Uncovering the structure and dynamics of information flow on the Telegram network

Thomas Louf, Aurora Vindimian, Riccardo Gallotti

September 2, 2025

UNIVERSITÀ DI TRENTO
Dipartimento di Matematica

FONDAZIONE BRUNO KESSLER

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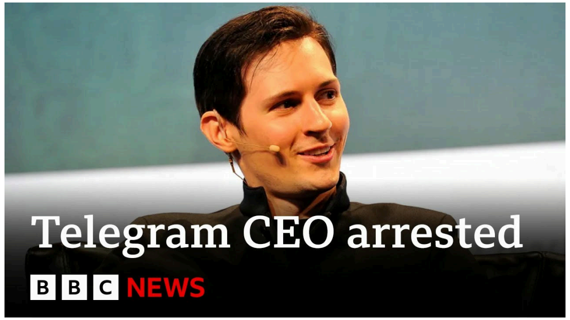

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→ Lots of work to be done

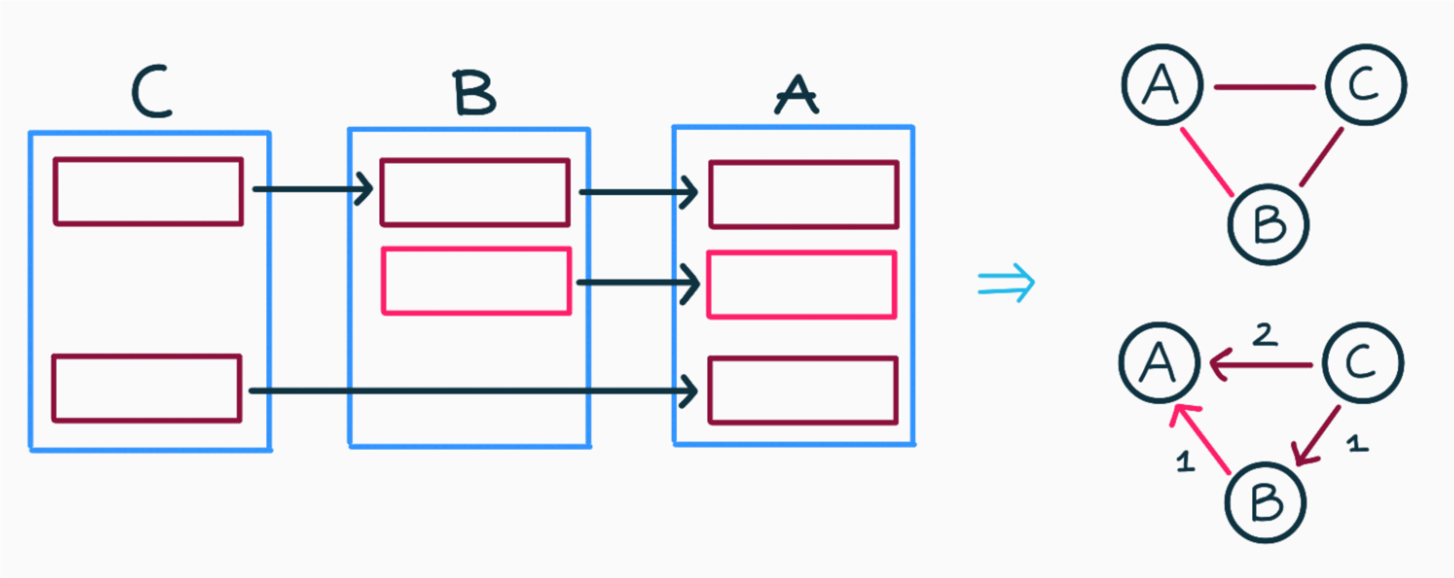
Is the network of Telegram channels anything like a social network?

What are the main mechanisms giving rise to it?

→ Analysis of the Telegram network using the Pushshift dataset (Baumgartner et al., 2020)

