Unnecessary but necessary
- An experience of commitment to Fukushima-

Ryugo S. HAYANO

Physics department, The University of Tokyo
“antimatter” physicist in Fukushima

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<td>10</td>
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</table>

2011, March 11

“antimatter” experiment at CERN

- Team leader since 1997
- No past experience in Radiation Protection
- nor Risk Communication
“antimatter” physicist in Fukushima

- tweeted Fukushima data & graphs, twitter followers from 3000→>150,000
“antimatter” physicist in Fukushima

- Tweeted Fukushima data & graphs,
  twitter followers from 3000→>150,000

2011, March 11
My first graph: Mar 13, 2011, 07:49

Dose rate @ Fukushima Dai-ichi main gate

μSv/h

Ranked 7th among the most influential twitter accounts

source, Tohoku Univ.
20. Steven Pinker, **Cognitive scientist**
145,000 followers [sapinker](http://twitter.com/@sapinker)
Citations: 49,933 K-index: 105
Total number of tweets: 1,674
*Harvard University, United States*

21. Richard Wiseman, **Psychologist**
135,000 followers [@RichardWiseman](http://twitter.com/@RichardWiseman)
Citations: 4,687 K-index: 209
Total number of tweets: 22,600
*University of Hertfordshire, United Kingdom*

22. Ryugo Hayano, **Nuclear physicist**
124,000 followers [hayano](http://twitter.com/@hayano)
Citations: 956 K-index: 319
Total number of tweets: 56,500
*University of Tokyo, Japan*
“antimatter” physicist in Fukushima

† proposed school lunch measurement to MEXT, funded in 2012, continued in 2013, 2014
An example: Fukushima city school lunch
An example: Fukushima city school lunch

Fukushima school lunches are practically free of radiocesium (results of other municipalities are similar).

- \(^{134}\text{Cs detection limit}\)
- \(^{137}\text{Cs detection limit}\)
- \(^{134}\text{Cs detected}\)
- \(^{137}\text{Cs detected}\)

started to serve local rice but Cs-level did not increase
“antimatter” physicist in Fukushima

2011, March 11

Today
“antimatter” physicist in Fukushima

collaborated with MDs in Fukushima to establish reliable WBC measurements
“antimatter” physicist in Fukushima

- collaborated with MDs in Fukushima to establish reliable WBC measurements
- large-scale WBC surveys (contributed to UNSCEAR 2013)
“antimatter” physicist in Fukushima

- Collaborated with MDs in Fukushima to establish reliable WBC measurements
- Large-scale WBC surveys (contributed to UNSCEAR 2013)
- “d-shuttle” (Dr. Miyazaki’s talk)
“antimatter” physicist in Fukushima

- collaborated with MDs in Fukushima to establish reliable WBC measurements
- large-scale WBC surveys (contributed to UNSCEAR 2013)
- “d-shuttle” (Dr. Miyazaki’s talk)
- BABYSCAN
This is how the BABYSCAN looks like
This is how the BABYSCAN looks like
Three BABYSCAN units so far

BABYSCAN: Geographical distribution of the families

Fukushima c.

Minamisoma
July, 2014

n=216

Koriyama c.

Hirata
Dec, 2013

n=293

Iwaki
May, 2014

←Fukushima
Dai-Ichi
~1000 “babies” (<130 cm) measured so far

- Detection limit for $^{134,137}$Cs < 50 Bq/BODY
~1000 “babies” (<130 cm) measured so far

- Detection limit for $^{134,137}\text{Cs} < 50 \text{ Bq/BODY}$

- $^{134,137}\text{Cs}$ NOT detected from any of the ~1000 babies
BABYSCAN is unnecessary
(for radioprotection)
Chernobyl studies infer 100kBq/m² of $^{137}\text{Cs}$ on soil + $^{134}\text{Cs}$ contribution → internal exposure 5 mSv/y?

$^{137}\text{Cs}$ deposition

Bq/m²

(2011/11/5)
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<td>1mSv未満  207, 967人</td>
</tr>
<tr>
<td>1-2 mSv</td>
<td>1mSv  14人</td>
</tr>
<tr>
<td>2-3 mSv</td>
<td>2mSv  10人</td>
</tr>
<tr>
<td>&gt;3 mSv</td>
<td>3mSv  2人</td>
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Internal radiocesium contamination of adults and children in Fukushima 7 to 20 months after the Fukushima NPP accident as measured by extensive whole-body-counter surveys

By Ryugo S. HAYANO,*1,† Masaharu TSUBOKURA,*2 Makoto MIYAZAKI,*3 Hideo SATOU,*4 Katsumi SATO,*4 Shin MASAKI*4 and Yu SAKUMA*4

Actual int. dose << Fukushima-Pref. statistics

June 2011 - July 2014
平成23年6月～平成26年7月 検査人数 207,993人

As of Aug 29, 2014

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99% were ND NOT shown in this graph

As of Aug 29, 2014

CED

<1 mSv
1-2 mSv
2-3 mSv
>3 mSv

n=21785, n=21573 (99.0%)

Frequency

137 Cs concentration (Bq/kg)

Children

Age £15

June 2011 - July 2014

As of Aug 29, 2014

Children

Age £15

99% were ND NOT shown in this graph

~ 1mSv/y

As of Aug 29, 2014
BUT

BABYSCAN is necessary for communicating
December 9, 2011, ASAHI, quoting Y. Bandazhevsky

“20-30 Bq/kg IS serious…

Cs accumulates in the heart muscles to cause cardiac disease”
FASTSCAN: most commonly used WBC
None before the accident
now about 60 such units in use in Fukushima

FASTSCAN detection limit ~ 300 Bq/body

60 kg ~ 5 Bq/kg
15 kg ~ 20 Bq/kg
10 kg ~ 30 Bq/kg

(+ small children cannot stand for 2 min)
3Bq/day (constant) ingestion scenario

Days

Bq/body

- detection limit of typical WBC

- adult
- 15 y
- 10 y
- 5 y
- 1 y
- 3 mo
- We say measure parents!

vs
- We say
  measure parents!

vs

- Mothers say
  please measure our children
BABYSCAN’s detection limit must be low.
3 units have been deployed.
BABYSCAN (1/10 model, May 2013)
more stable face down rather than face up
BABYSCAN (Nov 2013, detector roll in)
BABYSCAN - NOT a baby-friendly device, yet
BABYSCAN: design is an important element

The massive iron shielding is enclosed within a soft plastic cover
Designed by Prof. Shunji Yamanaka, U. Tokyo
BABYSCAN detection limit

Detection limit < $50 \text{ Bq/}\text{BODY}$

Detection limit < $3 \text{ Bq/kg}$
Communication is the key
when asked to fill in a questionnaire sheet...

In 2013, we were...

Much concerned
Concerned
Not much concerned
Not at all concerned

0 20 40 60 80 100

In 2014, we are...

July 2014 - Aug 2014

- water
- rice
- meat
- fish
- vegetable
- mushroom
- milk
- outdoor

Minamisoma
Conclusions

- Despite soil contamination, the internal exposures of 100% children are below the WBC detection limit.
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- Parents with small children are still very much concerned about internal exposures - this motivated us to develop BABYSCAN.
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- BABYSCAN is an important communication tool.
Conclusions

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- Parents with small children are still very much concerned about internal exposures - this motivated us to develop BABYSCAN.

- BABYSCAN is an important communication tool.

  Unnecessary (radiological protection) but necessary (psychosocial)