Giorgio Bellettini and the future of physics

Hans Grassmann

for the 90th birthday of Giorgio Bellettini
and the 31th birthday of the top quark

e + 4 jet event

40758_44414

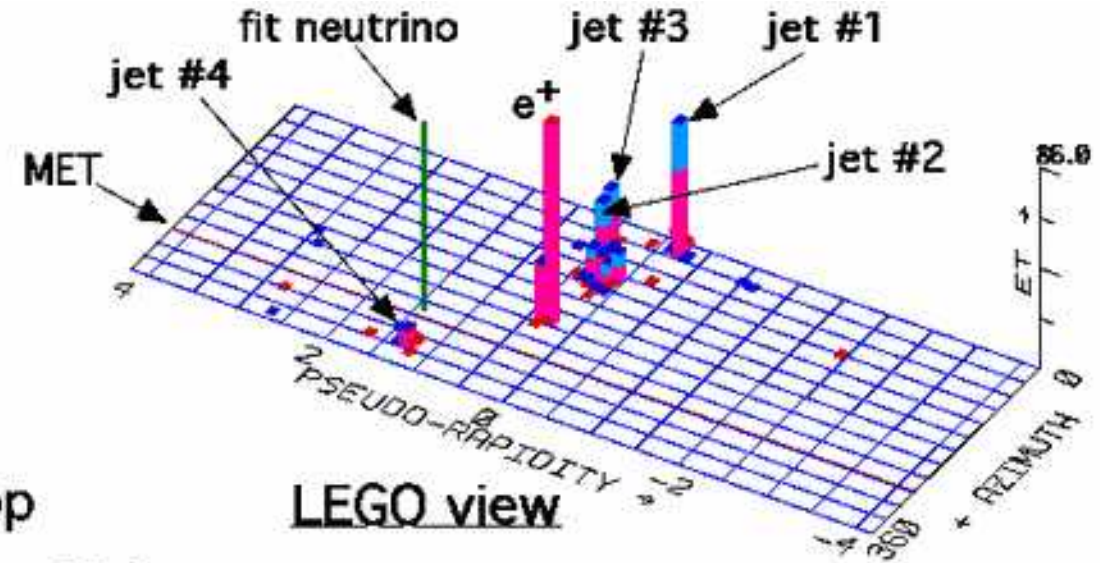
24-September, 1992

TWO jets tagged by SVX

fit top mass is 170 +- 10 GeV

e^+, Missing E_t, jet #4 from top

jets 1,2,3 from top (2&3 from W)



The human being consists 99% of past.

=> future can come only from the past.

Future will necessarily come from the past,

if we look at the past without canceling anything:

The Top Quark at UA1

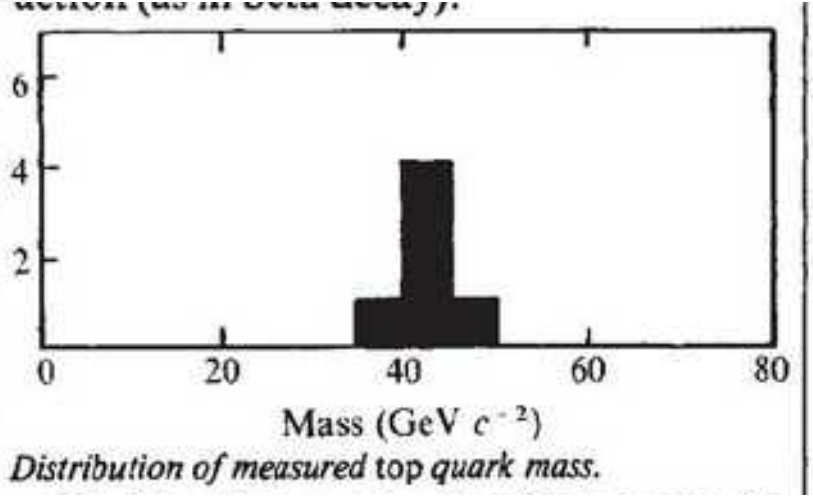
Physics Letters B
Volume 147, Issue 6, 15 November 1984, Pages 493-508

Associated production of an isolated, large-transverse-momentum lepton (electron or muon), and two jets at the CERN pp collider

UA1 Collaboration

Abstract

A clear signal is observed for the production of an isolated large-transverse-momentum lepton in association with two or three centrally produced jets. The two-jet events cluster around the $W^{\pm}$ mass, indicating a novel decay of the Intermediate Vector Boson. The rate and features of these events are not consistent with expectations of known quark decays (charm, bottom). They are, however, in agreement with the process $W \rightarrow t\bar{b}$ followed by $t \rightarrow b\ell\nu$, where t is the sixth quark (top) of the weak Cabibbo current. If this is indeed so, the bounds on the mass of the top quark are 30 $GeV/c^2 < m_t < 550\ GeV/c^2$.