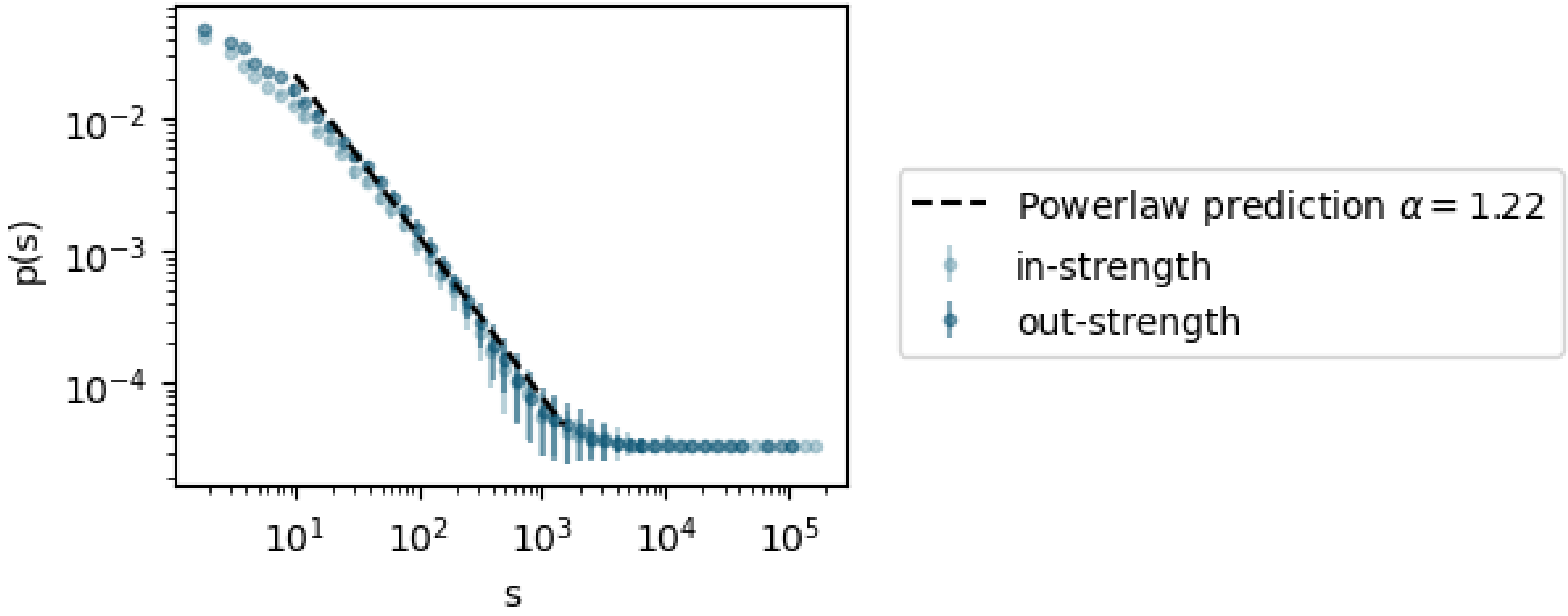
→ Model that reproduces its *topological* and *temporal* features

- Nodes: $29\,609$ channels
- Edge from B to A when A forwards a message from B → $501\,897$ directed edges

