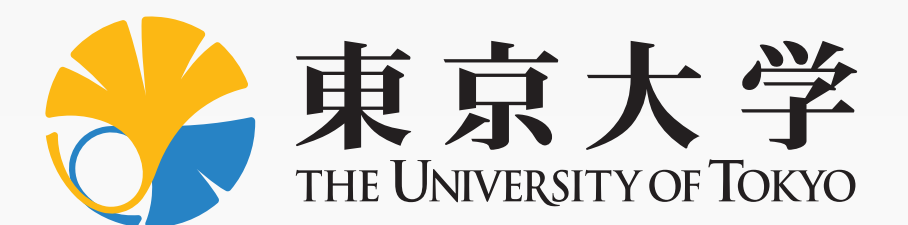


Unnecessary but necessary

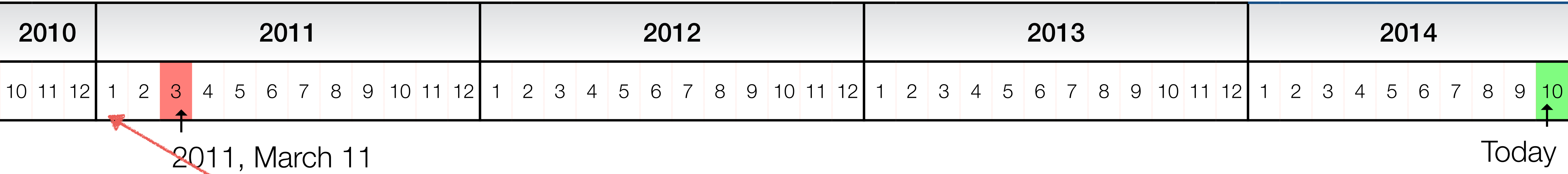
- An experience of commitment to Fukushima-

Ryugo S. HAYANO

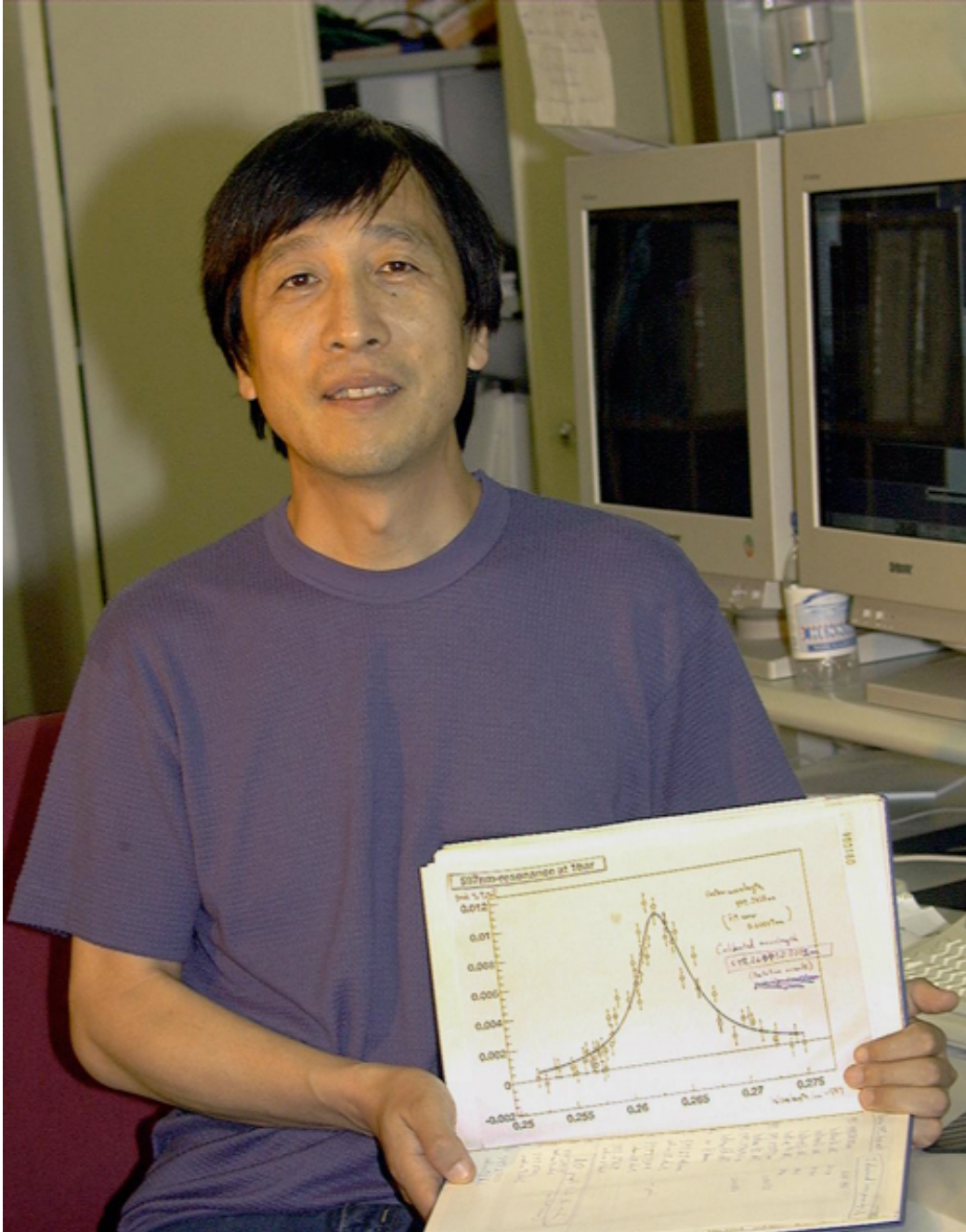
Physics department, The University of Tokyo



1 “antimatter” physicist in Fukushima

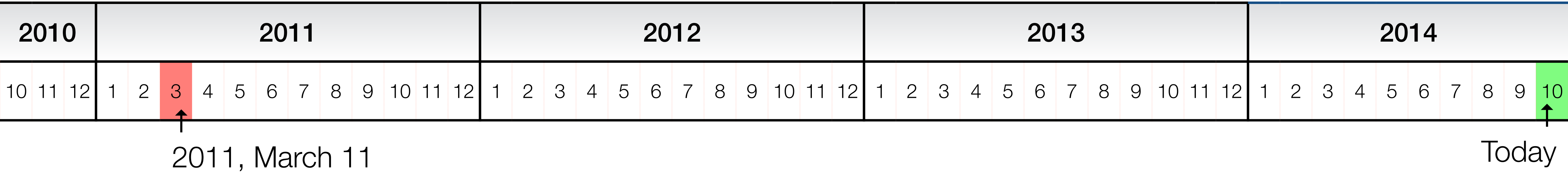


▶ “antimatter” experiment at CERN



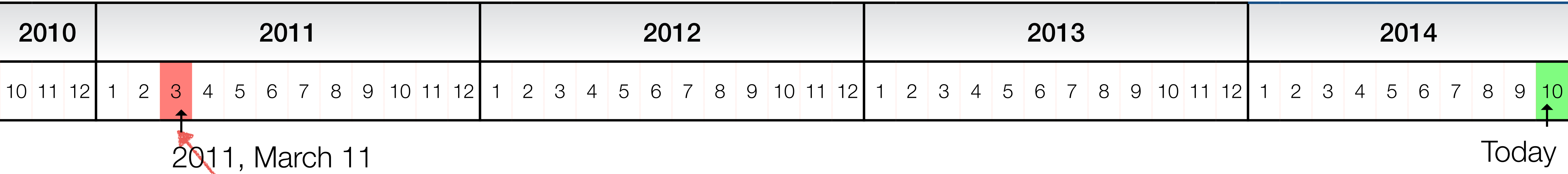
- Team leader since 1997
- No past experience in Radiation Protection
- nor Risk Communication