Distribution of measured top quark mass.

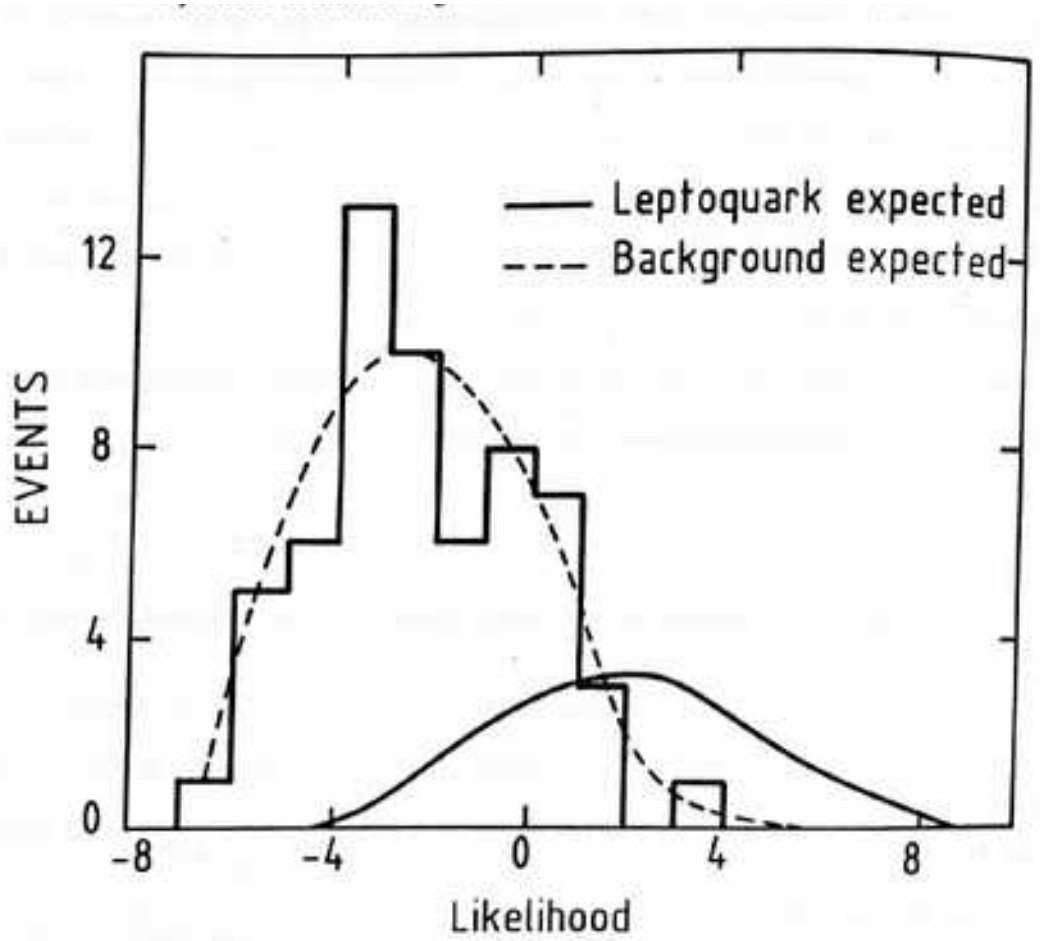


Figure 37: Leptoquark likelihood for single μ events

H.Grassmann, PhD Thesis, University Aachen, 1988

The Top Quark at CDF/Pisa

1) export lepto-quark analysis from UA1, modify and apply it to simulated top events

=> kinematic event structure for the top search.

Combining the event structure with the b-tags would have made the top search much more powerful!

M.Cobal,H.Grassmann,S.Leone, *On Exploiting the Single-Lepton Event Structure for the Top Search*, Il Nuovo Cimento, Vol 107 A.N.I. - Gennaio 1994, pp75-84.