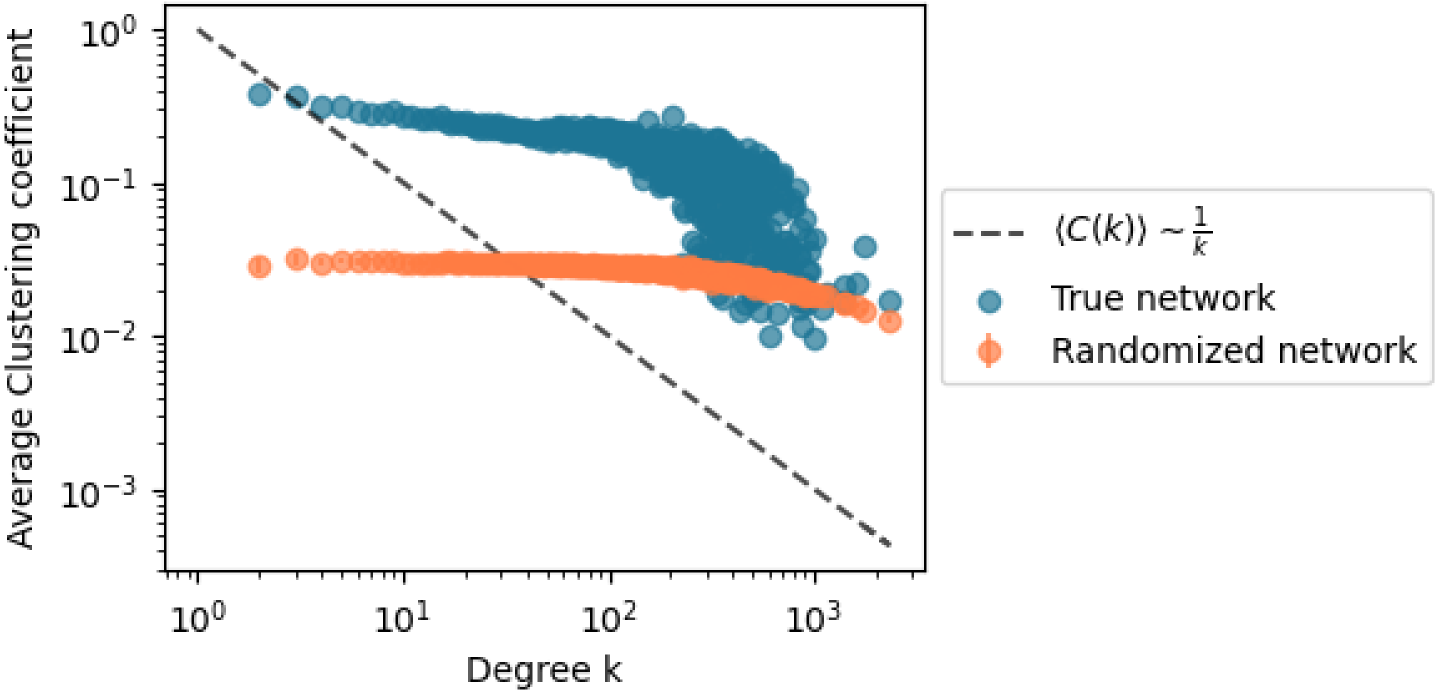


→ Network of information flow

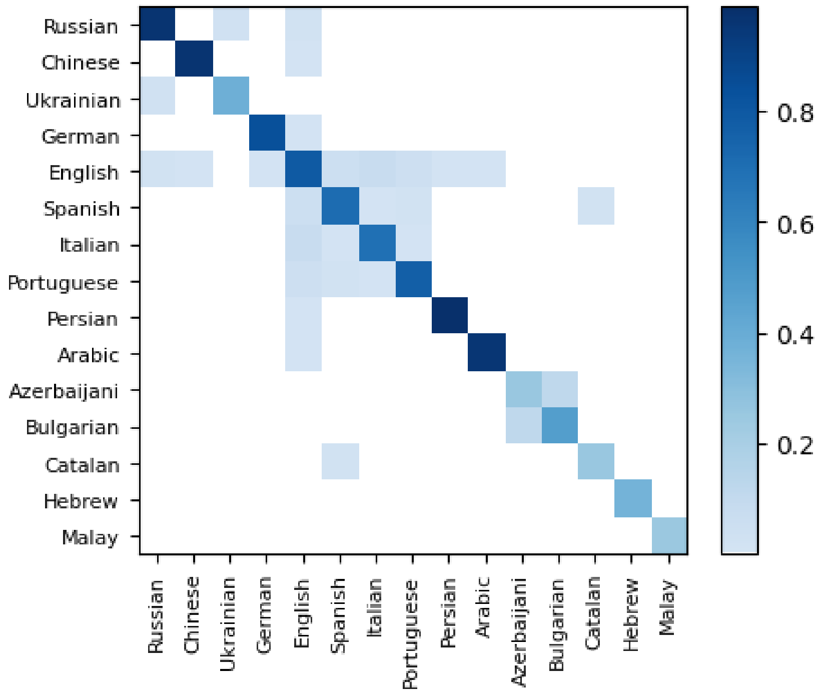
Do we have the usual Pareto law?



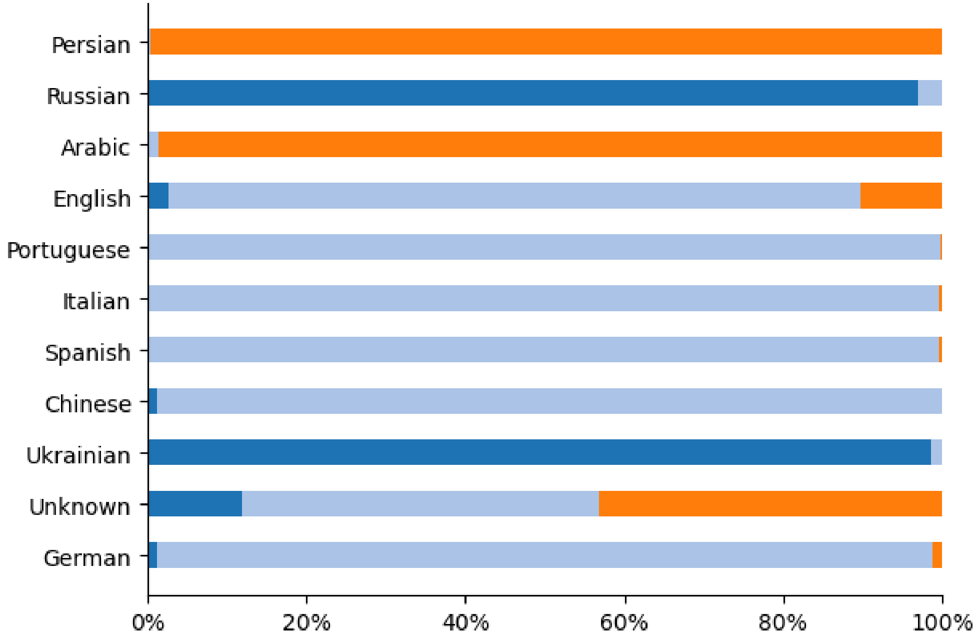
Tendency to forward from friends of my friends?



Ties formed preferably with same language...



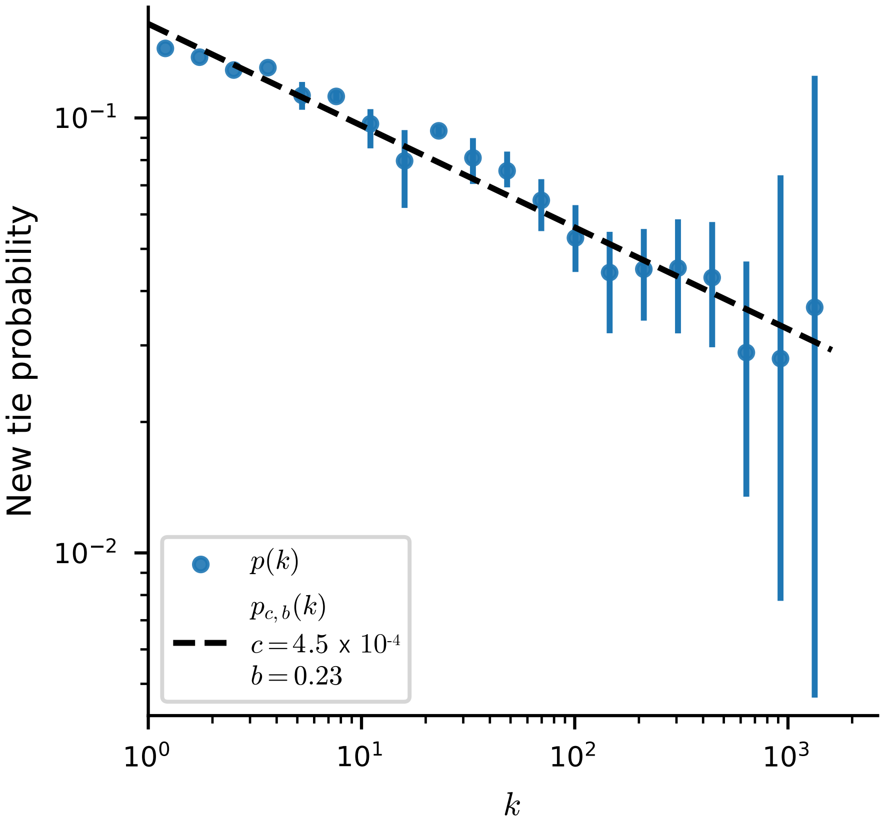
...also reflected in community partition (SBM)