1 “antimatter” physicist in Fukushima



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

1 “antimatter” physicist in Fukushima

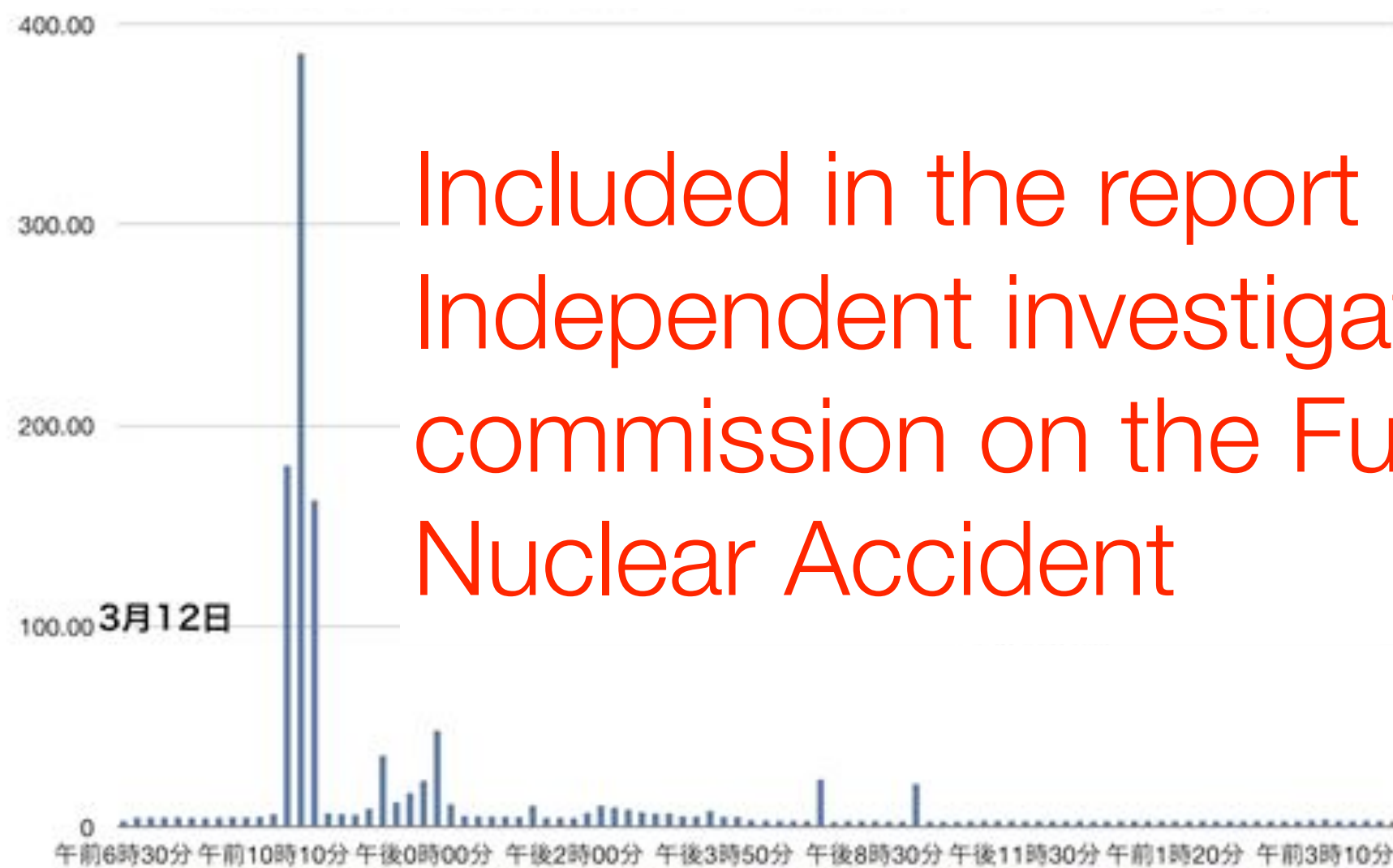


- ▶ tweeted Fukushima data & graphs, twitter followers from 3000 → > 150,000

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



$\mu\text{Sv/h}$ Dose rate @ Fukushima Dai-ichi main gate



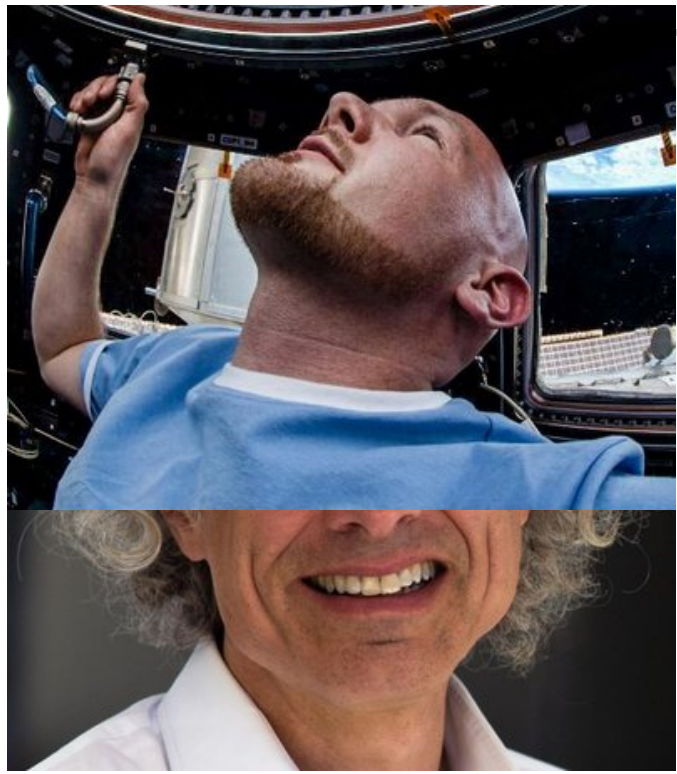
Ranked 7th among the most influential twitter accounts

順位	ユーザ	被RT回数
1	@NHK_PR	630459
2	@nhk_seikatsu	304824
3	@Asahi_Shakai	279259
4	@nhk_news	209515
5	@nhk_HORIJUN	173995
6	@tsuda	165434
7	@hayano	145436
8	@nhk_kabun	127916
9	@earthquake_jp	114806
10	@tohokujishin	112592





Science Magazine Blog top 100 scientists on twitter



20. Steven Pinker, *Cognitive scientist*

145,000 followers [@sapinker](http://twitter.com/@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) (<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*

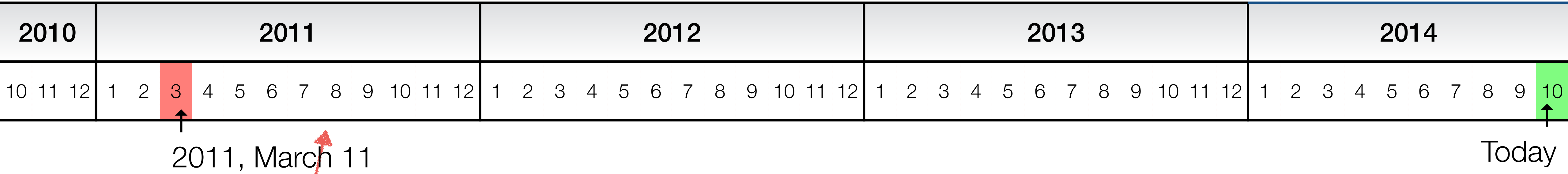
124,000 followers [@hayano](http://twitter.com/@hayano) (<http://twitter.com/@hayano>)

Citations: 956 K-index: 319

Total number of tweets: 56,500

University of Tokyo, Japan

1 “antimatter” physicist in Fukushima



- ▶ proposed school lunch measurement to MEXT, funded in 2012, continued in 2013, 2014