2) study the background = W events

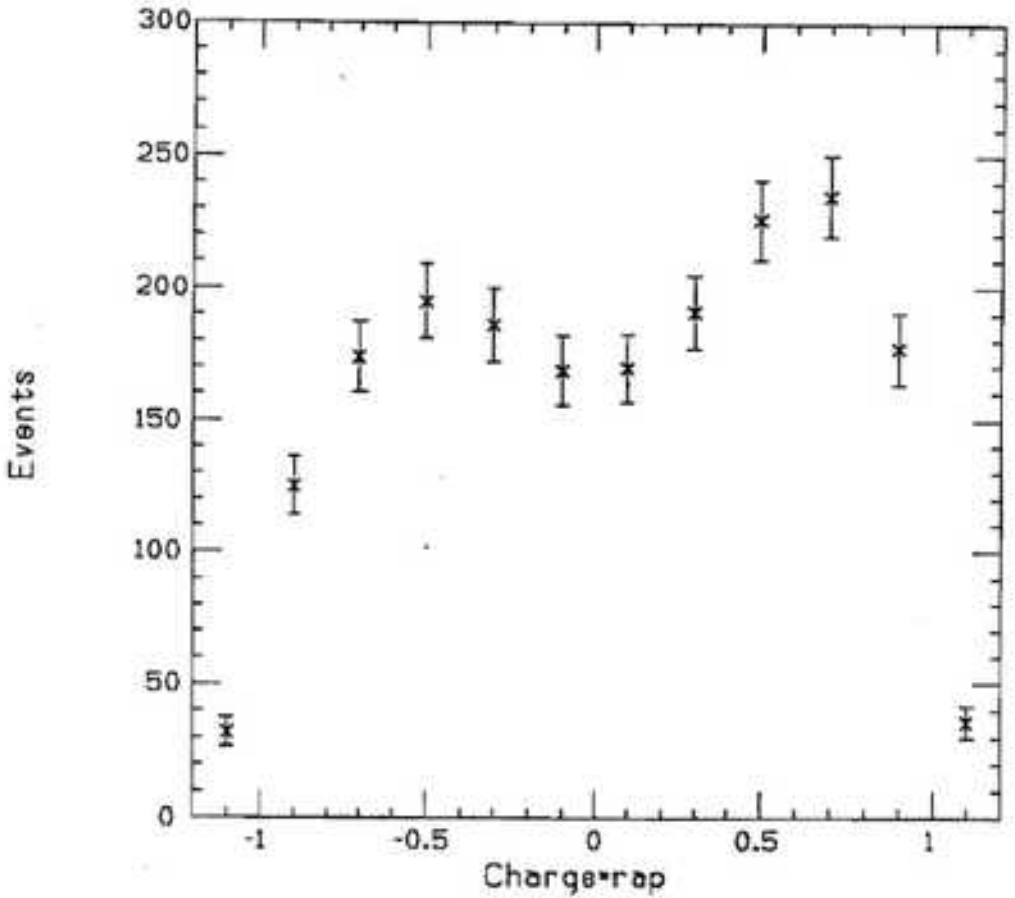


Fig. 6.3 Electron q x η distribution.

→ W charge asymmetry is sensitive to proton structure function.

S.Leone,INFN Pisa, *Lepton Charge Asymmetry from* $W^{+/-} \rightarrow l^{+/-}\nu$ *at the Tevatron Collider*. (1990) CDF/ANAL/ELECfROWEAKlCDFRl1245

CDF:
Phys. Rev. Lett. 68 (1992) 1458
Phys. Rev. Lett. 74 (1995) 850.
Phys. Rev. Lett. 81, (1998) 5754.
Phys. Rev. D 71 (2005) 051104(R)
Phys. Rev. Lett. 102, (2009) 181801
Phys.Rev.D 104 (2021) 9, 092002

D0
Phys.Rev.Lett. 101 (2008) 211801
Phys.Rev.D 77 (2008) 011106
Phys. Rev. D 88, 091102 (2013).
Phys. Rev. D 91, 032007 (2015).

ATLAS:
Eur. Phys. J. C 79, 128 (2019).
Eur. Phys. J. C 77 (2017) 367.
Eur.Phys.J.C 75 (2015) 1, 23
Eur. Phys. J. C 79-760 (2019) 1{25}

CMS
CMS Phys. Rev. Lett. 109, 111806 (2012).
CMS Phys. Rev. D 90, 032004 (2014).
CMS Eur. Phys. J. C 76, 469 (2016).