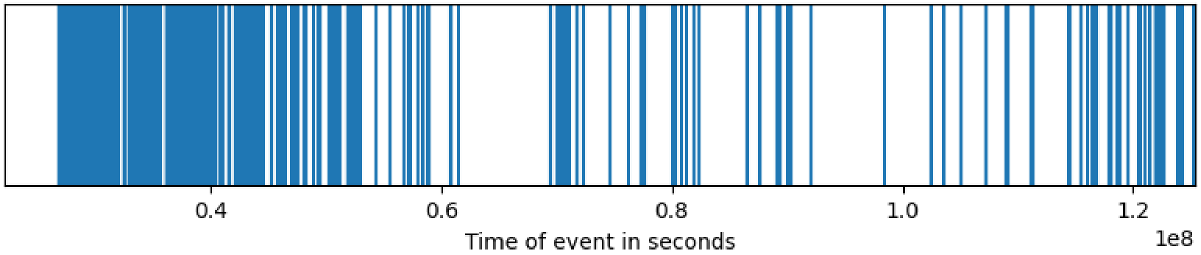
Aversion to form too many ties
→ probability to form new ties should decrease with in-degree k_{in}.

Model from (Ubaldi et al., 2016)

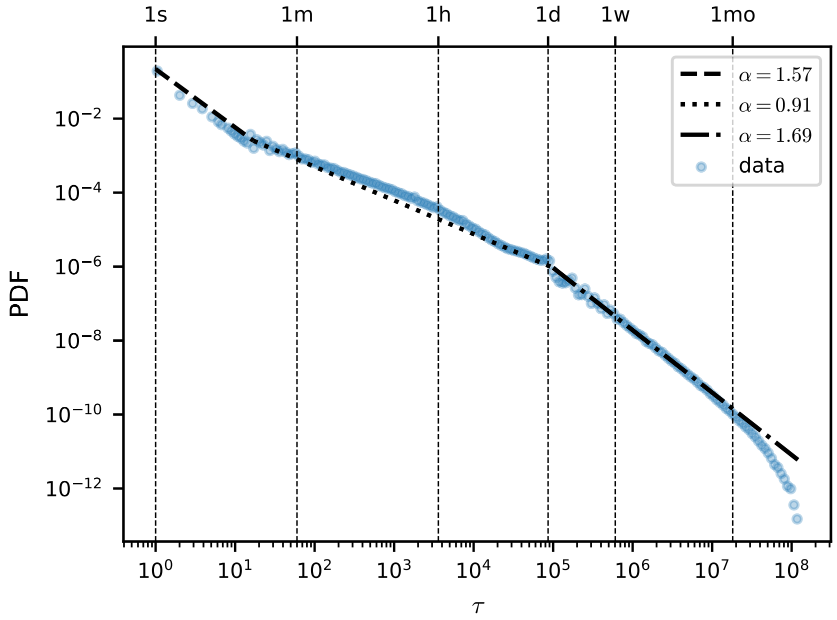
$$p_{\text{new}}(k_{\text{in}}) = \left(1 + \frac{k_{\text{in}}}{c}\right)^{-b}$$



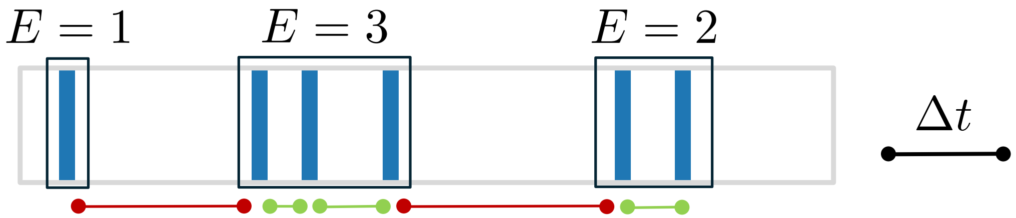
For all channels, get times between two forwarded messages = *inter-event times* τ



↪ $f(\tau)$ is piecewise power-law, with two main regimes separated by $\tau = 1 \text{ day}$