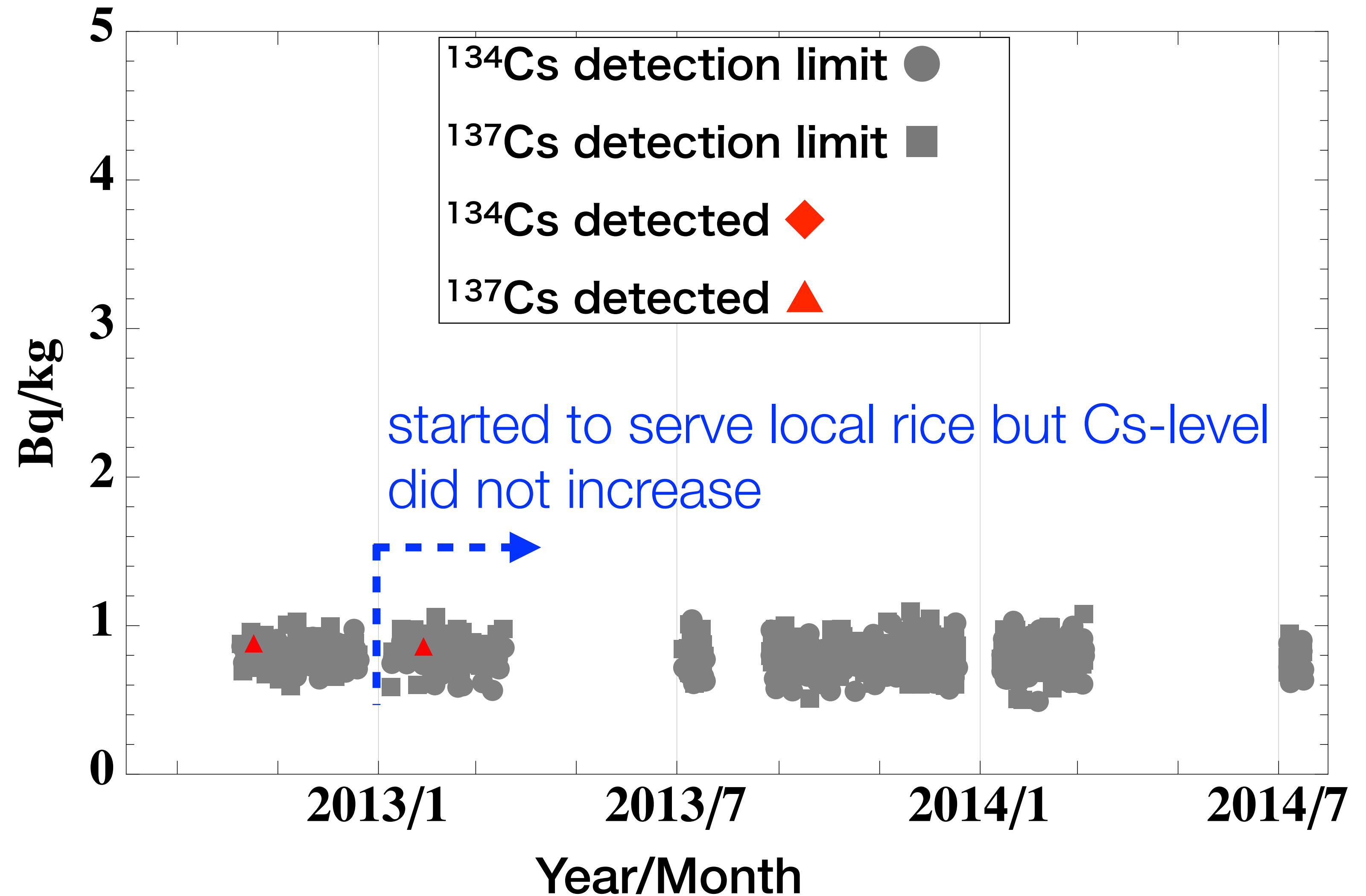
An example: Fukushima city school lunch



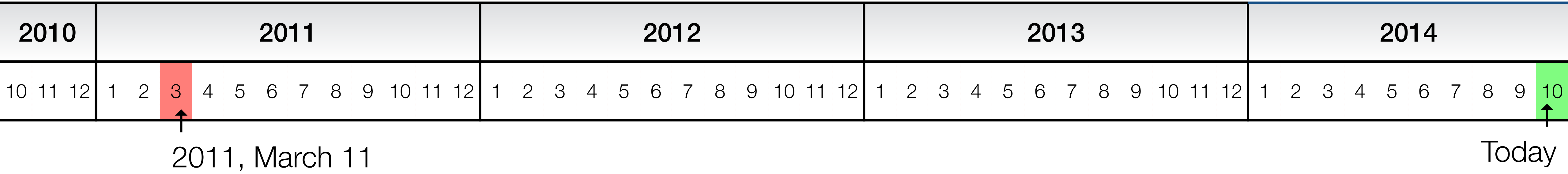
An example: Fukushima city school lunch



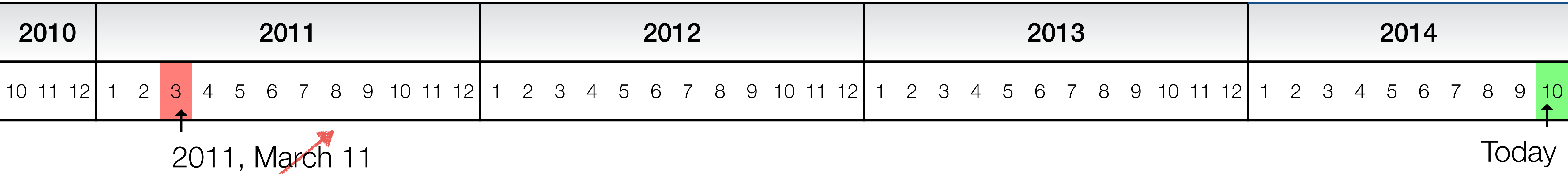
Fukushima school lunches are practically free of radiocesium (results of other municipalities are similar)



1 “antimatter” physicist in Fukushima

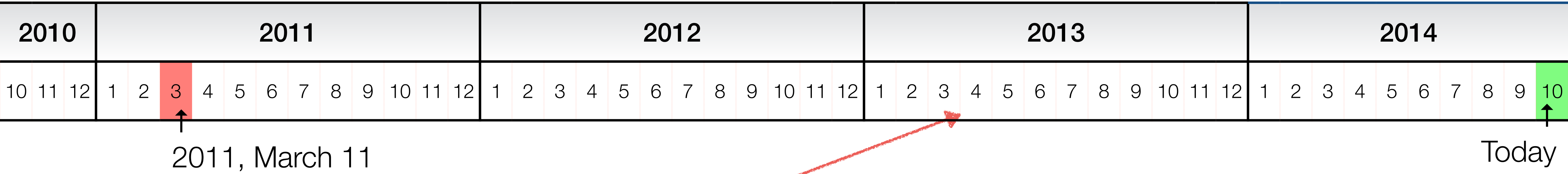


1 “antimatter” physicist in Fukushima



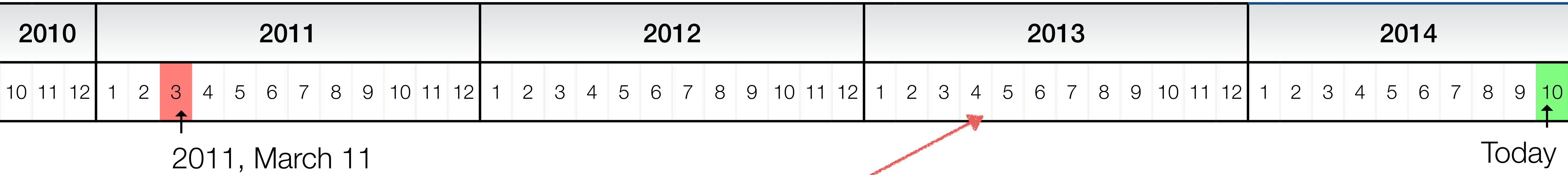
- ▶ collaborated with MDs in Fukushima to establish reliable WBC measurements

1 “antimatter” physicist in Fukushima



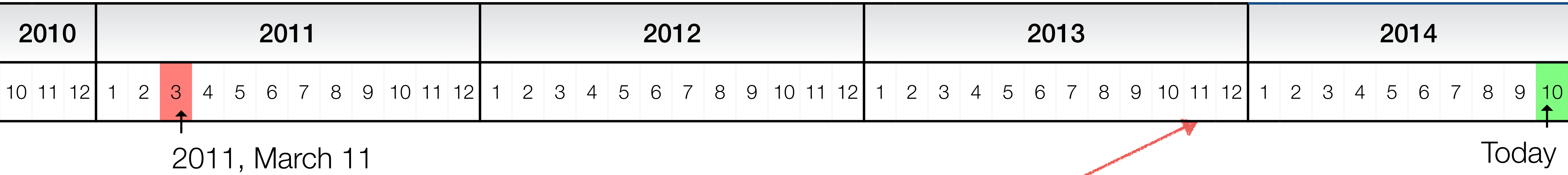
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- ▶ large-scale WBC surveys (contributed to UNSCEAR 2013)

1 “antimatter” physicist in Fukushima



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- ▶ large-scale WBC surveys (contributed to UNSCEAR 2013)
- ▶ “d-shuttle” (Dr. Miyazaki’s talk)