LHCb
LHCb JHEP 12, 079 (2014)
LHCb JHEP 01, 155 (2016).
LHCb JHEP 10, 030 (2016)

Giorgio Bellettini was not just the old professor who would do some adjustment at the end.

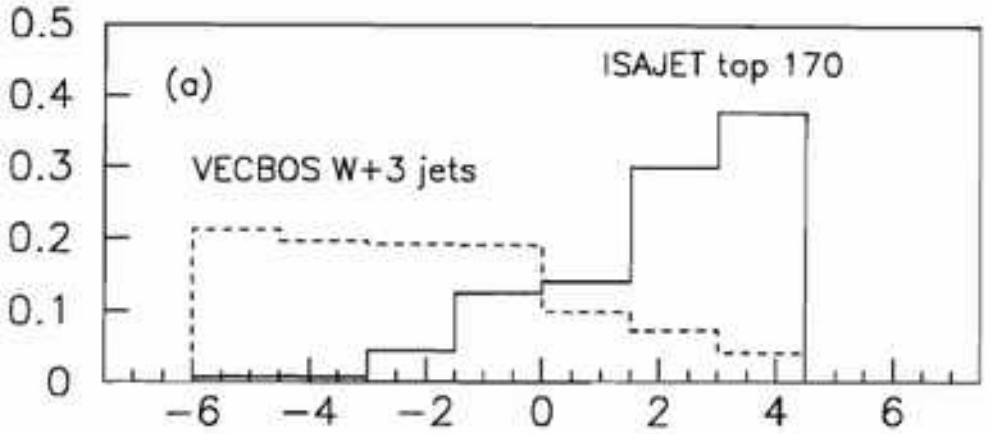
Rather he was fighting together with us and inspired us each day and made us continue even when everything seemed lost.

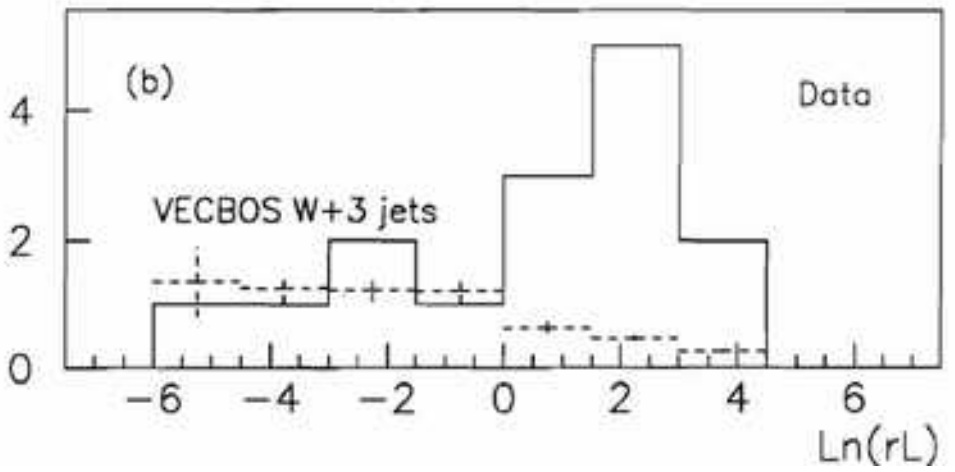
When we applied the event structure analysis, which we previously had published, to the W sample,

a clear top signal was seen.

Giorgio Bellettini succeeded to have a team of godparents assigned to the analysis, they approved publication.

Publication was refused by CDF.