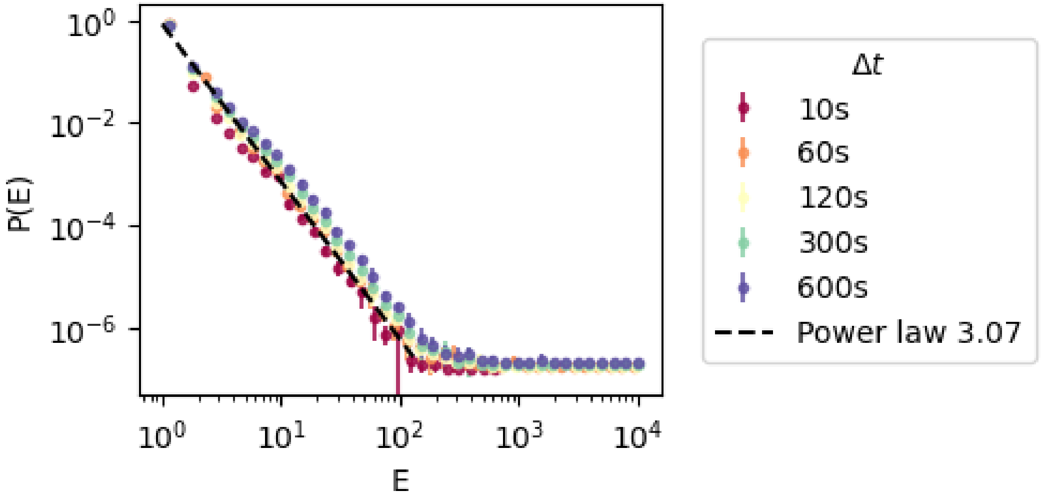
Investigate shape of distribution of *burst train sizes* E (Karsai et al., 2012):



We do have

$$p(E) \sim E^{-\beta}$$

↪ forwarding is bursty



Topology

- clustering
- power-law in/out-strength distributions
- language assortativity
- tendency to reinforce existing ties

Time

- two regimes
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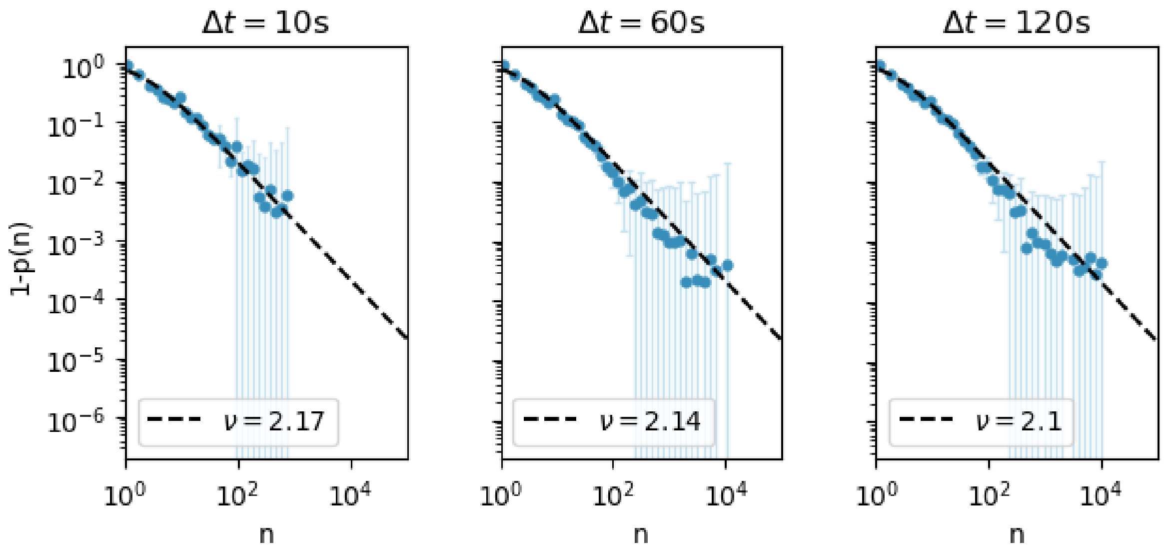
Simple-enough model that can reproduce these features?

↪ Could help simulate contagion model or equivalent and test effect of interventions on synthetic networks

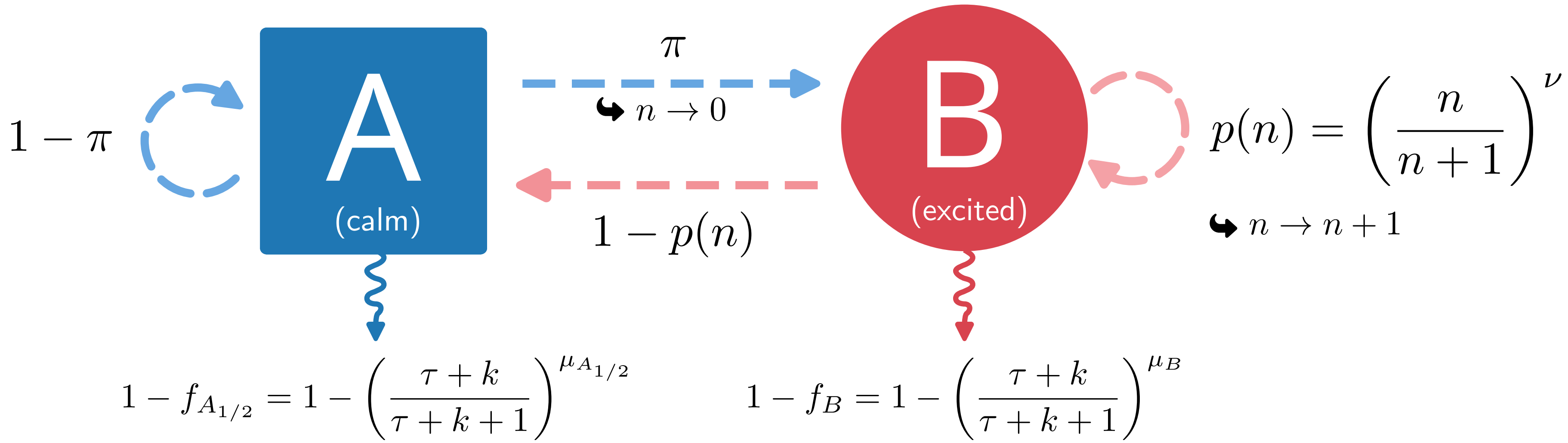
With already n events in a burst train, probability $p(n)$ to generate another within the same train?



