BANG DAY

September 22nd, 2009

Marie Doumic (*INRIA – BANG)*

My main activities

- ANR TOPPAZ
(with… see below)

- Interactions between PDE & statistics
(with P. Reynaud, M. Hoffmann, V. Rivoirard)

- Modelling leukemia
(with P. Kim, A. Marciniak, B. Perthame, J. Zubelli)

- Modelling apoptosis
(with A. Ballesta, G. Gillet)

ANR TOPPAZ

Theory & Observations of polymerization
in Prion and Alzheimer diseases

2 teams:

- I.N.R.A. Jouy-en-Josas

& C.EA. D.S.V

Bio-physicists and biologists team

- I.N.R.I.A. & J-L. Lions

Mathematical and numerical team

ANR TOPPAZ

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Biological team:

Human REZAEI, head of BPCP team (INRA Jouy)

Franck MOUTHON, CEA, DSV, SEPIA

Natacha LENUZZA, CEA, DSV, SEPIA

Sylvie NOINVILLE, CR. INRA

Stéphanie PRIGENT, post-doc INRA

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Biological team:

In INRA -> in vitro experiments

In CEA -> ex vivo and in vivo experiments

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Mathematical team: in France, around JLL & BANG:

Benoît PERTHAME
Vincent CALVEZ
Pierre GABRIEL
Thomas LEPOUTRE
Philippe MICHEL

From November, 2009: Frédérique CHARLES

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Associated team: in IMPA, Rio de Janeiro:

Inverse Problems team:

Jorge ZUBELLI

Mikhail SOLODOV

Claudia SAGASTIZABAL

Adriano DE CEZARO, PhD

Main goals

- **mathematical modelling**
- **numerical analysis**
- **comparison between simulations and experiments**

for prion and Alzheimer amyloid aggregation phenomena.

First model for prion proliferation: Masel et al., 1999

$$\frac{dv}{dt} = \lambda - \gamma v - v \sum_{i=n_0}^{\infty} \tau_i u_i + 2 \sum_{j \geq n_0} \sum_{i < n_0} i k_{i,j} \beta_j u_j,$$

$$\frac{du_i}{dt} = -\mu_i u_i - \beta_i u_i - v(\tau_i u_i - \tau_{i-1} u_{i-1}) + 2 \sum_{j>i} \beta_j k_{i,j} u_j,$$

Continuous version: Greer et al., 2006

$$\begin{cases} \dfrac{d}{dt} V(t) = & \lambda - \gamma V(t) - V(t) \displaystyle\int_{x \geq 0} \tau(x) u(t,x)\, dx\,, \\ \dfrac{\partial}{\partial t} u(t,x) = & \underbrace{-V(t) \dfrac{\partial}{\partial x} (\tau(x) u(t,x))}_{growth} \quad \underbrace{-\beta(x) u(t,x) + 2 \displaystyle\int_{y \geq x} \beta(y) k(x,y) u(t,y)\, dy}_{fragmentation}\,. \end{cases}$$

First aspect of the project: mathematical study of this problem (and related ones)

