_e \nu_\mu \nu_\tau$

$W^\pm, Z, \gamma, \text{gluons}$

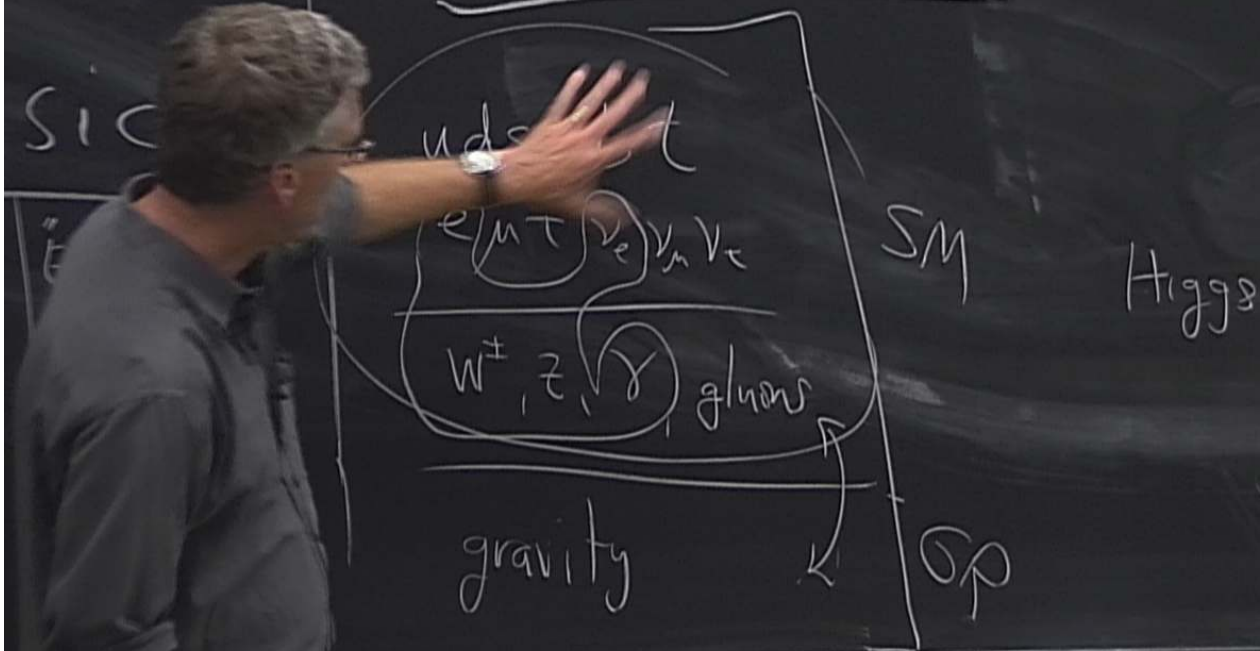
gravity

SM

OP

Higgs

# Standard Model 1967



# Standard Model 1967

S  
"effective field theories"

u d s c b t

$e, \mu, \tau, \nu_e, \nu_\mu, \nu_\tau$

$W^\pm, Z, \gamma, \text{gluons}$

gravity

SM

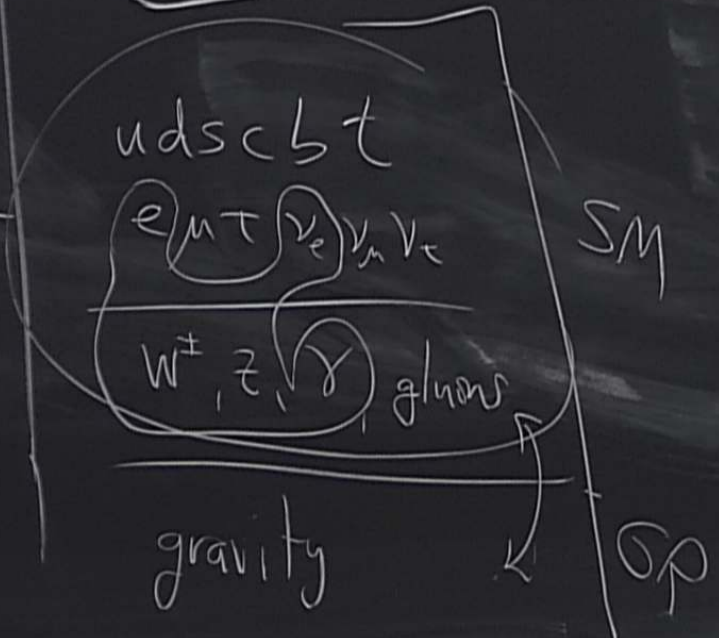
Higgs

SP

- Dark Matter
- Dark Energy

# Standard Model 1967

S  
"effective field theories"