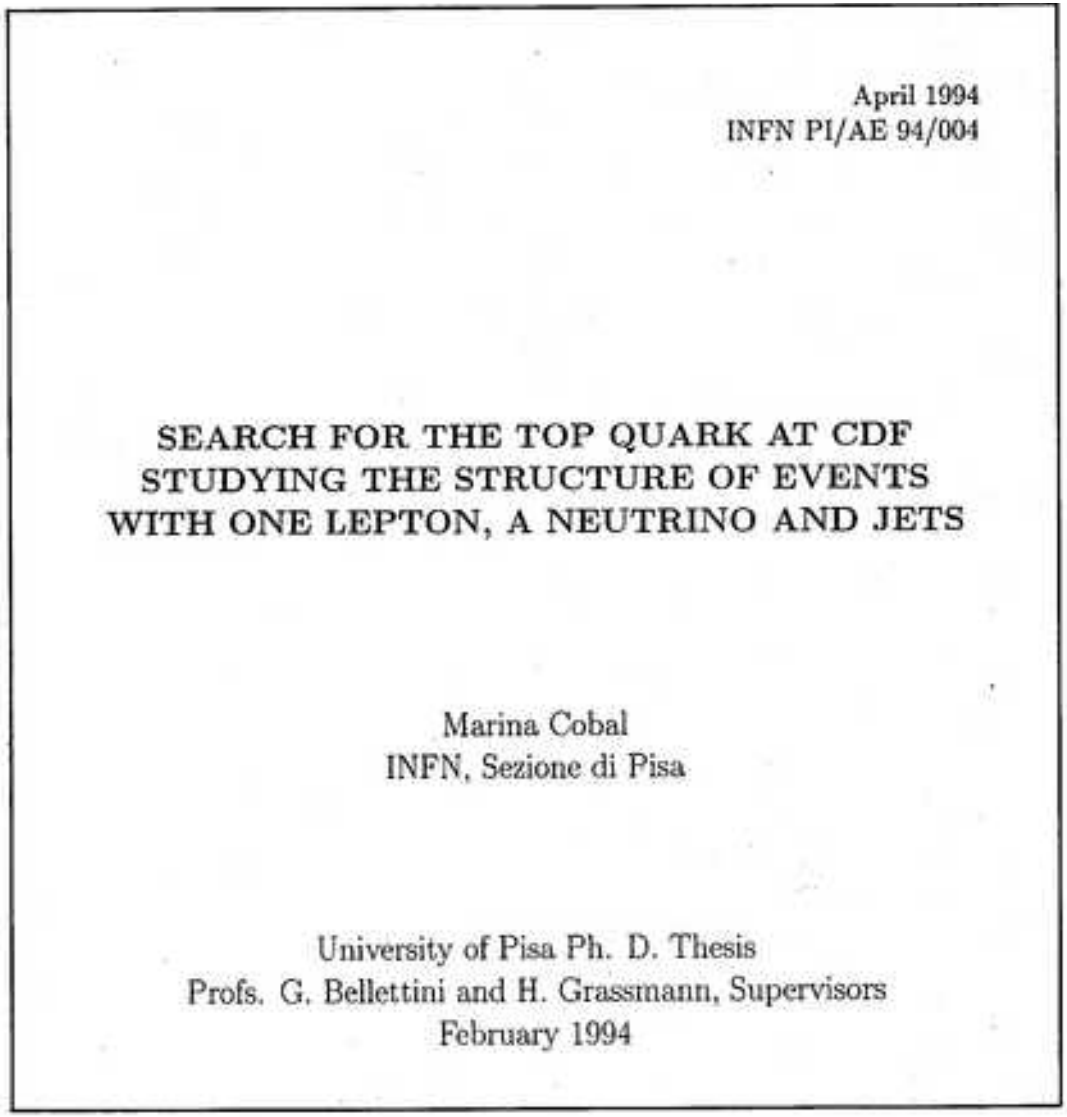
PhD Thesis Marina Cobal.

ln(rL)	JETVTX	SLT	4th jet	lept.
3.3	♠		*	*el*
3.3	♠		*	*el*
2.9			*	μ
2.7	♠	♠	*	μ
1.8				μ
1.3			*	*el*
1.0		♠	*	μ
-2.7	♠	♠		μ
-3.9				*el*
-4.6				*el*
2.4		♠	*	*el*
2.2			*	*el*
1.2				μ
-1.2				*el*
-2.7				*el*

Table 1: *JETVTX and SLT bottom-tags and the values for* $ln(rL^{\prime 170})$ *for the 15 events of the signal sample. The upper section shows the 10 events which have at least one jet which is SVX-taggable (within the geometrical acceptance of the SVX). The asterisks in the third column indicates that there is a 4th jet in the event with* $E_T > 15$

Marina Cobal had to submit her PhD thesis in Feb. 1994, in order to respect the deadlines for PhD students

and Giorgio Bellettini had to register it as an INFN note in order to respect his responsibility towards the INFN.