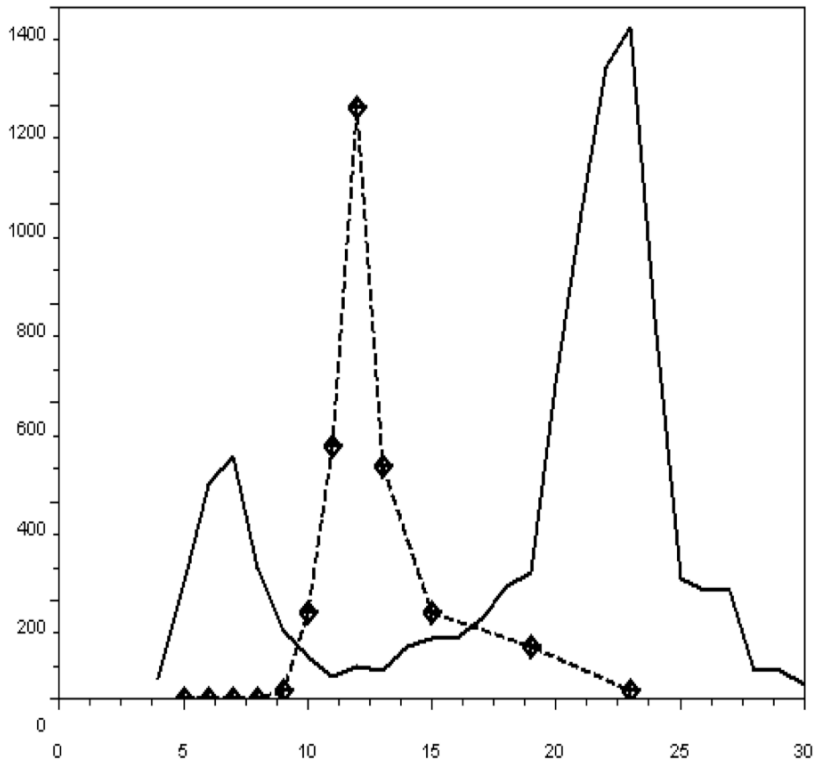
- Part of the very active field of structured population equations & fragmentation equations

- Original work of our group on prion

(Calvez, Lenuzza, Oelz, Perthame, Mouthon, BMB 2008):

  – Study of the asymptotic behavior

  – Possibility to obtain 2-peak asymptotic distributions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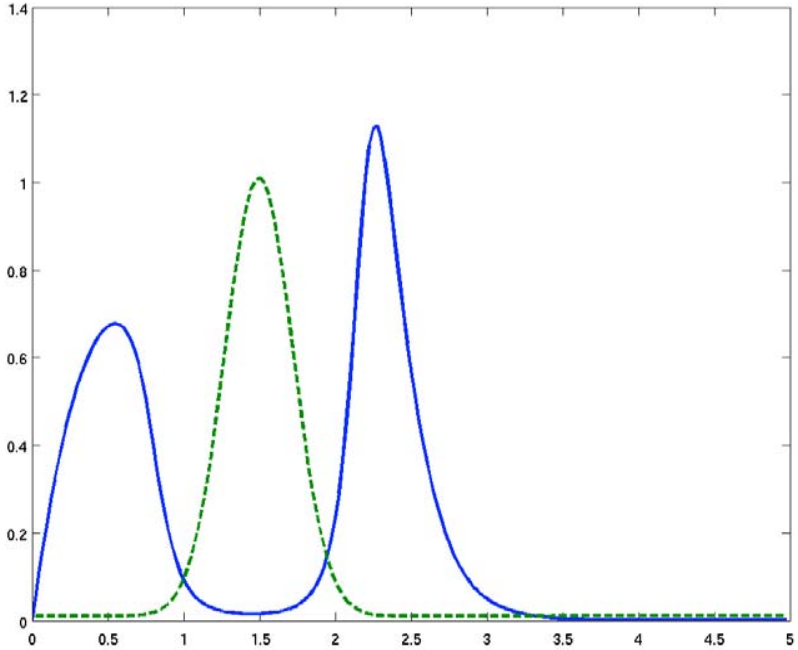
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3
3.5
4
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5

First achievements

- Study of the eigenvalue problem

(D. Gabriel, M3AS, 2010)

- Link between the discrete and the continuous versions of the model

(D. Goudon Lepoutre, CMS, accepted)

- High-order scheme to solve a generalised version of the model

(Gabriel, Tine, CEMRACS 2009)

In process…

- Investigate the dependency on the parameters: how the fitness depends on the parameters ?

(D, Calvez, Gabriel)

- Optimization of the PMCA protocole

(Calvez, Gabriel)

- Generalize the original model, and justify its use by asymptotic analysis and experiences

(in strong interaction with H. Rezaei)

- Apply inverse problem techniques to recover the equation parameters from INRA experiments

(F. Charles post-doc, in strong interaction with J. Zubelli)