1 “antimatter” physicist in Fukushima



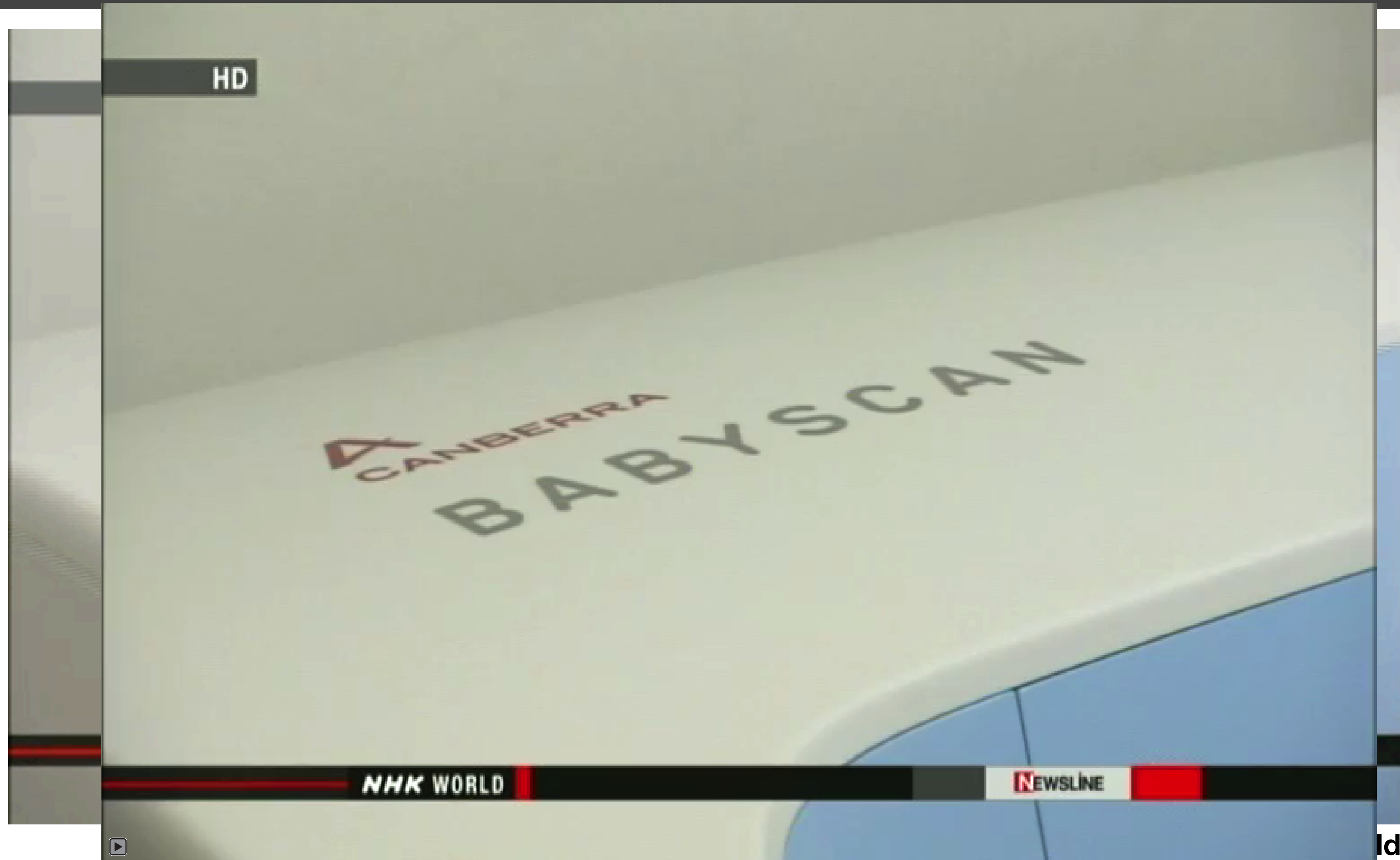
- ▶ collaborated with MDs in Fukushima to establish reliable WBC measurements
- ▶ large-scale WBC surveys (contributed to UNSCEAR 2013)
- ▶ “d-shuttle” (Dr. Miyazaki’s talk)
- ▶ BABYSCAN