→ Train size distribution generated from memory process (Karsai et al., 2012)

$$p(E) \sim E^{-\beta} \Leftrightarrow p(n) = \left(\frac{n}{n+1}\right)^{\nu} \qquad \text{with } \nu \approx \beta - 1$$

Generalisation from (Karsai et al., 2012)



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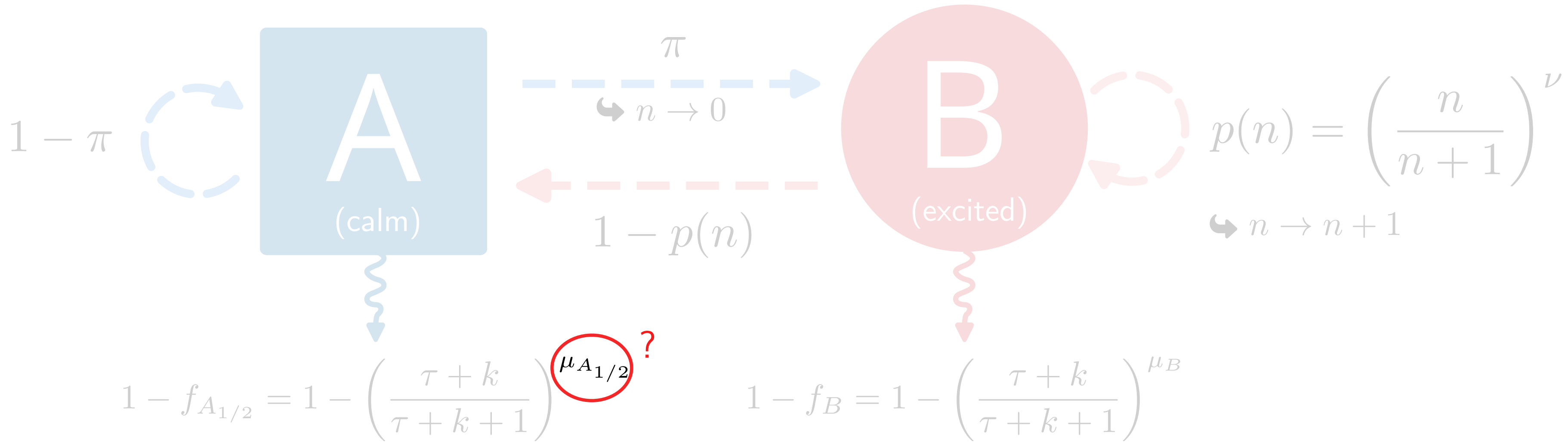

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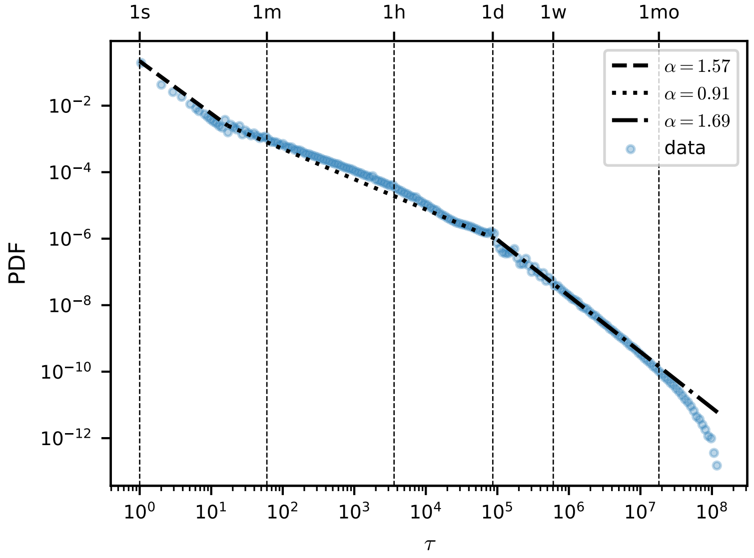

