Some preliminary thoughts on the invention of constrained Hamiltonian dynamics

Don Salisbury

Austin College

2011 Fall Joint Meeting of the Texas Sections of APS and AAPT

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Some of my recent work related to the roots of constrained Hamiltonian dynamics

- "Peter Bergmann and the invention of constrained Hamiltonian dynamics", in Einstein and the Changing Worldviews of Physics, C. Lehner, J. Renn, and M. Schemmel (eds.) (Birkhauser, 2011), 247-258

- "Léon Rosenfeld's Pioneering Steps Toward a Quantum Theory of Gravity", *Journal of Physics: Conference Series* 222.1 (2010)

- "Translation and commentary of Léon Rosenfeld's 'Zur Quantelung der Wellenfelder', *Annalen der Physik*, 113 (1930)", Max-Planck-Institut für Wissenschaftgeschichte preprint 381, available online at http://www.mpiwg-berlin.mpg.de/en/resources/preprints.html, to appear in the MPIWG Open Access book series

- "Léon Rosenfeld and the challenge of the vanishing momentum in quantum electrodynamics", *Studies in History and Philosophy of Modern Physics* ", 363-373 (2009)

- "Rosenfeld, Bergmann, Dirac and the invention of constrained Hamiltonian dynamics", in *The Eleventh Marcel Grossmann Meeting On Recent Developments in Theoretical and Experimental General Relativity, Gravitation and Relativistic Field Theories*, edited by H. Kleinert, R. Jantzen, and R. Ruffini (World Scientific, New Jersey, 2008) ISBN 978-981-283-426-3, 2467-2469

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The March quantum gravity interview marathon with Dean Rickles

Stanley Deser	*Californian Institute of Technology*
Cecile DeWitt	*University of Texas at Austin*
Ivor and Joanna Robinson	*University of Texas at Dallas*
Charles Misner	*University of Maryland*
Dieter Brill	*University of Maryland*
Louis Witten	*University of Cincinnati*
James Anderson	*Stevens Institute of Technology*
Joshua Goldberg	*Syracuse University*

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Stanley Deser with riff raff

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Joanna and Ivor Robinson

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Louis Witten

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Contents - Book I. (1957/8)

Content page of Dieter Brill's Stephens Meetings Notebook

Contents – Book II (1958-1957)

Apr. 17	Sherr, Direct interaction
May 6	Bleuler, Nuclear structure
	Summary of Phys Rev 110, 336 (rotating body & poln. of l
May 8	Marshak, Galactic acceleration
May 20	Calculation of Sargnac expt with dielectric
May 21	Schwarzschild, stratosphere observation
May 29	Krotkov, Motion of Jupiter
June 4	Rocking ship
	Karren, Spin in General Relativity
	Talk with Bondi on gravitational waves
Aug 3 ff	Varenna meeting
	Heisenberg, Elementary Particles
	Pauli, spin & statistics
	Wightman, Holomorphy domains
	Pauli, Group structure and elem. Part (report onGürs
	Goldhaber, Results on beta decay- interaction
Sept. 24	Lindquist, 2-body problem
Sept 26	Moffat, Equations of motion from field equations
	Fletcher, Conservation laws
	Wheeler, structure of universe
Oct. 7	Pais, Elem. particles
Oct. 7	Misner, on Takeno's plane gravitational waves
Oct 15	Rosen, fuzzy lightcone
Oct. 16	Dicke, Principle of equivalence
oct 20	Urey, Origin of meteorites
	Euwema, Neutrino processes
Oct 21	Telegdi, Beta decay of free neutrons
Oct 28	Relativity conference
	Pirani, definition of energy
	Baldwin (?) Spherical waves in linear approx.
	Dirac, Hamiltonian form of grav'l field equs
	Misner, variational princ, coord, condns.
Oct 29	Harrison, Exact 3-variable solutions in Gen. Rel.
	Fox, Knot theory (Math club)
Nov 5	?(Misner?) Many faces of Schwarzschild
Nov. 7	Steinberger, beat decay of π - meson
Nov 10	Dirac, Quantization of Relativity
Nov 13	Cronin, Parity violation in Hyperon decay
Nov 14	Wightman, Field theory seminar (theory of distributions)
	Wigner, Low-energy nuclear physics
Nov 19	Dirac, cont.
	Klauder, Feynman sum yielding Fermi statistics
Nov 20	Bender, gyromagnetic moment
Nov 21	Wightman, cont.
Nov 24	Dirac, cont.
	Wightman, cont.
Dec 9	Vanuxem lecture, Interior of the earth
Dec 10	Lindquist, non-singular Schwarzschild
Dec 16	Relativity Seminar
	Plebanski, new derivation of Eq. of Motion.
	DeWitt, Remark on space-like description
Jan 6, 1957	Kalabi, some theorems
Jan 13	Bertotti, Pfaff problem in Rainich theory