This is how the BABYSCAN looks like



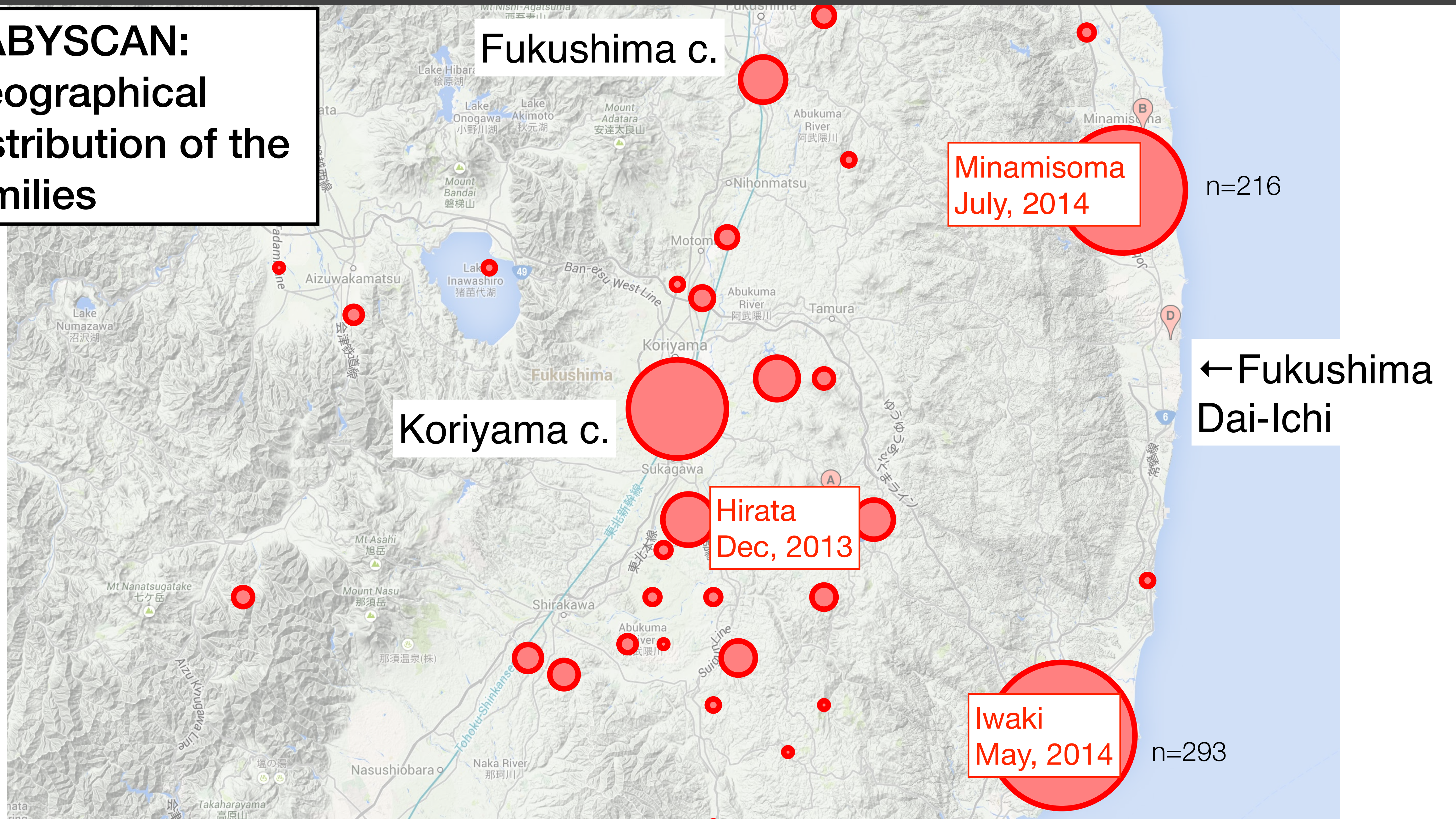
Courtesy, NHK World

This is how the BABYSCAN looks like



Three BABYSCAN units so far

**BABYSCAN:
Geographical
distribution of the
families**



~1000 “babies” (<130 cm) measured so far

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

~1000 “babies” (<130 cm) measured so far

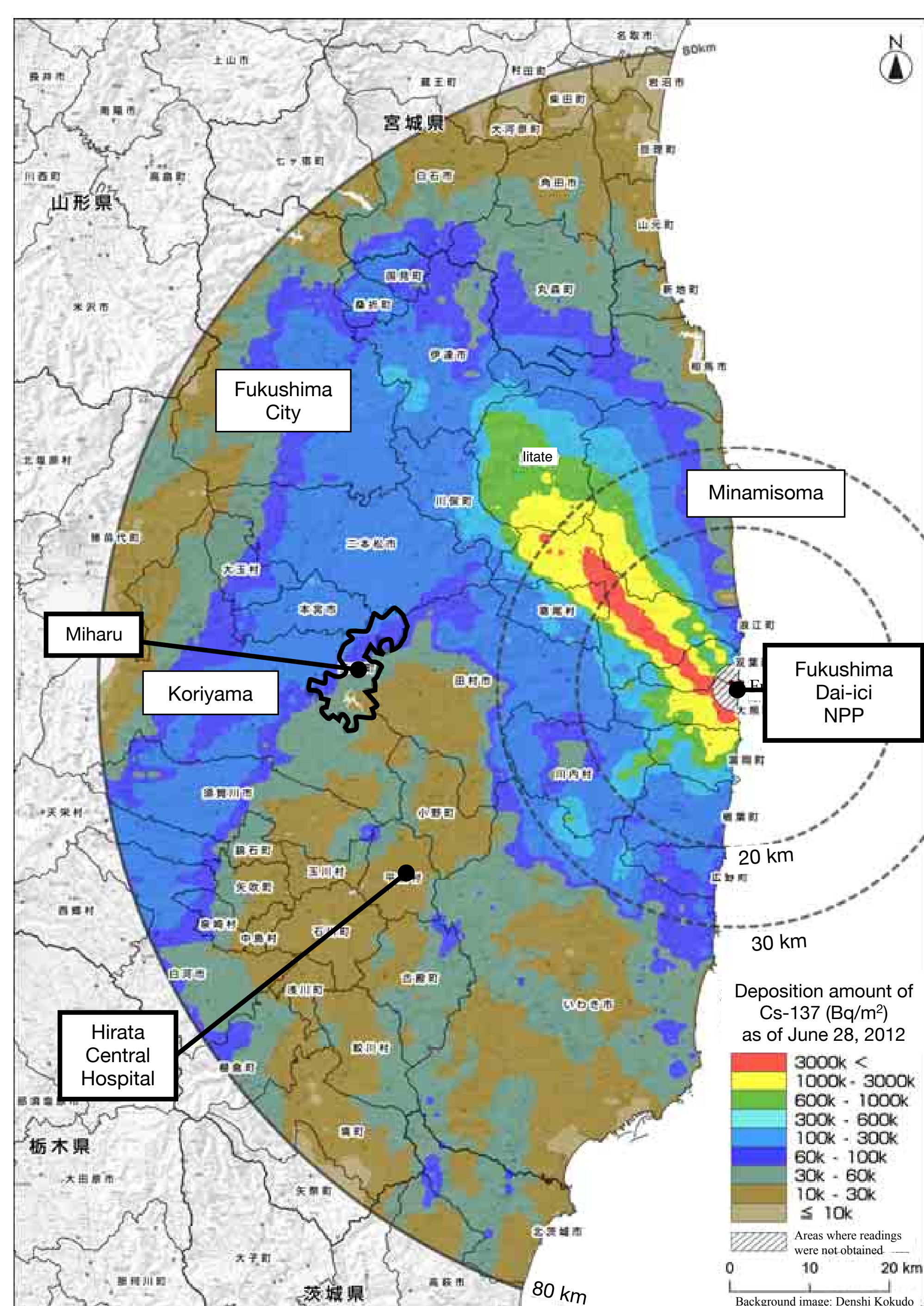
- ▶ Detection limit for $^{134,137}\text{Cs}$ < 50 Bq/**BODY**
- ▶ $^{134,137}\text{Cs}$ **NOT** detected from any of the ~1000 babies

2

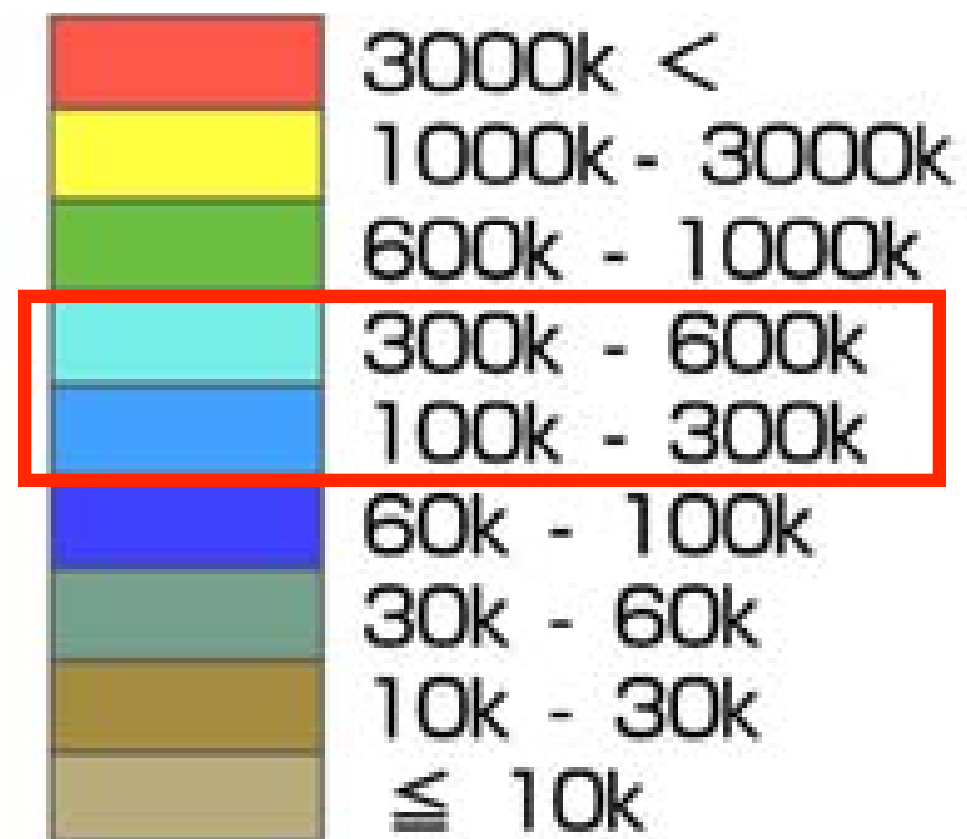
BABYSCAN is unnecessary

(for radioprotection)

Chernobyl studies infer-
 100kBq/m² of ¹³⁷Cs on soil
 + ¹³⁴Cs contribution
 → internal exposure 5 mSv/y ?



¹³⁷Cs deposition
 Bq/m²
 (2011/11/5)



Fukushima-Pref. statistics



June 2011 - July 2014

平成23年6月～平成26年7月

検査人数

As of Aug 29, 2014

207,993人

検査結果

CED

預託実効線量

<1 mSv

1mSv未満 207,967人

1-2 mSv

1mSv 14人

2-3 mSv

2mSv 10人

>3 mSv

3mSv 2人

**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

99% were ND
NOT shown in this graph

June 2011 - July 2014

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平成23年6月~平成26年7月

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~ 1mSv/y

3

BUT
BABYSCAN is necessary for
communicating

20-30 Bq/kg (in body) dangerous... ?

プロメテウスの罠わな

学長の逮捕 ②

チエルノバイリ被災者の研究を続けるゴメリ医科大学の元学長、バンダジエフスキー(54)は警告する。

「1㎡当たり20〜30μSvの放射能は、体外にあれば大きな危険はありません。それが内部被曝で深刻なのは、全身の平均値だからです。心筋細胞はほとんど分裂しないため放射能が蓄積しやすい。子供の心臓は全身平均の10倍以上ということもある

のです」

実際はどうか。チエルノバイリ発から約30kmのプリピャチ市から130kmほど離れたキエフ市郊に移住した人たちに聞いた。

1986年4月26日。その日は曜日で暑い日だった。未明にチ

December 9, 2011, ASAHI, quoting Y. Bandazhevsky

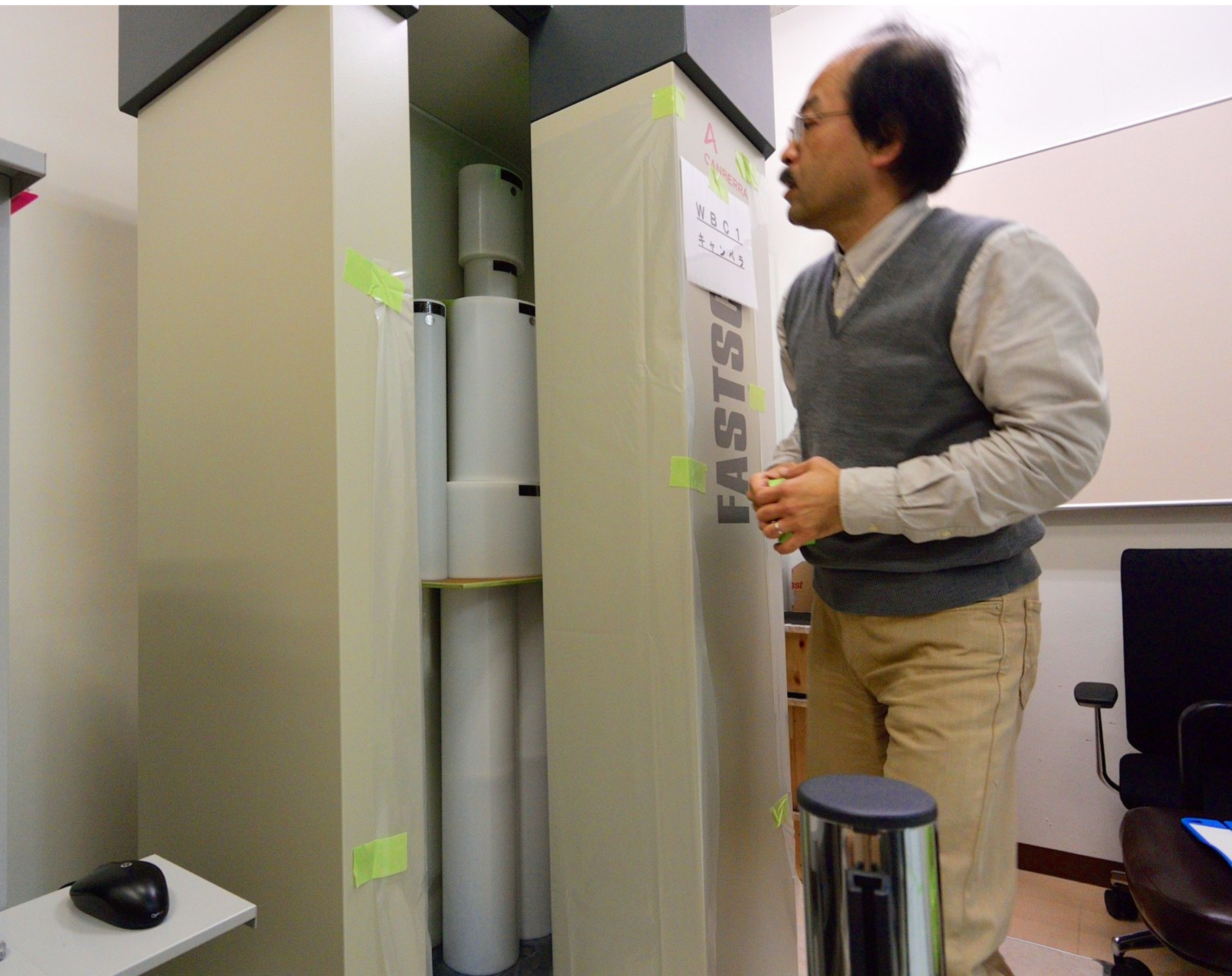
“20-30 Bq/kg IS serious...”