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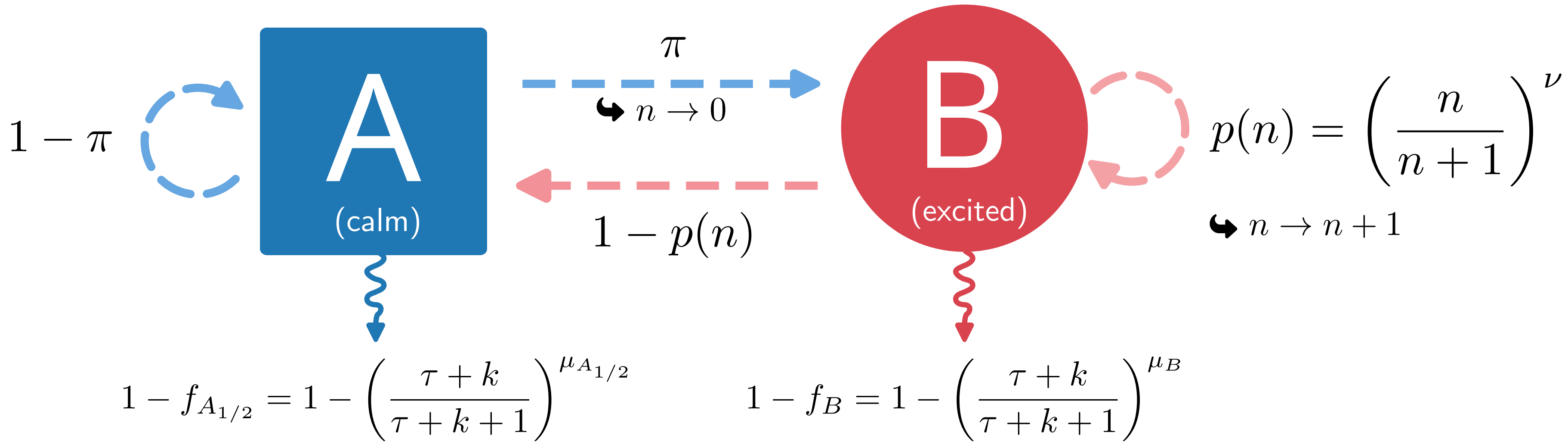
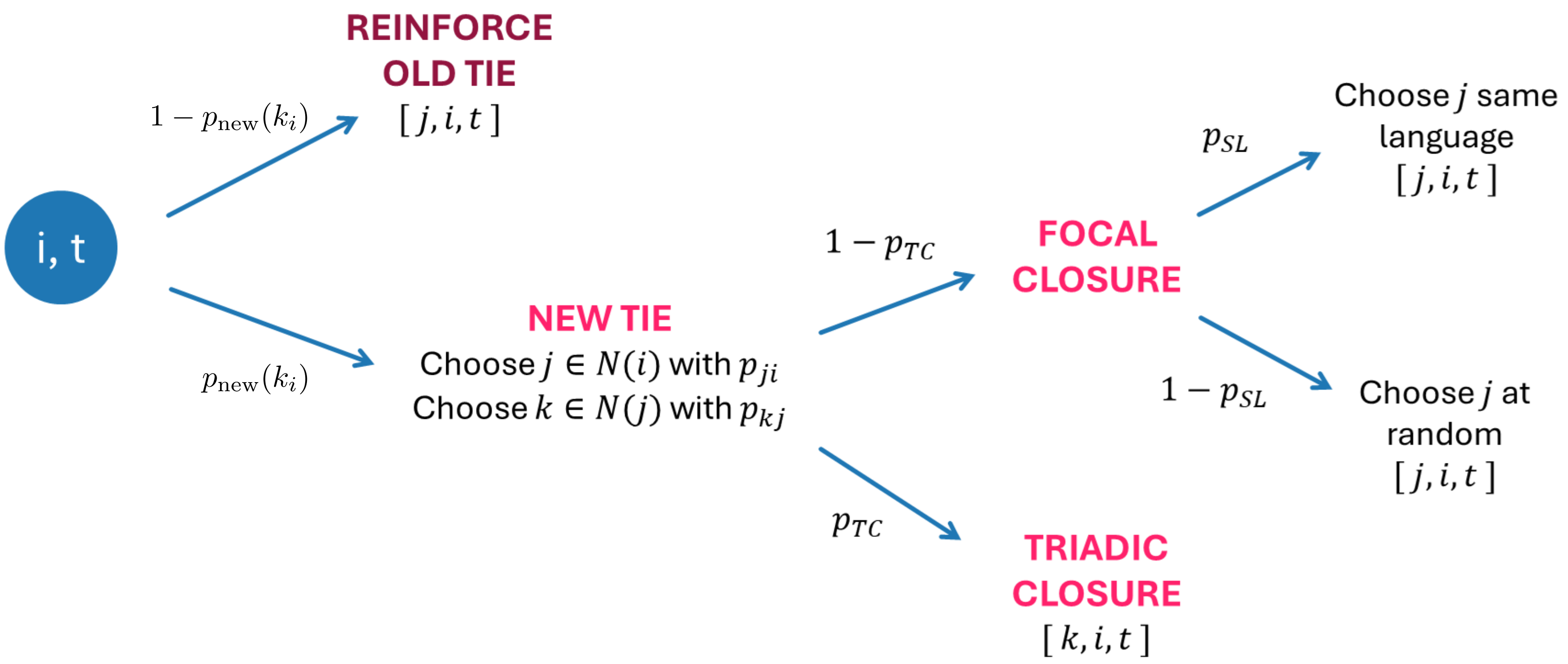
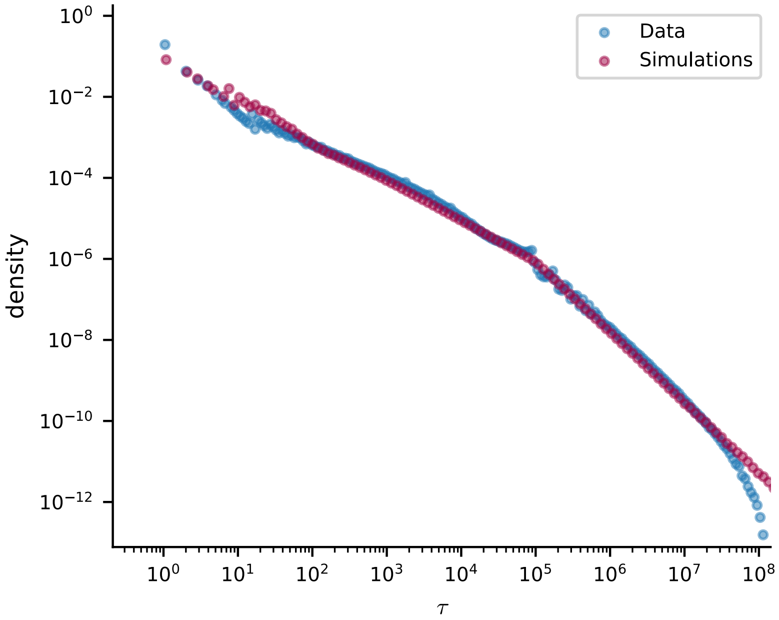


