LEC 17 POTENTIAL THEORY

31 OCT

WHY SO MUCH EMASP: THIS IS BASE "CULTURAL" GROUNDING HOR ALL PHYSEES

STORY THUS FAR

TANKERT

hanna abyer

CONTRIBUTES.

USUAL SPACE

" moderate for

CALCULUS ON THIS SPACE

differential forms w Contragon lensors

that developes regnute

WHAT IS HINTED (beyOND SCOPE of this class):

GET WEIRD!

CURUSO SPACES -> GR

- sometimes spaces have itsest



HE IS A BOUNDARY

THIS DOWNDARY ...

SO ALL THIS MACHINERY IS GREAT FOR ESM IN CURVED SPACE. (ALSO GEOMETRIC MECHANICS ON CONSTRAINED SYSTEMS!)

	BUT THIS MACHINERY IS ALSO USEFUL IN SPOINARY
may aky sahaninka kisingkin ng 47 ginata dhina Bibbi ng 48 kisingan Afrika kina mak a sagai ga mata	FLAT SPACE CTIME!
والمساورة	
and grade a section of the section o	[EXAT.] > $\vec{\nabla} \times \vec{E} + \vec{B} = 0$ \iff [JF = 0]
ر المواقعة ا	7.8 = 0
- The state of the	
	POINCARE LEMMA: FOR A SMOOTH, CONTRACTIBLE (WICE)
	Maniford C no Moles!],
the state of the s	JW = 0 => W= dp
	L-1 FORM
	K-H FORM
Condess to his the first furnishment of the Condess (Stands (Stands (Stands (Stands (Stands (Stands (Stands (St	FH FORM
	" closed form" "Exact form"
og de procession de la grande por processor de processo de processo de processo de la composição de la compo	The second control of
	comes from a
والمساورة	POTENTIAL P
ر. در سست در در ارداد در	
and the second continues of the second secon	POINCARE SAYS: for suff. mice space, all
en inne bloom film on from the second of	closed forms are exact.
	(Alternatively: closest forms are locally exact)
	GRACT => CLOSED 13 THE GARY PH
nggesand ta sari 14 t tunun geré és ngilligiphonomien de la pap ilme je 44 d novembre designe des sondi.	SINCE 2 (Jay) = 0.
_{тат} у у доргания (1864 год. в 122 год. 223 год. на почето доргания у почето дог. 1964 год. на на на почето почет	
egyp for the engine of a state of the entire	
roads of a fairning of the fifth state are planted among the state had to be full grouped in seaso of an ill regions for the season for the season of the state of the season for the seas	

80: $dF = 0 \Leftrightarrow F = dA$ LELECTROM. POT. $A_{\mu} = (\Psi, \Delta)$

the moment we say EM FIELDS (F > E, B)
come from a potential, we get half
of Maxwell's egns. From CEDOMETRY. PORTRES

You'll spell this out in the HW!

WHAT ABOUT THE PEST OF MAYWELL?

VXB = = 4TT = 4TT 5T

BUT HOW TO WRITE THIS IN A COORDINATE - FREE WAY.

UHS IS NOT JAA ... PHS A IS NOT O

... FURTHER, IT IS NOT A 3-FORM!

INTRODUCE: HODGE STAR X: takes forms

man and the state of the state	X: iF M HAS DIM. ON 3 has a
	K-form (K = n), W, then
	the Hodge star gues
manalistiska shi kalikikar nan 1822/1914 A Farakar wa ya kana canaya kazarini maha wasai A Ja Sa Sa Sa Sa Sa S	
may participate (section of the section of the sect	(*w), an (n-k)-form:
A STATE OF THE STA	ACTION ON BASIS:
	Xdx ^ dx =
	(n-k)! Ndet g Ejiii dx x x x dx n
AND COM, AND ARTHUR AND ARTHUR COMMUNICATION AND ARTHUR A	
_{то} ну (учествення в достигня в дости	COMPENSATE Jawhoian Levi-Cinta (1-K)-form RASIS
og jungsparen gjeggener gjelger med det kritiske til 2000-til 100 for til 100	
	=1 FOR FLAT
والمنافعة	coords x(giii girbk)
marmilians of letter and letters for the letters of	muse metrics
	TO MATCH INDICES.
kanganara makasamunaran nye nye ngaminganakanganan ana sakahar saminahara sakahar saminahara sakahar saminahar	
ika manahan Mahahim ya matu matu mpanya masuna ya maya maya masu masu makini hiki 3 (1 Maja ma 1919).	eg: *dx = dy r dz in 3D Ever
tita taun munimpi ja ja ja jami matemati kan ya taun sana sa Salah Saya ja ja ja ja ja ja ja sa sa sa sa sa sa	Agxida = 495 v9F W AD WINK
e der med er	

SO WHAT. IN NOWS HOW: AND WILL CHECK CHAY

SO REMAINING PART OF MAXIMEN'S GANS
SEEMS TO HAVE A d(xF)

ey dF HAD T.B, so d*F HAS T.E

further, dxF = dxdA

BUT: dxF=d*dA is A 3-FORM.