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

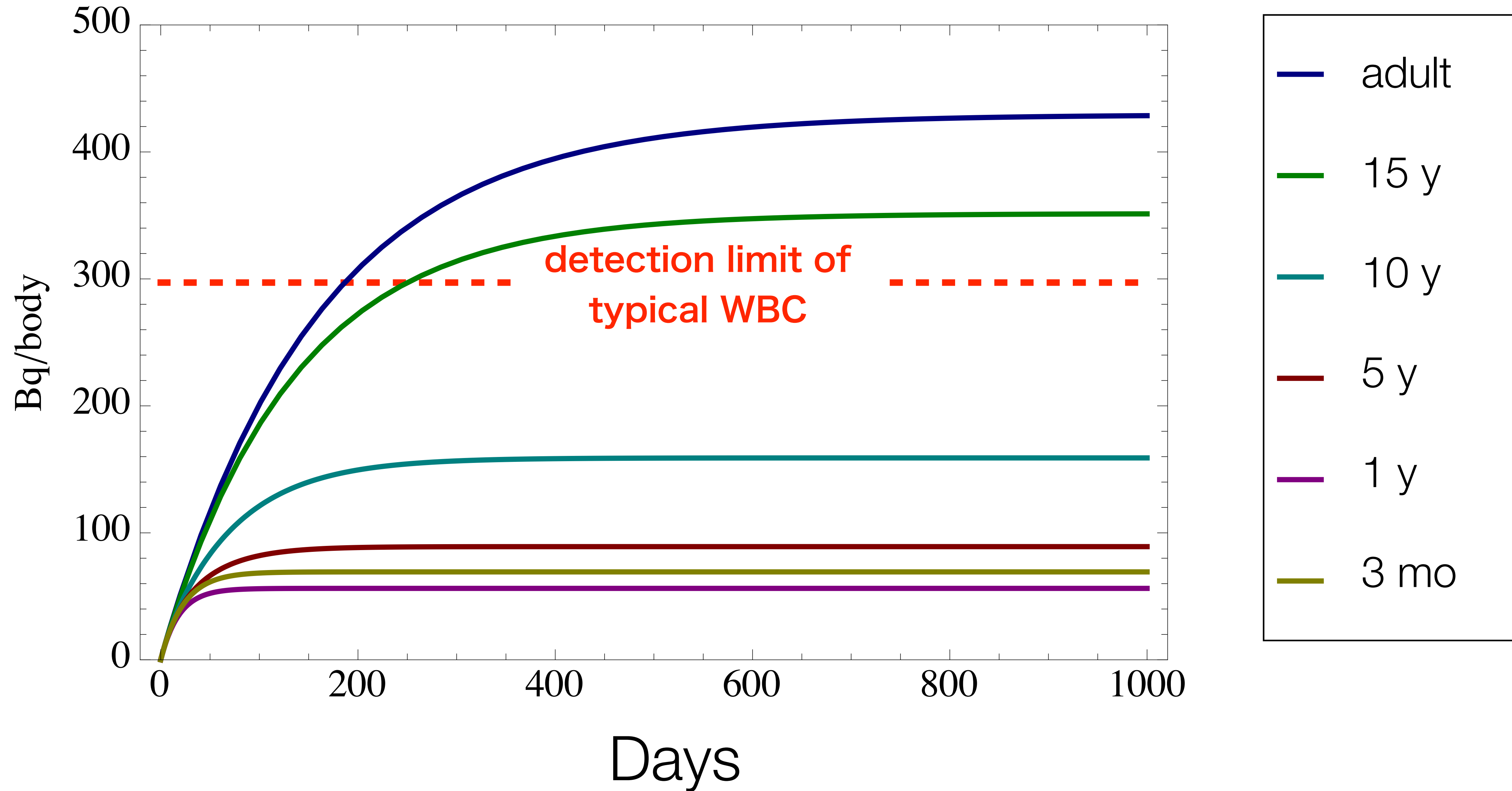
?

15 kg ~ 20 Bq/kg

10 kg ~ 30 Bq/kg

(+ small children cannot stand for 2 min)

3Bq/day (constant) ingestion scenario



– We say
measure parents!

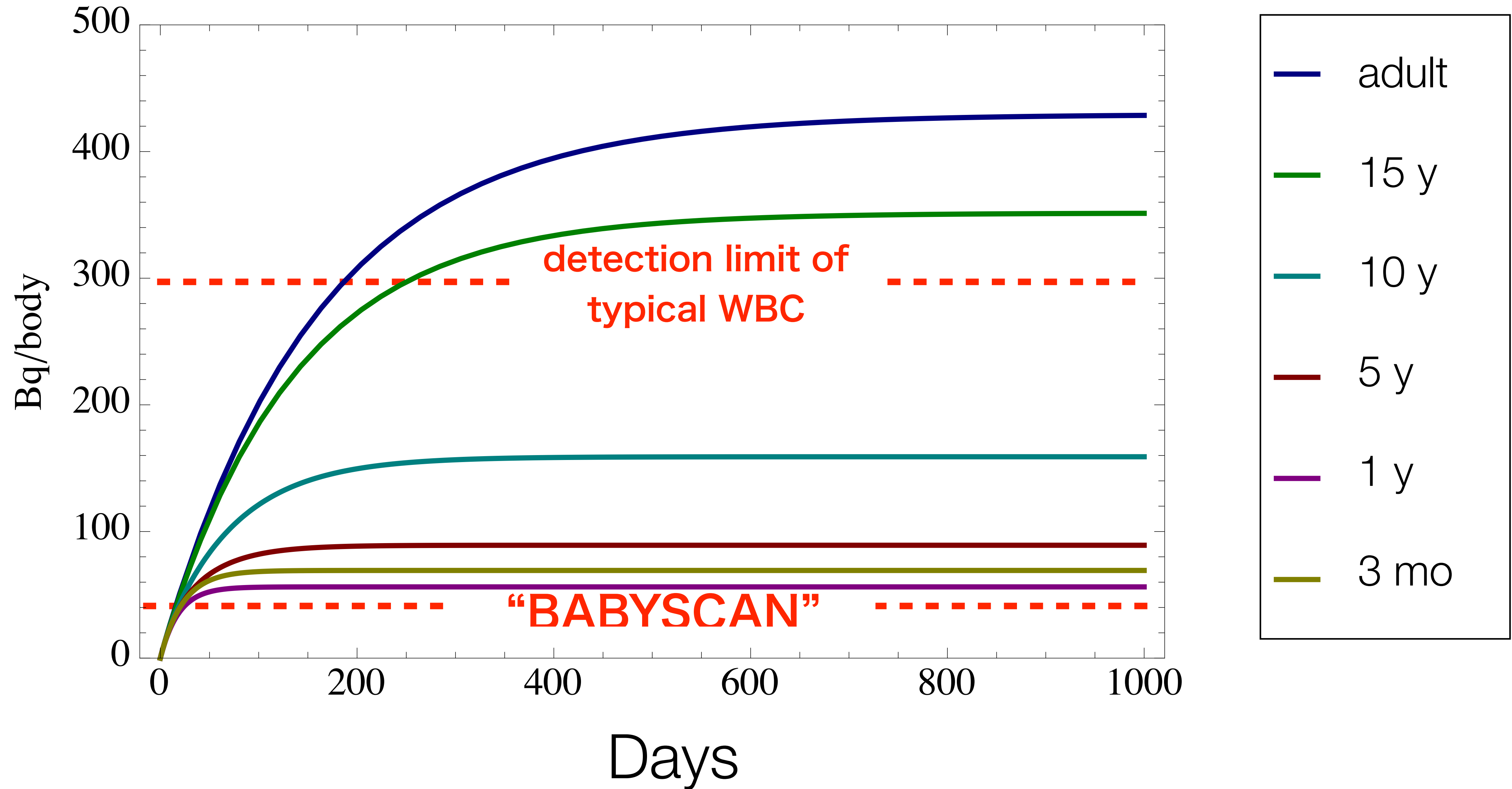
VS

- We say
measure parents!