Adapted from (Laurent et al., 2015)



Fitted time model (π, $\mu_{A_{1/2}}$, μ_B, k) to reproduce piecewise power-law $p(\tau)$



↪ *It fits* (+ it runs fast: $\sim 10s$) ($\pi \approx 0.20, \mu_{A_1} \approx 0.019, \mu_{A_2} \approx 0.74, \mu_B \approx 4.8, k = 81$)

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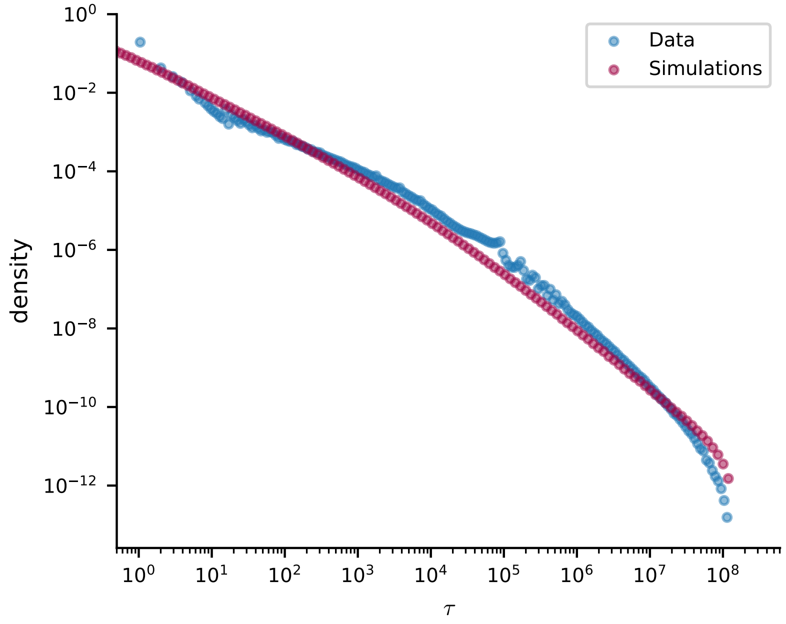

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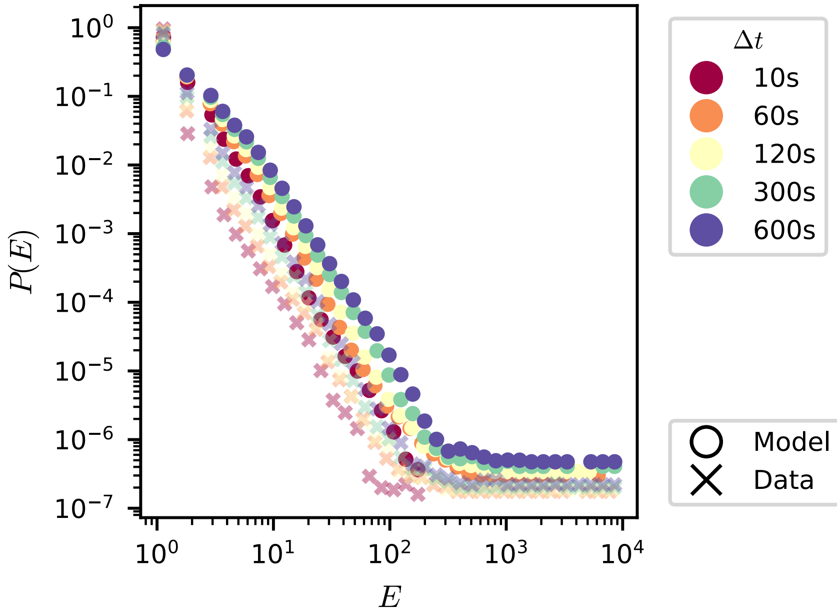
↪ very similar β in $p(E) \sim E^{-\beta}$



What we've shown...

- Network of Telegram channels is very social-network-like
- Main mechanisms behind its emergence: tie reinforcement, clustering, language assortativity + memory process

...and what this leads to

- Model information propagation and effect of interventions
- Very global view of temporal process: what about local coordination?

and much more!

Thanks for your attention 🤗

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