80 MAXWELL'S REMAINING BOS: 2 = 4TT (1)

BUT BY HODGE STAR, & J IS A 3-FORM IN to J 15 A 1-FORM. V 4D MUNKOWSKI

Mb: this of Dots NOT come from Geometry; IT HAS

	IN PARTICULAR, LXF = 4TT J COMES FOROM
	A LEAST ACTION PRINCIPLE.
announces, arm and a many a many sea or a film again 1 pulse for the first procedure of a shift part () [11 11 () pulse for the first part of the first part	S= ldE L= (d(vai) L
rass essential legal (1 de manuel (1 de legal) de la manuel	NOT bolen our Winkomiski,
	} flus & operative is really great for
may, papa, maramat in maramatan maramatan maramatan maramatan maramatan maramatan maramatan maramatan maramata Maramatan maramatan m	WRITING LABRANGIAMS: 4 is "all the Garm-ness
maasing generating personal mengenter beloemde van die deel die Gebeurk (1960-1969) van die gebeurk (1960-1969) va	you need to make a volume form"
naan qaasharaa aa daalaa aa a	so (FAXF) is a good LAGRANGIAN
	FOR EYM IN ANY DIMENSION.
түү үүлийн арагуучун арагу	COUPUNG CO STURET
	HEURISTICALLY CAMPUTA / SOURCE
	L= JANDEA + 4TT A^J
oggapana, gyym y manegama na panagaman idinaaran lai yinidiinid diilindii di	DERCUATIVE CERMS -> DYNAMICS OF A
ummamamassa ya wasa sarepa isa gili asa sa sa sa da isa da is Isa da isa d	LAATH + AbxbA-~
والمنافذة والمرافضة المنافذة والمنافزة والمناف	
	27 = - dxdA + 41783 = 5
mannananganagainar maana Pilminh (VI) aliilida lalah 2014 majim 19 500	A
enna, d'anner de meneralisa dikanien erek ililikeren. Eller e dele film in dit inner den dikan di	before, non han can go of IM in and grui
	@ thus template Bilbus for any force
оди рене _н а постори стори стори в на постори в	(GRANTEN too, but it's a little more subtle)

MARE NOTES

3. IF J=0, then MAYWOU'S EQUIS
AME COMPLETELY SYMMETERIC:

of it's not clear which eg comes from an action penciple!

-> ELECTROMARNETIC DUALITY

NOT TRUE IT WE HAVE JED BUT

dF = 4Th) drdA = 4Th Im to ?!

> F \pm dA \text{ everywhere!

	F J & MUNDAND OF A
	MENTAL MONOPOLE
- Company	F=dA evoywhere
	X BUT the workpunt
Contractor Constitution Contractor	-> HAVE TO PUNCTURE A HOLE IN THE
The second secon	SPACETIME MANIFOND THAT A LIVES ON.
- CONTRACTOR OF COLUMN	
COUNTY SECTION	THE MOMENT YOU PUNCTURE A HOLE,
07/00/20/00/20	ALL "NICE" THINGS ARE WIT NICE!
-	> breaking Pomoaré lemma

***************************************	& now integrals of 4-forms
-	(like S = SFAXF) pick up the
	boundaries at the princtures.
1	
	=> THE PHYSICS OF MAR. MONOPOLES CAPES AROUT
-	THE TOPOLOGY OF THE SPACETIME MINIPUD
	CONSISTENCY OF THE RESULTING THEORY
	IMPOSES CONDITIONS ON D? JM
-	among them is the femous dirac want- and:
-	19= 8 m = # Z BG % -> SMORL BY 1VV.
-	EM WHAY is A
*A	PERT - NONPERT BYKLEY,

GAUGE REDUNDANCY

GO BACK TO SIMPLE, MONOPOLE-GREE UNIVERSE

F=dA

A Mas a redundancy
GAUGE SYMMETRY

L -> L + d

A -> A 0- \dagger

A -> A + dal

C because ddd =0, F is unchanged

this gauge redundancy gives treedoom to pick

BUT ALSO GIVES PROBLEMS: MORE MARKEMATURAL DEGREES OF PREEDOM THAN PHYSICAL

ey. A PLANT WAVE ~ A, eik.x

POLANIZATION.

1405 4 COMPONENTS...

ONLY 2 ALT PHYSICAL!

7	
(A)	-> 1 COMB is LEFT POLAMIZED
	1 DOMB 1'S PIGHT POLARIZED
The first term of the section of the	1 _st unigiliance, not present
((x,y,y,y,z,z,z)) = ((x,y,y,y,z,z,z,z)) + ((x,y,y,y,z,z,z,z)) + ((x,y,y,y,z,z,z)) + ((x,y,y,z,z,z)) + ((x,y,z,z)) + ((x,y,z)) + ((x,	br massless photon
m/21-09-high Comme with the disconnection and	(T VELTOVER) US EDM, BLEG.
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inella atliminarum Ciril (inella lancia) ramann	the strong of problem
w.P	
	, > G14G + G1G.
	PIEUD STUBNISH
رسوان ساور دو خود و الاستان المعاملية و المعاملة و المع	FOR STRONG FORCE SINCE G B A 2-PORM,
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- 24 miliona propiosa propiosa propiosa por secono e se s	USPACOTIME USACONO CO
	or eight of Enbergy

BUT FOR STRONG FARCE, (non Abelian),
TURNS OUT THAT GIG UND BE MONZERD

@ 00 RECOUSE THE "UNPHYSICK COMPONENTS"
AGE NON ZERD.

but gives an overall pulses

Zeeis (eis) eier

TACT: PHYSICALLY, THIS PHASE WILL

NEFFERENTIATE PARTICLES FROM ANTIPARTICLES

-- SHENS OF THE DIPOLE MOMENT OF

MEUTRON.

YOU dou'nten found

OCE < 10-11

Z> AUGE OPEN ENERGION IN PHYSICS.