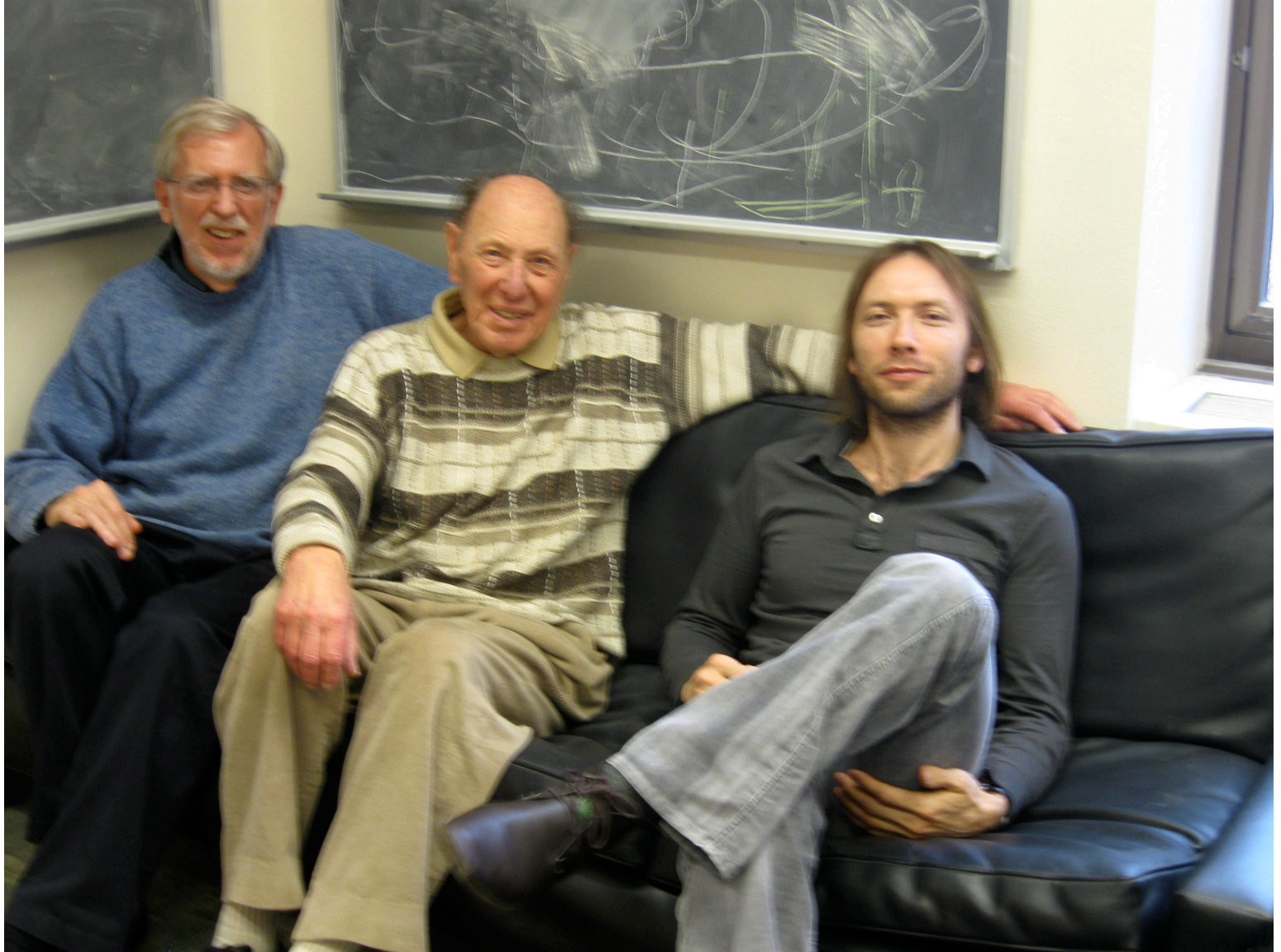Content page of Dieter Brill's Stephens Meetings Notebook

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Jim Anderson

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Stevens Meeting - 1959

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Josh Goldberg

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Four (relatively) independent roads to constrained Hamiltonian dynamics

- Rosenfeld: 1929 - 1930
- Dirac: 1949 - 1950
- Bergmann: 1949 – 1951
- Arnowitt, Deser, and Misner: 1959 - 1962

Later developments

- Dirac: 1958 - 1959
- Komar and Bergmann: 1972

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Some of my recent contributions regarding the group theoretical significance of constrained dynamics

- "Revisiting observables in generally covariant theories in the light of gauge fixing methods", *Physical Review D*, 084015 (2009) (with J. Pons and K. Sundermeyer)
- "The issue of time in generally covariant theories and the Komar-Bergmann approach to observables in general relativity", *Physical Review D*, 12402 (2005)

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