Higgs

- Dark Matter  
- Dark Energy  
neutrino masses

$$v = H d$$

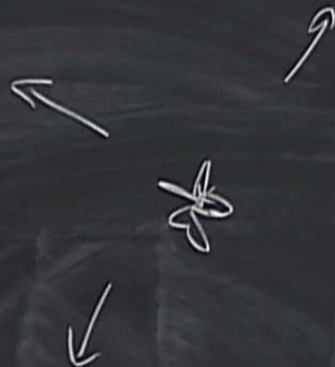


70 km/s/Mpc

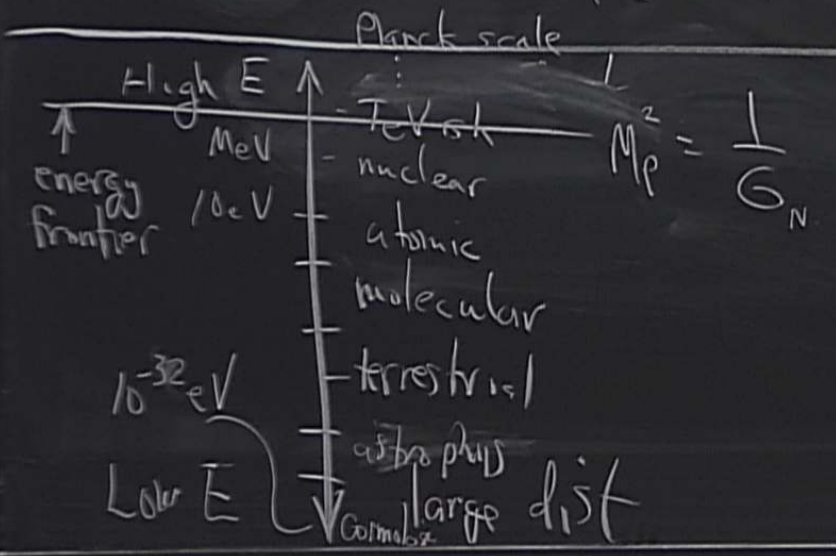
$$v = H d$$



70 km/s/Mpc

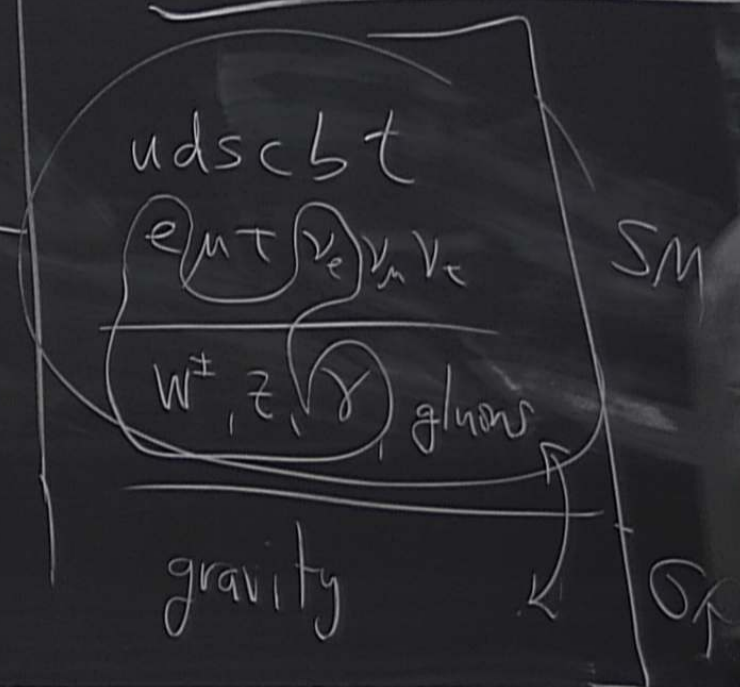


# Cliff Burgess Particle Physics



"Effective Field Theories"