April 1994
INFN PI/AE 94/004

SEARCH FOR THE TOP QUARK AT CDF STUDYING THE STRUCTURE OF EVENTS WITH ONE LEPTON, A NEUTRINO AND JETS

Marina Cobal
INFN, Sezione di Pisa

University of Pisa Ph. D. Thesis
Profs. G. Bellettini and H. Grassmann, Supervisors
February 1994

In response to the INFN note,
Fermilab management had their employee Morris Binkley write an article of 56 pages (*) :
“the data presented here give evidence for, but do not firmly establish the existence of, $t\bar{t}$ production in $p\bar{p}$ collision at $\sqrt{s} = 1.8\,TeV$. Work is continuing on kinematic analyses of the present data...”

This was about 1 year after the CDF godparents had approved the event structure analysis as being correct.

(*) Physical Review D, Vol. 50 (1994), Evidence for top quark production at $p\bar{p}$ collisions at $\sqrt{s} = 1.8\,TeV$ submitted 25 April 1994

May 1994 the CDF collaboration announced the discovery of the top quark from a primitive counting experiment, without any mention of the work of the Pisa group.

At the same time and with the same significance also D0 announced the top discovery.

F. Abe u. a. Evidence of the top quark production at p-anti p collisions at s=1,8 TeV, Physical Review Letters, Vol. 73, 1994, p225
Submitted 18 May 1994

After this announcement,
Giorgio Bellettini succeeded to get our analysis blessed,

And a few months later we were also allowed to publish it in Phys.Rev.

H.Grassmann, *Kinematical Evidence for Top Paris at the Tevatron*, Nucl.Phys, B (Proc. Suppl.), Proceedings of QCD-94, Montepllier, July 1994.

F. Abe et al., *Kinematic evidence for top quark pair production in W+multi jet events at p-anti p collisions at s=1,8 TeV*, Physical Review D, Vol. 51, 1995, p4623
submitted Dec 1994

F.Abe et al.,*Identification of top quarks using kinematic variables*, Physical Review D, Vol 52 (1995), 2605. submitted April 1995

Giorgio Bellettini has shown
that one can do also nowadays physics,
provided you fight
for your right
to do physics

This is confirmed by the lives of other Italian scientists:

Carlo Rubbia, Adalberto Giazzotto, Giacomo Rizzolatti ...

Many people think that physics has discovered everything by now, physics has become ironic. That physics has come to its end.

Unfortunately it is true, that physics is not the spearhead of intellectual progress anymore, it says nothing about the prime topics of our time:

renewable energies and **artificial intelligence**.

can we find examples for future physics still to be done?

Alessandro Prest

Parsu
Ram
Sharma

M.L.Ganis

Also information theory and -technology would need urgently physics input:

For example:

“The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. **Frequently the messages have meaning; .... These semantic aspects of communication are irrelevant to the engineering problem**. “ (*)

Ray Kurzweil was wrong for the last 30 years, Sam Altman will be wrong for the next 30 years.

(*) Claude E. Shannon: "A Mathematical Theory of Communication", Bell System Technical Journal, Vol. 27, pp. 379–423, 623–656, 1948

A physics of information would be based on mathematical structure (*).

An example for a physics based information processing system was the first level trigger of UA1: no Turing machine and far beyond Shannon.

This principle can be generalized using category theory
=> computing systems can understand what they are seeing or doing, in the same way as the human brain.

(*) H.Grassmann, *Applying physics methods to information theory*, Fras Phys Ser 47, 653-666 (2008) (conference La Thuile)

In non-mathematical language:
the computing system becomes an
“image” of the world it is looking at

The physics of information will
substitute “artificial intelligence”,
the question is only where:
USA? Italy? China?

Conclusion

1) The group created by and led by Giorgio Bellettini has discovered the top quark in 1993.
Also what was presented about renewable energies and the physics of information exists only thanks to Giorgio Bellettini.

2) Italy should be proud of scientists like Bellettini, and allow its young people to become like him.

3) Society and culture need physics, the lack of physics produces disasters and Giorgio Bellettini has shown us, that in order to do physics

we have to fight
for the human right
to do physics.

וַיַּ֣רְא אֱלֹהִ֔ים אֶת־כָּל־אֲשֶׁ֥ר עָשָׂ֖ה וְהִנֵּה־טֹ֣וב מְאֹ֑ד וַיְהִי־עֶ֥רֶב וַיְהִי־בֹ֖קֶר
יֹ֥ום הַשִּׁשִּֽׁי׃ {פ}

And God saw all that had been made, and found it very good. And there was evening and there was morning, the sixth day.