vs

- Mothers say
please measure our children

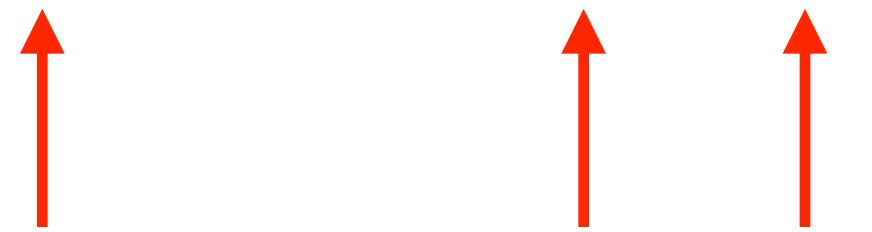
BABYSCAN's detection limit must be low



2010			2011												2012												2013												2014									
10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10												

← Development →

3 units have been deployed



BABYSCAN (1/10 model, May 2013)



BABYSCAN (wooden model July 2013)

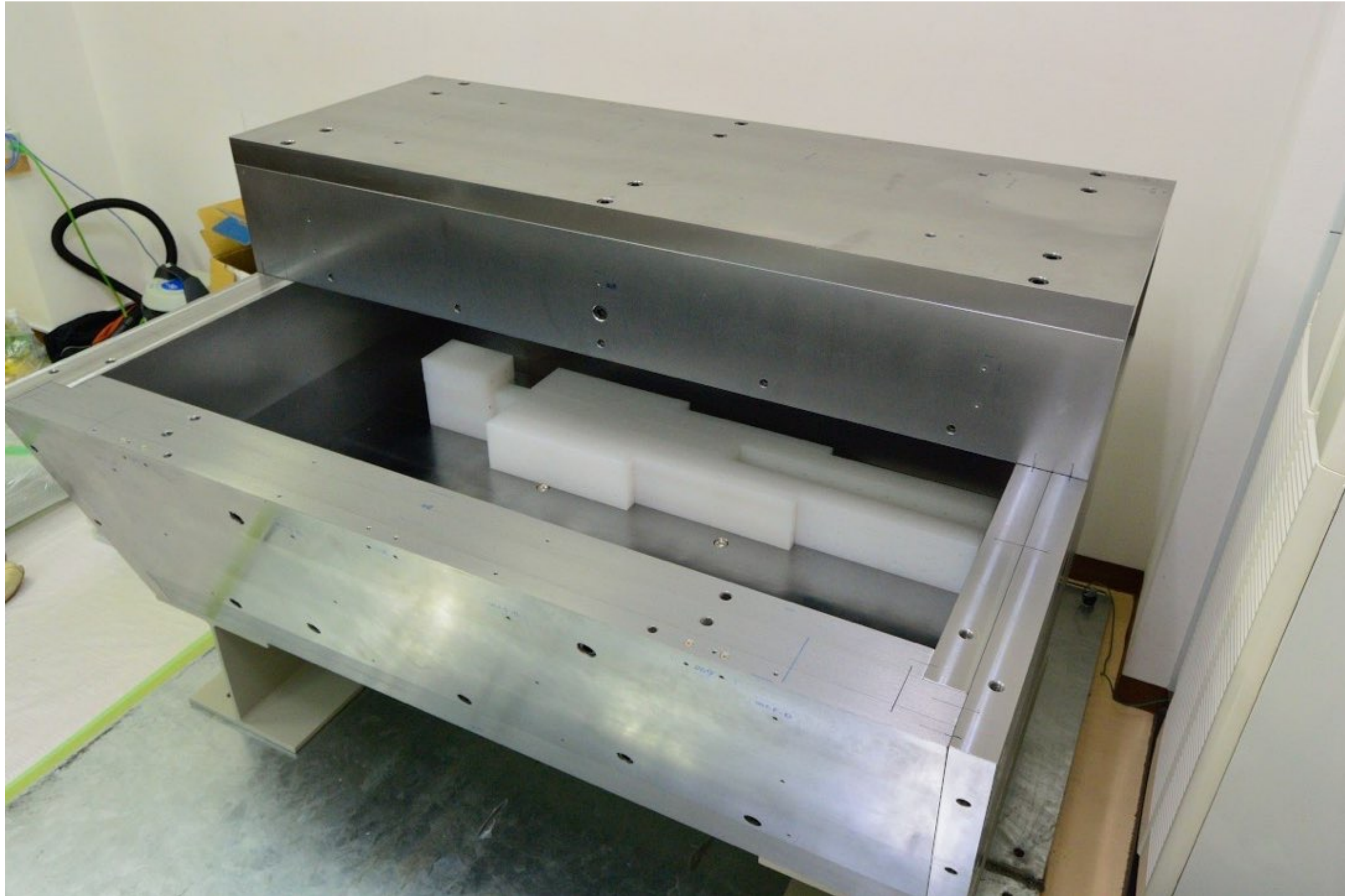


more stable face down rather than face up

BABYSCAN (Nov 2013, detector roll in)



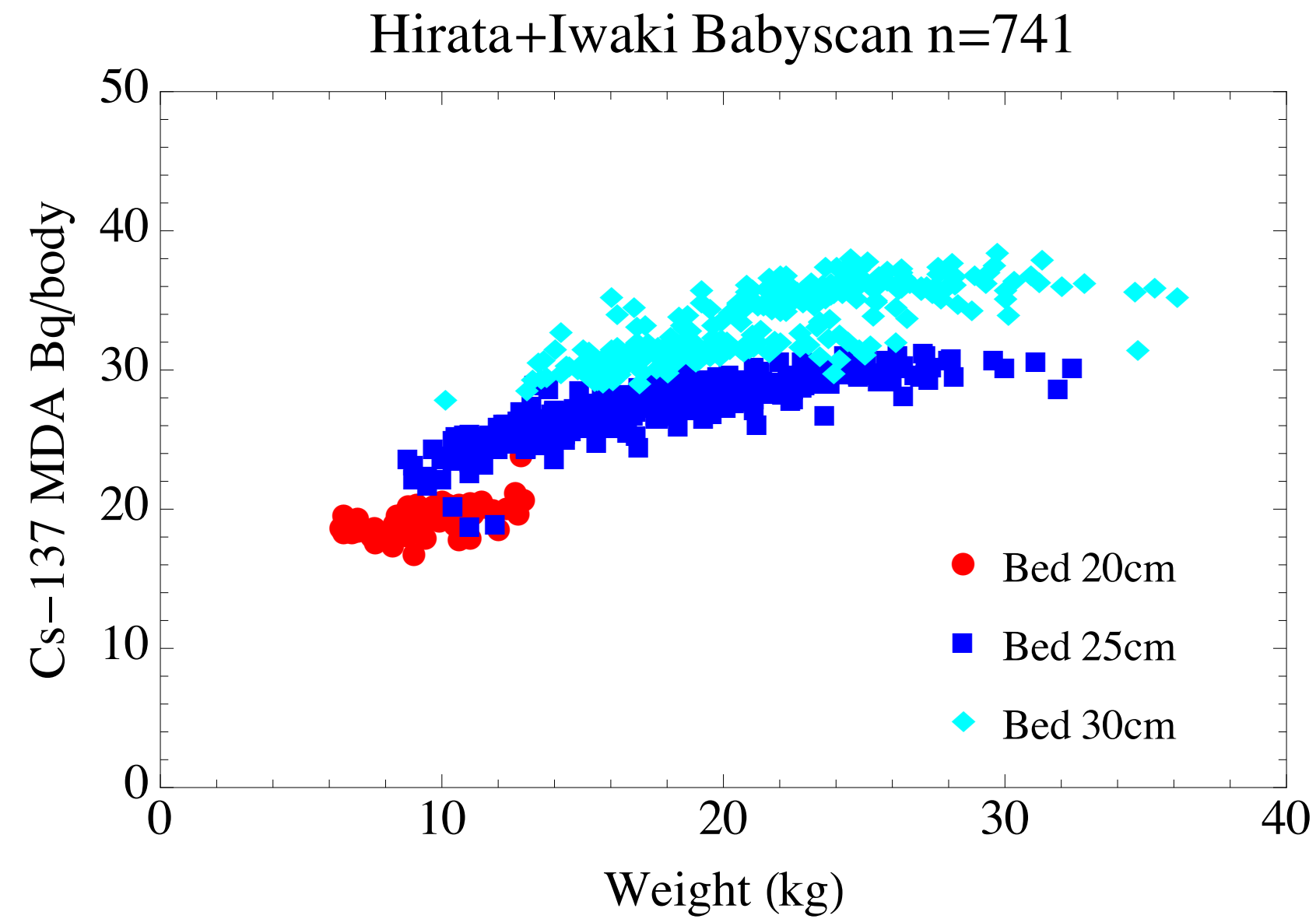
BABYSCAN - NOT a baby-friendly device, yet