## Standard Model



# Standard Model 1967

u d s c b t

$e, \mu, \tau, \nu_e, \nu_\mu, \nu_\tau$

$W^\pm, Z, \gamma, \text{gluons}$

gravity

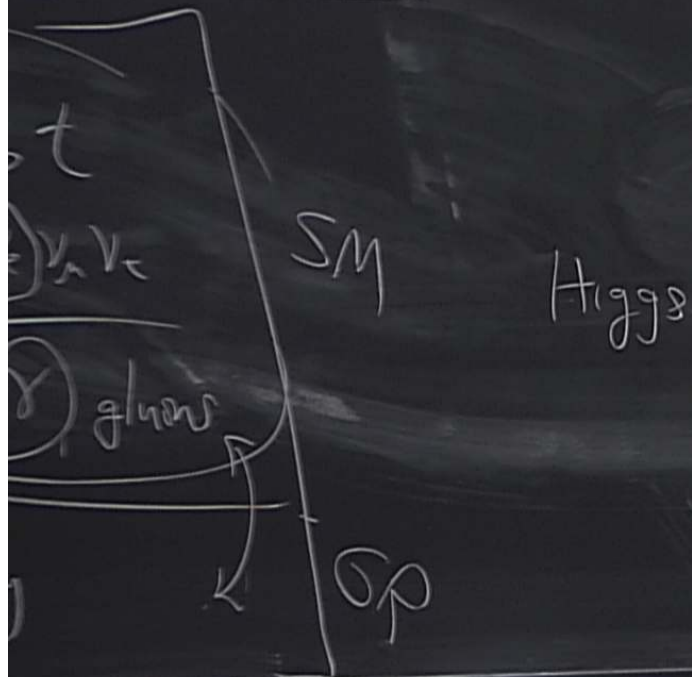
SM

Higgs

OP

- Dark Matter
- Dark Energy
- neutrino masses
- primordial fluctuation

Standard Model 1967



- Dark Matter
- Dark Energy
- neutrino masses
- primordial fluctuations

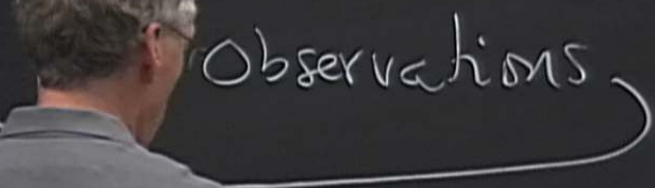
267

993

- Dark Matter
- Dark Energy
- neutrino masses
- primordial fluct

Clues:

Observations



267

ggg

- Dark Matter
- Dark Energy
- neutrino masses
- primordial fluctuations

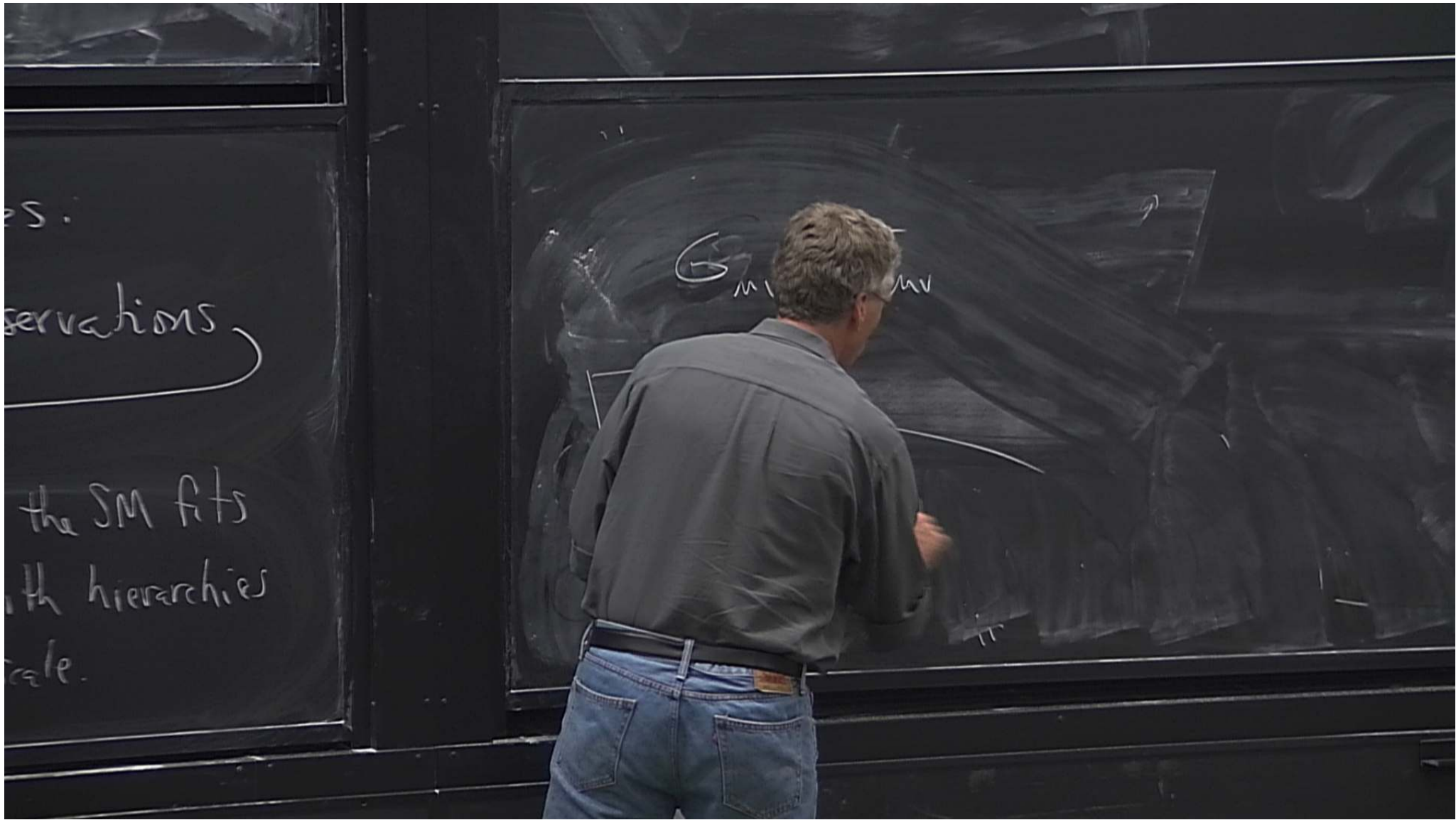


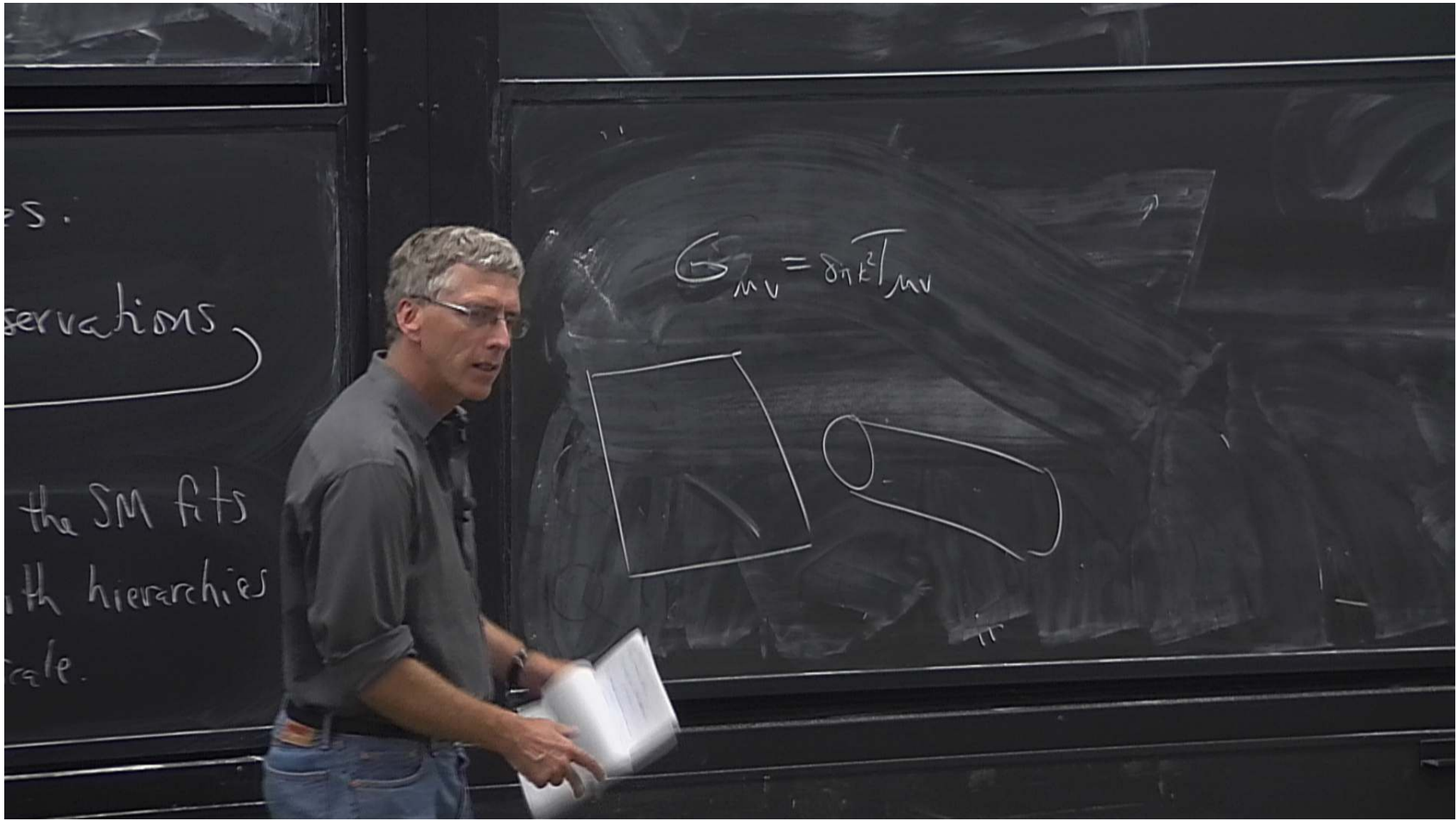
## Clues:

1) Observations

2) How the SM fits in with hierarchies of scale.

$$G_{\mu\nu} = 8\pi k^2 T_{\mu\nu}$$



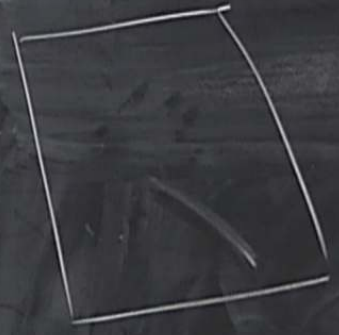


es.

observations

the SM fits  
with hierarchies  
scale.

$$G_{\mu\nu} = 8\pi k^2 T_{\mu\nu}$$

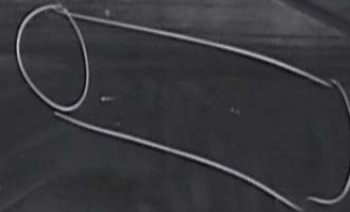


Clues:

1) Observations

2) How the SM fits  
in with hierarchies  
of scale.

$$G_{\mu\nu} = \delta_{\mu\nu} T_{\mu\nu}$$



1967

Higgs

- Dark Matter
- Dark Energy
- neutrino masses
- primordial fluctuations

LHe

Clues:

1) Observations

2) How the SM fits in with hierarchies of scale.

$$G_{\mu\nu} = 8\pi k^2 T_{\mu\nu}$$



Dark Matter.

- galactic rotation curves

$$\rho_{\nu} = \frac{8\pi^2}{3} T_{\nu\nu}$$



## Dark Matter.

- galactic rotation curves
- clusters of galaxies
- formation of structure

$$G_{\mu\nu} = 8\pi k^2 T_{\mu\nu}$$



## Dark Matter.

- galactic rotation curves
- clusters of galaxies  $\leftarrow$  grav-lensing
- formation of structure

## Dark Matter.

- galactic rotation curves
- clusters of galaxies
  - grav-lensing
  - velocities of galaxies
  - X-ray emission
- formation of structure
- 