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

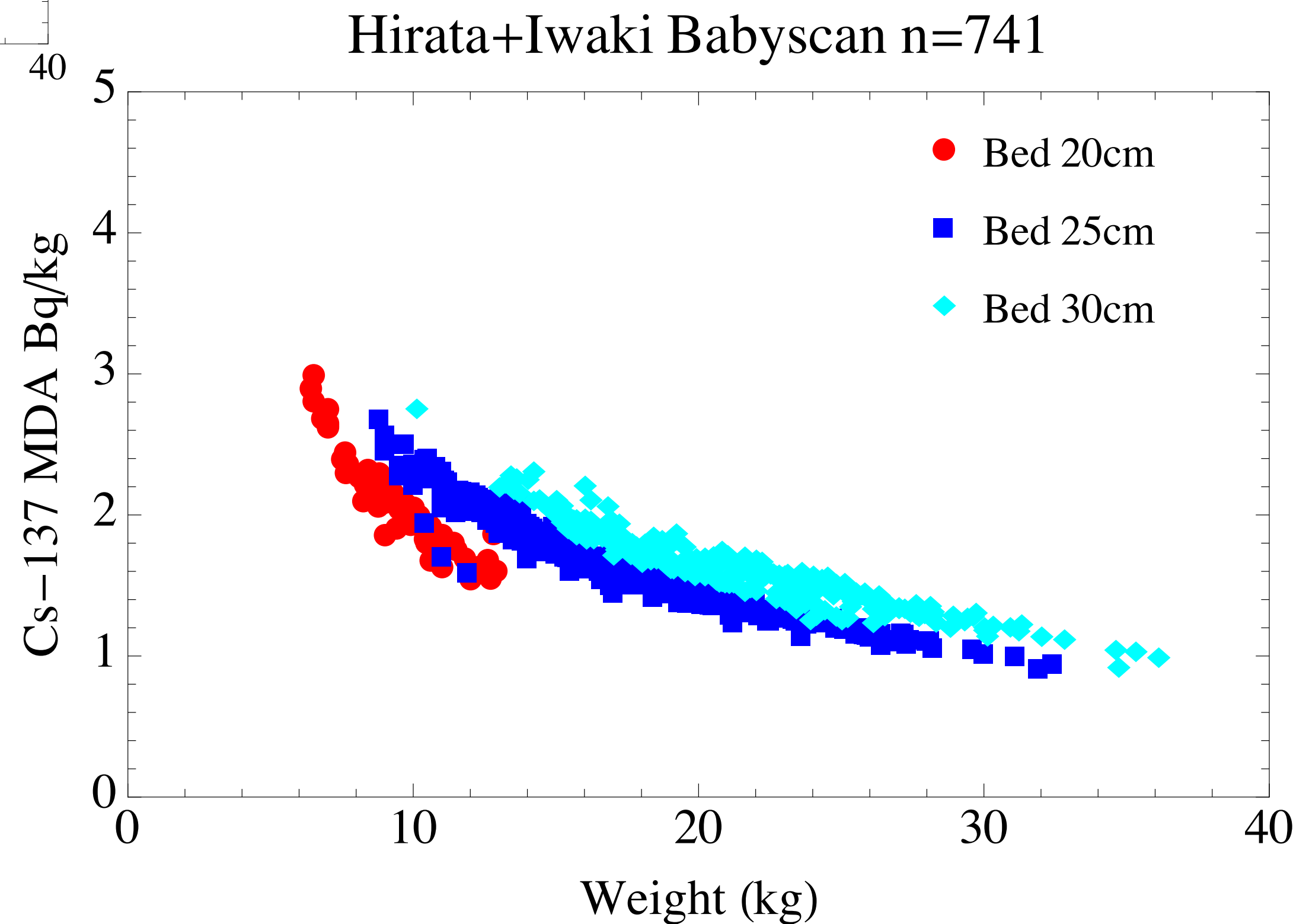


BABYSCAN detection limit



← Detection limit < 50 Bq/**BODY**

Detection limit < 3Bq/**kg** →

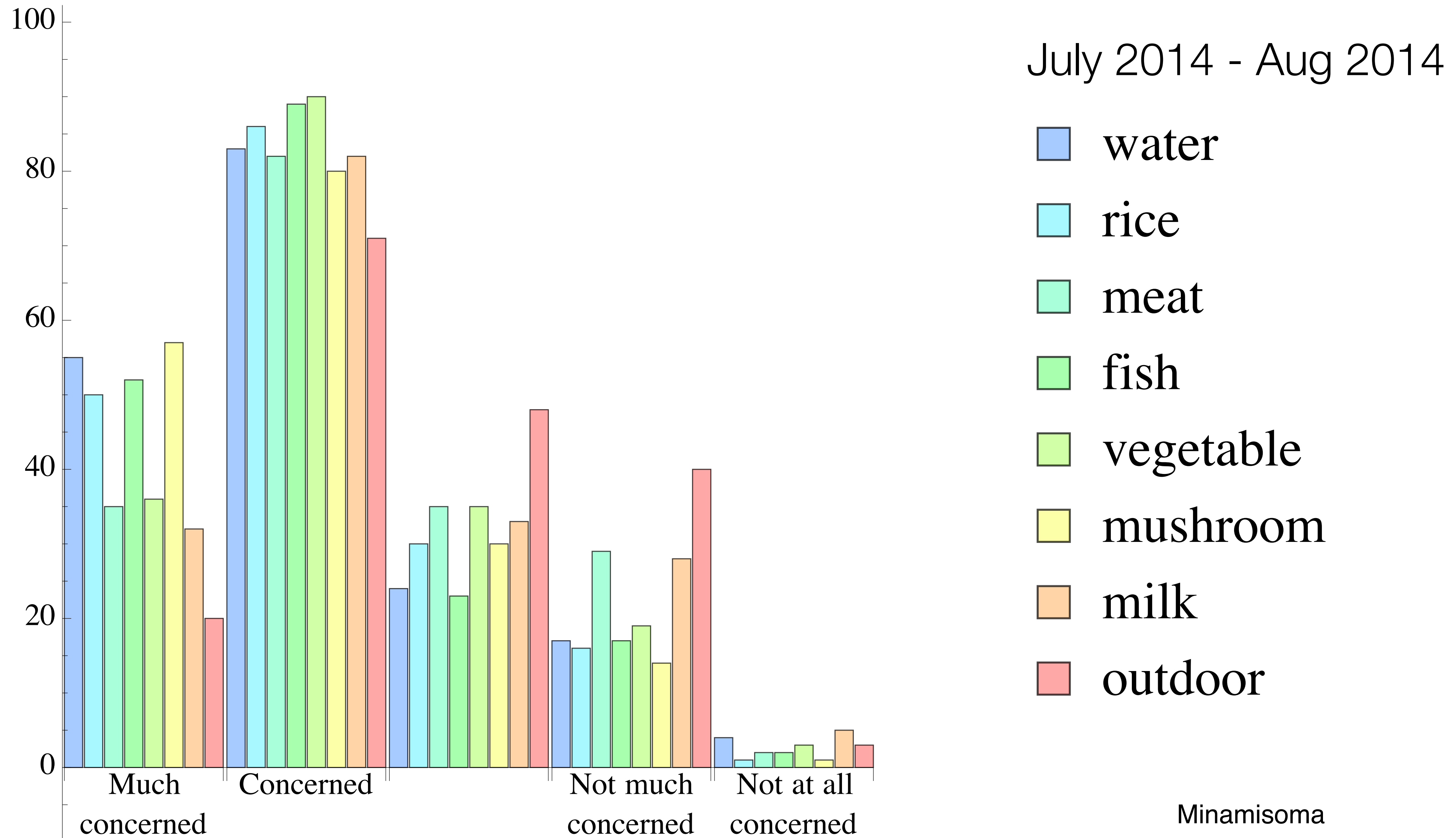


Communication is the key



Dr. Masaharu Tsubokura, Minamisoma

when asked to fill in a questionnaire sheet...



Conclusions

- ▶ Despite soil contamination, the internal exposures of 100% children are below the WBC detection limit

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Conclusions

- ▶ Despite soil contamination, the internal exposures of 100% children are below the WBC detection limit
- ▶ 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)